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Our File No. 131167

November 18, 2016

VIA EMAIL

Ontario Energy Board
27th Floor
2300 Yonge Street
Toronto, ON M4P 1E4

Attention: Kirsten Walli
Board Secretary

Dear Ms. Walli:

Re: Sagatay Transmission LP
Application for Leave to Construct Transmission Facilities
OEB File Number: EB-2016-0017

Please find attached the Submission of Sagatay Transmission LP.

Yours truly,

FOGLER, RUBINOFF LLP

Thomas Brett
TB/sz
Encls.
cc: Kristi Sebalj (*via email*)
K:\tbrett\wpdata\Algonquin 131167\L-Walli 20161118 TB.docx

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November 18, 2016

VIA RESS, EMAIL AND COURIER

Ontario Energy Board
27th Floor
2300 Yonge Street
Toronto, ON M4P 1E4

Attention: Kirsten Walli
Board Secretary

Dear Ms. Walli:

Re: Sagatay Transmission LP ("Sagatay")
Application for Leave to Construct Transmission Facilities
OEB File Number: EB-2016-0017

These submissions are in response to the Registrar's letter to Mr. Todd Anderson of Sagatay dated November 2, 2016 in which the Registrar indicated that the Ontario Energy Board (the "Board") intends to dismiss the Sagatay Application referenced therein.

Our client, Sagatay, urges the Board not to dismiss the Sagatay Application at this time. It is Sagatay's view that such a decision would be premature, unfair, and contrary to the Board's statutory mandate to promote economic efficiency and cost effectiveness in the generation transmission distribution and demand management for electricity set out in Section 1.(1)2 of the Ontario Energy Board Act (the "Act"). It would conflict with the Board's objective stated above in that it would eliminate a demonstrated competitive market for the opportunity to construct the Pickle Lake line rather than allow that market to function, as was the case in the successful East-West Tie Proceeding. In that proceeding, the Board already has an established precedent to designate a transmitter to develop a line in a competitive environment. In addition, Sagatay received a Transmission Licence from the Board on February 25, 2016 (EB-2016-0016). The Licence is for a period of five years. Moreover, pursuant to section 18.01 of the Board's Rules of Practice and Procedure, the Board may propose to dismiss a proceeding without a hearing only if the proceeding is vexatious, or related to a matter outside the Board's jurisdiction or some statutory requirement for launching the proceeding has not been met. Sagatay's Application does

not fall into any of these three categories. Sagatay, therefore, requests a hearing on the proposed dismissal.

Your letter mentions that Sagatay's Application remains incomplete as of the letter's date. You had advised Sagatay earlier in a letter dated February 18, 2016 (see Attachment 1 for the Board's February 18th letter) that its Application was being held in abeyance pending the filing of certain studies, specifically, the System Impact Assessment ("SIA") and the Customer Impact Assessment ("CIA") which were to be completed by the IESO and HONI, respectively, and provided to Sagatay and the Board. You stated in that letter that "the reports were expected to be filed by February 2016, however the OEB understands that the reports are expected to be filed in April or May of 2016".

Unfortunately, the IESO did not provide the SIA in a timely fashion. Sagatay received the SIA– Final Report dated June 28, 2016, a copy of which is attached as Attachment 2. We have not yet received a copy of the Customer Impact Assessment Report from HONI.

Your letter of November 2, 2016 stated that Section 97.1(1) of the Act precludes the Board from granting Leave to Construct a transmission line to a person if a licence issued under Part 5 of the Act held by another person includes an obligation to develop construct, expand or reinforce the line or make the interconnection that is the subject of that person's application, and that Section 97.1(2) extends the prohibition to an application for Leave to Construct filed prior to Section 97.1(1) coming into force. However, in our client's view, Sagatay's proposed transmission line is not the line which Wataynikaneyap Power is obliged to develop and construct pursuant to its amended licence.

Your letter then stated that since the transmission line in Sagatay's proposal was "functionally equivalent" to the transmission line to Pickle Lake proposed by Wataynikaneyap Power, the above sections of the Act preclude the Board from granting Leave to Construct to Sagatay's proposed transmission line.

In our client's view, Sagatay's proposed line is not "functionally equivalent" to the Wataynikaneyap Power's line in several respects. In assessing whether one line is functionally equivalent to another, it is not enough to say that both lines will transmit power from the portion of circuit D26A between Dryden and Ignace to Pickle Lake. Attention must also be paid, *inter alia*, to the constructability of the two lines, the two lines' environmental impacts, their respective costs, and their impact on First Nations' lands and rights in the area between circuit D26A and Pickle Lake, as well as First Nations led land use palnning efforts under the Far North Act.

The starting point for the Sagatay transmission line is at Ignace Station, which is 80 kilometres southeast from Dryden and results in a very different route. The Sagatay route is superior to the route selected by Wataynikaneyap Power for several reasons. As noted in the Sagatay Application, Sagatay's route is the only route that minimizes disturbance to the endangered Woodland Caribou Herd as evidenced by two independent studies conducted by the CPAWS

Wildlands League, and the University of Guelph Integrative Biology Department, both of which are included in the Sagatay Application at Exhibits 29 and 30.

Sagatay's proposed Pickle Lake Line will follow Highway 599 from Ignace to Pickle Lake, immediately adjacent to existing right of way, which will reduce the cost and environmental impacts of the construction, maintenance, and repair of the line.

Except for Sagatay's proposed line, the Mishkeegogamang First Nation will oppose a new transmission line south of Pickle Lake which traverses their traditional territory, and will enforce their rights as they deem necessary. Moreover, the Mishkeegogamang First Nation are more likely to support Wataynikaneyap Power's proposed north of Pickle Lake line which also traverses their territory, as shown in Exhibit 7 of the Sagatay Application if the province of Ontario supports the Sagatay proposal. Wataynikaneyap Power's proposed route is inconsistent with the objectives of Taa Shi Key Wia Land Use Planning Area, set out in Exhibit 7 to the Sagatay Application, established pursuant to the Ontario's Far North Act. As you are aware, the Mishkeegogamang First Nation and the Ojibway Nation of Saugeen together hold a 50% interest in the Sagatay project. Unlike the First Nations' partners in Wataynikaneyap Power, these two First Nations' reserve lands and territories are located in the region to be traversed by the Pickle Lake line. Sagatay's proposed Pickle Lake Line will be partly owned by the very First Nations whose territory is utilized.

More generally, a decision to dismiss Sagatay's Application at this time is premature. The process to develop, finance and construct the two transmission lines is at a very early stage with many steps required to reach successful completion. Sagatay is not aware of any compelling reason why its Application should be dismissed at this early date.

Moreover, dismissal of Sagatay's Application at this time would compromise commercial discussions that it is currently having with Wataynikaneyap Power with respect to the two proposed lines. In this connection, we note that the Ontario government's statement, at page 84 in its 2016 Budget:

> *"The government considers reducing diesel use in the 25 remote First Nation communities in northwestern Ontario an important social, economic and environmental priority. The 2013 LTEP highlighted a strong economic case for connecting up to 21 First Nation communities, currently supplied by diesel generation, to Ontario's electricity grid. The Province encourages all interested transmission line proponents to work collaboratively in their efforts to connect remote communities in northwestern Ontario."*

An early, unnecessary dismissal of our Application would also be unfair to Sagatay as it fully intends to pursue the development and construction of the Pickle Lake line and dismissing its Application before it has had full opportunity to make its case is not consistent with the principles of fairness and the Board's customary practices. Sagatay should have the opportunity to continue to advance its Application to and including a public hearing.

In addition, dismissal of Sagatay's Application at this time would eliminate competition between two large technically capable and well-financed entities, each with major ownership positions held by First Nations to develop and construct the Pickle Lake line. Eliminating this competition is not consistent with Section 1.(1)2 of the Board's objectives referred to above to encourage efficiency and cost effectiveness in the transmission of electricity.

The Board has issued an amended licence to Wataynikaneyap Power in EB-2016-0258, "further to Ministerial directive" on September 1, 2016. Sagatay is of the view that issuing the amendment to the licence is inconsistent with the Board's statutory objective as discussed above.

More particularly, Section 96.1(1) of the Act provides that the Lieutenant Governor in Counsel ("LGIC") may make an Order declaring that the construction, expansion or reinforcement of an electricity transmission line specified in the Order is a priority project. In that case, however, the Board still retains the authority and the obligation under Section 92 of the Act to approve the construction of that transmission line including its efficiency, cost effectiveness and related matters. The directive only deems the need for the line to be established.

Finally, we are of the view that section 28.6.1(1) does not authorize the Minister and/or the Lieutenant Governor in Council to issue a directive to the Board to amend Wataynikaneyap Power's licence to require it to develop and construct the two lines. We take this view for the following reason. Section 96.1(1) of the Act states that:

> *"The Lieutenant Governor in Council may make an order declaring that the construction, expansion or reinforcement of an electricity transmission line specified in the order is needed as a priority project."*

Section 28.6.1(1) of the Act provides that:

> *"the Minister may issue and the Board shall implement directives approved by the Lieutenant-Governor Council requiring the Board to take such steps as are specified in the directive relating to the construction, expansion or reinforcement of transmission systems".*

Section 28.6.1(2) provides that subsections (2) and (3) of Section 28.6 apply with necessary modifications in respect of directives issued pursuant to Section 28.6.1(1) (our emphasis).

However, Section 28.6(1) deals with a directive to transmission and distribution electric utilities to connect renewable energy systems to their systems. Subsection 28.6(2) states that a directive under (1) above may require the Board to amend a licence previously issued to the utility to take the action specified in 28.6(1). Section 28.6(1) is consistent with the Board's statutory objective in Section 1(1)5 of the Act to promote the use of renewable energy consistent with government policy.

However, the application of subsections (2) and (3) of section 28.6 to section 28.6.1(1) must not result in the Board being required to take an action which would be inconsistent with its statutory objectives, one of which is:

> *"2. To promote economic efficiency and cost effectiveness in the generation, transmission, distribution, sale and demand management of electricity and to facilitate the maintenance of a financially viable electricity industry."*

A competitor from a two party competitive process to develop and construct the Pickle Lake Line by directing the Board to dismiss the second party's application would be asking the Board to take an action contrary to one of its statutory objectives.

Exercising caution in the application of subsections 28.6(2) and (3) to section 28.6.1(1) is justified by the way in which the Act deals with the Minister's Directive powers. Section 28.1.6(1) is only one of several statutory provisions which authorize the Minister to issue directives to the Board. Others include section 27(1), policy directives; section 27(2), conservation directives; section 28(1), directives in relation to market rules; section 28.2, customer billing; section 28.3, smart metering; and section 28.5 smart grid directives. In each of the sections, there are specific provisions which allow the Minister to direct the Board to amend a person's licence to assist with implementation of the subject matter of the directive. However, section 28.6.1 does not contain such a provision. It does not give the Minister the power to direct the Board to amend a person's licence to assist in the implementation of the directive. It only states subsections (2) and (3) of section 28.6, the renewable energy directive should be applied with necessary modifications.

To summarize, the Board should, following the accepted principles of statutory interpretation, interpret the Act in a manner that enhances the consistency of its provisions, not in a manner that puts the Board in conflict with one of its fundamental objectives.

If the government wishes to nominate a particular company for whatever reason to carry out a particular transmission project in a situation where more than one applicant has applied to develop and construct that project, the government, in our view, needs to legislate.

We trust that you found these comments helpful.

Yours respectfully,

FOGLER, RUBINOFF LLP

Thomas Brett

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ATTACHMENT 1

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Ontario

BY E-MAIL

February 18, 2016

Todd Anderson
Sagatay Transmission LP
345 Davis Road
Oakville ON L6J 2X1

Dear Mr. Anderson:

Re: Sagatay Transmission LP
Application for Leave to Construct Transmission Facilities
OEB File Number: EB-2016-0017

This is with reference to your application to the Ontario Energy Board (OEB) for leave to construct a transmission line from Ignace to Pickle Lake and related transmission facilities.

The OEB has reviewed your application and notes that you have not provided a System Impact Assessment Report or a Customer Impact Assessment Report (collectively, the Reports) as required pursuant to Chapter 4 of the OEB's *Filing Requirements for Transmission Applications,* dated July 31, 2014. The Reports were expected to be filed by February 2016 however, the OEB now understands that the Reports are expected to be filed in April or May of 2016. The Reports are critical to the OEB's review of an application. The OEB will therefore hold your application in abeyance until the final Reports are filed with the OEB.

Yours truly,

Original signed by

Kristi Sebalj
Registrar

c: Tom Brett, Fogler Rubinoff LLP

ATTACHMENT 2

REPORT

ieso
Connecting Today.
Powering Tomorrow.

Independent Electricity System Operator
Station A, Box 4474
Toronto, ON M5W 4E5
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www.ieso.ca

System Impact Assessment Report

CONNECTION ASSESSMENT & APPROVAL PROCESS

Final Report

CAA ID: 2015-549
Project: Ignace Junction to Pickle Lake 230 kV Transmission Line
Connection Applicant: Sagatay Transmission L.P.

Connections & Registration Department
Independent Electricity System Operator

Date: June 28, 2016

Document Name	System Impact Assessment Report
Issue	Final
Reason for Issue	First release
Effective Date	June 28, 2016

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 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. 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 project 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 project 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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Executive Summary

Conditional Approval for Connection

Sagatay Transmission L.P. (the "connection applicant") is proposing to build a new 296 km 230 kV single-circuit transmission line between existing 230 kV circuit D26A, 80 km from the Dryden Transformer Station (TS), and existing 115 kV circuit E1C at the Crow River Distribution Station (DS). D26A and E1C are owned by Hydro One Networks Inc. (the "transmitter").

The proposed transmission line will be terminated using a single breaker connected to a 230/115 kV transformer at the new Pickle Lake TS, which will connect through a less than 1 km 115 kV transmission line to a new transmitter owned Switching Station (SS), named Pickle Lake SS. Pickle Lake SS will be adjacent to Crow River DS. At the other end near D26A, the proposed transmission line will be terminated to a 230 kV inline breaker at the new Ignace SS, which will connect to an adjacent new transmitter owned junction, named Ignace 2 Junction. Ignace 2 Junction will incorporate 230 kV switching facilities that will allow the proposed transmission line to be supplied radially from Dryden TS or Mackenzie TS for D26A circuit section outages. The new transmission line and its associated termination facilities (the "project") are scheduled to be in service by October 31, 2020.

A single-line diagram of the project is shown in Figure 1.

North of Dryden and Remote Communities Study

The IESO conducted a feasibility study to support the North of Dryden Integrated Regional Resource Plan ("IRRP") and the Remote Community Connection Plan. Based on the results of the feasibility study and economic analysis of options, the North of Dryden IRRP recommended a new line from a connection point between Dryden and Ignace on D26A, to Pickle Lake, to support the connection of remote communities and growth in the mining sector north of Pickle Lake.

Since there isn't yet a committed transmission project to supply loads north of Pickle Lake and this project does not include a plan for supplying these loads, this assessment assumed that the loads north of Pickle Lake are not connected. Should the connection of these loads become committed, the IESO may need to issue an addendum to this SIA.

In the North of Dryden IRRP analysis, E1C was assumed open at Ear Falls TS to increase the load meeting capability of the transmission system and support the connection of loads north of Pickle Lake. If these loads are not connected, there are benefits to keeping E1C closed; however, additional facilities would be required to realize those benefits.

In this report, distinct requirements are provided for E1C open and closed.

Findings

(1) Inductive reactive power compensation is needed at Pickle Lake TS, Ear Falls TS and Ignace SS to ensure that maximum voltage limits are not exceeded:

   a. When the new 230 kV circuit is energized – Further details are provided in section 5.3.

   b. During steady state (i.e. pre-contingency) – Further details are provided in section 5.4.

   c. Immediately following an event (i.e., post-contingency) – Further details are provided in section 5.4.

(2) Voltages remain above minimum voltage levels with the new 230 kV circuit in service. Further details are provided in section 5.5.

(3) The total required reactive power compensation at Ignace SS and Ear Falls TS can be switched without exceeding the maximum allowable voltage change. Further details are provided in section 5.6.

If E1C is closed at Ear Falls TS

(4) The new 230 kV circuit, 115 kV circuit E1C and all transmission elements at Ignace SS, Pickle Lake TS, and Pickle Lake SS would be classified as part of the Bulk Electric System (BES).

(5) In some of the studied scenarios, the generating units at Manitou Falls Generation Station (GS) and Ear Falls GS became unstable following the loss of 115 kV circuit E4D. Further details are provided in section 5.7.

(6) The maximum load that could be supplied from 115 kV circuit E2R following the loss of 115 kV circuit E4D is 43.5 MW. This represents a total maximum load of 41 MW at Red Lake TS and Balmer CTS after accounting for active power transmission losses on 115 kV circuit E2R. Further details are provided in section 5.8.

(7) The pre-contingency and post-contingency thermal loading of the transmission system with the project incorporated was within equipment ratings in all studied scenarios. Further details are provided in section 5.9.

(8) The project is expected to reduce the maximum interrupted load in the Ear Falls area following the loss of 115 kV circuit E4D from 98.7 MW to 29.1 MW based on the 2030 peak load forecast. Further details are provided in section 5.10.

If E1C is open at Ear Falls TS

(9) The new 230 kV circuit, 115 kV circuit E1C and all transmission elements at Ignace SS, Pickle Lake TS, and Pickle Lake SS would not be classified as part of the Bulk Electric System (BES).

(10) The project is expected to reduce the maximum interrupted load in the Ear Falls area following the loss of 115 kV circuit E4D from 98.7 MW to 74.6 MW based on the 2030 peak load forecast. Further details are provided in section 5.10.

(11) Following a permanent fault on 115 kV circuit E4D, the project can help in restoring Ear Falls TS load and up to 41 MW at a lagging power factor of 0.9 from Red Lake TS and Balmer CTS, by closing 115 kV circuit E1C at Ear Falls TS. Further details are provided in section 5.10.

IESO's Requirements for Connection

Transmitter Requirements

The transmitter shall satisfy all applicable requirements specified in the Market Rules, the Transmission System Code and reliability standards.

Project Specific Requirements: The following *specific* requirements are applicable for the incorporation of the project.

(1) The transmitter is required to change the protection settings for 230 kV circuit D26A and 115 kV circuit E1C according to the PIA. If the transmitter identifies that further changes to the protection settings are required after this SIA is finalized, those changes must be submitted by the transmitter to the IESO at least six (6) months before any modifications are to be implemented on the existing protection systems.

(2) As per finding #1, the transmitter is required to install 10 Mvar at 118.1 kV of inductive reactive power compensation at Ear Falls TS on 115 kV circuit E1C. If a static device is to be employed, it must be connected through a single 115 kV circuit breaker or circuit switcher and be capable of auto-switching based on voltage settings provided by the IESO. Further details are provided in section 5.3.

If E1C is closed at Ear Falls TS

(3) As per finding #5, the transmitter in conjunction with Ontario Power Generation Inc. is required to install a Remedial Action Scheme (RAS) that detects the loss of 115 kV circuit E4D and rejects individual generating units at Manitou Falls GS and Ear Falls GS. The RAS is expected to be Type 3 and must be designed in accordance with section 3.4.1 in ORTAC. The RAS must have full redundancy and separation of the communication channels, and to the extent possible satisfy the Type I requirements of the NPCC Reliability Reference Directory #7 Special Protection Systems. Further details are provided in section 5.7.

(4) As per finding #6, the transmitter is required to install a RAS that detects the loss of 115 kV circuit E4D and rejects load at Red Lake TS and Balmer CTS such that at most 41 MW of load at 0.9 lagging power factor at their high voltage buses remains connected. The RAS is expected to be classified as Type 3 and must be designed in accordance to section 3.4.1 in Ontario Resource and Transmission Assessment Criteria (ORTAC). The RAS must have full redundancy and separation of the communication channels, and to the extent possible satisfy the Type I requirements of the NPCC Reliability Reference Directory #7 Special Protection Systems. Further details are provided in section 5.8.

If E1C is open at Ear Falls TS

No additional requirements.

General Requirements: Some of the general requirements that are applicable to the transmitter for this project are presented in detail in section 2 of this report.

Connection Applicant Requirements

The connection applicant shall satisfy all applicable requirements specified in the Market Rules, the Transmission System Code and reliability standards.

Project Specific Requirements: The following *specific* requirements are applicable for the incorporation of the project. They will not change whether E1C is closed or opened at Ear Falls TS.

(1) The connection applicant is required to notify the IESO at connection.assessments@ieso.ca as soon as they become aware of any changes to the project design or data used in this assessment. The IESO will determine whether these changes require a re-assessment.

(2) The connection applicant is required to register as a "transmitter" in the IESO Market Registration process.

(3) The connection applicant is required to provide the 10 day winter and summer limited time ratings and 15 minute winter and summer short time ratings of the new transformer at Pickle Lake TS during the IESO Market Registration process.

(4) The connection applicant is required to provide a protection description document for the new 230 kV circuit and other equipment, including all relay settings, during the IESO Market Registration process.

(5) As per findings #1, the connection applicant is required to install two 40 Mvar at 220 kV inductive reactive power devices on the new 230 kV circuit at Pickle Lake TS. If two static devices are to be employed, each device must be connected by a motorized disconnect switch, where one motorized disconnect switch is operated normally closed while the other motorized disconnect switch is operated normally open. Further details are provided in sections 5.3 and 5.4.

(6) The connection applicant is also required to install a 40 Mvar at 220 kV inductive reactive power device on the new 230 kV circuit at Ignace SS. If a static device is to be employed, it must connected to a single 230 kV circuit breaker or circuit switcher and be capable of auto-switching based on voltage settings provided by the IESO. Further details are provided in section 5.4.

General Requirements: Some of the general requirements that are applicable to the project are presented in detail in section 2 of this report.

– End of Section –

1. Project Description

Sagatay Transmission L.P. (the "connection applicant") is proposing to build a new 296 km 230 kV single-circuit transmission line between existing 230 kV circuit D26A, 80 km from the Dryden Transformer Station (TS), and existing 115 kV circuit E1C at the Crow River Distribution Station (DS). D26A and E1C are owned by Hydro One Networks Inc. (the "transmitter").

The proposed transmission line will be terminated using a single breaker connected to a 230/115 kV transformer at the new Pickle Lake TS, which will connect through a less than 1 km 115 kV transmission line to a new transmitter owned Switching Station (SS), named Pickle Lake SS. Pickle Lake SS will be adjacent to Crow River DS. At the other end near D26A, the proposed transmission line will be terminated to a 230 kV inline breaker at the new Ignace SS, which will connect to an adjacent new transmitter owned junction, named Ignace 2 Junction. Ignace 2 Junction will incorporate 230 kV switching facilities that will allow the proposed transmission line to be supplied radially from Dryden TS or Mackenzie TS for D26A circuit section outages. The new transmission line and its associated termination facilities (the "project") are scheduled to be in service by October 31, 2020.

A single-line diagram of the project is shown in Figure 1.

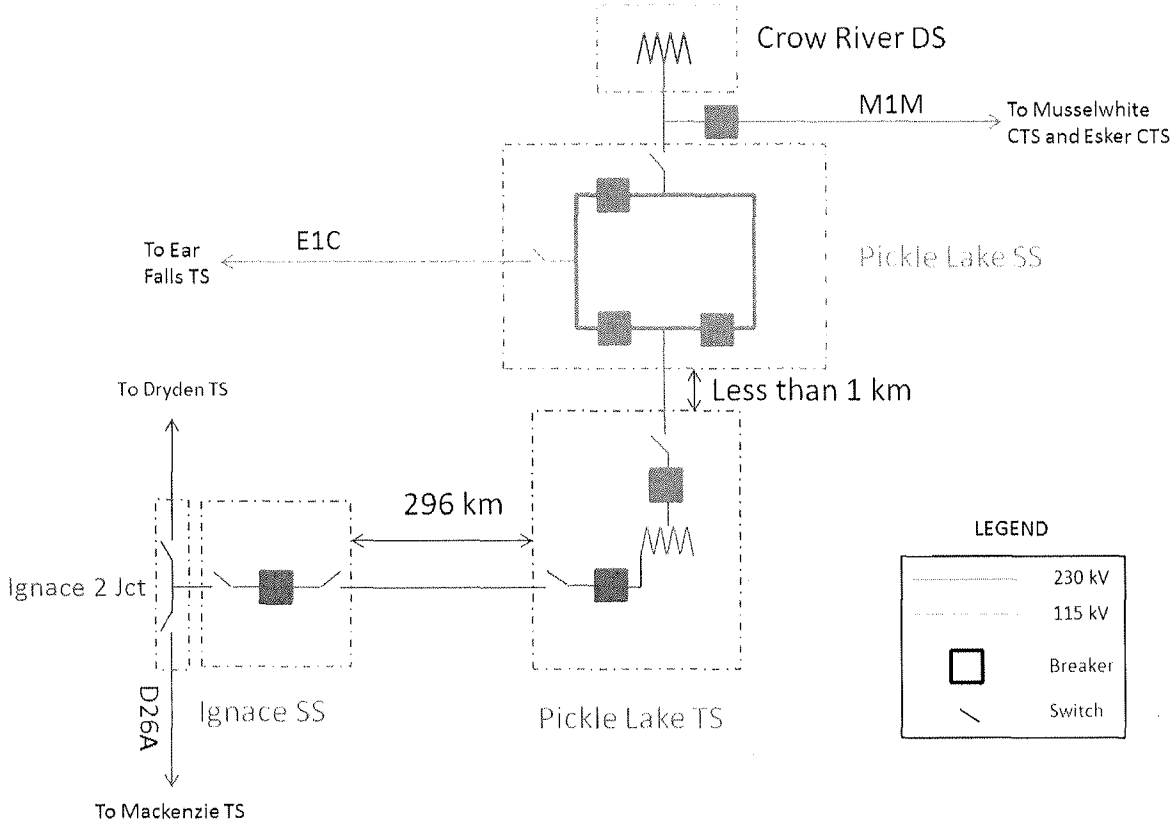

Figure 1: Single Line Diagram for the proposed project

– End of Section –

2. General Requirements

The connection applicant and the transmitter shall satisfy all applicable requirements in the Market Rules, the Transmission System Code (TSC) and reliability standards. The following sections highlight some of the general requirements that are applicable to the project.

2.1 Reliability Standards

If E1C is closed at Ear Falls TS

As currently assessed, the project does not fall within the Northeast Power Coordinating Council's (NPCC) definition of the Bulk Power System (BPS).

Effective July 1, 2014, the new North American Electric Reliability Corporation's (NERC) definition of the Bulk Electric System (BES) is effective in Ontario. Based on this new definition, the new 230 kV circuit, E1C and all elements of Ignace SS, Pickle Lake TS, and Pickle Lake SS will be classified as BES.

The connection applicant and the transmitter will need to bring the all BES elements into compliance with the applicable NERC reliability standards. To determine the standard requirements that are applicable to this project, the IESO provides a mapping tool titled "NERC Reliability Standard Mapping Tool/Spreadsheet," which can be accessed at the IESO's public website: http://ieso.ca/imoweb/pubs/ircp/NERC_Reliability_Standards_Mapping_Tool_Spreadsheet.xls.

Note, the connection applicant or the transmitter may request an exception to the application of the BES definition. The procedure for submitting an application for exemption can be found in Market Manual 11.4: "Ontario Bulk Electric System (BES) Exception" at the IESO's website: http://ieso.ca/imoweb/pubs/ircp/rc_OntarioBESException.pdf.

The IESO's criteria for determining applicability of NERC reliability can be found in the Market Manual 11.1: "Applicability Criteria for Compliance with NERC Reliability Standards and NPCC Criteria" at the IESO's website: http://ieso.ca/imoweb/pubs/ircp/IESO_Applicability_Criteria_for_Compliance_with_NERC_Standards_and_NPCC_Criteria.pdf.

Compliance with these reliability standards will be monitored and assessed as part of the IESO's Ontario Reliability Compliance Program. For more details about compliance with applicable reliability standards reliability standards, the connection applicant is encouraged to contact orcp@ieso.ca and also visit the following webpage: http://www.ieso.ca/imoweb/ircp/orcp.asp.

Note, the BPS and BES classifications of this project will be re-evaluated as the electrical system evolves.

If E1C is open at Ear Falls TS

As currently assessed, the project does not fall within the North American Electric Reliability Corporation's (NERC) definition of the Bulk Electric System (BES) or the Northeast Power Coordinating Council's (NPCC) of the Bulk Power System (BPS). As such, the project does not have to meet NERC or NPCC requirements and is only required to meet obligations and requirements under the IESO's Market Rules.

Note that the BPS and BES classifications of this project will be re-evaluated as the electrical system evolves.

2.2 Voltage Requirements

The project's 230 kV and 115 kV equipment must meet the voltage requirements specified in section 4.2 and section 4.3 of ORTAC.

2.3 Connection Equipment Design

The connection applicant and the transmitter 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 Fault Levels

The TSC requires the project's equipment to be designed to withstand the fault levels in the area where the equipment is installed. Thus, the connection applicant and the transmitter shall ensure that the project's connection equipment 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 and the transmitter are required to replace the equipment with higher rated equipment capable of withstanding the increased fault level, up to maximum fault level specified in the TSC. Appendix 2 of the TSC establishes the maximum fault levels for the transmission system. For the 230 kV system, the maximum 3 phase symmetrical fault level is 63 kA and the maximum single line to ground symmetrical fault level is 80 kA (usually limited to 63 kA), and for the 115 kV system, the maximum 3 phase and single line to ground symmetrical fault levels are 50 kA.

Appendix 2 of the TSC states that the maximum rated interrupting time for the 230 kV breakers must be $\leq$ 3 cycles and for the 115 kV breakers must be $\leq$ 5 cycles. Thus, the connection applicant and the transmitter shall ensure that the installed breakers meet the required interrupting time specified in the TSC. Fault interrupting devices must be able to interrupt fault currents at the maximum continuous voltage of 250 kV for 230 kV devices and 132 kV for 115 kV devices.

2.5 IESO Telemetry Data

In accordance with Section 7.4 of Chapter 4 of the Market Rules, the connection applicant and the transmitter 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 Appendixes 4.20 and 4.21, subject to Section 7.6A of Chapter 4 of the Market Rules. The whole telemetry list will be finalized during the IESO Market Registration process.

The connection applicant and the transmitter 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 Market Registration process, the connection applicant and the transmitter 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 project is granted.

2.6 Protection Systems

The connection applicant and the transmitter shall ensure that the protection systems are designed to satisfy all the requirements of the Transmission System Code and any additional requirements identified by the transmitter. New protection systems must be coordinated with the existing protection systems.

As currently assessed by the IESO, the project's facilities are not deemed to be part of the Bulk Power System and are not considered essential to the power system, and therefore do not require complete redundant protection systems in accordance with section 8.2.1a of the TSC. In the future, as the electrical system evolves, this facility may be placed on the BPS list, or designated as essential by either the IESO or by the transmitter. In that case these redundant protections systems would have to satisfy all requirements of the TSC, and in particular, they could not use common components, common battery banks or common secondary CT or PT windings.

The protection systems within the project must only trip the appropriate equipment required to isolate the fault. After the incorporation of the project, if an improper trip of 230 kV circuit D26A or 115 kV circuit E1C occurs due to events within the project, the project 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.

The connection applicant and the transmitter are required to have adequate provision in the design of protections and controls at their new stations to allow for future installation of Remedial Action Scheme (RAS) equipment. Should a future RAS be installed or an existing RAS be expanded to improve the transfer capability in the area or to accommodate transmission reinforcement projects, the new stations may be required to participate in the RAS and to install the necessary protection and control facilities to affect the required actions. These SPS facilities would need to comply with the NPCC Reliability Reference Directory #7 for Type 1 SPS.

2.7 Restoration Participant Requirements

According to the Market Manual 7.8 which states restoration participant criteria and obligations, the connection applicant is required to be a participant in the Ontario Power System Restoration Plan. Details regarding restoration participant requirements will be finalized during the IESO Market Registration process.

As currently assessed by the IESO, this facility is not classified as a Key Facility that is required to establish a Basic Minimum Power System following a system blackout. Key Facility and Basic Minimum Power System are terms defined in the NPCC Glossary of Terms.

2.8 IESO Market Registration Process

The connection applicant and the transmitter must initiate and complete the IESO Market Registration process in a timely manner, at least nine months before energization to the IESO-controlled grid and prior to the commencement of any project related outages, in order to obtain IESO final approval for connection.

The connection applicant and the transmitter is required to provide "as-built" equipment data for the project (including impedance, admittance and thermal ratings) during the IESO Market Registration

process. If the submitted data differs materially from the data used in this assessment, then further analysis of the project will need to be done by the IESO.

At the sole discretion of the IESO, performance tests may be required at load and transmission facilities, including the operational times of special protection systems. The objectives of these tests are to demonstrate that equipment performance meets the IESO requirements, and to confirm models and data are suitable for IESO purposes.

– End of Section –

3. Data Verification

3.1 Connection Arrangement

The connection arrangement of the project, as shown in Figure 1, will not reduce the level of reliability of the integrated power system and is, therefore, acceptable to the IESO.

3.2 Equipment Data

The connection equipment specifications were assessed based on the information provided by the connection applicant. Equipment specifications for Pickle Lake SS to be provided by the transmitter.

3.2.1 230 kV Circuit Breakers at Ignace SS & Pickle Lake TS

Identifier	No nomenclature provided
Maximum continuous rated voltage	273 kV
Continuous current rating	1200 A
Rated symmetrical short circuit capability	63 kA
Interrupting time	less than or equal 3 cycles

3.2.2 230 kV Motorized Disconnect Switches at Ignace SS & Pickle Lake TS

Identifier	No nomenclature provided
Maximum continuous rated voltage	273 kV
Continuous current rating	1200 A
Rated symmetrical short circuit capability	63 kA

3.2.3 115 kV Circuit Breaker at Pickle Lake TS

Identifier	No nomenclature provided
Maximum continuous rated voltage	145 kV
Continuous current rating	2000 A
Rated symmetrical short circuit capability	40 kA
Interrupting time	less than or equal 5 cycles

3.2.4 115 kV Motorized Disconnect Switch at Pickle Lake TS

Identifier	No nomenclature provided
Maximum continuous rated voltage	145 kV
Continuous current rating	2000 A
Rated symmetrical short circuit capability	40 kA

3.2.5 230 kV Transformer at Pickle Lake TS

Identifier	T1
Thermal ratings	100/130/160 MVA
Rated voltage	230/115/17 kV
Under-load tap changer (ULTC)	+/-34.5 kV in 33 steps on HV winding
Transformer connections	HV: Wye (neutral grounded) Secondary X: Wye (neutral grounded) Secondary Y: Delta
Summer and Winter 10-day limited time rating	No data provided
Summer and Winter 15-minute short time rating	No data provided
Impedance	HX: 0.5 + j12 % on 100 MVA base

3.2.6 230 kV Transmission Circuit

Identifier	No nomenclature provided
Maximum operating voltage	No data provided
Summer continuous current rating	1024.6 A
Summer long term emergency current rating	1439 A
Summer short term emergency current rating	1522.6A
Winter continuous current rating	1360.4 A
Winter long term emergency current rating	1578.1 A
Winter short term emergency current rating	1818.1 A
Positive sequence resistance	0.07447 ohms/km
Positive sequence reactance	0.43671 ohms/km
Positive sequence susceptance	3.79392 micro-siemens/km

– End of Section –

4. Fault Level Assessment

A fault level assessment was performed by comparing the circuit breaker interrupting capability in the vicinity of the project with their associated fault levels before and after the incorporation of the project with E1C operated closed at Ear Falls TS. The data used for this assessment was obtained from studies completed by the transmitter.

The existing circuit breaker interrupting capability at Musselwhite CSS and Ear Falls TS are 40 kA and 10.5 kA, respectively. The project is expected to increase fault levels at Musselwhite CSS and Ear Falls TS as shown in Table 1, however the fault levels are expected to remain within the circuit breaker interrupting capability at both stations.

Table 1: Fault levels

Base Case	Line to ground fault levels (kA)				Three phase fault levels (kA)			
	Symmetrical		Asymmetrical		Symmetrical		Asymmetrical	
	Ear Falls TS	Musselwhite CSS	Ear Falls TS	Musselwhite CSS	Ear Falls TS	Musselwhite CSS	Ear Falls TS	Musselwhite CSS
Without project incorporated	3.309	0.252	3.754	0.252	2.814	0.5	3.105	0.505
With project incorporated	3.528	2.287	3.963	2.43	3.033	1.801	3.316	1.875

– End of Section –

5. Impact on System Reliability

The technical studies focused on identifying the impact of the project on the reliability of the IESO-controlled grid; including: energization, maximum and minimum voltage levels, reactive devices switching, rotor angle stability, voltage stability, thermal ratings, load security and load restoration.

5.1 Existing System

The project will connect in Ontario's Northwest transmission zone which is defined as the part of the IESO-controlled grid (ICG) bounded by Kenora TS in the west, Algoma TS in the east and Fort Frances TS at the Minnesota-Ontario border. Northwest transmission zone usually has its peak load in winter.

The relevant generating facilities in this area are the 67 MW Manitou Falls Generating Station (GS) (hydroelectric) and the 32 MW Ear Falls GS (hydroelectric).

The relevant shunt reactors include two 40 Mvar reactors, R22 and R23, at Dryden TS and 40 Mvar reactor R3 at Mackenzie TS. The relevant shunt capacitors include a total of 62.3 Mvar at Red Lake TS and Balmer CTS TS, which is expected to be fully in-service by July 2016 as per the requirements in the 2nd addendum of CAA 2013-495 and CAA 2010-407. The relevant dynamic shunt devices include -23/+15 Mvar Static Voltage Compensator (SVC) at Esker Customer TS (CTS) and -5/+10 Mvar Static Synchronous Compensator (STATCOM) at Musselwhite CTS.

Figure 2 provides an overview of the ICG in the vicinity of the project.

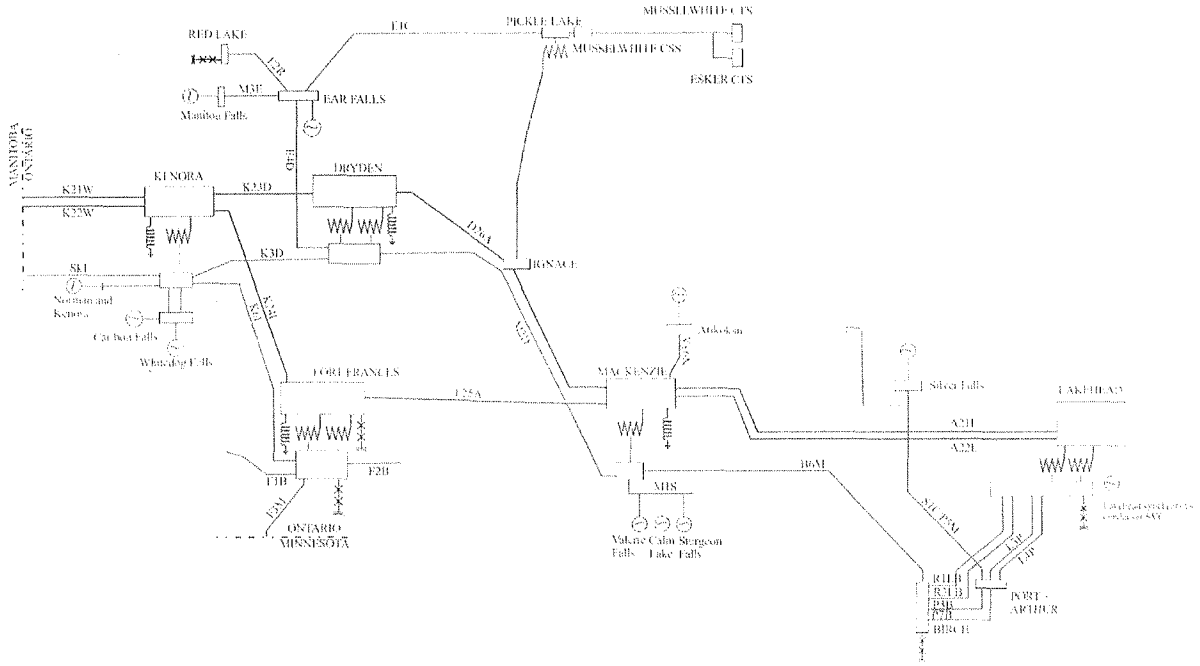

Figure 2: IESO-controlled grid in the vicinity of the project

5.2 Assumptions

A winter 2015 base case with the following assumptions was used:

(1) **Base quantities:** Base voltages for all 115 kV and 230 kV elements are 118.1 kV and 220 kV respectively and base power for all circuits is 100 MVA.

(2) **Maximum continues operating voltage levels:** 132 kV for 115 kV elements and 250 kV for 230 kV elements.

(3) **Transmission Facilities:** The connection applicant and the transmitter indicated short connections between Pickle Lake SS and Crow River DS, and between Ignace 2 Jct and Igance SS. For the purpose of this connection assessment, these connections were assumed to have zero impedance. Moreover, they also indicated a less than 1 km 115 kV transmission circuit between Pickle Lake TS and Pickle Lake SS; this connection was also assumed to have zero impedance.

(4) **Maximum Generation Dispatch:** 67 MW at Manitou Falls GS and 32 MW at Ear Falls GS

(5) **98% Dependable Generation Dispatch:** In accordance with the Ontario Resources and Transmission Assessment Criteria (ORTAC) and consistent with the 2nd addendum of CAA 2013-495 and CAA 2010-407 , Manitou Falls GS and Ear Falls GS 98% dependable generation levels are listed in Table 2.

Table 2: 98% dependable generation dispatch

Station	Manitou Falls GS	Ear Falls GS
Dispatch (MW)	12.5	10

(6) **Peak load forecast:** The transmitter indicated that the peak load forecast net of conservation, demand side management and embedded generation for year 2030 is the same as the forecast for 2025, which was used in the 2nd addendum of CAA 2013-495 and CAA 2010-407 as shown in Table 3.

Table 3: Peak load forecast for year 2030

Load forecast (MW)	Red Lake TS	Balmer CTS	Ear Falls TS	Crow River DS	Slate Falls DS	Perrault Falls DS	Cat Lake DS	Musselwhite CTS/Esker CTS
Peak Load	36.2	33	4.5	2.93	0.7	0.9	0.94	19.5

- Perrault Falls DS is connected to E4D.
- Red Lake TS and Balmer CTS are connected to E2R.
- Crow River DS, Slate Falls DS and Cat Lake DS are connected to E1C.
- Musselwhite CTS and Esker CTS are connected to 115 kV circuit M1M.

(7) **Light load assumptions:** An hourly coincident load duration curve for Red Lake TS, Balmer CTS, and Musselwhite CTS/Esker CTS for year 2015 is shown in Figure 3. From the load duration curve, the first percentile was selected as representing light load conditions as values below this level were considered outlier points. The first percentile of the coincident loads at Red Lake TS, Balmer CTS, and Musselwhite CTS/Esker CTS was found to be approximately 40 MW. The distribution of load was proportioned based on the forecasted peak load for 2030 in Table 3. The small distribution station loads were assumed to be 50% of their 2030 peak load. The detailed light load assumptions are listed in Table 4.

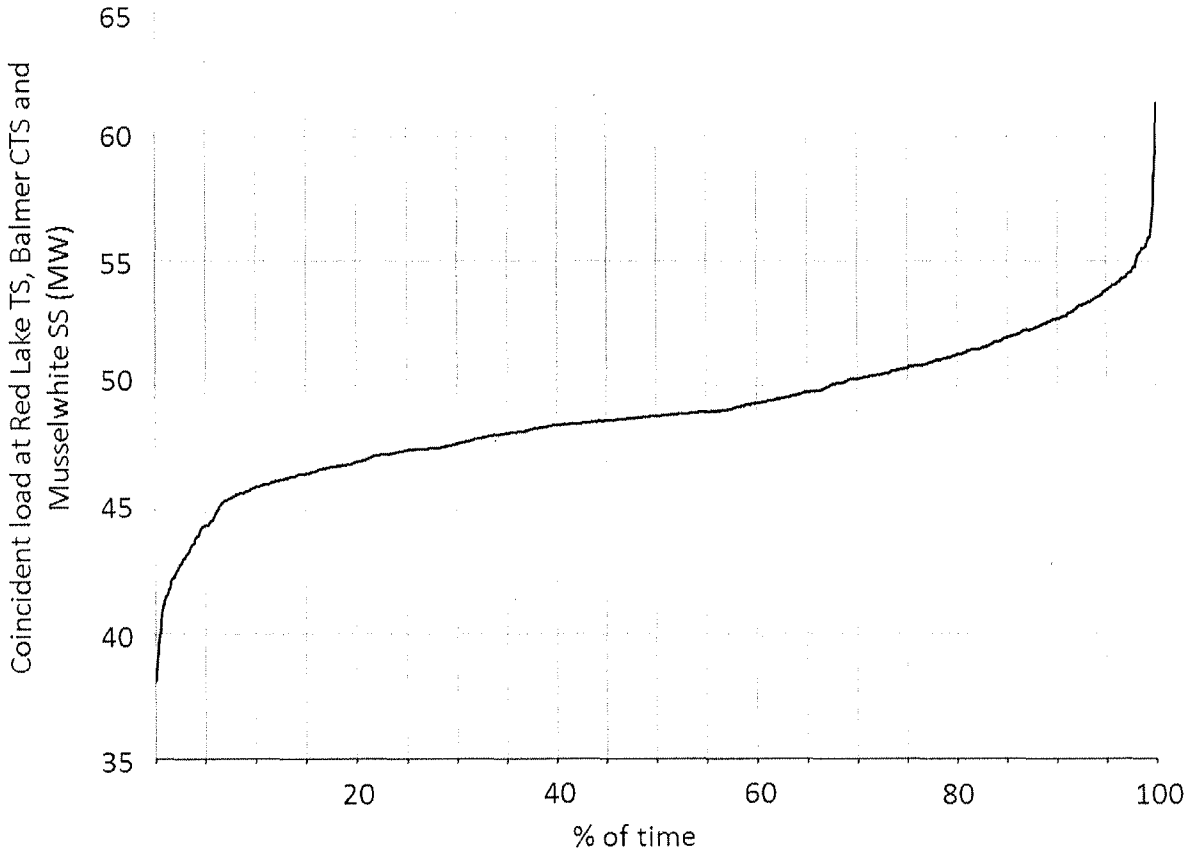

Figure 3: Hourly coincident load for year 2015 at Red Lake TS, Balmer CTS, and Musselwhite CTS/Esker CTS

Table 4: Light load assumption for year 2030

Load forecast (MW)	Red Lake TS	Balmer CTS	Ear Falls TS	Crow River DS	Slate Falls DS	Perrault Falls DS	Cat Lake DS	Musselwhite CTS/Esker CTS
Peak Load	16.3	14.9	2.25	1.465	0.35	0.45	0.47	8.8

(8) **Load Power Factor:** In accordance with section 2.4 of the ORTAC, load power factors were assumed to be 0.9 lagging at the associated high voltage buses.

(9) **Base cases:** In accordance with the ORTAC, Table 5 lists the base cases used for different assessment conditions.

Table 5: Base cases

Base Case	Load levels	Generation dispatch	Assessment
Base Case 1	Peak Load	98 % dependable dispatch	Voltage stability, thermal and minimum voltage
Base Case 2	Light Load	Maximum dispatch	Transient rotor angle stability, thermal and minimum voltage
Base Case 3	Light Load	98 % dependable dispatch	Maximum voltage and Reactive devices switching
Base Case 4	No Load	98 % dependable dispatch	Energization

(10) **Thermal ratings:** Thermal ratings of monitored circuits are listed in Table 6. Thermal ratings were provided by Hydro One Networks Inc. and were calculated for summer weather conditions based on an ambient temperature of 30°C and wind speed of 4 km/h. The continuous ratings for the conductors were calculated at the lower of the sag temperature or a 93°C operating temperature. The LTE ratings for the conductors were calculated at the lower of the sag temperature or a 127°C operating temperature. The STE ratings were calculated at the sag temperature with 100% continuous pre-load.

Table 6: Monitored circuits winter thermal ratings

Circuit	Section		Continuous	LTE Rating	STE Rating
	From	To	Amps	Amps	Amps
E1C	Ear Falls TS	Selco JCT	230	230	230
	Selco JCT	Slate Falls JCT	230	230	230
	Slate Falls JCT	Golden Patricia JCT	230	230	230
	Golden Patricia JCT	Etruscan JCT	230	230	230
	Etruscan JCT	Placer JCT	230	230	230
	Placer JCT	Placer JCT	230	230	230
	Placer JCT	Pickle Lake SS	340	340	340
	Pickle Lake SS	Musselwhite CSS	340	340	340
E4D	Ear Falls TS	Scout Lake JCT	470	470	470
	Scout Lake JCT	Dryden TS	470	470	470

5.3 Energization Assessment

As per ORTAC, the 115 kV and 230 kV voltage levels in Northern Ontario must not exceed 132 kV and 250 kV, respectively.

Without the incorporation of the project, the energization sequence for the Ear Falls area starts with E4D, then E2R, then E1C and ends with M1M.

After the incorporation of the project, an energization sequence could start with D26A (or either D26A Dryden TS by Ignace 2 Jct or Mackenzie TS by Ignace 2 Jct), then the new 230 kV circuit, then M1M, then E4D from Dryden TS, then E2R, and ends with E1C (opened or closed at Ear Falls TS). For an E4D outage, the energization sequence would start with D26A, then new 230 kV circuit, then M1M, then E1C and ends with E2R. Table 7 summarizes what reactive power compensation is required to energize line without exceeding maximum voltage levels. The specific details are provided in sub-sections 5.3.1, 5.3.2 and 5.3.3.

Table 7: Summary of requirements – Energization

Pickle Lake TS	Ear Falls TS
40 Mvar at 220 kV	10 Mvar at 118.1 kV

5.3.1 All elements in-service

Energizing the new 230 kV circuit from D26A will cause voltage levels at Ignace SS, Pickle Lake TS, Pickle Lake SS and Musselwhite CSS to exceed maximum permissible voltage levels as shown in Table 8. Accordingly, 30 Mvar at 220 kV of inductive reactive power compensation is required to be connected to the new 230 kV circuit at Pickle Lake TS to reduce the voltages to within acceptable levels.

Table 8: Energization voltage levels

Facility Name	Maximum continuous voltage (kV)	Voltage (kV)	
		Project incorporated	Project incorporated - with inductive 30 Mvar at 220 kV at Pickle Lake TS
Dryden TS	250	234.9	233.6
Mackenzie TS	250	246.7	242.2
Ignace SS	250	263.9	248.6
Pickle Lake TS	250	287.3	243.4
Pickle Lake SS	132	150	127
Musselwhite CSS	132	150	127

5.3.2 Dryden TS reactor R22 or R23 out of service

Energizing the new 230 kV circuit from D26A will cause voltage levels at Ignace SS, Pickle Lake TS, Pickle Lake SS and Musselwhite CSS to exceed maximum permissible voltage levels as shown in Table 9. Accordingly, 40 Mvar at 220 kV of inductive reactive power compensation is required to be connected on the new 230 kV circuit at Pickle Lake TS to reduce the voltages to acceptable levels.

Table 9: Energization voltage levels

Facility Name	Maximum continuous voltage (kV)	Voltage (kV)	
		Project incorporated	Project incorporated - with inductive 40 Mvar at 220 kV at Pickle Lake TS
Dryden TS	250	248.8	247.2
Mackenzie TS	250	244.2	243.5
Ignace SS	250	252	249.8
Pickle Lake TS	250	256.4	248.6
Pickle Lake SS	132	134.6	130.8
Musselwhite CSS	132	134.6	130.8

5.3.3 115 kV circuit E4D out of service

Energizing the new 230 kV circuit from D26A will cause voltage levels at Ignace SS, Pickle Lake TS, Pickle Lake SS, Musselwhite CSS and Ear Falls TS to exceed maximum permissible voltage levels as shown in Table 10. Accordingly, 40 Mvar at 220 kV of inductive reactive power compensation is required to be connected to the new 230 kV circuit at Pickle Lake TS, and 10 Mvar at 118.1 kV of inductive reactive power compensation is required at Ear Falls TS, as shown in Figure 4. If a static device is to be employed at Ear Falls TS, it must be connected to a single 115 kV circuit breaker or circuit switcher and be capable of auto-switching based on voltage settings provided by the IESO as shown in Figure 4.

Table 10: Energization voltage levels

Facility Name	Maximum continuous voltage (kV)	Voltage (kV)	
		Project incorporated	Project incorporated - with inductive 40 Mvar at 220 kV at Pickle Lake TS and inductive 10 Mvar at 118.1 kV at Ear Falls TS
Dryden TS	250	240.9	233.6
Mackenzie TS	250	242.1	242.2
Ignace SS	250	246.9	248.6
Pickle Lake TS	250	253.2	243.4
Pickle Lake SS	132	135	127
Musselwhite CSS	132	135	127
Ear Falls TS	132	151.5	131.6

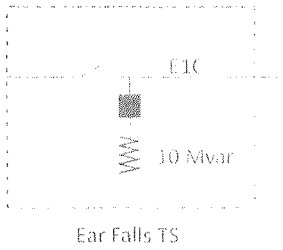

Figure 4: Acceptable connection arrangement for a static inductive reactive device at Ear Falls TS

5.4 Maximum Voltage Level Assessment

ORTAC states that for recognized planning events, the following criteria shall be satisfied:

- The pre-contingency and post-contingency voltages on 115 kV buses must not be more than 132 kV, and on 230 kV buses must not be more than 250 kV;
- The voltage change following a contingency must not exceed 10% pre-ULTC and 10% post-ULTC on both 115 kV and 230 kV buses.

Table 11 summarizes what inductive reactive power compensation is required to ensure that the maximum allowable voltage levels are not exceeded with E1C closed at Ear Falls TS. The specific findings are described in detail in sub-sections 5.4.1 and 5.4.2.

Table 11: Summary of additional requirements – Maximum allowable voltage levels

Pickle Lake TS	Ignace SS
40 Mvar at 220 kV	40 Mvar at 118.1 kV

5.4.1 All elements in-service

As shown in Table 12, without the 40 Mvar, at 220kV, inductive reactive power compensation at Pickle Lake TS required in Table 7, voltages exceed the maximum permissible voltage levels in ORTAC. Therefore, this reactive compensation will be required to be in service whenever the new 230 kV line is in

service. To allow the line to remain in service when the reactive compensation at Pickle Lake is unavailable, an additional 40 Mvar at 220kV of inductive reactive power compensation is also required at Pickle Lake TS. If two static devices are to be employed to meet this requirement, each device must be connected by a motorized disconnect switch, where one motorized disconnect switch is operated normally closed and the other motorized disconnect switch is operated normally open as shown in Figure 5.

Table 12: Pre-contingency voltage levels

Facility Name	Maximum continuous voltage (kV)	Voltage (kV)	
		Project incorporated	Project incorporated - with inductive 40 Mvar at 220 kV at Pickle Lake TS
Dryden TS	250	234.9	233.6
Mackenzie TS	250	246.7	242.2
Ignace SS	250	251.6	248.6
Pickle Lake TS	250	270.2	243.4
Pickle Lake SS	132	132.6	127
Musselwhite CSS	132	132.6	127

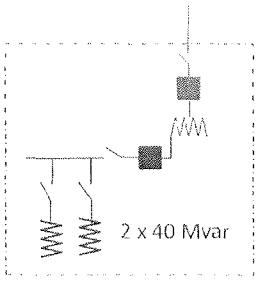

Figure 5: Acceptable connection arrangement for static inductive devices at Pickle Lake TS

5.4.2 Dryden TS reactor R22 out of service

The loss of reactor R23 at Dryden TS results in voltages at Dryden TS, Mackenzie TS, Ignace SS, Pickle Lake TS and Pickle Lake SS higher than the maximum permissible voltage levels. Accordingly, 40 Mvar at 220 kV of inductive reactive power compensation is required at Ignace SS as shown in Table 13.

Table 13: Post-contingency voltage - Loss of R23 at Dryden TS

Facility Name	Pre-contingency voltage (kV)	Project incorporated – Loss of R23 at Dryden TS				Project incorporated – with inductive 40 Mvar at 220 kV at Ignace SS			
		Pre-ULTC		Post-ULTC		Pre-ULTC		Post-ULTC	
		Voltage (kV)	%	Voltage (kV)	%	Voltage (kV)	%	Voltage (kV)	%
Dryden TS	245.4	254.5	3.7	253.6	3.34	250	1.9	249.6	1.7
Mackenzie TS	243.3	246.7	1.4	245.1	0.7	244.3	0.4	243	-0.1
Ignace SS	249	255.3	2.5	254.2	2.1	249	0	248	-0.4
Pickle Lake TS	249.7	255.2	2.2	254	1.7	249.3	-0.1	248.8	-0.4
Pickle Lake SS	130.4	133.2	2.1	132.4	1.5	130	0.3	130	0.3

If a static device is to be employed at Ignace SS, it must connected to a single 230 kV breaker as shown in Figure 6 and must auto-switch according voltage settings provided by the IESO.

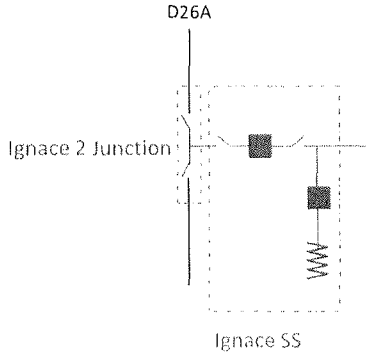

Figure 6: Acceptable connection arrangement for a static auto-switching inductive device at Ignace SS

5.5 Minimum Voltage Levels Assessment

ORTAC states that for recognized planning events, the following criteria shall be satisfied:

- The pre-contingency voltages on 115 kV buses must not be less than 113 kV, and on 230 kV buses must not be less than 220 kV;
- The post-contingency voltages on 115 kV buses must not be less than 108 kV, and on 230 kV buses must not be less than 207 kV;
- The voltage change following a contingency must not exceed 10% pre-ULTC and 10% post-ULTC on both 115 kV and 230 kV buses.

Table 14 summarizes the conditions that were studied with E1C operated closed at Ear Falls TS. In all of these cases, even with 40 Mvar of inductive reactive power compensation connected at Pickle Lake TS, voltages were above the minimum allowable voltage levels.

Table 14: List of studied scenarios

Base Case	Outage	Contingency	Requirements
Base Case 1 & 2	None	None	None
	None	E4D	None
	None	D26A	None
	None	F23D	None
	None	K24F	None
	None	F25A	None
	D26A (Dryden TS x Ignace 2 Jct)	E4D	None
	D26A (Dryden TS x Ignace 2 Jct)	F25A	None
	D26A (Dryden TS x Ignace 2 Jct)	E1C	None
	D26A (Dryden TS x Ignace 2 Jct)	E2R	None
	D26A (Dryden TS x Ignace 2 Jct)	M1M	None
	D26A (Ignace 2 Jct x Mackenzie TS)	E4D	None
	D26A (Ignace 2 Jct x Mackenzie TS)	F25A	None
	D26A (Ignace 2 Jct x Mackenzie TS)	E1C	None
	D26A (Ignace 2 Jct x Mackenzie TS)	E2R	None
	D26A (Ignace 2 Jct x Mackenzie TS)	M1M	None

5.6 Reactive Power Device Switching Assessment

Reactive power compensation devices should be sized to ensure that voltage declines or rises following switching operations will not exceed 4% of steady state rms voltage. This 4% is calculated before tap changer action using a voltage dependent load model (e.g. $P \alpha V^{1.5}$, and $Q \alpha V^2$).

A switching study of the two 40 Mvar at 220 kV static devices at Pickle Lake TS, if employed, was not needed because the devices will only be switched when the new 230 kV circuit is de-energized.

Table 15 shows that switching 40 Mvar at 220 kV at Ignace SS does not violate ORTAC's maximum switching voltage change criteria at Ignace SS.

Table 15: Switching study results - 40 Mvar at 220 kV at Ignace SS

Facility Name	Outage	Before Switching (kV)	After Switching 40 Mvar at 220 kV at Ignace SS	
			kV	%
Ignace SS	D26A (Dryden TS x Ignace 2 Jct)	245	240	2

Table 16 shows that switching 10 Mvar, at 118.1 kV, at Ear Falls TS does not violate ORTAC's maximum switching voltage change criteria at Ear Falls TS.

Table 16: Switching study results - 10 Mvar at 118.1 kV at Ear Falls TS

Facility Name	Outage	Before Switching (kV)	After Switching 10 Mvar at 118.1 kV at Ear Falls TS	
			kV	%
Ear Falls TS	E4D	135	130.9	3.5

5.7 Transient Rotor Angle Stability Assessment

As per the ORTAC, the power system must be stable following design criteria contingencies. Currently, the loss of E4D will disconnect Manitou Falls GS and Ear Falls GS from ICG. However, after the incorporation of the project, these generating stations will remain connected following the loss of E4D assuming that E1C is operated closed at Ear Falls TS.

Rotor angle responses of the units at Manitou Falls GS and Ear Falls GS following the loss of E4D are presented in Figure 7 with 40 Mvar at 220kV of inductive reactive power compensation incorporated at Pickle Lake TS, illustrating post-contingency instability. Therefore, automatic rejection for individual generating units at Manitou Falls GS and Ear Falls GS via a Remedial Action Scheme (RAS) is required following the loss of E4D. This RAS is expected to be classified as a Type 3.

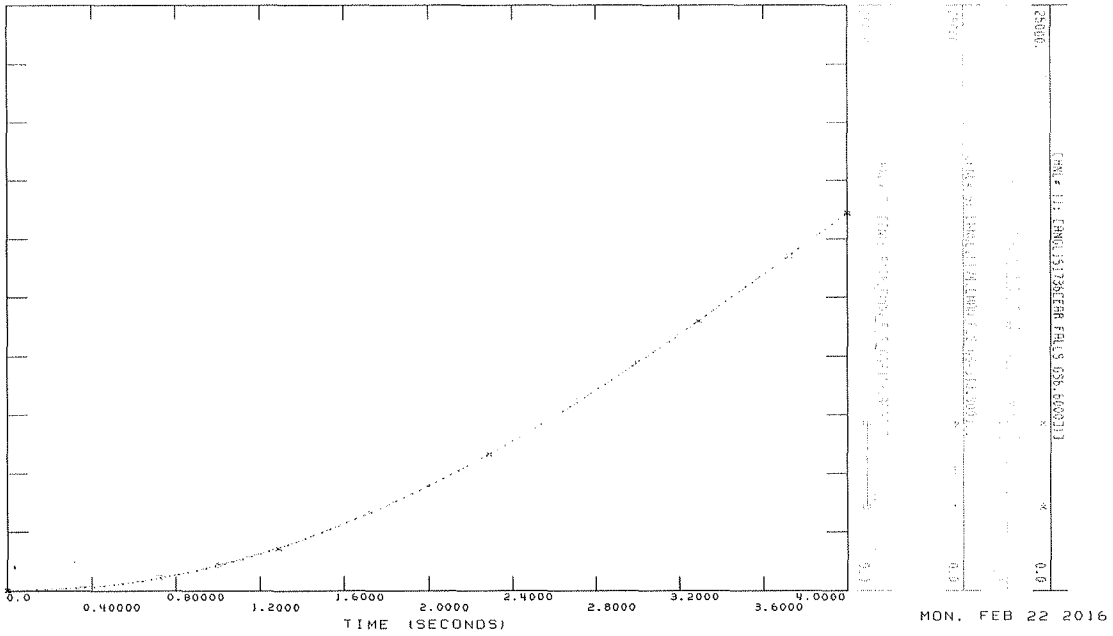

Figure 7: Post-contingency rotor angle responses for Manitou Falls GS and Ear Falls GS units following the loss of E4D

5.8 Voltage Stability Assessment

As per the ORTAC, 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 Power-Voltage (P-V) curve, and

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

Currently, the loads at Ear Falls TS and on 115 kV circuits E2R, M3E, E1C and M1M are radially supplied from Dryden TS through 115 kV circuit E4D. Accordingly, the loss of E4D will result in the disconnection of these loads from ICG.

After the incorporation of the project, the loads at Ear Falls TS and on 115 kV circuits E2R, M3E, E1C and M1M will remain connected following the loss of E4D, assuming that E1C is operated closed at Ear Falls TS. As a result, the loads at Red Lake TS and Balmer CTS will be the most downstream loads supplied radially from E1C, and will accordingly have the lowest voltage stability limit. The total reactance of E1C is 0.9018 pu which is 2.75 times the total reactance of E4D (0.32778 pu). Therefore, the voltage stability limit at Ear Falls TS when supplied from E1C is less than when it is supplied from E4D.

The Power–Voltage (P-V) curve at Ear Falls TS following the loss of E4D is presented in Figure 8 with 40 Mvar at 220kV of inductive reactive power compensation incorporated at Pickle Lake TS. The post-contingency voltage stability limit for the load supplied from Ear Falls TS is 43.5 MW. To ensure post-contingency voltage stability for the loss of E4D, a RAS that detects the loss of E4D and rejects load is required such that at most 41 MW at 0.9 lagging power factor on the high voltage buses at Red Lake TS and Balmer CTS remains connected, accounting for active power transmission losses in E2R. This RAS is also expected to be classified as a Type 3 RAS.

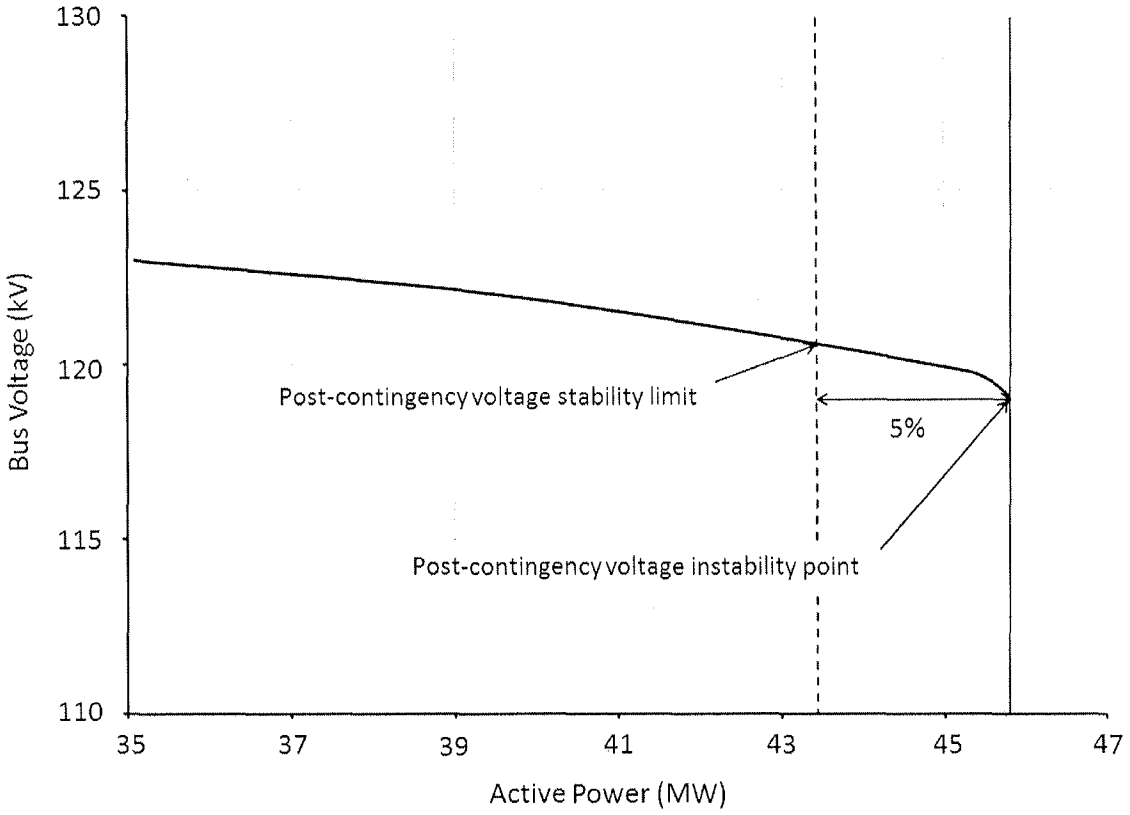

Figure 8: Post-contingency P-V curve at Ear Falls TS bus following the loss of E4D

5.9 Thermal Assessment

The ORTAC specifies the following criteria for 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.
- With two elements out of service, equipment loading must be within applicable short-term ratings

Table 17 summarizes the studied scenarios for the thermal assessment. With the two RASs described in sections 5.7 and 5.8 in service and with E1C operated closed at Ear Falls TS, no thermal rating violations were observed.

Table 17: List of studied scenarios for thermal assessment

Base Case	Outage	Contingency	Additional Requirements
Base Case 1 & 2	None	None	None
	None	E4D	None
	None	E1C	None
	None	E2R	None
	None	M1M	None

5.10 Load Security and Restoration

The ORTAC specifies the following criteria for load security criteria:

a. With one element out of service, not more than 150 MW of load may be interrupted by configuration.
b. With two elements out of service, 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.

If E1C is closed at Ear Falls TS, then for the loss of E4D, a maximum of 29.1 MW of load at Red Lake TS, Balmer CTS and Perrault DS would be interrupted based on the load forecast for 2030. Although, ORTAC does not permit load rejection with one element out of service, without the project a maximum of 98.7 MW of load at Red Lake TS, Balmer CTS, Ear Falls TS, Crow River DS, Slate Falls DS, Perrault Falls DS, Cate Lake DS, Musselwhite CTS and Esker CTS would be interrupted following the loss of E4D. Therefore, the project improves load security in the area.

If E1C is open at Ear Falls TS, then for the loss of E4D, a maximum of 70.1 MW of load at Red Lake TS, Balmer CTS, Perrault DS and Ear Falls TS would be interrupted based on the load forecast for 2030; which is within the 150 MW permitted by ORTAC. It should be noted that without the project, a maximum of 98.7 MW of load at Red Lake TS, Balmer CTS, Ear Falls TS, Crow River DS, Slate Falls DS, Perrault Falls DS, Cate Lake DS, Musselwhite CTS and Esker CTS would be interrupted following the loss of E4D.

ORTAC states that the transmission system must be planned such that, following design criteria contingencies on the transmission system, affected loads can be restored with the restoration times listed below:

a. All load must be restored within approximately a target of 8 hours.
b. When the amount of load interrupted is greater than 150MW, the amount of load in excess of 150MW must be restored within approximately a target of 4 hours.
c. When the amount of load interrupted is greater than 250MW, the amount of load in excess of 250MW must be restored within a target of 30 minutes.

If E1C is operated closed at Ear Falls TS, then for a permanent fault on E4D, load at Perrault DS and 28.2 MW at Red Lake TS and Balmer CTS will be interrupted.

If E1C is operated open at Ear Falls TS, then for a permanent fault on E4D, loads at Ear Falls TS, Red Lake TS, Balmer CTS and Perrault DS will be interrupted. The project can help in restoring Ear Falls TS load and up to 41 MW at a lagging power factor of 0.9 from Red Lake TS and Balmer CTS loads, by closing E1C at Ear Falls TS.

– End of Document –

Appendix A Protection Impact Assessment

Hydro One Networks Inc.
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Toronto, Ontario
M5G 2P5

PROTECTION IMPACT ASSESSMENT

SAGATAY

IGNACE JUNCTION SS BY PICKLE LAKE SS NEW LINE

PCT – 761

REV #1

Date: September 28, 2015

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Disclaimer

This Protection Impact Assessment has been prepared solely for the IESO for the purpose of assisting the IESO in preparing the System Impact Assessment for the proposed connection of the proposed transmission facilities to the IESO–controlled grid. This report has not been prepared for any other purpose and should not be used or relied upon by any person, including the connection applicant, for any other purpose.

This Protection Impact Assessment was prepared based on information provided to the IESO and Hydro One by the connection applicant in the application to request a connection assessment at the time the assessment was carried out. It is intended to highlight significant impacts, if any, to affected transmission protections early in the project development process. The results of this Protection Impact Assessment are also subject to change to accommodate the requirements of the IESO and other regulatory or legal requirements. In addition, further issues or concerns may be identified by Hydro One during the detailed design phase that may require changes to equipment characteristics and/or configuration to ensure compliance with the Transmission System Code legal requirements, and any applicable reliability standards, or to accommodate any changes to the IESO-controlled grid that may have occurred in the meantime.

Hydro One shall not be liable to any third party, including the connection applicant, which uses the results of the Protection Impact Assessment under any circumstances, whether any of the said liability, loss or damages arises in contract, tort or otherwise.

Revision History

Revision	Date	Change
R0	Sept. 28 2015	Released Revision
R1	Dec. 3 2015	Addition of sectionalizing switches on D26A

1 INTRODUCTION

1.1 GENERAL

This PIA study is prepared for the IESO to assess the potential impact of the proposed the new connection between lines D26A and E1C. The primary focus of this study is on protecting Hydro One system equipment while meeting IESO System Reliability Criteria. The study is based on technical data of new tap, lines, transformers, etc. as provided by the proponent.

1.2 DESCRIPTION OF THE PROPOSED CONNECTION

Sagatay Transmission LP is seeking the development of a new 291km single circuit 230kV transmission line from Dryden/Ignace area to Pickle Lake. This line will join the 230kV line D26A to the 115kV line E1C. It will be connected through a 3 breaker ring bus Switching Station (referenced as Pickle Lake SS in this document), a 2 breaker 115:230kV Transformer Station (referenced as Sagatay TS), and a single breaker Switching Station (referenced as Sagatay SS).

As illustrated in Fig. 4:

- Pickle Lake SS will have terminal points for: Line (named as C1M in this document) to Crow River DS and Musselwhite CSS, E1C to Ear Falls TS, and a short line to the Sagatay TS.
- The autotransformer (YYD rated as 100/133/167MVA) in Sagatay TS will be bounded by the two breakers and connect through a short line to the Pick Lake SS on the 115kV system. The HV breaker of the autotransformer will connect to the new line terminating at Sagatay SS.
- Sagatay SS will connect to D26A through a single breaker.
- Two in-line switches will be added at Ignace 2 Jct, where Sagatay SS will be tapped.

1.3 ASSUMPTION

The protection design and settings at the Point of Common Connect equipment must be approved by HONI for the purpose of protection coordination between HONI and the proponent. Telecommunication aided protection scheme for the new lines will be required.

In this document, it is assumed that Hydro One owns Pickle Lake SS, and Ignace 2 Jct.; and the proponent owns Sagatay TS, Sagatay SS and the new 230kV circuit.

1.4 DESCRIPTION OF THE EXISTING PROTECTION SYSTEM

Circuit E1C is a 260km long 115kV radial line which connects to Musselwhite CSS. The line then continues on as customer owned circuit M1M for another 180km terminating at 2 customer owned transformer stations. The existing protection here from Ear Falls TS is a direct over reaching scheme with instantaneous and timed zones. There are no teleprotection circuits for E1C.

Circuit D26A is a 174km long 230kV line between Dryden TS and Mackenzie TS. The protection scheme utilizes Directional Comparison Blocking (DCB) and Permissive Overreaching Transfer Tripping (POTT) using Power Line Carrier (PLC). There are currently no taps on this line.

PIA – Sagatay Ignace Junction x Pickle Lake 230kV Line Revision: 1

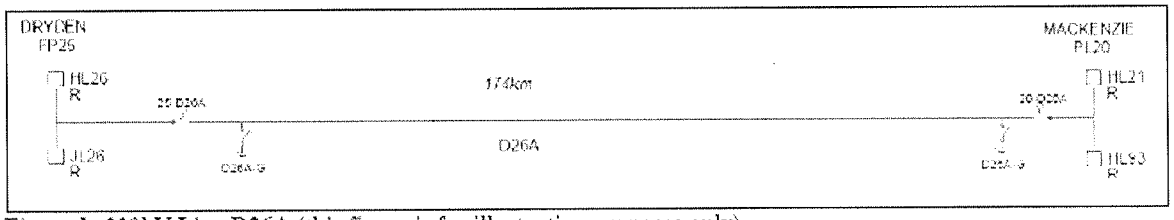

Figure 1: 230kV Line D26A (this figure is for illustrative purposes only)

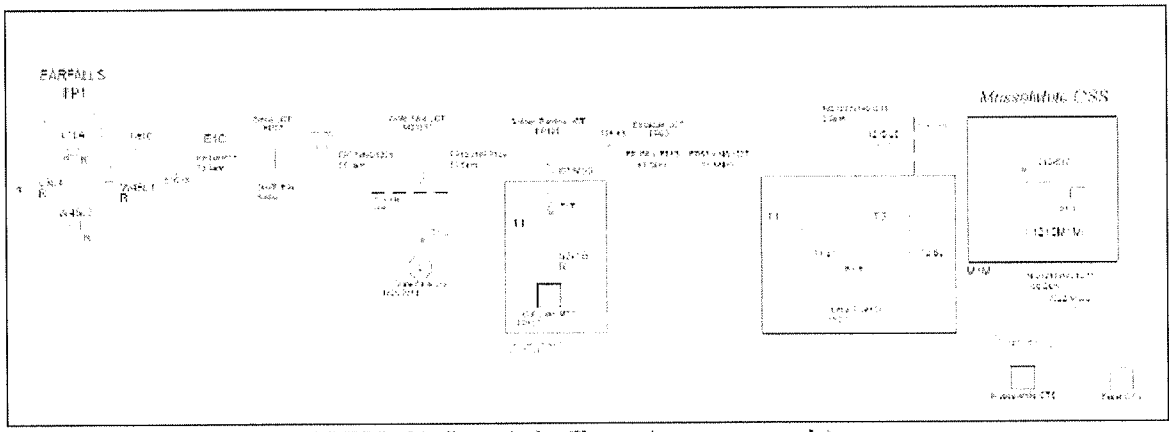

Figure 2: 115kV Line E1C and M1M (this figure is for illustrative purposes only)

Table 1: Existing Settings Data for Dryden TS D26A

Setting Data for Dryden TS D26A				
Element	Scheme	Model	Delay (s)	Settings (Ohms Primary)
A21G1	DUR/TT (Direct Under Reaching/Transfer Trip)	D60		63.5
A21G2	DOR/TT/DB (Direct Over Reach/Transfer Trip/Directional Blocking)	D60	0.4	105.8
A21G3	DRB (Directional Reverse Blocking)	D60		55.0
A21P1	DUR/TT	D60		67.7
A21P2	DOR/TT/DB (DOR/TT/Directional Blocking)	D60	0.4	105.8
A21P3	DRB	D60		55.0
B21G1	DUR/TT	SEL321-1		64.3
B21G2	DOR/TT/P (DOR/TT/Permissive)	SEL321-1	0.4	105.8
B21P1	DUR/TT	SEL321-1		67.7
B21P2	DOR/TT/P	SEL321-1	0.4	105.8
B21P3	DRB	SEL321-1		55.0

PIA – Sagatay Ignace Junction x Pickle Lake 230kV Line Revision: 1

Table 2: Setting Data for Mackenzie TS D26A

Setting Data for Mackenzie TS D26A				
Element	Scheme	Model	Delay (s)	Settings (ohms primary)
A21G1	DUR/TT	D60		63.5
A21G2	DOR/TT/DB	D60	0.4	105.8
A21G3	DRB	D60		55.0
A21P1	DUR/TT	D60		67.7
A21P2	DOR/TT/DB	D60	0.4	105.8
A21P3	DRB	D60		55.0
B21G1	DUR/TT	SEL321-1		63.5
B21G2	DOR/TT/P	SEL321-1	0.4	105.8
B21P1	DUR/TT	SEL321-1		67.7
B21P2	DOR/TT/P	SEL321-1	0.4	105.8

Communication Matrix for Circuit D26A [230kV]

Key Info

A Group

Dryden TS	Mackenzie TS	Path	Medium	Channel	Relationships	Notes
		PTC1133	Power Line	MAIN		TT, DRYDEN TS TO MACKENZIE TS (RECEIVE) - [A]
		PTC1135	Power Line	MAIN		DC, DRYDEN TS TO MACKENZIE TS (RECEIVE) - [A]
		PTC1136	Power Line	MAIN	PTC1137	TT, MACKENZIE TS TO DRYDEN TS (SEND) - [A]
		PTC1134	Power Line	MAIN		DC, DRYDEN TS TO MACKENZIE TS (SEND) - [A]

B Group

Dryden TS	Mackenzie TS	Path	Medium	Channel	Relationships	Notes
		PTC1134	Power Line	ALTERNATE		TT, DRYDEN TS TO MACKENZIE TS (RECEIVE) - [B]
		PTC1137	Power Line	ALTERNATE	PTC1136	TT, MACKENZIE TS TO DRYDEN TS (SEND) - [B]

Figure 3: Communication Matrix for D26A

Table 3: Settings Data for Ear Falls TS E1C

Element	Scheme	Model	Delay (s)	Settings (ohms Primary)
A21P2-2PH	DOR/T	KD-4	0.4	229.375
A21P2-3PH	DOR/T	KD-4	0.4	229.375
A50N	DOR/T	CAG	0.4	6.25
B21G1	DUR	SEL321-1		140.625
B21G2	DOR/T	SEL321-1	0.4	243.75
B21G3	DOR/T	SEL321-1	0.6	412.5
B21P1	DUR	SEL321-1		150
B21P2	DOR/T	SEL321-1	0.4	234.375
B21P3	DOR/T	SEL321-1	1.0	257.5

There are currently no teleprotection paths on E1C.

2 PROPOSED PROTECTION & TELEPROTECTION SCHEME

2.1 GENERAL

The following is a representation of the proposed connection:

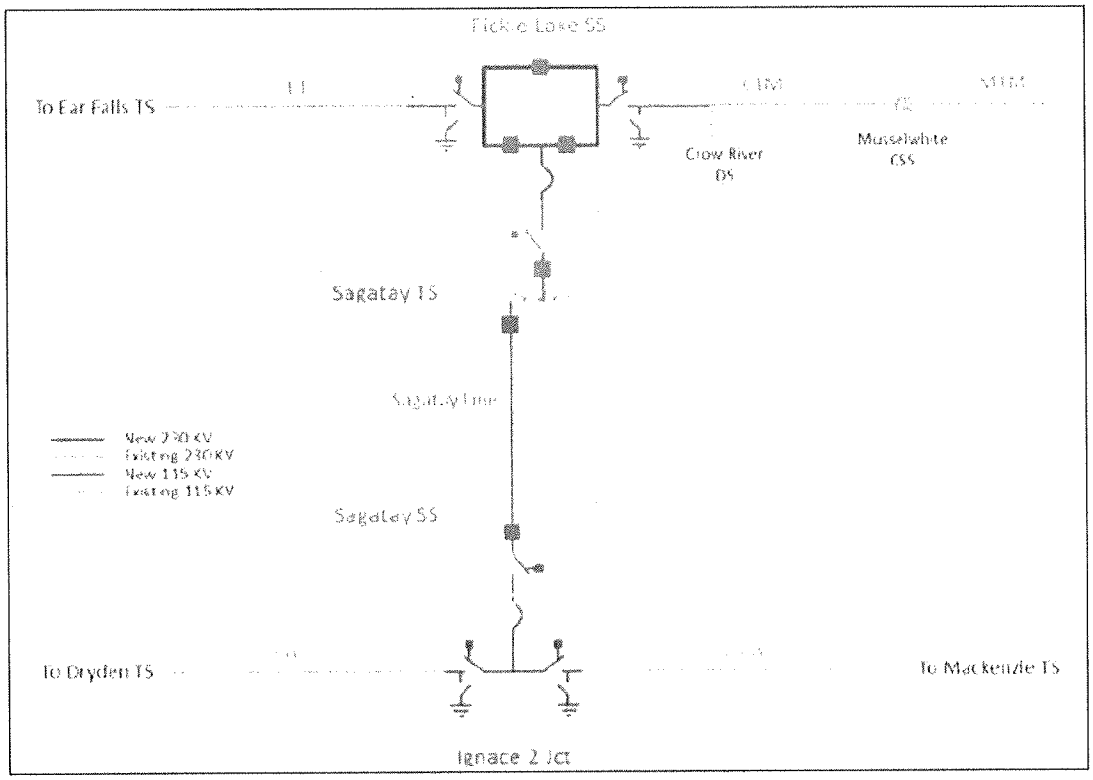

Figure 4: D26A/E1C 230kV Line Connection (this figure is for illustrative purposes only)

The installations of the proposed connections are feasible as long as the proposed changes/additions are made.

2.2 SPECIFIC PROTECTION REQUIREMENTS

2.2.1 Dryden TS

The connection of this new line changes D26A from a 2 ended line to a 3 ended line. The addition of a third end to the line has limited effect on the apparent impedance due to its low fault contribution.

- The protection and control system design for D26A shall consider relevant interlocking/enabling functions based on the status of the two in-line switches to be installed at Ignace 2 Jct. The details will be decided during the detailed design stage.
- The settings shall be updated to reflect the new impedances and distances to nearest terminals.
- Zone 1 settings shall be updated to 75/80% (for ground and phase respectively) of the positive sequence line impedance to Sagatay SS.
- Due to the weak in feed from the new line, the existing DCB and POTT scheme combination will be changed to both Three-Terminal-DCB schemes.
- Dual Teleprotection circuits shall be built to send/receive transfer trip and blocking signals to/from Sagatay SS.
- Modify existing protection system as necessary to accommodate the new installation.

The existing teleprotection utilizes Power Line Carrier, and the use of this to Sagatay SS shall be explored.

Table 4: New Settings Data for Dryden TS D26A

Setting Data for Dryden TS D26A				Settings (Ohms Primary)	
Element	Scheme	Model	Delay (s)	Existing	New
A21G1	DUR/TT	D60		63.5	29
A21G2	DOR/TT/DB	D60	0.4	105.8	110
A21G3	DRB	D60		55.0	33
A21P1	DUR/TT	D60		67.7	31
A21P2	DOR/TT/DB	D60	0.4	105.8	107
A21P3	DRB	D60		55.0	29
B21G1	DUR/TT	SEL321-1		64.3	29
B21G2	DOR/TT/P	SEL321-1	0.4	105.8	110
B21G3	DRB	SEL321-1		DNE	33
B21P1	DUR/TT	SEL321-1		67.7	31
B21P2	DOR/TT/P	SEL321-1	0.4	105.8	107
B21P3	DRB	SEL321-1		DNE	29

2.2.2 Mackenzie TS

The connection of this new line changes D26A from a 2 ended line to a 3 ended line. The addition of a third end to the line has limited effect on the apparent impedance due to its low fault contribution.

- The protection and control system design for D26A shall consider relevant interlocking/enabling functions based on the status of the two in-line switches to be installed at Ignace 2 Jct. The details will be decided during the detailed design stage.
- The settings shall be updated to reflect the new impedances and distances to nearest terminals.
- Zone 1 settings shall be updated to 75/80% (for ground and phase respectively) of the positive sequence line impedance to Sagatay SS.
- Due to the weak in feed from the new line, the existing DCB and POTT combination scheme will be changed to both Three-Terminal-DCB schemes.
- Dual teleprotection circuits shall be built to send/receive transfer trip and blocking signals to/from Sagatay SS.
- Modify existing protection system as necessary to accommodate the new installation.

Table 5: New Settings Data for Mackenzie TS D26A

Setting Data for Mackenzie TS D26A				Settings (Ohms Primary)	
Element	Scheme	Model	Delay (s)	Existing	New
A21G1	DUR/TT	D60		63.5	34
A21G2	DOR/TT/DB	D60	0.4	105.8	109
A21G3	DRB	D60		55.0	33
A21P1	DUR/TT	D60		67.7	36.4
A21P2	DOR/TT/DB	D60	0.4	105.8	106
A21P3	DRB	D60		55.0	29
B21G1	DUR/TT	SEL321-1		64.3	34
B21G2	DOR/TT/P	SEL321-1	0.4	105.8	109
B21G3	DRB	SEL321-1		DNE	33
B21P1	DUR/TT	SEL321-1		67.7	36.4
B21P2	DOR/TT/P	SEL321-1	0.4	105.8	106
B21P3	DRB	SEL321-1		DNE	29

2.2.3 Sagatay SS

- The protection and control system design for D26A shall consider relevant interlocking/enabling functions based on the status of the two in-line switches to be installed at Ignace 2 Jct. The details will be decided during the detailed design stage.
- Redundant 'A' and 'B' line protections shall be provided in Sagatay SS for line D26A.
- Due to the low fault contribution from the new line, the apparent impedance as seen from this station looking out into D26A is very high. Therefore the DCB scheme is chosen to allow for the strong terminals Dryden and Mackenzie to see all faults within at least their zone 2 settings and trip, and Ignace will trip sequentially after Dryden or Mackenzie trips, or receive transfer trip.

- Zone 1 settings shall be updated to 75/80% (for ground and phase respectively) of the positive sequence line impedance to Dryden TS.
- Zone 2 settings shall be set to 125% of the positive sequence impedance to Mackenzie TS. Setting this to the maximum apparent impedance would be prohibitively high setting value and therefore shall not be done.
- Zone 3 setting shall be set to 125% of the zone 2 setting from Dryden less the positive sequence impedance of the line.
- Breaker failure protection shall be installed, and transfer trip shall be sent to Dryden and Mackenzie in case of breaker failure.
- Dual Teleprotection circuits shall be built to send/receive transfer trip and blocking signals to/from Dryden TS.
- Dual Teleprotection circuits shall be built to send/receive transfer trip and blocking signals to/from Mackenzie TS
- The existing facilities on D26A are PLC, so the feasibility of making use of these existing channels shall be explored.
- Redundant 'A' and 'B' line protections with proper teleprotection scheme shall be provided for the new 291km 230kV line, to meet the requirement of TSC.

Table 6: Settings Data for Sagatay SS D26A

Element	Scheme	Delay (s)	Settings (ohms primary)
21G1	DUR/TT		29
21G2	DOR/TT/DB	0.4	57
21G3	DRB		89
21P1	DUR/TT		31
21P2	DOR/TT/DB	0.4	57
21P3	DRB		89

2.2.4 Ear Falls TS

- With the addition of the Pickle Lake SS at the end of E1C, there is a change in configuration from a single ended line to a 2 ended line. A DCB scheme shall be utilized in this situation. The existing protection is a Direct Overreaching scheme.
- Zone 1 settings shall be updated to 75/80% (for ground and phase respectively) of the positive sequence line impedance.
- Zone 2 settings shall be set to 125% of the positive sequence impedance.
- Zone 3 reverse blocking shall be set to 125% of the Zone 2 setting of the opposite terminal station minus the positive sequence impedance of the line. 1.25*(Z2-ZL1)
- There shall be Main and Alternate teleprotection signals sent between Pickle Lake SS and Ear Falls TS.
- Modify existing protection system as necessary to accommodate the new installation.

Table 7: Settings Data for Ear Falls TS and Pickle Lake SS E1C

Element	Scheme	Delay (s)	Settings (ohms primary)
21G1	DUR/TT		136

21G2	DOR/TT/DB	0.4	226
21P1	DUR/TT		145
21P2	DOR/TT/DB	0.4	226
21Z3	DCB		57

2.2.5 Pickle Lake SS

- Pickle Lake SS shall be a ring bus configuration with 3 breakers. Each pair of breakers terminates into the following:
  - Existing E1C
  - The breaker of the customer owned 115:230kV transformer, forming a short line to Sagatay TS.
  - New C1M line to Musselwhite CSS with Crow River DS connecting to it.
- Each breaker shall have breaker failure protection, and will trip off adjacent zones (including sending transfer trip to remote stations) in case of breaker failure.
- Redundant 'A' and 'B' line protection utilizing DCB scheme shall be provided for E1C. Table 7 has the proposed settings.
- Redundant 'A' and 'B' line protection utilizing differential scheme shall be provided for the short line between Pickle lake SS and Sagatay TS.
- Redundant 'A' and 'B' Line protection utilizing differential scheme shall be provided for the line between Pickle Lake SS and Musselwhite CSS. Line differential settings will take into account the 'leakage current' of the attached Crow River DS within its zone.

2.2.6 Sagatay TS

- Redundant 'A' and 'B' line protections utilizing differential scheme shall be provided for the short line between Pickle lake SS and Sagatay TS.
- Redundant 'A' and 'B' transformer differential protections shall be provided for the auto-transformer.
- The 230kV and 115kV breakers shall provide breaker failure protection, and will trip off adjacent zones (including sending transfer trip to remote stations) in case of breaker failure.
- Redundant 'A' and 'B' line protections with proper teleprotection scheme shall be provided for the new 291km 230kV line, to meet the requirement of TSC.

2.2.7 Musselwhite CSS

- Redundant 'A' and 'B' Line protection utilizing differential scheme shall be provided for the line between Pickle Lake SS and Musselwhite CSS. Line differential settings will take into account the 'leakage current' of the attached Crow River DS within its zone.
- 1210M1M breaker shall provide breaker failure protection (if not existing), and will trip off adjacent zones (including sending transfer trip to remote stations) in case of breaker failure.
- Existing protection system shall be reviewed and be modified as necessary to accommodate the new system configuration.

2.2.8 Ignace 2 Jct.

- Two in-line switches will be installed at Ignace 2 Jct., as illustrated in Figure 4. These two switches will not be tripped by protection, and will be only used to facilitate Operator control.
- The protection and control system design for D26A shall consider relevant interlocking/enabling functions based on the status of these two in-line switches. The details will be decided during the detailed design stage.
-

2.2.9 Proponent Requirements

- In additional to the technical requirement specified in section 2.2.3 Sagatay SS, section 2.2.6 Sagatay TS, the proponent shall provide proper protection/teleprotection systems to protect its own assets, and to meet TSC and IESO requirements.
- The proponent shall provide dual telecommunication (Main and Alt.) between Sagatay SS and Dryden TS for D26A to facilitate bi-directional transfer trip and blocking implementation.
- The proponent shall provide dual telecommunication (Main and Alt.) between Sagatay SS and Mackenzie TS for D26A to facilitate bi-directional transfer trip and blocking implementation.
- The proponent shall provide dual optical-fiber cables between Pickle Lake SS Sagatay TS to facilitate the line differential protection implementation

2.3 TELE-PROTECTION

- New dual telecommunication links (Main and Alt.) will be required for the protection of E1C at Ear Falls TS and Pickle Lake SS.
- New dual fiber telecommunication links will be required between Pickle Lake SS and Musselwhite CSS
- New dual fiber telecommunication links will be required between Pickle Lake SS and Sagatay TS.
- New dual telecommunication links (Main and Alt.) will be required between Sagatay SS and Dryden TS
- New dual telecommunication links (Main and Alt.) will be required between Sagatay SS and Mackenzie TS
- Modifications in the existing teleprotection systems or installations of new teleprotection systems at HONI stations Dryden TS and Mackenzie TS
- New telecommunication links between Sagatay SS and Sagatay TS will be determined by the proponent, while meet TSC and IESO requirement

2.4 LONGEST FAULT CLEARING TIME

- On D26A the addition of Sagatay SS will increase maximum fault clearing times. The maximum time will be at a time when Sagatay SS zone 1 cannot see the fault and the

other line ends only see the fault from their zone 2 protections. At Sagatay SS the protections will then rely on transfer trip receive.

- For Sagatay SS the Teleprotection will receive the trip over assumed PLC = (MR 25ms + DCB 50ms + TP 33ms) from Dryden or Mackenzie TS + (BTM 6ms + BKR 50ms) at Sagatay SS = **164ms**. This is an increase of 33ms.

— The changes on E1C will result in a decrease in maximum fault clearing time of 350ms (400ms zone 2 time delay, minus 50ms DCB waiting time). This is due to the existing DOR scheme clearing 80% of the line instantaneously and 125% upon a time delay of 400ms. The new scheme will employ a DCB scheme with teleprotection channels which will decrease the fault clearing time.

— The fault clearing time on the line between Pickle Lake SS and Musselwhite CSS will be 89ms.

— The fault clearing time on the line between Pickle Lake SS and the Sagatay TS will be 89ms.

— The fault clearing time on the new 291km 230kV lines will depend on the proponent's design.

The following functional specifications listed below are outside the scope of Protection Impact Assessment that deals exclusively with protection and tele-protection. However, should this become a project it will be addressed according to IESO Market Rules in the future in a PCT Planning Specification (former Appendix E) of a Transmission Planning Specification.

- *DC Station Services*
- *Relay Rooms, Cables and Wiring*
- *SCADA*
- *Power System Telecommunication (excluding Tele-protection)*
- *Station LAN*
- *Cyber Security*
- *Power System Monitoring*
- *Revenue Metering*
- *Infrastructure*
- *Aurora Vulnerability*
- *Functional Specification Compliance*
- *Project Completion Requirements*