Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

NEEDS ASSESSMENT REPORT

Sudbury/Algoma Region

Date: August 6, 2020

REPORT STATUS: DRAFT

Prepared by: Sudbury/Algoma Region Study Team

Revision History

Date	Rev #	Purpose of revision
June 30th, 2020	0.0	Initial Release
August 6th , 2020	0.1	Revision to incorporate additional comments

Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the Sudbury/Algoma Region and to recommend which need may be a) directly addressed by developing a preferred plan as part of NA phase and b) identify needs requiring further assessment and/or regional coordination. The results reported in this Needs Assessment are based on the input and information provided by the Study Team for this region.

The Study Team participants, their respective affiliated organizations, and Hydro One Networks Inc. (collectively, "the Authors") shall not, under any circumstances whatsoever, be liable to each other, to any third party for whom the Needs Assessment Report was prepared ("the Intended Third Parties") or to any other third party reading or receiving the Needs Assessment Report ("the Other Third Parties"). The Authors, Intended Third Parties and Other Third Parties acknowledge and agree that: (a) the Authors make no representations or warranties (express, implied, statutory or otherwise) as to this document or its contents, including, without limitation, the accuracy or completeness of the information therein; (b) the Authors, Intended Third Parties and Other Third Parties and their respective employees, directors and agents (the "Representatives") shall be responsible for their respective use of the document and any conclusions derived from its contents; (c) and the Authors will not be liable for any damages resulting from or in any way related to the reliance on, acceptance or use of the document or its contents by the Authors, Intended Third Parties or Other Third Parties or their respective Representatives.

Executive Summary

REGION Sudbury/Algoma n Region (the "Region")

LEAD Hydro One Networks Inc. ("HONI")

START DATE: APRIL 1ST, 2020 **END DATE:** June 30th , 2020

1. INTRODUCTION

The first cycle of the Regional Planning process for the Sudbury/Algoma Region was completed in June 2016 with the publication of the Regional Infrastructure Plan ("RIP") which provided a description of needs and recommendations of preferred wires plans to address near-term needs.

This is the second cycle of regional planning starting from Needs Assessment ("NA"). The purpose of this NA is a) to identify any new needs and/or to reaffirm needs identified in the previous Sudbury/Algoma Regional Planning cycle and b) recommend which need may be a) met more directly by distributors or other customers and their respective transmitter b) identify needs requiring further assessment and/or regional coordination.

2. REGIONAL ISSUE/TRIGGER

In accordance with the Regional Planning process, the regional planning cycle should be triggered at least every five years. In light of these timelines, the 2nd Regional Planning cycle was triggered for Sudbury/Algoma Region.

3. SCOPE OF NEEDS ASSESSMENT

The assessment's primary objective is to identify the electrical infrastructure needs over the study period, develop options and recommend which needs require further regional coordination.

The scope of this NA includes:

- Review and reaffirm needs/plans identified in the previous RIP; and
- Identify and assess system capacity, reliability, operation, and aging infrastructure needs in the region: and
- Identify needs that will require further coordination at the regional level and those which can be met more directly by distributors and other customers as their respective transmitter.

The Study Team may also identify additional needs during the next phases of the planning process, namely Scoping Assessment ("SA"), IRRP and RIP, based on updated information available at that time.

As per the PPWG Regional Planning Report to the Board (May 2013), the planning horizons of regional facilities are typically considered over the 1-20 years; however, in most situations focus is over the 1 – 10 years.

4. INPUTS/DATA

The Study Team representatives from Local Distribution Companies ("LDC"), the Independent Electricity System Operator ("IESO"), and Hydro One provided input and relevant information for this Region regarding capacity needs, reliability needs, operational issues, and major assets/facilities approaching end-of-life ("EOL").

5. ASSESSMENT METHODOLOGY

The assessment methodology includes review of planning information such as load forecast, conservation and demand management ("CDM") forecast and available distributed generation ("DG") information, system reliability and operational issues, and major high voltage equipment identified to be at or near the end of their life.

A technical assessment of needs was undertaken based on:

- Current and future station capacity and transmission adequacy;
- Reliability needs and operational concerns; and
- Any major high voltage equipment reaching the end of its life.

6. NEEDS

I. Needs Identified from Previous Cycle – Implementation Plan Update

i. The majority of the equipment at **Coniston TS** was assessed to be at the end of life and in need of replacment. Upon decommissioning of Coniston TS, the existing 22kV customers will be converted to 44kV and connected to the M6 feeder out of Martindale TS. This project is presently underway with an in-service date scheduled for Q4 2020..

ii. **Espanola TS** – Replace 115/44kV 15MVA (T1) and 42MVA (T2) transformers with new 115/44kV 42MVA units. These transformers were assessed at being at their end of life and in need of replacement due to the assets'condition. This project was successfully carried out and in serviced in Q4 2016.

iii. **Larchwood TS** – Replace 110/44 kV 20 MVA (T2) transformer with a new 115/44kV 42MVA unit. This project was successfully completed and in serviced in Q4 2015.

iv. **Martindale TS** – Replace 230/115kV 115MVA (T21) and 125MVA (T23) autotransformers with new 230/115kV 125 MVA units. This investment is currently underway with a planned in service date scheduled in Q4 2020.

v. **Manitoulin TS** –Voltage Regulation – pre-contingency voltages at Manitoulin TS 115kV can at times be below the ORTAC criteria of 113kV. Without McLean's Mountain windfarm in service, and under peak load conditions, pre-contingency voltage at Manitoulin TS high voltage bus can be as low as 111kV when supplied from Algoma TS, and 110kV when supplied from Martindale TS. Hydro One and the LDC reviewed this need as part of a local plan, and agreed to monitor supply voltages and take corrective action if needed.

II. Newly Identified Needs in the Region

i. **Manitoulin TS -** Load growth at this station is restricted due to a limiting component within the low votage yard. In the event where one of the transformers at the station is unavailable, the remaining transformer will not be able to supply the entire station load due to this restriction. Based on the collected historical data at the station, the 2019 winter peak at the station already surpasses the station 10 day LTR. It should be noted that the station low voltage bus configuration is as such that the loss of one of the transformers will remove half of the load by configuration[1]. That being said, necessary capability at the station should be maintained to pick up the dropped load in the occurrence of such an event. Given its geographical location, this station cannot rely on any other nearby station for capacity relief via low voltage load transfer. This limiting component will need to be corrected by as soon as practically feasibible to enable the utilization of the full capacity of the transformers.

ii. **Martindale TS** – This station will exceed its normal winter supply capacity in 2028. Hydro One is planning to replace the two 230/44kV 125MVA (T25/T26) power transformers in 2028 with new 230/44kV 125MVA units to address end of life needs. A plan is required to address the supply capacity need beyond what the new transformers units will be able to provide.

7. RECOMMENDATIONS

i. Manitoulin TS – Full utilization of the station transformer capacity is restricted by a series limiting component and will need to be addressed as soon as practically feasible. A CT ratio setting on the low voltage bushing of the transformer breaker can be modified to allow full transformer LTR capability. Hydro One will address this need directly in collaboration with the LDCs as soon as practically feasibilty. Further regional coordination is not required.

ii. Martindale TS – Supply capacity constraints at Martindale TS will appear in 2028 based on winter demand forecast. Given the anticipated timing of the need, there is time to re-evaluate this need in the next cycle of regional planning, scheduled to take place in 2025. Should the need materializes sooner than anticipated at Martindale TS, a station specific needs assessment can be carried out at that time so as to determine the best course of action for meeting the station supply capacity needs

[1] Discussion between the Transmitter and the LDC have confirmed that the existing configuration continues to provide an acceptable level of reliability.

TABLE OF CONTENTS

List of Tables and Figures

1 INTRODUCTION

The first cycle of the Regional Planning process for the Sudbury/Algoma Region was completed in June 2016 with the publication of the Regional Infrastructure Plan ("RIP"). The RIP provided a description of needs and recommendations of preferred wires plans to address near- and medium-term needs.

The purpose of this Needs Assessment ("NA") is to identify new needs and to reconfirm needs identified in the previous Sudbury/Algoma regional planning cycle. Since the previous regional planning cycle, some new needs in the region have been identified.

This report was prepared by the Sudbury/Algoma Study Team ("Study Team"), led by Hydro One Networks Inc. Participants of the Study Team are listed below in Table 1. This report presents the results of the assessment based on information provided by Hydro One, the Local Distribution Companies ("LDC") and the Independent Electricity System Operator ("IESO").

Table 1: Sudbury/Algoma Region Study Team Participants

Company
Greater Sudbury Hydro INC
Hydro One Networks Inc. (Distribution)
North Bay Hydro (Embedded LDC)
Independent Electricity System Operator ("IESO")
Hydro One Networks Inc. (Lead Transmitter)

2 REGIONAL ISSUE/TRIGGER

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least every five years. In light of Regional Planning cycle timelines and new needs in the Sudbury/Algoma region, the 2nd Regional Planning cycle was triggered for the Sudbury/Algoma region.

3 SCOPE OF NEEDS ASSESSMENT

The scope of this NA covers the Sudbury/Algoma region and includes:

- Review the status of needs/plans identified in the previous RIP; and
- Identification and assessmen of any new needs (e.g. system capacity, reliability, operation, and aging infrastructure)

The Study Team may identify additional needs during the next phases of the regional planning process, namely Scoping Assessment ("SA"), Local Planning ("LP"), IRRP, and/or RIP.

4 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The Sudbury to Algoma Region includes Greater Sudbury Area, Manitoulin Island, and townships of Verner, Warren, Elliot Lake, Blind River and Walden. The boundaries of the Sudbury to Algoma Region are shown below in Figure 1.

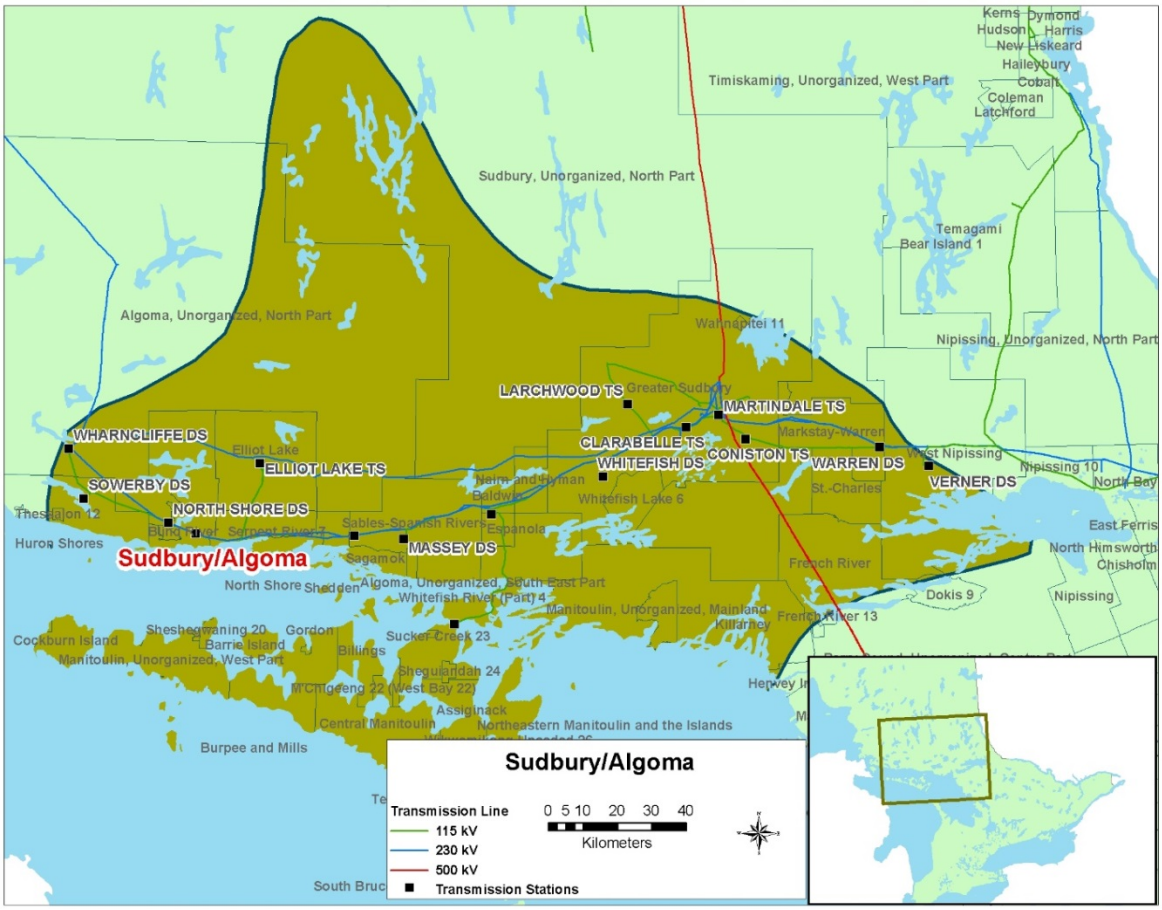

Figure 1: Geographical Area of Sudbury/Algoma Region with Electrical Layout

Electrical supply to the Sudbury/Algoma Region is provided through a network of 230kV and 115kV transmission circuits supplied by autotransformers at Hanmer TS, Algoma TS and Martindale TS. This area is further reinforced through the 500kV circuits (P502X and X504/503E) connecting Hanmer TS (Sudbury) to both Porcupine TS (Timmins) and Essa TS (Barrie). It is also connected to northwest Ontario through Mississagi TS. Appendix C lists the major transmission circuits and Hydro One stations in the subject region.

This region has the following two transmission-connected local distribution companies (LDC):

- Greater Sudbury Hydro Inc.
- Hydro One Networks Inc. (Distribution)

North Bay Hydro is a third LDC in this region embedded into the Hydro One Disribution system. Although invited to participate directly in the NA process, the data related to this LDC as well as their operational concerns was communicated through their host LDC namely Hydro One Distribution.

Tranmission connected industrial/commercial loads in the Sudbury to Algoma region form a large percentage (approximately 50%) of the overall demand. Although these customers are not explicitly participating in the regional planning process, Hydro One will consider their impact in the NA of this region.

Below is a description of the major assets in the region:

- Hanmer TS is the major transmission station that connects the 500kV network to the 230kV system via two 500/230 kV autotransformers.

- Algoma TS (230 kV) and Martindale TS (230 kV) are the transmission stations that connect the 230kV network to the 115kV system via 230/115 kV autotransformers.

- Eight (8) step-down transformer stations supply the Sudbury/Algoma load Algoma TS (115 kV), Martindale TS (115 kV), Coniston TS[2], Larchwood TS, Manitoulin TS, Espanola TS, Clarabelle TS, Elliot Lake TS. There are also nine HVDS that supply load in the Region: Sowerby DS, Wharncliffe DS, North Shore DS, Striker DS, Spanish DS, Massey DS, Whitefish DS, Warren DS and Verner DS.

- Nine (9) Customer Transformer Stations (CTS) are supplied in the Region: Carmeuse Lime CTS, Sudbury Smelter CTS, Falconbridge CTS, Nickel Rim CTS, Eacom Nairn CTS, Onaping Area M&M CTS, Milman Foundry CTS, Vale Copper #4 CTS and Vale Frood Stbe #2 CTS.

- There are four (4) existing transmission connected generating stations (GS) in the region as follows:
    - Red Rock GS is a 40 MW hydro electric generation plant connected to circuit T1B
    - Rayner GS is a 42MW hydro electric generation plant connected to circuit T1B
    - McLean's Mountain Wind is a 60 MW wind farm connected to circuit S2B. It is located at the North end of the Manitoulin Island.
    - Aux Sables GS is a 5 MW hydro electric generation plant connected to 115kV circuit S2B
    - Serpent GS is a 8 MW hydro electric generation facility connected to 115kV circuit S2B

[2] *Coniston TS in its entirety is being decommissioned and removed. The targeted completion date falls between now and the next Regional Planning Cycle for this region.*

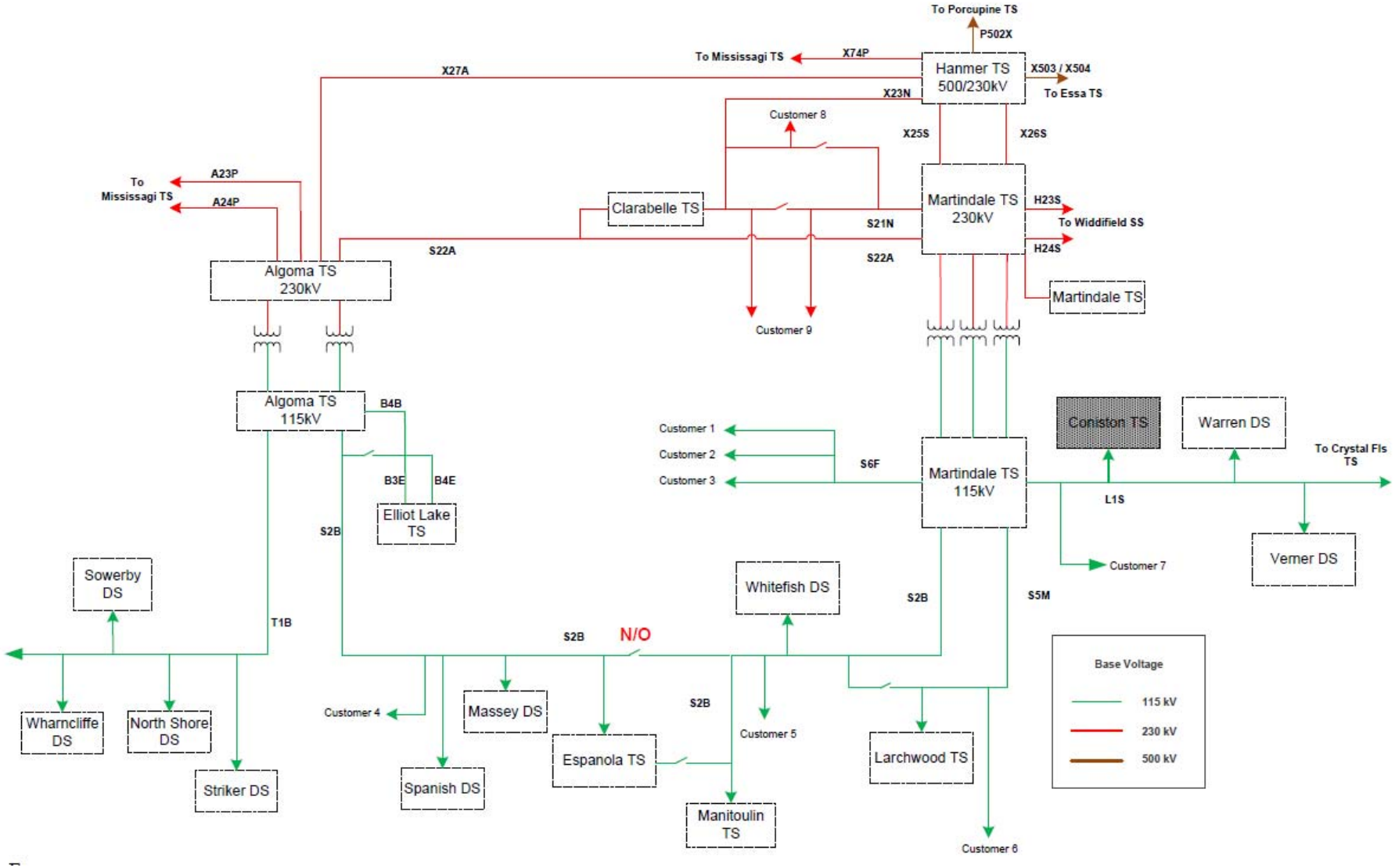

Figure 2: Single Line Diagram of Sudbury/Algoma Region

5 INPUTS AND DATA

Study Team participants, including representatives from LDCs, IESO, and Hydro One provided information and input for the Sudbury/Algoma Region NA. The information provided includes the following:

- Sudbury/Algoma Region Load Forecast for all supply stations;
- Known capacity and reliability needs, operating issues, and/or major assets approaching the end of life ("EOL"); and
- Planned/foreseen transmission and distribution investments that are relevant to regional planning for the Sudbury/Algoma Region.

6 ASSESSMENT METHODOLOGY

The following methodology and assumptions are made in this Needs Assessment:

Information gathering including:

i. Load forecast: The LDCs provided load forecasts for all the stations supplying their loads in the Sudbury/Algoma region for the 10 year study period. The IESO provided a Conservation and Demand Management ("CDM") and Distributed Generation ("DG") forecast for the Sudbury/Algoma region. The region's extreme winter non-coincident peak gross load forecast for each station were prepared by applying the LDC load forecast load growth rates to the actual 2019/20 winter peak extreme weather corrected loads. The extreme winter weather correction factors were provided by Hydro One. The net extreme weather winter load forecasts were produced by reducing the gross load forecasts for each station by the percentage CDM and then by the amount of effective DG capacity provided by the IESO for that station. It is to be noted that in the mid-term (5 to 10 year) time frame, contracts for existing DG resources in the region begin to expire, at which point the load forecast indicates a decreasing contribution from local DG resources, and an increase in net demand. These load forecasts for the individual stations in region is given in Appendix A;

ii. Relevant information regarding system reliability and operational issues in the region; and

iii. List of major High Voltage (HV) transmission equipment planned and/or identified to be refurbished and/or replaced due to the end of life which is relevant for regional planning purposes. This includes HV transformers, autotransformers, HV Breakers, HV underground cables and overhead lines.

A technical assessment of needs was undertaken based on:

- Current and future station capacity and transmission adequacy;
- System reliability and operational concerns; and
- Any major high voltage equipment reaching the end of life.

7 NEEDS

This section describes emerging needs identified in the Sudbury/Algoma Region, and also reaffirms the near, mid, and long-term needs already identified in the previous regional planning cycle. The recent load forecast prepared for this report is higher than that of the previous cycle of regional planning. This is attributed to observed higher demand in the region. A contingency analysis was performed for the region and no new system needs were identified.

The status of the previously identified needs is summarized in Table 2 below.

Table 2: Needs Identified in the Previous Regional Planning Cycle

Type of Needs identified in the previous RP cycle	Needs Details	Preferred Solution/ Current Status	In Service
Pre-contingency volages at Manitoulin TS 115 kV	Pre-contingency voltages at Manitoulin TS 115kV bus may be below the ORTAC criteria of 113 kV	Maintain Status Quo provided the customer side voltage remains within criteria and is acceptable to the customers.	N/A
Post contingency voltage declines at Martindale TS	With either X25S or X26S is out of service, the loss of the companion circuit may result in voltage declines at Martindale 230kV and 115kV buses below acceptable ORTAC limits.	X25S unbundling project[3]/ **Underway**	2023
Post Contingency Thermal Overload of Martindale Autotransformers	Under peak load conditions, the loss of two Martindale 230/115kV transformers may result in the overload of the third Martindale transformer	Martindale autotransformers T21/T23 Replacement project/ **Underway**	2020
End of Life Asset Replacement	Build a new 230/44kV station at Hanmer TS to replace Coniston TS (115/22kV).	Upon decommission of Coniston TS, the existing 22kV customers will be converted to 44kV and connected to the M6 feeder out of Martindale TS/ **Underway**	2020
	Replace 115/44kV power transformers at Espanola TS (T1/T2)	**Completed**	2016
	Replace 115/44kV power transformer at Larchwood TS (T2)	**Completed**	2015

[3] The X25S unbundling project was initiated at the directive of the IESO via a letter dated October 19th, 2018 adressed to Hydro One Transmission Planning Division.

7.1 End-Of-Life (EOL) Equipment Needs

Hydro One and LDCs have provided high voltage asset information under the following categories that have been identified at this time and are likely to be replaced over the next 10 years:

- Autotransformers
- Power transformers
- HV breakers
- Transmission line requiring refurbishment where an uprating is being considered for planning needs and require Leave to Construct (i.e., Section 92) application and approval
- HV underground cables where an uprating is being considered for planning needs and require EA and Leave to Construct (i.e., Section 92) application and approval

The end-of-life assessment for the above high voltage equipment typically included consideration of the following options:

1. Replacing equipment with similar equipment and built to current standards (i.e., "like-for-like" replacement);
2. Replacing equipment with similar equipment of higher / lower ratings i.e. right sizing opportunity and built to current standards;
3. Replacing equipment with lower ratings and built to current standards by transferring some load to other existing facilities;
4. Eliminating equipment by transferring all of the load to other existing facilities;

In addition, from Hydro One's perspective as a facility owner and operator of its transmission equipment, do nothing is generally not an option for major HV equipment due to safety and reliability risk of equipment failure. This also results in increased maintenance cost and longer duration of customer outages.

Accordingly, following major high voltage equipment has been identified as approaching its end of life over the next 10 years and assessed for right sizing opportunity.

i. **Algoma TS** - 230/115kV Autotransformer Replacement – Replace 230/115kV 195 MVA and 115 MVA autotransformers (respectively T5 and T6) with new 230/115kV 125 MVA transformers. The new replacement units will also be procured with Under Load Tap Changer for better operational flexibility.

ii. **Clarabelle TS** - 230/44kV Power transformer replacement – Replace 230/44kV 125 MVA (T1/T2) power transformers with new 230/44kV 125 MVA units.

iii. **Coniston TS** - The previous Regional Planning cycle Needs Assessment makes mention of the removal of the Coniston TS and its load being transferred to a newly built Hanmer TS DESN. Due to customers's changing system needs, this plan was reviewed and it evolved into the removal of the station in concurrence with the conversion of the legacy 22kV loads to 27.6kV and their transfer onto one of the feeders originating from Martindale TS. The project is currently in execution with a targeted completion date falling in Q4 2020.

iv. Elliot Lake TS – Station Refurbishement – Right-sizing that station by replacing 115/44 kV 42 MVA (T1) power transformer with new 115/44kV 42 MVA unit. Remove 115/44 kV 19 MVA (T2) autotransformer. Upon completion of this project, the station will remain with 2 – 115/44kV 42 MVA (T1/T3) power transformers.

v. Martindale TS

Martindale TS 230/115kV Autotransformer replacement - Martindale TS hosts three (3) 230/115kV autotransformers that principally supply the local 115kV system. Two of the three autotransformers(T21, T22) are 125MVA units and one (T23) is a 115MVA unit. Assuming one of the larger autotransformer is already out service, the loss of the second larger autotransformer results in thermal overload on the smallest of the autotransformers. As part of an on going transformer replacement investment at the Station, the smallest of the transformer is being replaced with a 125MVA unit, bringing it up to par with the other two existing units and alleviating the thermal overload issue for the entire assessed planning horizon.

Martindale TS 230/44kV Power Transformer replacement - The existing 230/44kV 125 MVA power transformers are scheduled to be replaced in 2028 to address end-of-life needs, and will be replaced with units of similar size. These are the largest standard 230/44kV transformers Hydro One uses. The scope of this project as presently planned does not aim at increasing the Martindale TS supply capacity beyond what exists today nor does it deviate from Hydro One's standard transformer size and procurement practices.

The Study Team recommended continuation of these end-of-life asset replacement as per the plan.

7.2 Station and Transmission Capacity Needs in the Sudbury/Algoma Region

The following Station and Transmission supply capacities needs have been identified in the Sudbury Algoma region during the study period of 2020 to 2029.

7.2.1 230/115 kV Autotransformers

The 230/115 kV autotransformers (Algoma TS and Martindale TS) supplying the Region are within their thermal limits and within the voltage range as per Ontario Resource and Transmission Assessment Criteria (ORTAC) over the study period for the loss of a single 230/115 kV autotransformer in the Region.

7.2.2 230 kV Transmission Lines

The 230 kV circuits supplying the Region are within their thermal limits as per ORTAC over the study period for the loss of a single 230 kV circuit in the Region.

7.2.3 115kV Transmission Lines

The 115 kV circuits supplying the Region are within the thermal limits of the circuits as per ORTAC over the study period adequate over the study period for the loss of a single 115 kV circuit in the Region.

7.2.4 230 kV and 115 kV Connection Facilities

A station capacity and voltage assessment was performed over the study period for the 230 kV and 115 kV TSs in the Region using the winter station peak load forecasts that were provided by the study team. The results are as follows:

i. Clarabelle TS

The 2019 actual non-coincident winter peak load at Clarabelle TS was 121 MW which is below the its 10-day winter LTR of 184 MW. Based on demand forecast Clarabelle TS will not be loaded above its 10 day LTR during the assessed planning horizon.

ii. Elliot Lake TS

The 2019 actual non-coincident winter peak load on Elliot Lake TS was 20 MW which is below its 10 day winter LTR of 66 MW. Based on demand forecast, Elliot Lake TS will not be loaded above its 10 day LTR during the assessed planning horizon.

iii. Espanola TS

The 2019 actual non-coincident winter peak for Espanola TS was 13 MW which is below the station 10 day winter LTR of 61 MW. As per the demand forecast, the loading at Espanola TS will not exceed the station 10 day winter LTR within the assessed planning horizon.

iv. Larchwood TS

The 2019 actual non-coincident winter peak for Larchwood TS was 13 MW which is below the station 10 day winter LTR of 37 MW. Based on the submitted load forecast, the loading on Larchwoord TS will not exceed the station 10 day winter LTR within the assessed planning horizon.

~~v.~~ Manitoulin TS

Manitoulin TS has a summer and winter 10-day LTR of 37 MW. The station LTR is already below the weather adjusted 2019 station winter peak load (37.8 MW). The station supply capability is limited by a Current TransformerCT ratio setting on the low voltage bus of the station, thereby restricting the ability to utilize the full supply capability of the transformers. It should be noted that the station low voltage bus configuration is such that the loss of one of the transformers will remove half of the load by configuration[4]. That being said, adequate supply capability at the station should be maintained to pick up the dropped load in the occurrence of such an event. Given its geographical location, this station cannot rely on any other nearby station for capacity relief via load transfer. This need must be adressed as soon as practically feasible to allow full utilization of the station transformers capacity.

IESO has expressed concerns on the voltage performance at the 115kV connection point of circuit S2B at Manitoulin TS. During system conditions where the nearby McCleans Mountain wind farm is unavailable, voltages on the 115kV side of the station can be as low as 108 kV which is below ORTAC voltage limit of 113kV. This low voltage incidence has previously been well documented and studied and was further reiterated in 2015 during the first cycle of the Sudbury Algoma Needs Assessment. Circuit S2B is normally operated open, leaving Manitoulin TS, McCleans Mountain wind farm, one industrial customer and Whitefish DS on the Martindale TS side of the circuit. The low voltage at Manitoulin TS stems from the station being at the end of a long radial circuit under normal operating conditions. The power transformers at Manitoulin TS are equipped with under load tap changers with wide regulation bands (+/- 20%) to maintain the LV side voltage within acceptable voltage limits. As such, Hydro One is assured that the low voltage incidence at the Manitoulin TS high side connection point has no material impact on the system or its connected customers. Hydro One will continue to monitor the voltage performance at the Manitoulin TS high side connection point and will take the appropriate remedial actions if and when this low voltage incidence is deemed adversely impactive to customers and system reliability.

vi. Martindale TS

Martindale TS has a winter 10 day LTR of 164 MW. Based on current load growth projections at the station, the station load will surpass the station winter 10 day LTR starting in 2028. This is the first iteration of the NA that shows a potential supply capacity congestion at the station. Given the anticipated timing of the need, there is time to re-evaluate this need in the next cycle of regional planning, scheduled to take place in 2025. Should the need materialize sooner than anticipated at Martindale TS, a station specific needs assessment can be carried out at that time so as to determine the best course of action for meeting the station supply capacity needs

[4] Discussion between the Transmitter and the LDC have confirmed that the existing configuration continues to provide an acceptable level of reliability.

Studies show that an additional 10 MW of supply capacity can be enabled by the the addition of a capacitor bank on the low voltage bus of this station. The addition of the capacitor bank will improve the station load power factor and draw less reactive power through the power transformers, enabling more active power flow on the units. This solution will provide capacity relief at Martindale TS beyond the study period and defer the need for additional transformation capacity. Hydro One, in collaboration with directly connected customers, will address the addition of the capacitor bank though Local Planning.

7.3 System Reliability, Operation and Restoration Review

No new significant system reliability and operating issues were identified for this Region.

The IESO has expressed the need for additional voltage control flexibility at Algoma TS and this is being addressed as part of the autotransformer replacement project planned at the station. The new autotransformers being procured are equipped with Under Load Tap Changers that will provide the required voltage control flexibility.

Based on the net coincident load forecast, the loss of one element will not result in load interruption greater than 150 MW as per ORTAC. The maximum load interrupted by configuration due to the loss of two elements is below the ORTAC limit of 600MW by the end of the 10-year study period.

8 CONCLUSION AND RECOMMENDATIONS

The Study Team recommends the following –

i. Manitoulin TS – Full utilization of the station transformer capacity is restricted by a series limiting component and will need to be addressed as soon as practically feasible. A CT ratio setting on the low voltage bushing of the transformer breaker can be modified to allow full transformer LTR capability. Hydro One will address this need directly in collaboration with the LDCs as soon as practically feasibilty. Further regional coordination is not required.

ii. Martindale TS – Supply capacity constraints at Martindale TS will appear in 2028 based on winter demand forecast. Given the anticipated timing of the need, there is time to re-evaluate this need in the next cycle of regional planning, scheduled to take place in 2025. Should the need materialize sooner than anticipated at Martindale TS, a station specific needs assessment can be carried out at that time so as to determine the best course of action for meeting the station supply capacity needs

9 REFERENCES

[1] RIP Report – Sudbury Algoma Region – June 2016

[2] Local Planning Report – Sudbury- Algoma – September 2015

[3] Planning Process Working Group Report to the Ontario Energy Board - May 2013

[4] Ontario Resource and Transmission Assessment Criteria (ORTAC) – Issue 5.0 -August 2007

[5] 2017 Long Term Energy Plan – Ontario Government

[6] Government of Canada – Excerpts from Greening Government Strategy Website (as of Nov 7, 2019)

Appendix A: Weather Adjusted Non-Coincident Winter Load Forecast

Table A.1: Sudbury/Algoma Region Winter Non-Coincident Load Forecast

Transformer Station Name	DESN ID (e.g. T1/T2)	LTR (MVA)	LTR (MW)	LV Cap Bank	Historical Data (MW)				Winter Peak Load (MW) - Linearized Load Forecast - Data to be used in the Needs Assessment										
						2019	WAN	WAE	Load Growth Factor	Near Term Forecast (MW)					Medium Term Forecast (MW)				
					Customer Data	1	1.0158	1.0758		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Clarabelle TS	*T1/T2*	204.8	184.32	N	H1Dx Gross Peak				1.07%	47.19	47.64	48.08	48.53	48.98	49.43	49.88	50.32	50.77	51.22
					GSH Gross Peak				0.81%	83.67	84.28	84.89	85.50	86.11	86.72	87.33	87.94	88.55	89.16
					Station Gross Peak					130.86	131.92	132.97	134.03	135.09	136.15	137.20	138.26	139.32	140.38
					DG					6.70	6.70	6.70	6.70	6.70	6.70	0.00	0.00	0.00	0.00
					CDM					0.48	0.50	0.51	0.53	0.55	0.56	0.58	0.60	0.62	0.63
					Station Net Peak	121.19	123.10	130.37		123.68	124.72	125.76	126.80	127.84	128.88	136.62	137.66	138.70	139.74
Elliot Lake TS	*T1/T2/T3*	73.8	66.42	N	Gross Peak				0.67%	20.02	20.15	20.27	20.40	20.52	20.65	20.77	20.90	21.02	21.15
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.10	0.10
					Station Net Peak	19.59	19.90	21.07		19.94	20.23	20.35	20.48	20.61	20.74	20.86	20.99	21.12	21.25
Espanola TS	*T1/T2/T3*	64.4	61.18	Y	Gross Peak				0.65%	13.06	13.14	13.21	13.29	13.37	13.45	13.53	13.61	13.69	13.77
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06
					Station Net Peak	12.78	12.98	13.74		13.01	13.08	13.16	13.24	13.32	13.39	13.47	13.55	13.63	13.70
Larchwood TS	*T2*	41.7	37.53	N	Gross Peak				1.02%	13.11	13.24	13.37	13.49	13.62	13.74	13.87	13.99	14.12	14.25
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.07	0.07
					Station Net Peak	12.79	12.99	13.76		13.06	13.19	13.31	13.44	13.56	13.68	13.81	13.93	14.05	14.18
Manitoulin TS	*T3/T4*	41.7	37.53	N	Gross Peak				1.08%	40.21	40.59	40.98	41.37	41.75	42.14	42.52	42.91	43.30	43.68
					DG					2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
					CDM					0.15	0.15	0.16	0.16	0.17	0.17	0.18	0.19	0.19	0.20
					Station Net Peak	37.22	37.81	40.04		38.05	38.43	38.81	39.19	39.58	39.96	40.34	40.72	41.10	41.48

Transformer Station Name	DESN ID (e.g. T1/T2)	LTR (MVA)	LTR (MW)	LV Cap Bank	Historical Data (MW)				Winter Peak Load (MW) - Linearized Load Forecast - Data to be used in the Needs Assessment										
						2019	WAN	WAE	Load Growth Factor	Near Term Forecast (MW)					Medium Term Forecast (MW)				
					Customer Data	1	1.0158	1.0758		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Martindale TS	*T25/T26*	182.6	164.34	N	H1Dx Gross Peak				0.06%	53.33	53.36	53.38	53.41	53.44	53.47	53.50	53.52	53.55	53.58
					GSH Gross Peak				2.15%	97.54	99.49	101.44	103.39	105.34	107.29	109.25	111.20	113.15	115.10
					Station Gross Peak					150.86	152.84	154.82	156.80	158.78	160.76	162.74	164.72	166.70	168.68
					DG					7.49	7.49	7.49	7.49	7.49	2.49	2.49	0.89	0.89	0.89
					CDM					0.57	0.58	0.61	0.64	0.68	0.70	0.72	0.73	0.75	0.77
					Station Net Peak	139.19	141.39	149.75		142.80	144.77	146.73	148.67	150.62	157.58	159.53	163.10	165.06	167.02
Massey DS	*T1*	N/A	N/A	N/A	Gross Peak	6.81	6.92	7.33	0.57%	6.95	6.99	7.03	7.07	7.10	7.14	7.18	7.22	7.25	7.29
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
					Station Net Peak	6.81	6.92	7.33		6.93	6.96	7.00	7.04	7.07	7.11	7.15	7.18	7.22	7.26
North Shore DS	*T1*	N/A	N/A	N/A	Gross Peak				1.06%	5.75	5.81	5.87	5.93	5.98	6.04	6.10	6.15	6.21	6.27
					DG					2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59	2.59
					CDM					0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03
					Station Net Peak	5.61	5.70	6.03		3.14	3.20	3.25	3.31	3.36	3.42	3.48	3.53	3.59	3.65
Sowerby DS	*T1*	N/A	N/A	N/A	Gross Peak				0.81%	4.96	5.00	5.04	5.08	5.12	5.15	5.19	5.23	5.27	5.31
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
					Station Net Peak	4.85	4.93	5.22		4.95	4.98	5.02	5.06	5.09	5.13	5.17	5.21	5.24	5.28
Spanish DS	*T1*	N/A	N/A	N/A	Gross Peak				0.88%	3.94	3.97	4.00	4.03	4.07	4.10	4.13	4.17	4.20	4.23
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
					Station Net Peak	3.84	3.90	4.13		3.92	3.95	3.99	4.02	4.05	4.08	4.11	4.15	4.18	4.21
Striker DS	*T1/T2*	N/A	N/A	N/A	Gross Peak				0.79%	7.83	7.89	7.95	8.01	8.06	8.12	8.18	8.24	8.29	8.35
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04
					Station Net Peak	7.65	7.77	8.23		7.80	7.86	7.92	7.97	8.03	8.09	8.14	8.20	8.26	8.31

Transformer Station Name	DESN ID (e.g. T1/T2)	LTR (MVA)	LTR (MW)	LV Cap Bank	Historical Data (MW)				Winter Peak Load (MW) - Linearized Load Forecast - Data to be used in the Needs Assessment											
						2019	WAN	WAE	Load Growth Factor	Near Term Forecast (MW)					Medium Term Forecast (MW)					
					Customer Data	1	1.0158	1.0758		2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Verner DS	*T1/T2*	N/A	N/A	N/A	Gross Peak				0.69%	6.10	6.14	6.18	6.22	6.26	6.30	6.34	6.38	6.42	6.46
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
					Station Net Peak	5.97	6.06	6.42		6.08	6.12	6.16	6.20	6.24	6.27	6.31	6.35	6.39	6.43
Warren DS	*T1/T2*	N/A	N/A	N/A	Gross Peak				0.78%	7.61	7.67	7.72	7.78	7.83	7.89	7.95	8.00	8.06	8.11
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
					Station Net Peak	7.44	7.55	8.00		7.58	7.64	7.69	7.75	7.80	7.86	7.91	7.97	8.02	8.08
Wharncliffe DS	*T1/T2*	N/A	N/A	N/A	Gross Peak				1.30%	5.52	5.59	5.66	5.72	5.79	5.86	5.93	5.99	6.06	6.13
					DG					0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
					CDM					0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03
					Station Net Peak	5.37	5.45	5.78		5.08	5.15	5.22	5.28	5.35	5.42	5.48	5.55	5.62	5.68
Whitefish DS	*T1*	N/A	N/A	N/A	Gross Peak				0.67%	6.65	6.69	6.74	6.78	6.82	6.86	6.90	6.94	6.99	7.03
					DG					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM					0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
					Station Net Peak	6.51	6.61	7.00		6.6	6.67	6.71	6.75	6.79	6.83	6.87	6.91	6.95	6.99

*

Appendix B: Lists of Step-Down Transformer Stations

Sr. No.	Transformer Stations	Voltages (kV)
1.	Algoma TS	230/115
2.	Coniston TS	115/22
3.	Clarabelle TS	230/44
4.	Elliot Lake TS	115/44
5.	Espanola TS	115/44
6.	Hamner TS	500/230
7.	Larchwood TS	115/44
8.	Manitoulin TS	115/44
9.	Martindale TS	230/115 230/44

Appendix C: Lists of Transmission Circuits

Sr. No.	Circuit ID	From Station	To Station	Voltage (kV)
1.	X74P	Hanmer TS	Mississagi TS	230
2.	X27A	Hanmer TS	Algoma TS	230
3.	A23P, A24P	Algoma TS	Mississagi TS	230
4.	X23N	Hamner TS	-	230
5.	S21N	Martindale TS	-	230
6.	X25S, X26S	Hanmer TS	Martindale TS	230
7.	S22A	Martindale TS	Algoma TS	230
8.	S6F	Martindale TS	-	115
8.	S5M	Martindale TS	Larchwood TS	115
9.	S2B	Martindale TS	Algoma TS	115
10.	B4B	Algoma TS	B3E Tap	115
11.	T1B	Algoma TS	-	115
12.	B3E	B4B Tap	Elliot Lake TS	115
13.	B4E	B4B Tap	Elliot Lake TS	115
14.	L1S	Martindale TS	Crystal Falls TS	115

Appendix D: Lists of LDCs in the Sudbury/Algoma Region

Sr. No.	Company	Connection Type (TX/DX)
1.	Greater Sudbury Hydro	TX / DX
3.	Hydro One Distribution	TX

Appendix E: Acronyms

Acronym	Description
A	Ampere
BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CSS	Customer Switching Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DS	Distribution Station
GS	Generating Station
HV	High Voltage
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Plan
kV	Kilovolt
LDC	Local Distribution Company
LP	Local Plan
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low Voltage
MTS	Municipal Transformer Station
MW	Megawatt
MVA	Mega Volt-Ampere
MVAR	Mega Volt-Ampere Reactive
NA	Needs Assessment
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
NUG	Non-Utility Generator
OEB	Ontario Energy Board
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Plan
SA	Scoping Assessment
SIA	System Impact Assessment
SPS	Special Protection Scheme
SS	Switching Station
STG	Steam Turbine Generator
TS	Transformer Station