REGIONAL INFRASTRUCTURE PLAN REPORT

[North and East of Sudbury]

Regional Infrastructure Plan Report

North and East of Sudbury

[Date: November 03, 2023]

Lead Transmitter:

Hydro One Networks Inc.

Prepared by:

North & East of Sudbury Technical working group

Page intentionally left blank

Disclaimer

This Regional Infrastructure Plan (RIP) Report was prepared for the purpose of developing an electricity infrastructure plan to address electrical supply needs identified in previous planning phases and also any additional needs identified based on new and/or updated information provided by the RIP Technical Working Group (TWG).

The preferred solution(s) that have been identified in this report may be reevaluated based on the findings of further analysis. The load forecast and results reported in this RIP report are based on the information provided and assumptions made by the participants of the RIP Technical Working Group.

The TWG 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 Regional Infrastructure Plan Report was prepared ("the Intended Third Parties") or to any other third party reading or receiving the Regional Infrastructure Plan 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	**North and East of Sudbury** Region (the "Region")
LEAD	Hydro One Networks Inc. ("HONI")
START DATE: May 10,2023	**END DATE:** November 03, 2023

1. INTRODUCTION

The Regional Infrastructure Plan (RIP) is the final step of Regional Planning Process for the North & East of Sudbury Region, preceded by, the publication of Needs Assessment (NA) report in May 2021 by Hydro One, followed by the Scoping Assessment (SA) & Integrated Regional Resource Plan (IRRP) in August 2021 and in April 2023 published by the IESO respectively.

Hydro One as the lead transmitter undertake the development of a RIP with input from the TWG for the region and publishes a RIP report. The RIP report includes a common discussion of all the options and recommended plans and preferred wire infrastructure investments identified in earlier phases to address the near- and medium-term needs. This is second cycle of RIP.

2. OBJECTIVES AND SCOPE

Objectives:

- Provide a comprehensive summary of needs and wires plans to address the needs for the North & East of Sudbury Region.
- Identify new supply needs that may have emerged since previous planning phases (e.g., Needs Assessment, Scoping Assessment, Local Plan, and/or Integrated Regional Resource Plan).
- Assess and develop wires plans to address these new needs.
- Identify investments in transmission and distribution facilities or both that should be developed and implemented on a coordinated basis to meet the electricity infrastructure needs within the region.

Scope:

- A consolidated report of the needs and relevant wires plans to address near and medium-term needs [2023-2033] identified in previous planning phases (i.e., Needs Assessment, Scoping Assessment, Local Plan, or Integrated Regional Resource Plan).
- Identification of any new needs over the 2023-2043 period and wires plans to address these needs based on new and/or updated information.
- Consideration of long-term needs identified in the North & East of Sudbury IRRP, Bulk system studies or as identified by the TWG.

3. REGIONAL PLANNING PROCESS & RIP METHODOLOGY

This section provides a detailed overview of the various steps followed during different phases of Regional Planning Process and their outcomes starting with the Needs Assessment, Scoping Assessment, Local Plan, Integrated Regional Resource Plan and finally details the Regional Infrastructure Plan Methodology.

4. REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

This section provides a general overview of the Geographical boundaries, Circuit connections and Stations located in the North & East of Sudbury Region though a regional planning area map and a Single Line diagram.

The North & East of Sudbury Region are bounded by regions of North Bay, Timmins, Hearst, Moosonee, Kirkland Lake and Dymond. Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits. This area is further reinforced through the 500kV circuits P502X and D501P connecting Hanmer TS to Pinard TS.

5. TRANSMISSION FACILITIES COMPLETED IN THE LAST TEN YEARS AND/OR UNDERWAY

This section provides a summary and brief description of all the projects completed or are currently underway in past ten years.

I. Following Major projects were completed during the last ten years:

- Kapuskasing Area Reinforcement – H9K Circuit Upgrade (2020)
- Kirkland Lake TS (T12/T13) transformers (2017)
- Dymond TS (T3/T4) transformers (2016)
- Timmins TS (T63/T64) with single 83MVA (2016)
- Hanmer TS Northern Station Replacement Project (2022)

II. Following Major projects are underway:

- Kapuskasing Area Reinforcement – Install 115kV Reactive Devices (2023)
- Kirkland Lake TS – Replace low voltage breakers, Instrument Transformers, P&C equipment (2025)
- Hearst TS - Replace low voltage breakers, P&C Equipment, switches (2028)
- Hunta SS - Replace P&C Equipment (2025)
- Porcupine TS – Replace 1 - 500kV/230kV autotransformer (T7), 2- 500kV/115kV autotransformers (T3/T4), switches, station service and P&C equipment (2025)

- Otto Holden TS - Replace 2 – 230 kV/115 kV autotransformers (T3/T4), high voltage breakers, switches, station service equipment, and protections (2027)
- K4 circuit - Refurbish Kirkland Lake TS X Matachewan JCT (10km) (2024)
- A8K/A9K circuits – Refurbish A8K/A9K (90km) (2023)

Note: The planned in-service year for the above projects is tentative and is subject to change.

6. LOAD FORECAST AND STUDY ASSUMPTIONS

During the study period, the load in the North & East of Sudbury Region is expected to grow at an average annual rate of approximately 0.50% in winter and 0.25% in summer from 2023 to 2043.

The following other assumptions are made in this report.

- The study period for the RIP assessments is 2023-2043.
- LDCs reconfirmed load forecasts up to 2040. The additional 3 years of forecasts were extrapolated based on the growth rate as a reasonable position to complete the 20-year period.
- All planned facilities for which work has been initiated and are listed in section 4 are assumed to be in-service.
- The Region is winter peaking, so this assessment is based on winter peak loads.
- Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity, assuming a 90% lagging power factor for stations having no low-voltage capacitor banks and 95% lagging power factor for stations having low-voltage capacitor banks, or on the basis of historical power factor data.
- Normal planning supply capacity for transformer stations in the region is determined by the summer 10-day Limited Time Rating (LTR).
- Regional transmission line and auto transformer capacity adequacy is assessed by using coincident peak loads in the area. Capacity assessment for radial lines and stepdown transformer stations use non-coincident peak loads.
- Resources assumptions align with the IRRP.

7. SYSTEM ADEQUACY AND REGIONAL NEEDS

This section reviews the adequacy of the existing Transmission Systems and Transformer Station facilities supplying the North & East of Sudbury Region and lists the facilities requiring reinforcement over the near and midterm period. The adequacy assessment assumes that all the projects that are currently underway are completed.

I. Needs identified in the region

a. Asset Renewal for Major HV Transmission Equipment

- Kirkland Lake TS
- Hunta SS
- Porcupine TS
- Otto Holden TS
- Hearst TS
- Timmins TS
- Kapuskasing TS
- Dymond TS
- Ansonville TS
- Crystal Falls TS
- Trout Lake TS
- A8K/A9K circuits
- K4 circuit
- T61S circuit
- K1/K2 circuits
- D2H/D3H circuits
- A4H/A5H circuits

b. Station Capacity

- Ramore TS

c. Transmission Line Capacity

- D3K

d. System Reliability, Operation and Load restoration

- Dymond TS - Voltage violation
- Kirkland Lake TS - Voltage control
- Ansonville, Hunta, Kapuskasing TS - Voltage control
- ORTAC load security criteria not met for 500 kV circuit outages
- Difficulty supplying loads during planned outages to circuit D501P

8. REGIONAL PLANS

This section discusses the regional electric supply needs and presents all the wires alternatives considered to address these needs and identifies the best and preferred wires solutions for the North & East of Sudbury Region. The needs include those previously identified in the NA and IRRP for the North & East of Sudbury Region as well as any new needs identified during the RIP phase.

9. CONCLUSION AND RECOMMENDATIONS

The major infrastructure investments recommended by the TWG in the North & East of Sudbury Region is given below:

Station/Circuit Name	Recommended Plan	Lead	Planned ISD	Cost ($M)
Asset Renewal Needs				
Kirkland Lake TS	Replacement of Instrument Transformers, P&C equipment, station service equipment and low voltage circuit breakers.	Hydro One Transmission	2025	36
Hunta SS	Replacement of P&C and telecom equipment.	Hydro One Transmission	2025	12
Porcupine TS	Replacement of 1-500/230kV 360MVA autotransformer (T8), 2- 500/115kV 225MVA autotransformers (T3/T4), switches, station service equipment and P&C equipment.	Hydro One Transmission	2026	91
Otto Holden TS	Replacement of 2-230/115 kV 60MVA autotransformers (T3/T4), high voltage circuit breakers, switches, station service equipment, and P&C equipment.	Hydro One Transmission	2027	74
Hearst TS	Replacement of low voltage circuit breakers, switches, P&C Equipment.	Hydro One Transmission	2028	19
Timmins TS	Replacement of 1-115/27.6kV 83MVA (T2) transformer and associated protections.	Hydro One Transmission	2028	14

Kapuskasing TS	Replace low voltage circuit breakers, switches, station service equipment and protections.	Hydro One Transmission	2030	24
Dymond TS	Replacement of low voltage breakers, and associated P&C equipment.	Hydro One Transmission	2031	42
Ansonville TS	Replace P&C equipment, Instrument transformers, station service equipment.	Hydro One Transmission	2031	11
Crystal Falls TS	Replacement of 2-230/44kV 42MVA (T5/T6) transformers, station service equipment, switches and P&C equipment.	Hydro One Transmission	2031	32
Trout Lake TS	Replacement of 2–230/44 kV 125MVA (T3/T4) transformers, low voltage circuit breakers and surge arresters.	Hydro One Transmission	2033	17
K4	Replace conductor and refurbish circuit Kirkland Lake TS X Matachewan JCT (10km)	Hydro One Transmission	2024	4
T61S	Replace conductor and refurbish circuit Timmins TS x Shiningtree JCT (115km)	Hydro One Transmission	2024	
K1/K2	Replace conductor and refurbish circuit Kirkland Lake TS x American Barrick JCT (14km)	Hydro One Transmission	2024	4
D2H/D3H*	Replace conductor and refurbish circuit Hunta SS x Abitibi Canyon SS (183km)	Hydro One Transmission	2029	96
A4H/A5H**	Replace conductor and refurbish circuit Tunis JCT x Fournier JCT (47km)	Hydro One Transmission	2027	22
Station Capacity Needs				
Ramore TS	To be monitored and reviewed in next planning cycle	Hydro One Distribution	NA	NA
Transmission Line Capacity Needs				
D3K	Monitoring & further exploration in future RIP cycle	Hydro One Transmission	NA	NA

System Reliability, Operation and Load restoration Needs				
Dymond TS	Continue to investigate sizing of the existing 115kV SC11 & SC12 capacitor banks	Hydro One Transmission	NA	NA

Note:

a) The planned in-service dates are tentative and subject to change
b) Costs are based on budgetary planning estimates and excludes the cost for distribution infrastructure (if required)

* IESO to inform by end of Q2 2025 if an upgrade is required

** IESO to inform by end of 2024 if an upgrade is required

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

The Regional Infrastructure Plan (RIP) is the final step of Regional Planning Process where, Hydro One as the lead transmitter undertakes the development of a RIP with input from the TWG for the region and publishes a RIP report. The second cycle of the Regional Planning process for the North & East of Sudbury Region was initiated with the publication of Needs Assessment (NA) report in May 2021 by Hydro One, followed by the Scoping Assessment (SA) & Integrated Regional Resource Plan (IRRP) in August 2021 and in April 2023 published by the IESO respectively.

The RIP report includes a common discussion of all the options and recommended plans and preferred wire infrastructure investments identified in earlier phases to address the near- and medium-term needs.

This report was prepared by the North & East of Sudbury Technical Working Group("TWG"), led by Hydro One Networks Inc. The report presents the results of the assessment based on information provided by the Hydro One, the Local Distribution Companies ("LDC"), the Municipalities and the Independent Electricity System Operator ("IESO"). Participants of the TWG are listed below in Table 1.

Table 1: North & East of Sudbury Region TWG Participants

Hydro One Networks Inc. (Lead Transmitter)	Lead Transmitter
Independent Electricity System Operator ("IESO")	System Operator
Hydro One Networks Inc. (Distribution)	LDC
North Bay Hydro	LDC
Northern Ontario Wires Inc.	LDC
Hearst Power Distribution Co.	LDC
Greater Sudbury Hydro Inc.	LDC

2. OBJECTIVES AND SCOPE OF REGIONAL INFRASTRUCTURE PLAN

This RIP report examines the needs in the North & East of Sudbury Region. Its objectives are to:

- Provide a comprehensive summary of needs and wires plans to address the needs for the North & East of Sudbury region.
- Identify new supply needs that may have emerged since previous planning phases (e.g., Needs Assessment, Scoping Assessment, Local Plan, and/or Integrated Regional Resource Plan).
- Assess and develop wires plans to address these new needs.
- Identify investments in transmission and distribution facilities or both that should be developed and implemented on a coordinated basis to meet the electricity infrastructure needs within the region.

The RIP reviewed factors such as the load forecast, asset renewal for major high voltage transmission equipment, transmission, and distribution system capability along with any updates with respect to local plans, conservation and demand management ("CDM") forecasts, renewable and non-renewable generation development, and other electricity system and local drivers that may impact the need and alternatives under consideration.

The scope of this RIP is as follows:

- A consolidated report of the needs and relevant wires plans to address near and medium-term needs (2023-2033) identified in previous planning phases (i.e., Needs Assessment, Scoping Assessment, Local Plan, or Integrated Regional Resource Plan).
- Identification of any new needs over the 2023-2033 period and wires plans to address these needs based on new and/or updated information.
- Consideration of long-term needs identified in the North & East of Sudbury IRRP, Bulk system studies or as identified by the TWG.

3. REGIONAL PLANNING PROCESS & RIP METHODOLOGY

3.1 Overview

Bulk System Planning, Regional Planning and Distribution Planning are the three levels of planning for the electricity system in Ontario. Bulk system planning typically looks at issues that impact the system on a provincial level and requires longer lead time and larger investments. Comparatively, planning at the regional and distribution levels look at issues on a more regional or localized level. Typically, the most

essential and effective regional planning horizon is the near- to medium-term (1- 10 years), whereas long-term (10-20 years) regional planning mostly provides a future outlook with little details about investments because the needs and other factors may vary over time. On the other hand, bulk system plans are developed for the long term because of the larger magnitude of the investments.

The regional planning process begins with a Needs Assessment (NA) which is led by the transmitter to identify, assess, and document which of the needs

a) can be addressed directly between the customer and transmitter along with a recommended plan, and;
b) that require further regional coordination and identification of Local Distribution Companies (LDCs) to be involved in further regional planning activities for the region.

At the end of the NA, a decision is made by the Technical Working Group (TWG) as to whether further regional coordination is necessary to address some or all the regional needs. If no, further regional coordination is required, recommendation to implement the recommended option and any necessary investments are planned directly by the LDCs (or customers) and the transmitter. The Region's TWG can also recommend to the transmitter and LDCs to undertake a local planning process for further assessment when needs

a) are local in nature,
b) require limited investments in wires (transmission or distribution) solutions, and;
c) do not require upstream transmission investments.

If coordination at the regional or sub-regional levels is required for identified regional needs, then the Independent Electricity System Operator (IESO) initiates the Scoping Assessment (SA) phase. During this phase, the IESO, in collaboration with the transmitter and impacted LDCs, reviews the information collected as part of the NA phase, along with additional information on potential non-wires or resource alternatives, e.g., Conservation and Demand Management (CDM), Distributed Generation (DG), etc., in order to make a decision on the most appropriate regional planning approach including Local Plan (LP), Integrated Regional Resource Plan (IRRP) and/or Regional Infrastructure Plan (RIP).

The primary purpose of the IRRP is to identify and assess both resource and wires options at a higher or macro level, but sufficient to permit a comparison of resource options vs. wire infrastructure to address the needs. Worth noting, the LDCs' CDM targets as well as contracted DG plans provided by IESO and LDCs are reviewed and considered at each step in the regional planning process.

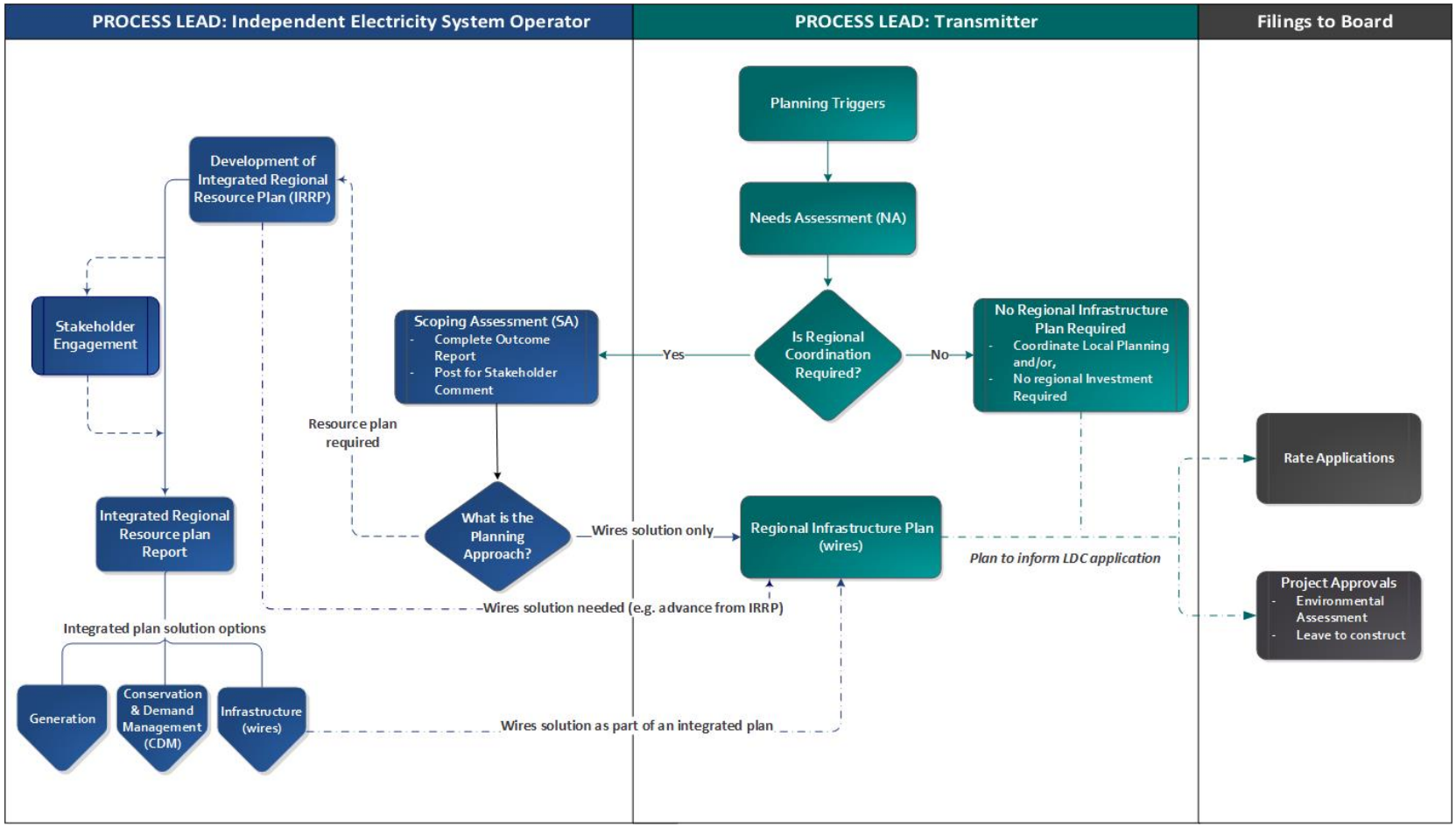
If and when an IRRP identifies that resource and/or wires options may be most appropriate to meet a need, resource/wires planning can be initiated in parallel with the IRRP or in the RIP phase to undertake a more detailed assessment, develop specific resource/wires alternatives, and recommend a preferred wires solution.

The RIP phase is the final phase of the regional planning process and involves: discussion of previously identified needs and plans; identification of any new needs that may have emerged since the start of the planning cycle; and, development of a wires plan to address these needs. This phase is led and coordinated by the transmitter and the deliverable is a comprehensive and consolidated report of a wires plan for the

region. Once completed, this report is also referenced in transmitter's rate filing submissions and as part of LDC rate applications with a planning status letter provided by the transmitter to the LDC(s). Respecting the Ontario Energy Board (OEB) timeline provision of the RIP, planning level stakeholder engagement is not undertaken during this phase. However, stakeholder engagement at a project specific level will be conducted as part of the project approval requirement.

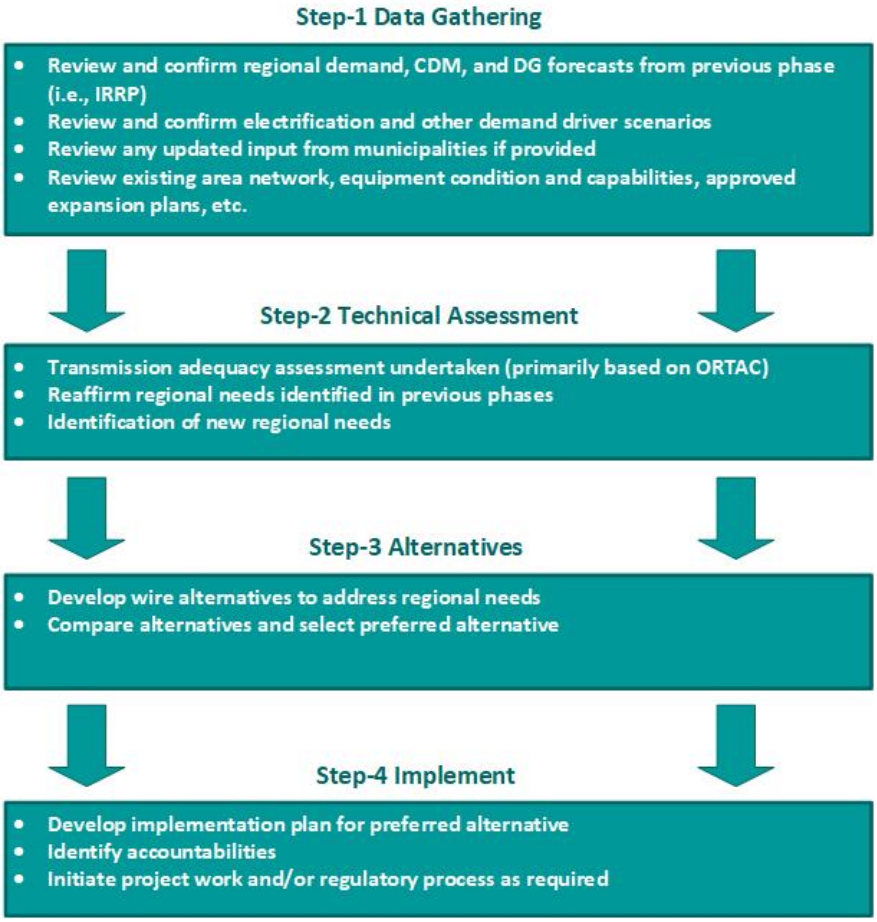
The various phases of Regional Planning Process (NA, SA, IRRP, and RIP) and their respective phase trigger, lead, and outcome are shown below in Figure-1.

Figure-1 Regional Planning Process Flowchart



3.2 Regional Infrastructure Plan Methodology

Figure-2 Regional Infrastructure Plan Methodology



Regional Infrastructure Plan phase is a four-step process which are described below:

3.2.1. Data Gathering:

The first step of the RIP process is the review of planning assessment data collected in the previous stages of the regional planning process. Hydro One collects this information and reviews it with the technical working group (TWG) to reconfirm or update the information as required. The data collected includes:

- Net peak demand forecast at the transformer station level. This includes the effect of any distributed generation or conservation and demand management programs. As agreed by TWG members, the load forecast from the IRRP was used for this RIP.

- Review and confirm electrification and other growth scenarios which effects the projects recommended in in previous stages and also update the inputs provided by the Municipalities.
- Existing area network and capabilities including any bulk system power flow assumptions.
- Other data and assumptions as applicable such as asset condition, load transfer capabilities, and previously committed transmission and distribution system plans.

3.2.2. Technical Assessment:

The second step is a technical assessment to review the adequacy of the regional system including any previously identified needs. Additional near and medium-term needs may be identified at this stage.

3.2.3. Alternative Development:

The third step is the development of wires options to address the needs and determine a preferred alternative based on an assessment of technical considerations, feasibility, environmental impact, and costs.

3.2.4. Implementation Plan:

The fourth and last step is the development of the implementation plan for the preferred alternative, identifying accountabilities and initiate project work or obtain permissions from Regulatory Commission if any.

4. REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The North & East of Sudbury Region are bounded by regions of North Bay, Timmins, Hearst, Moosonee, Kirkland Lake and Dymond. The geographical boundaries of the North & East of Sudbury region is shown in Figure 3 below.

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits. This area is further reinforced through the 500kV circuits P502X and D501P connecting Hanmer TS to Pinard TS.

This region has the following four local distribution companies (LDC):

- Hydro One Networks (distribution)
- Northern Ontario Wires Inc
- Hearst Power Ltd
- North Bay Hydro Distribution Ltd.
- Greater Sudbury Hydro Inc.

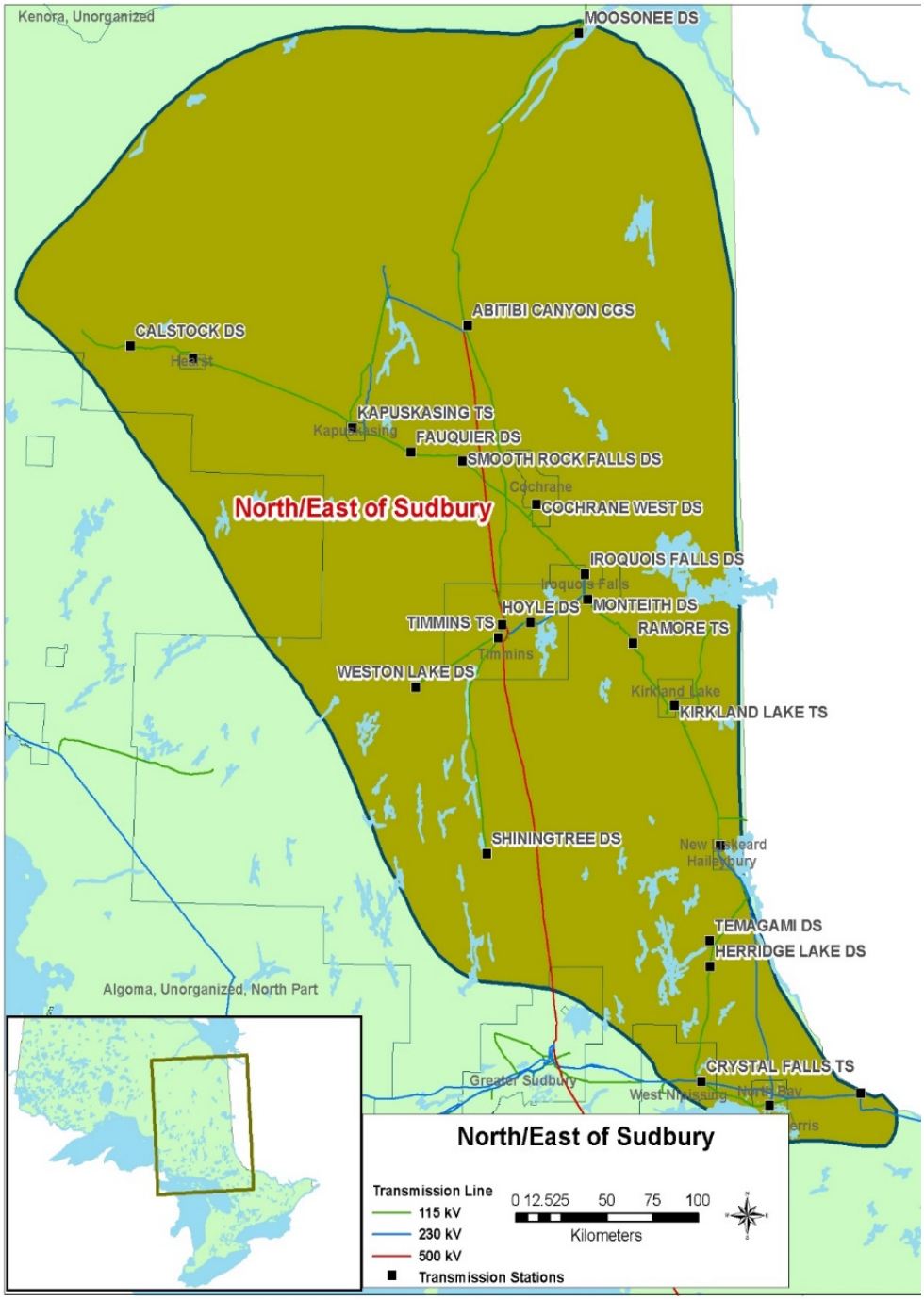


Figure 3: Map of North & East of Sudbury Regional Planning Area

The circuits and stations of the area are summarized in the Table 2 below:

Table 2: Transmission Station and Circuits in the North & East of Sudbury Region

115kV circuits	230kV circuits	Hydro One Transformer Stations	Generation Stations
A4H/A5H	D23G	Ansonville TS*	Otter Rapids GS
A8K/A9K	H22D	Crystal Falls TS	Abitibi Canyon GS
D2H/D3H	H23S/H24S	Dymond TS*	Empire CGS (10 MW)
H6T/H7T	K38S	Hearst TS	Martin's Meadows CGS (10 MW)
P13T/P15T	L20D	Hunta SS	Abitibi CGS (10 MW)
T7M/T8M	L21S	Kapuskasing TS	Long Lake CGS (10 MW)
D2L	P91G	Kirkland Lake TS	Kipling GS (164 MW)
H9K	R21D	Little Long SS	Kipling 2 GS (79 MW)
K2	W71D	Moosonee SS	Harmon GS (140 MW)
K4		North Bay TS	Harmon 2 GS (78 MW)
L1S		Otter Rapids SS	Smoky Falls 2 GS (264 MW)
L5H		Otto Holden TS*	Little Long GS (MW)
D3K		Pinard TS*	Little Long 2 GS (70 MW)
P7G		Porcupine TS*	A.P. Kapuskasing CGS (57 MW)
T61S		Ramore TS	Nagagami CGS (18 MW)
F1E		Spruce Falls TS	A.P. Calstock CGS (39 MW)
T2R		Timmins TS	Carmichael Falls CGS (18 MW)
		Trout Lake TS	Smooth Rock Fall CGS (8 MW)
		Widdifield SS	Yellow Falls CGS (16 MW)
			Iroq Falls Power CGS (126 MW)
			New Liskeard CGS (30 MW)
			Northland Power Kirkland Lake CGS (172 MW)

*Stations with Autotransformers installed

The single line diagram of the Transmission Network of North & East of Sudbury region is shown in Figure 4 below.

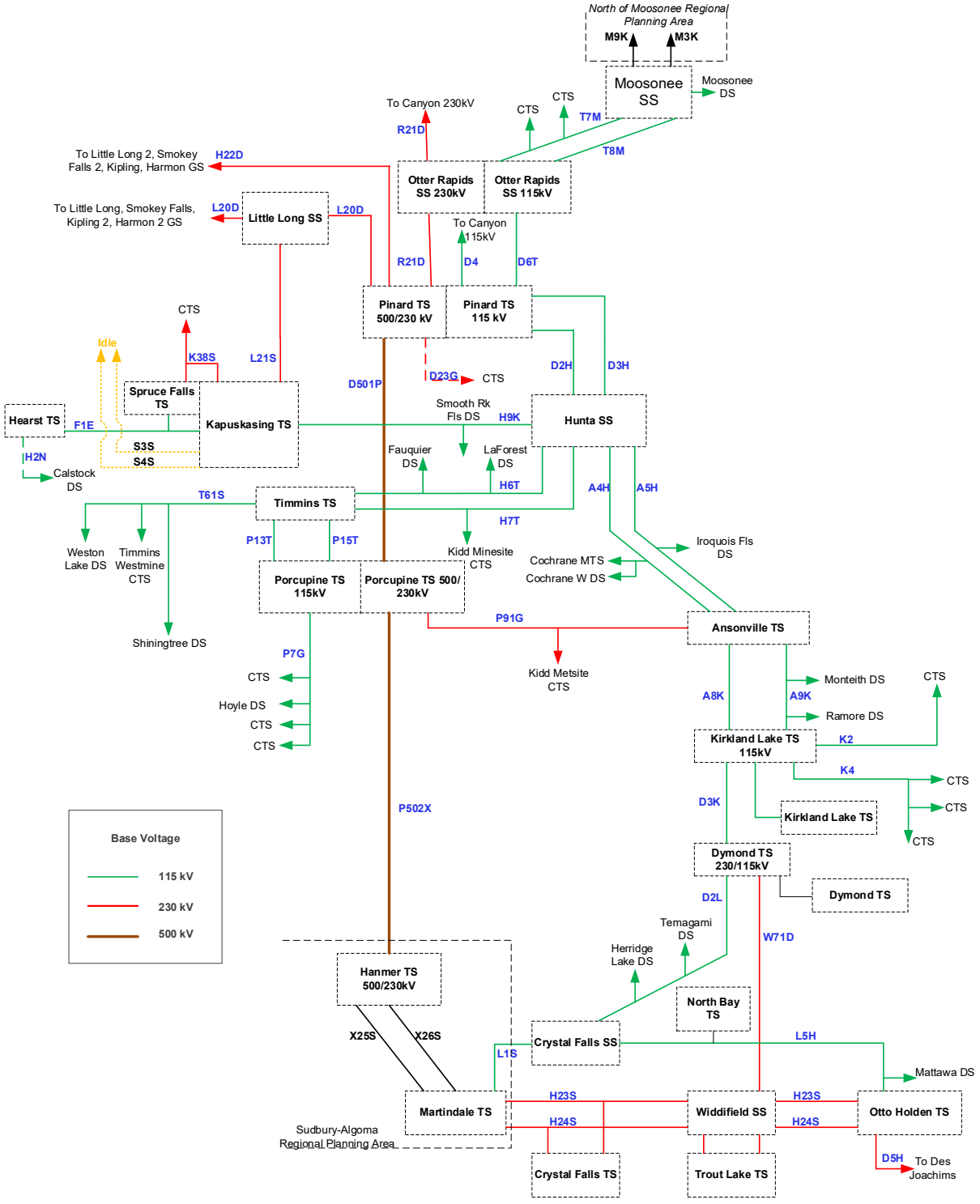


Figure 4: North & East of Sudbury Transmission Single Line Diagram

5. TRANSMISSION FACILITIES COMPLETED IN THE LAST TEN YEARS AND/OR ARE UNDERWAY

In this section a complete list of all the projects that are completed in past ten years or are currently underway is provided and are briefly discussed in the sub sections. As a part of this or previous Regional Planning Cycle(s), several "Major HV Transmission Projects" were recommended in the **North & East of Sudbury** Region to improve the supply capability and reliability.

Hydro One, being the only Transmission Asset Owner (TAO) in the region have undertaken execution of the projects recommended in the past ten years. A summary and brief description of all the projects completed or are currently underway is given below:

I. Following Major projects were completed during the last ten years:

- Kapuskasing Area Reinforcement – H9K Circuit Upgrade (ISD 2020)
- Kirkland Lake TS (T12/T13) transformer replacement (ISD 2017)
- Dymond TS (T3/T4) transformer replacement (ISD 2016)
- Timmins TS (T63/T64) replace with a single 83MVA (ISD 2016)

II. Following Major projects are underway:

- Kapuskasing Area Reinforcement – Install 115kV Reactive Devices (ISD 2023)
- Kirkland Lake TS – Replace low voltage breakers, Instrument Transformers, P&C equipment (ISD 2025)
- Hearst TS - Replace low voltage breakers, P&C Equipment, switches (ISD 2028)
- Hunta SS - Replace P&C Equipment (ISD 2025)
- Porcupine TS – Replace 1 - 500kV/230kV autotransformer (T7), 2- 500kV/115kV autotransformers (T3/T4), switches, station service and P&C equipment (ISD 2025)
- Otto Holden TS - Replace 2 – 230 kV/115 kV autotransformers (T3/T4), high voltage breakers, switches, station service equipment, and protections (ISD 2027)
- K4 circuit - Refurbish Kirkland Lake TS X Matachewan JCT (10km) (ISD 2024)
- A8K/A9K circuits – Refurbish A8K/A9K (90km) (ISD 2023)

Note: The planned in-service year for the above projects is tentative and is subject to change.

6. LOAD FORECAST AND STUDY ASSUMPTIONS

6.1. Load Forecast

The TWG participants reviewed and verified that there is no material change in load forecast from those used in the North & East of Sudbury Region IRRP Load Forecasts (April 2023). Thus, the IRRP forecasts were used in development of this Report. TWG participants, including representatives from LDC's, IESO and Hydro One, provided information and input for the IRRP Load forecast, which also includes the inputs from the Municipal Energy Plans (MEP) and/or Community Energy Plans (CEP). New industrial/mining load connections requests have been received after publication of IRRP report. These new potential load connections have not been explicitly listed in the load forecast tables, however these loads have been studied in the RIP to assess their impact to the area.

During the study period, the load in the North & East of Sudbury Region is expected to grow at an average annual rate of approximately 0.50% in winter and 0.25% in summer from 2023 to 2043. The Region is winter peaking, so this assessment is based on winter peak loads. This growth does not include significant increases in the industrial sector.

Figures 5 & 6 shows the North & East of Sudbury Region extreme summer/winter weather net coincident and non-coincident load forecast from 2023 to 2043. The load forecasts from the North & East of Sudbury Region were adopted as agreed to by the TWG. The load forecast shown is the regional non-coincident forecast, representing the sum of the load in the area for the step-down transformer stations.

Non-coincident and coincident forecast for the individual stations in the region is available in Appendix A and is used to determine any need for station capacity relief in the region.

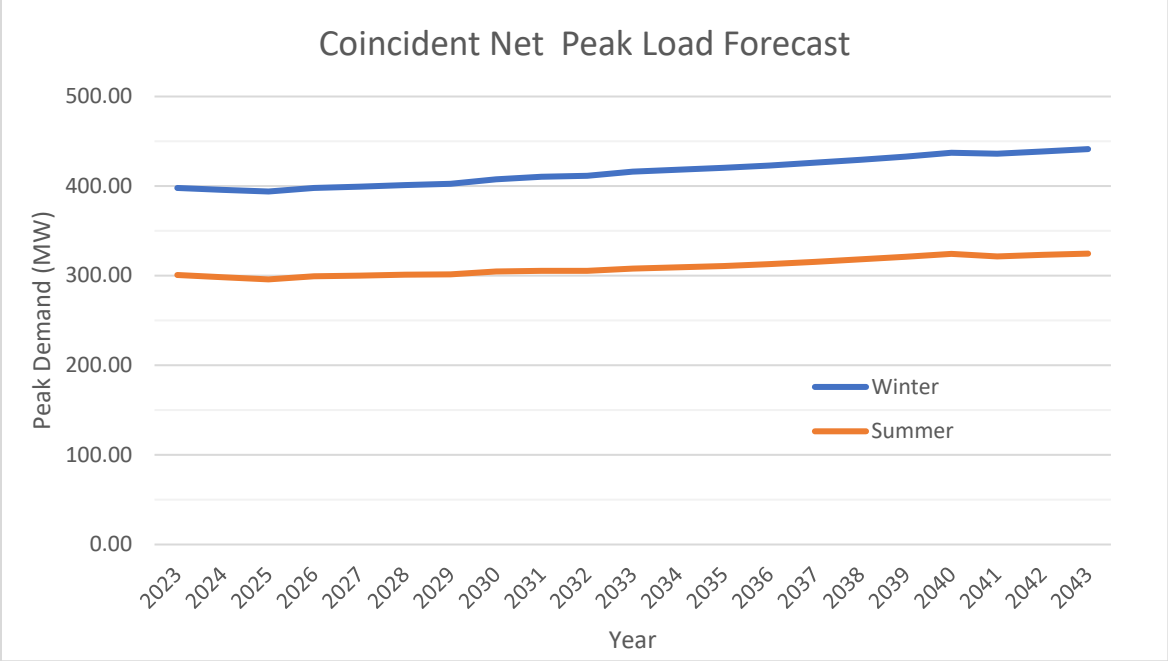


Figure 5: North & East of Sudbury Region summer/winter coincident Net Peak Load Forecast

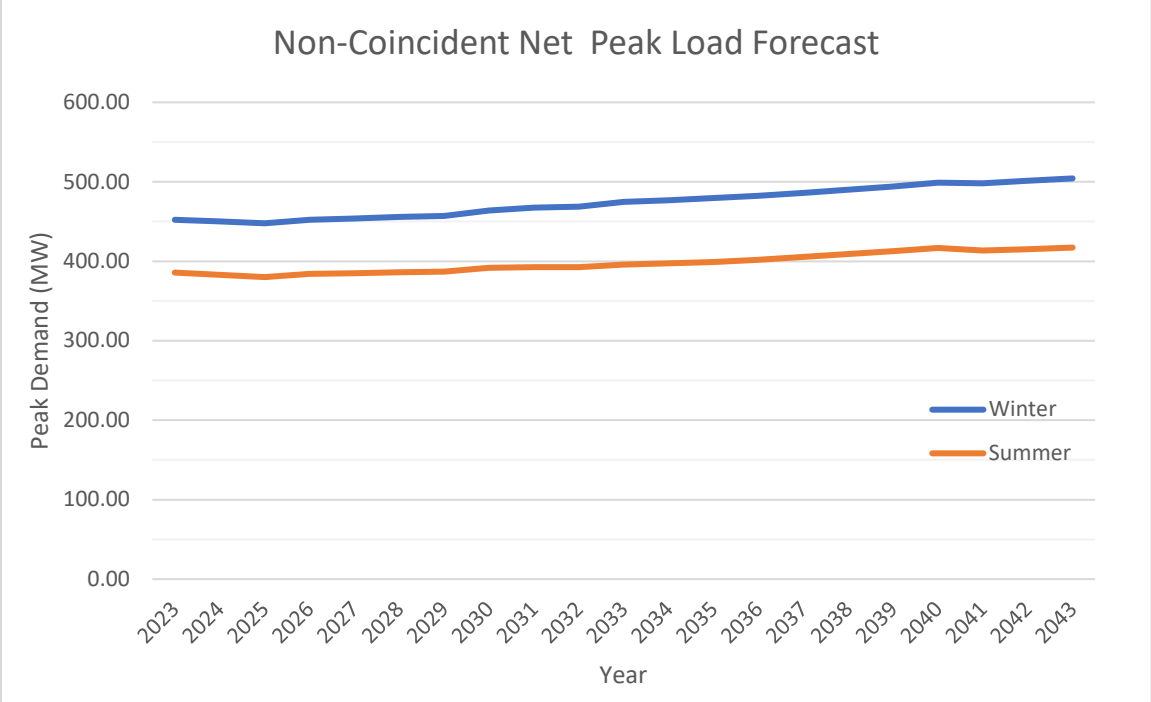


Figure 6: North & East of Sudbury Region summer/winter Non-coincident Net Peak Load Forecast

6.2. Other Study Assumptions

The following other assumptions are made in this report.

- The study period for the RIP assessments is 2023-2043.
- LDCs reconfirmed load forecasts up to 2040. The additional 3 years of forecasts were extrapolated based on the growth rate as a reasonable position to complete the 20-year period.
- All planned facilities for which work has been initiated and are listed in section 4 are assumed to be in-service.
- The Region is winter peaking, so this assessment is based on winter peak loads.
- Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity, assuming a 90% lagging power factor for stations having no low-voltage capacitor banks and 95% lagging power factor for stations having low-voltage capacitor banks, or on the basis of historical power factor data.
- Normal planning supply capacity for transformer stations in the region is determined by the winter 10-day Limited Time Rating (LTR).
- Regional transmission line and auto transformer capacity adequacy is assessed by using coincident peak loads in the area. Capacity assessment for radial lines and stepdown transformer stations use non-coincident peak loads.
- Resources assumptions align with the ORTAC.

7. SYSTEM ADEQUACY AND REGIONAL NEEDS

This section reviews the adequacy of the existing Transmission Systems and Transformer Station facilities supplying the North & East of Sudbury Region and lists the facilities requiring reinforcement over the near and midterm period. The adequacy assessment assumes that all the projects that are currently underway, listed in **"Section 5"** are completed.

In current regional planning cycle, the following regional assessments were completed, and their findings were used as inputs to this RIP report:

- North & East of Sudbury Region Second cycle Needs Assessment Report, Completed in May 2021 by Hydro One
- North & East of Sudbury Region Second cycle Scoping Assessment Report, Completed in August 2021 by the IESO
- North & East of Sudbury Region Second cycle Integrated Regional Resource Plan Report, Completed in April 2023 by the IESO

The Technical Working Group identified several regional needs based on the forecasted load demand over the near to mid-term period in the reports mentioned above. The results of the Adequacy Assessment to define the needs are discussed in sub-sections "7.1 to 7.4" and a detailed description and status of plans to meet these needs are given in **"Section 8"** of this report.

7.1. Asset Renewal Needs for Major HV Transmission Equipment

In addition to the asset renewal needs identified in previous regional planning cycle, Hydro One and TWG has also identified new asset renewal needs for major high voltage transmission equipment that are expected to be replaced over the next 10 years in the **North & East of Sudbury** Region. The complete list of major HV transmission equipment requiring replacement in the **North & East of Sudbury** Region is provided in table 3 in this sub-section. Hydro One is the only Transmission Asset Owner (TAO) in the Region

Asset Replacement needs are determined by asset condition assessment. Asset condition assessment is based on a range of considerations such as:

- Equipment deterioration due to aging infrastructure or other factors,
- Technical obsolescence due to outdated design,
- Lack of spare parts availability or manufacturer support, and/or
- Potential health and safety hazards, etc.

The major high voltage equipment information shared and discussed as part of this process is listed below:

- 230/115kV autotransformers
- 230 and 115kV load serving step down transformers
- 230 and 115kV breakers where:
  replacement of six breakers or more than 50% of station breakers, the lesser of the two
- 230 and 115kV transmission lines requiring refurbishment where:
  Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like
- 230 and 115kV underground cable requiring replacement where:

Leave to Construct (i.e., section 92) approval is required for any alternative to like-for-like

Table 3: Major HV Transmission Asset assessed for Replacement in the region

Station/Circuit	Need Description	Planned ISD
Kirkland Lake TS	Replacement of Instrument Transformers, P&C equipment, station service equipment and low voltage circuit breakers.	2025
Hunta SS	Replacement of P&C and telecom equipment.	2027

Porcupine TS	Replacement of 1-500/230kV 360MVA autotransformer (T8), 2- 500/115kV 225MVA autotransformers (T3/T4), switches, station service equipment and P&C equipment.	2026
Otto Holden TS	Replacement of 2-230/115 kV 60MVA autotransformers (T3/T4), high voltage circuit breakers, switches, station service equipment, and P&C equipment.	2027
Hearst TS	Replacement of low voltage circuit breakers, switches, P&C Equipment.	2030
Timmins TS	Replacement of 1-115/27.6kV 83MVA (T2) transformer and associated protections.	2028
Kapuskasing TS	Replace low voltage circuit breakers, switches, station service equipment and protections.	2030
Dymond TS	Replacement of low voltage breakers, and associated P&C equipment.	2031
Ansonville TS	Replace P&C equipment, Instrument transformers, station service equipment.	2032
Crystal Falls TS	Replacement of 2-230/44kV 42MVA (T5/T6) transformers, station service equipment, switches and P&C equipment.	2031
Trout Lake TS	Replacement of 2–230/44 kV 125MVA (T3/T4) transformers, low voltage circuit breakers and surge arresters.	2033
K4	Replace conductor and refurbish circuit Kirkland Lake TS X Matachewan JCT (10km)	2024
T61S	Replace conductor and refurbish circuit Timmins TS x Shiningtree JCT (115km)	2024
K2	Replace conductor and refurbish circuit Kirkland Lake TS x American Barrick JCT (14km)	2024
D2H/D3H*	Replace conductor and refurbish circuit Hunta SS x Abitibi Canyon SS (183km)	2029
A4H/A5H**	Replace conductor and refurbish circuit Tunis JCT x Fournier JCT (47km)	2027

Note: The planned in-service year for the above projects is tentative and is subject to change.

* IESO to inform by end of Q2 2025 if an upgrade is required

** IESO to inform by end of 2024 if an upgrade is required

7.2. Station Capacity Needs

Over the study period [2023-2043] RIP reviewed the capacity of all the 230kV and 115kV Transforming stations within the North & East of Sudbury Region. The NA and IRRP studies had previously indicated that the following stations require capacity relief within the study period. This RIP has further confirmed those needs and based on the load forecast, the stations which require capacity relief during the study period are shown in Table 4 below. The need timeframe defines the time when the peak load forecast exceeds the most limiting seasonal (summer or winter) Limited Time ratings.

Table 4: North & East of Sudbury Region Station Capacity Needs in the study period

Station Name	Capacity (MW)	2023 Loading (MW)	Station 10 day LTR (MW)	Need Date
Ramore TS	15	12	15	2033

The options and preferred solutions to address these needs are discussed further in Section 8 of the report.

7.3. Transmission Line Capacity Needs

Over the study period [2023-2033] RIP reviewed the capacity of all the 230kV and 115kV Transmission lines within the North & East of Sudbury Region. The NA and IRRP studies had previously indicated that the following Transmission lines require capacity relief within the study period. This RIP has further confirmed those needs and based on the load forecast and following contingencies, the Transmission lines which require capacity relief during the study period are shown in Table 5 below. The need timeframe defines the time when the peak load forecast exceeds the most limiting seasonal (summer or winter) Limited Time ratings.

Table 5: North & East of Sudbury Region Transmission Line Capacity Needs in the study period

Sr.no.	Name of Circuit	Name of Section	Contingency	Need Date
1	D3K	Dymond x Kirkland Lake	N-1-1 (AxK O/S + loss of companion circuit)	2030

The options and preferred solutions to address these needs are discussed further in Section 8 of the report.

7.4. System Reliability, Operation and Load Restoration Needs

Load security and load restoration needs were reviewed as part of the current study. The ORTAC Section 7 requires that no more than 600 MW of load be lost as a result of a double circuit contingency.

Further, loads are to be restored in the restoration times[1] specified as follows:

- All loads must be restored within 8 hours.
- Load interrupted in excess of 150 MW must be restored within 4 hours.
- Load interrupted in excess of 250 MW must be restored within 30 minutes.

The post contingency voltage control issues have also been listed in Table 6 below.

Table 6: North & East of Sudbury Region System Operational Needs and Voltage Control in the study period

Sr.no.	Reliability / Operational Need	Description	Need Date
1	Dymond TS	Voltage control violations when switching existing 115kV Dymond TS capacitor banks	2030
2	Kirkland Lake TS	Voltage control challenges in Kirkland Lake area during concurrent outages to Kirkland Lake TS SVC and Northland Power Kirkland Lake GS.	2030
3	Ansonville, Hunta, Kapuskasing	Post contingency voltage control challenges for the loss of Ansonville T2 and Canyon Units.	Existing

[1] These approximate restoration times are intended for locations that are near staffed centers. In more remote locations, restoration times should be commensurate with travel times and accessibility

4	ORTAC load security criteria not met for 500 kV circuit outages	Loss of load and resources during outages to any of the two major 500kV transmission lines in the Northeast	Existing
5	Difficulty supplying loads during planned outages to circuit D501P	Area loads cannot be adequately supplied during planned circuit outages	Existing

8. REGIONAL PLANS

This section discusses the regional electric supply needs and presents all the wires alternatives considered to address these needs and identifies the best and preferred wires solutions for the North & East of Sudbury Region. These needs include those previously identified in the NA and IRRP for the North & East of Sudbury Region as well as any new needs identified during the RIP phase. All estimated costs included in the alternative analysis are considered as planning budgetary estimates and are used for comparative purposes only and may vary. The Needs in the region are summarized below in Table 6 below:

8.1 Asset Renewal Needs for Major HV Transmission Equipment

The Asset renewal assessment considers the following options for "right sizing" the equipment:

- Maintaining the status quo
- Replacing equipment with similar equipment with *lower* ratings and built to current standards
- Replacing equipment with similar equipment with *lower* ratings and built to current standards by transferring some load to other existing facilities
- Eliminating equipment by transferring all the load to other existing facilities
- Replacing equipment with similar equipment and built to current standards (i.e., "like-for-like" replacement)
- Replacing equipment with higher ratings and built to current standards

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.

8.1.1. Asset Name – Location

Table 7: Needs identified in the region

Station/Circuit	Need Description	Planned ISD
Kirkland Lake TS	Replacement of Instrument Transformers, P&C equipment, station service equipment and low voltage circuit breakers. This investment will replace equipment that is in poor condition and deemed end of life.	2025
Hunta SS	Replacement of P&C and telecom equipment. This investment will replace equipment that is in poor condition and deemed end of life.	2025
Porcupine TS	Replacement of 1-500/230kV 360MVA autotransformer (T8), 2- 500/115kV 225MVA autotransformers (T3/T4), switches, station service equipment and P&C equipment. This investment will replace end of life transformers to reduce the risk of interruptions caused by transformer asset failure.	2026
Otto Holden TS	Replacement of 2-230/115 kV 60MVA autotransformers (T3/T4), high voltage circuit breakers, switches, station service equipment, and P&C equipment. This investment will replace equipment that is in poor condition and deemed end of life. It will also replace end of life transformers to reduce the risk of interruptions caused by transformer asset failure. The new transformers will be installed in a greenfield location and connected to the existing 230kV bus at Holden CGS via a 230 conductor/bus. The replacement transformers and associated equipment will be constructed within the limits of a new station called Antonie TS	2027
Hearst TS	Replacement of low voltage circuit breakers, switches, P&C Equipment. This investment will replace equipment that is in poor condition and deemed end of life.	2028

Timmins TS	Replacement of 1-115/27.6kV 83MVA (T2) transformer and associated protections. This investment will replace equipment that is in poor condition and deemed end of life. It will also help maintain reliability of supply to area customers and reduce the risk of interruptions caused by transformer asset failure.	2028
Kapuskasing TS	Replace low voltage circuit breakers, switches, station service equipment and protections. This investment will replace equipment that is in poor condition and deemed end of life.	2030
Dymond TS	Replacement of low voltage breakers, and associated P&C equipment. This investment will replace equipment that is in poor condition and deemed end of life.	2031
Ansonville TS	Replace P&C equipment, Instrument transformers, station service equipment. This investment will replace equipment that is in poor condition and deemed end of life.	2031
Crystal Falls TS	Replacement of 2-230/44kV 42MVA (T5/T6) transformers, station service equipment, switches and P&C equipment. This investment will replace equipment that is in poor condition and deemed end of life. It will also help maintain reliability of supply to area customers and reduce the risk of interruptions caused by transformer asset failure.	2031
Trout Lake TS	Replacement of 2–230/44 kV 125MVA (T3/T4) transformers, low voltage circuit breakers and surge arresters. This investment will replace equipment that is in poor condition and deemed end of life. It will also help maintain reliability of supply to area customers and reduce the risk of interruptions caused by transformer asset failure.	2033
A8K/A9K	Replace conductor and refurbish circuit Ansonvillle x Kirkland Lake (180km) This investment will replace the conductor and also increase the thermal capacity to meet system needs.	2023

K4	Replace conductor and refurbish circuit Kirkland Lake TS X Matachewan JCT (10km) This investment will replace the conductor with a like for standard conductor. Right sizing has been taken into consideration to meet supply capacity of loads on the line.	2024
T61S	Replace conductor and refurbish circuit Timmins TS x Shining tree JCT (115km) This investment will replace the conductor with a like for standard conductor. Right sizing has been taken into consideration to meet supply capacity of loads on the line.	2024
K2	Replace conductor and refurbish circuit Kirkland Lake TS x American Barrick JCT (14km) This investment will replace the conductor with a like for standard conductor. Right sizing has been taken into consideration to meet supply capacity of loads on the line.	2024
D2H/D3H	Replace conductor and refurbish circuit Hunta SS x Abitibi Canyon SS (183km) This investment will replace the conductor with a like for standard conductor.	2029
A4H/A5H	Replace conductor and refurbish circuit Tunis JCT x Fournier JCT (47km) This investment will replace the conductor with a like for standard conductor.	2027

8.2 Station Capacity Needs

A Station Capacity assessment was performed over the study period [2023-2043] for the 230kV and 115kV Transforming stations in the North & East of Sudbury Region using either the summer or winter peak load forecasts that were provided by the study team. Based on the results, the following Station capacity needs have been identified in the during the study period:

8.2.1 Ramore TS

Ramore TS is a single transformer 115/27.6kV 17MVA station. The summer and winter 10-Day LTR is 15MW, and load at this station is expected to exceed the LTR in 2033.

Table 8: Ramore TS Load Forecast

Station	LTR (MW)	Load Forecast										
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Ramore TS	15	13.7	13.8	13.9	14	14.2	14.3	14.4	14.8	14.9	15	15.1

The following alternatives were considered to address Ramore TS capacity need:

Alternative 1 - Maintain Status Quo: Ramore TS will continue to operate with the existing installed capacity, and Hydro One will monitor load growth to ensure supply needs are met.

Alternative 2 – Replace T1 with a new 115/27.6 42MVA unit: Replacing T1 with the next largest standard size unit will increase the station LTR to 38MW. The station LTR will remain limited to the size of the transformer as there will still only be a single unit installed at the station. This was considered and rejected as this would result in additional cost of approximately $10M and prematurely retire T1 transformer. This transformer remains in acceptable condition and is not scheduled to be replaced by Hydro One within the study period due to end-of-life needs.

The TWG recommends Alternative 1 as the preferred and cost effective alternative for addressing the need. The capacity need will arise in 2033 and will allow both Hydro One and area LDCs to monitor load growth and take corrective action when needed. This need will also be refreshed in the next cycle or regional planning.

8.3 Transmission Lines Capacity Needs

All line and equipment loads shall be within their continuous ratings with all elements in service and within their long-term emergency ratings with any one element out of service. Immediately following contingencies, lines may be loaded up to their short-term emergency ratings where control actions such as re-dispatch, switching, etc. are available to reduce the loading to the long-term emergency ratings. A Transmission Lines Capacity Assessment was performed over the study period [2023-2043] for the 230kV and 115kV Transmission line circuits in the North & East of Sudbury Region by assessing thermal limits of the circuit and the voltage range as per ORTAC to cater this need. Based on the results, the following line capacity needs have been identified in the during the study period:

No new line capacity needs have been identified in this planning cycle.

8.3.1 D3K (Thermal Violation)

D3K is a single circuit 115kV transmission line which provides a critical network path between Dymond TS and Kirkland Lake TS. This circuit is approximately 80km in length and serves to provide connection to generating stations and provide a path for network flows. Sections of this line will start to experience supply capacity violations at the end of the study period and will require mitigating solutions to allow for increased flows. The circuit section is described below;

1. Dymond TS x Kirkland Lake TS (80km) – For the loss of A8K and A9K, the companion circuit will exceed its Long-Term Emergency (LTE) rating. As studied in the IRRP and verified in the RIP this is expected to occur as early as 2030 based on demand forecast.

Solutions to address these needs will be further explored in future planning cycles given the long-term nature of this need. Flows on this line and its violations are heavily influenced by area resource assumptions, and demand forecast for customers in the Kirkland Lake area. In addition, a new Kirkland Lake RAS (Remedial Action Scheme) has been installed to initiate control actions such as load rejection for system contingencies. Currently, this RAS will trip loads and avoid the D3K thermal violation. This scheme will continue to be utilized by control room operators and it is expected that reliance on this scheme will gradually be reduced as system upgrades and replacements are complete in the future. The TWG will continue to monitor this need in future planning cycles and initiate an investment should this violation be advanced due to changing system conditions.

8.4 System Reliability, Operation and Restoration Needs

The transmission system must be planned to satisfy demand levels up to the extreme weather, median-economic forecast for an extended period with any one transmission element out of service. A study has been performed, considering the net coincident load forecast and the loss of one element over the study period [2023-2043] to cater this need**.**

8.4.1 Dymond TS – Voltage Control

IESO operations team has reported voltage violations at Dymond TS during capacitor bank switching. Dymond TS has two 115kV shunt capacitor banks (SC11/SC12) each rated at 24MVar. IESO has observed that switching the banks under certain system conditions voltages can exceed the maximum voltage and step change permitted by IESO Market Rules. These violations are largely dependent on system configuration (W71D O/S + Loss of D3K) and less sensitive to area loading patterns. Voltage violations are not observed during system conditions where all elements are In-service, or one element is O/S as there is sufficient reactive support from adjacent stations to support Dymond pre-contingency.

Alternative 1 - Maintain Status Quo: IESO and Hydro One operations will continue to control the system with other reactive devices in the northeast. The existing capacitor banks can continue to be utilized to help meet single contingency planning scenarios.

Alternative 2 – De-rate the Existing capacitor banks (SC11/SC12) Hydro One can de-rate the capacitor bank between 14-16MVar to ensure voltage limits upon cap bank switching remain within acceptable limits. This option helps with operations primarily for a W71D+D3K contingency. This option reduces the total var support at Dymond by 50% and due to the de-rating in size. It has been discussed with the TWG that operations may have to rely on other reactive devices in the northeast to provide steady state voltage support for other system configurations.

The TWG recommends to continue to investigating the need to a de-rate the existing capacitor banks and provide enhanced automation and visibilty.

8.4.2 Kirkland TS – Voltage Control

IESO has reported difficulties in maintaining adequate system voltages in the Kirkland Lake area during outage conditions. Concurrent outages to the Kirkland Lake SVC and Northland Power Kirkland Lake Generating facility result in declining voltages at the end of the radial K2 transmission line.

Kirkland Lake TS presently has a 115kV connection SVC, and shunt capacitor bank to help maintain voltages during steady state, and contingencies.

K2 circuit is a radial line with multiple industrial customers tapped of this circuit. Voltage performance on this circuit is directly attributed to the load pattern of these customers. It is expected that future loads connecting to this circuit will be required to maintain their voltage within reasonable limits as a condition to connect. A new Kirkland Lake RAS is also available to address thermal and voltage violations in the area as a control action and can be expanded to include additional inputs and outputs. Planning level cost for a new 115kV capacitor bank will cost between $10M-$15M, and will be largely influenced by the available space at the station and the control building.

The TWG recommends to monitor the voltage performance at Kirkland Lake TS bus and ensure that voltages on the K2 delivery points remain within reasonable limits. Hydro One and IESO will engage in further discussion on system operating limits, and resource options to mitigate this finding.

8.4.3 Ansonville, Hunta, Kapuskasing Voltage Control

Voltage violations at Ansonville TS, Hunta TS, and Kapuskasing TS can occur for the loss of Ansonville T2 and Abitibi Canyon generating units. This is coupled with the general challenge of maintaining system voltages within acceptable limits in the northeast as a whole. A new Kirkland Lake RAS (remedial action scheme) has been installed to help operators take control actions for system contingencies. This RAS can also be expanded to accommodate changing system needs which will help to provide operating flexibility

in the future. Kapuskasing RAS will also be installed to provide voltage support in the Kapuskasing area for system contingencies. This RAS can also be expanded when needed to meet future system needs.

Porcupine SVC will also be refurbished in the planning cycle and will provide much needed reactive support for the northeast.

The TWG will continue to address voltage control issues as needed to accommodate system needs. IESO and Hydro One continues to work towards finding robust solutions that provide voltage support without over reliance on load rejection and other adverse control actions. No additional investments are required from this regional infrastructure plan to address this need.

8.4.4 ORTAC load security criteria not met for 500 kV circuit outages

The North & East of Sudbury region is supplied by two 500 kV circuits, P502X from Hanmer TS to Porcupine TS and D501P from Porcupine TS to Pinard TS.

The system connects substantial amount of hydroelectric generation on the Moose River and loads in the region. The planning requirement to respect the loss of either of the 500kV circuits results in the need to rely on a Remedial Action Scheme (RAS), the Northeast Load and Generation Rejection Scheme (the "Northeast LGR"), that enables full use of the scheme following the loss of a single transmission element.

This is a legacy system that does not meet today's planning criteria for the use of load rejection following the loss of a single transmission element. However, bringing it up to current standards would involve substantial capital investment that is difficult to justify without the introduction of new needs. Future bulk projects such as the new 230kV line between Porcupine TS and Wawa TS will help to reduce reliance on area RASs following a P502X outage, however, does not address the loss of D501P and will still result in load rejection for area customers. The Working Group (TWG) recommends that the next bulk system plan in Northeast Ontario address the load security concerns following an outage on D501P and develop a plan to proactively reduced reliance on RAS.

8.4.5 Difficulty supplying loads during planned outages to circuit D501P

IESO's outage planning staff have also identified that during recent outages to D501P, it has not been possible to supply all customer load in the area due to limitations on the 115 kV system, and certain industrial customers have been forced to reduce their production. These concerns have also been raised by these customers themselves. During D501P outages, generation must also be significantly curtailed, which can remove substantial capacity from the Ontario system.

Hydro One recently implemented a protection scheme to allow D501P outages and working to address the shortfalls experienced during the implementation. TWG recommends to continue discussions with Hydro One and IESO operation to ensure future projects can be completed effectively during 500kV

outages and the project team will work to develop effective solutions for the specific projects in question. These solutions may include modifications/additions to area RASs schemes or new transmission facilities.

8.5 Long Term Considerations

Like many other regions in Ontario, load growth in North & East of Sudbury region will be directly impacted by new energy policies specifically those which help drive electrification. In addition, it is anticipated large market participants will also have incentive programs to modify operations/technologies to reduce greenhouse emissions. Details of how future programs will impact demand is unknown at this time thus the TWG will continue to monitor these trends throughout planning cycles to identify areas in need of investment. Future connection requests in the region will be assessed as needed to determine system requirements.

9. CONCLUSION AND RECOMMENDATION

This section concludes the Regional Infrastructure Plan Report for North & East of Sudbury Region. The Major Infrastructure investments recommended by the TWG in the near and mid-term planning horizon [2023-2033] are provided in Table 7 below, along with their planned in-service dates (ISD) and budgetary estimates for planning purposes.

Table 9: Recommended Plans over the next 10 Years

Station/Circuit Name	Recommended Plan	Lead	Planned ISD	Cost ($M)
Asset Renewal Needs				
Kirkland Lake TS	Replacement of Instrument Transformers, P&C equipment, station service equipment and low voltage circuit breakers.	Hydro One Transmission	2025	36
Hunta SS	Replacement of P&C and telecom equipment.	Hydro One Transmission	2025	12
Porcupine TS	Replacement of 1-500/230kV 360MVA autotransformer (T8), 2- 500/115kV 225MVA autotransformers (T3/T4), switches, station service equipment and P&C equipment.	Hydro One Transmission	2026	91
Otto Holden TS	Replacement of 2-230/115 kV 60MVA autotransformers (T3/T4), high voltage circuit breakers, switches, station service equipment, and P&C equipment.	Hydro One Transmission	2027	74
Hearst TS	Replacement of low voltage circuit breakers, switches, P&C Equipment.	Hydro One Transmission	2028	19
Timmins TS	Replacement of 1-115/27.6kV 83MVA (T2) transformer and associated protections.	Hydro One Transmission	2028	14
Kapuskasing TS	Replace low voltage circuit breakers, switches, station service equipment and protections.	Hydro One Transmission	2030	24
Dymond TS	Replacement of low voltage breakers, and associated P&C equipment.	Hydro One Transmission	2031	42

Ansonville TS	Replace P&C equipment, Instrument transformers, station service equipment.	Hydro One Transmission	2031	11
Crystal Falls TS	Replacement of 2-230/44kV 42MVA (T5/T6) transformers, station service equipment, switches and P&C equipment.	Hydro One Transmission	2031	32
Trout Lake TS	Replacement of 2–230/44 kV 125MVA (T3/T4) transformers, low voltage circuit breakers and surge arresters.	Hydro One Transmission	2033	17
K4	Replace conductor and refurbish circuit Kirkland Lake TS X Matachewan JCT (10km)	Hydro One Transmission	2024	4
T61S	Replace conductor and refurbish circuit Timmins TS x Shiningtree JCT (115km)	Hydro One Transmission	2024	
K1/K2	Replace conductor and refurbish circuit Kirkland Lake TS x American Barrick JCT (14km)	Hydro One Transmission	2024	4
D2H/D3H*	Replace conductor and refurbish circuit Hunta SS x Abitibi Canyon SS (183km)	Hydro One Transmission	2029	96
A4H/A5H**	Replace conductor and refurbish circuit Tunis JCT x Fournier JCT (47km)	Hydro One Transmission	2027	22
Station Capacity Needs				
Ramore TS	To be monitored and reviewed in next planning cycle	Hydro One Distribution	NA	NA
Transmission Line Capacity Needs				
D3K	Monitoring & further exploration in future RIP cycle	Hydro One Transmission	NA	NA
System Reliability, Operation and Load restoration Needs				
Dymond TS	Continue investigating to correctly size the existing 115kV SC11 & SC12 capacitor banks	Hydro One Transmission	NA	NA

Note:

a) The planned in-service dates are tentative and subject to change

b) Cost are based on budgetary planning estimates and excludes the cost for distribution infrastructure (if required)

* IESO to inform by end of Q2 2025 if an upgrade is required

** IESO to inform by end of 2024 if an upgrade is required

10. REFERENCES

[1] Independent Electricity System Operator, Ontario Resource and Transmission Assessment Criteria (issue 5.0 August 22, 2007)

[2] Ontario Energy Board, Transmission System Code (issue July 14, 2000 rev. December 18, 2018)

[3] Ontario Energy Board, Distribution system Code (issue July 14, 2000 rev. October 1, 2022)

[4] Ontario Energy Board, Load Forecast Guideline for Ontario (issue October 13, 2022)

Appendix A: Extreme Winter Weather Adjusted Net Load Forecast

Table A.1: North & East of Sudbury Region – Winter Coincident- Net Load Forecast

Transformer Station	DESN ID	LTR (MVA)	LTR (MW)	Net Extreme Winter Weather Station Peak Demand Forecast, Coincident to NE of Sudbury Region (MW)																		
				2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Crystal Falls TS	T5/T6	53.60	48.24	19.94	20.19	20.23	20.28	20.31	20.37	20.38	23.70	25.18	25.31	25.47	25.65	25.84	26.16	26.42	26.70	26.97	27.24	28.59	29.11	29.62
Hearst TS	T4	39.60	35.64	18.39	18.37	18.36	18.37	18.37	18.39	18.38	18.38	18.36	18.34	18.34	18.36	18.39	18.44	18.51	18.60	18.68	18.76	18.59	18.61	18.62
Kapuskasing TS	T5/T6	106.50	95.85	5.88	5.84	5.81	5.79	5.76	5.74	5.70	5.68	5.64	5.61	5.59	5.57	5.56	5.56	5.58	5.60	5.62	5.64	5.52	5.50	5.48
Kirkland Lake TS	T12/T13	57.60	51.84	40.32	40.24	40.21	40.21	40.18	40.19	40.19	40.22	40.17	40.11	40.11	40.12	40.14	40.16	40.26	40.38	40.50	40.62	40.34	40.35	40.36
North Bay TS	T1/T2	64.10	57.69	25.16	24.02	22.88	23.27	23.71	24.14	24.57	25.01	25.43	25.83	26.25	26.69	27.16	27.65	28.14	28.63	29.13	29.63	29.41	29.78	30.14
Ramone TS	T1	20.90	18.81	12.36	12.44	12.51	12.58	12.71	12.83	12.94	13.27	13.38	13.47	13.58	13.70	13.84	13.98	14.12	14.26	14.41	14.56	14.66	14.79	14.93
Timmins TS	T2/T4	113.10	101.79	52.77	52.81	52.92	53.09	53.22	53.42	53.58	53.78	53.87	53.93	54.09	54.28	54.48	54.69	55.03	55.41	55.78	56.16	55.85	56.04	56.22
Dymond TS	T3/T4	62.00	55.80	30.82	30.79	30.80	30.84	30.87	30.94	30.96	31.01	31.01	30.98	33.88	33.93	34.00	34.08	34.23	34.40	34.57	34.73	35.13	35.42	35.71
Trout Lake	T3/T4	209.50	188.55	98.85	97.86	96.96	100.18	100.79	101.50	102.00	102.58	103.32	103.85	104.79	105.56	106.38	107.38	108.51	109.69	110.87	113.07	112.08	112.92	113.76
Calstock DS	-	-	-	5.29	5.28	5.29	5.30	5.31	5.33	5.35	5.37	5.38	5.38	5.40	5.41	5.43	5.44	5.47	5.50	5.53	5.57	5.54	5.56	5.57
CochraneMTS	-	-	-	11.46	11.39	11.34	11.28	11.22	11.16	11.10	11.05	10.99	10.92	10.88	10.84	10.81	10.79	10.79	10.79	10.79	10.79	10.62	10.58	10.53
Cochran West DS	-	-	-	3.55	3.55	3.56	3.57	3.58	3.59	3.59	3.60	3.61	3.61	3.62	3.63	3.65	3.66	3.69	3.71	3.74	3.76	3.74	3.75	3.76
Fauquier DS	-	-	-	2.08	2.09	2.10	2.11	2.12	2.13	2.14	2.15	2.16	2.17	2.18	2.19	2.20	2.22	2.24	2.26	2.28	2.30	2.29	2.30	2.31
Herridge Lake DS	-	-	-	3.41	3.42	3.43	3.45	3.46	3.47	3.49	3.50	3.51	3.52	3.53	3.54	3.56	3.58	3.61	3.64	3.66	3.69	3.67	3.69	3.70
Hoyle DS	-	-	-	7.05	7.06	7.07	7.08	7.09	7.12	7.13	7.15	7.15	7.16	7.17	7.19	7.22	7.25	7.28	7.33	7.37	7.41	7.37	7.39	7.41
Iroquois Falls DS	-	-	-	5.19	5.16	5.15	5.13	5.11	5.09	5.07	5.06	5.03	5.01	5.00	4.99	4.98	4.98	4.98	4.99	5.00	5.01	4.94	4.93	4.91
Laforest Road DS	-	-	-	12.79	12.80	12.83	12.87	12.90	12.95	12.99	13.03	13.06	13.07	13.11	13.16	13.21	13.27	13.35	13.45	13.54	13.64	13.55	13.60	13.65
Mattawa DS	-	-	-	5.06	5.07	5.09	5.11	5.13	5.15	5.17	5.19	5.20	5.21	5.23	5.26	5.28	5.31	5.35	5.39	5.43	5.47	5.45	5.47	5.49
Monteith DS	-	-	-	2.93	2.94	2.96	2.97	2.99	3.00	3.02	3.03	3.04	3.05	3.06	3.08	3.10	3.12	3.15	3.18	3.21	3.23	3.22	3.23	3.25
Moosonee DS	-	-	-	14.31	14.31	14.33	14.37	14.40	14.45	14.48	14.53	14.55	14.56	14.59	14.63	14.68	14.74	14.82	14.91	15.00	15.09	15.01	15.05	15.09
Shiningtree DS	-	-	-	3.95	3.94	3.94	3.93	3.93	3.93	3.94	3.94	3.94	3.93	3.93	3.93	3.93	3.94	3.95	3.96	3.98	3.99	3.96	3.96	3.96
Smooth Rock Falls DS	-	-	-	1.80	1.80	1.80	1.81	1.81	1.81	1.81	1.82	1.82	1.82	1.82	1.82	1.82	1.83	1.84	1.85	1.86	1.87	1.85	1.86	1.86
Temagami DS 2	-	-	-	1.39	1.40	1.40	1.41	1.42	1.43	1.44	1.45	1.46	1.47	1.48	1.49	1.50	1.51	1.53	1.54	1.56	1.58	1.57	1.58	1.59
Verner DS	-	-	-	5.93	5.93	5.94	5.95	5.96	5.97	5.97	5.97	5.97	5.97	5.98	5.99	6.00	6.03	6.06	6.09	6.13	6.16	6.11	6.12	6.13
Warren DS	-	-	-	7.10	7.09	7.09	7.10	7.10	7.11	7.11	7.11	7.10	7.10	7.10	7.11	7.12	7.14	7.17	7.21	7.24	7.28	7.21	7.22	7.23

Table A.2: North & East of Sudbury Region – Winter non-Coincident – Net Load Forecast

Transformer Station	DESN ID	LTR (MVA)	LTR (MW)	Winter Weather Station Non Coincident to NE of Sudbury Region (MW)																			
				2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Crystal Falls TS	T5/T6	53.60	48.24	29.98	30.36	30.42	30.49	30.54	30.63	30.65	35.63	37.87	38.06	38.30	38.57	38.86	39.34	39.74	40.15	40.56	40.96	42.99	43.77	44.55
Hearst TS	T4	39.60	35.64	20.41	20.38	20.38	20.39	20.38	20.40	20.39	20.39	20.37	20.35	20.36	20.38	20.41	20.46	20.54	20.64	20.73	20.82	20.63	20.65	20.67
Kapuskasing TS	T5/T6	106.50	95.85	14.72	14.62	14.55	14.49	14.40	14.35	14.27	14.21	14.12	14.03	13.98	13.95	13.92	13.92	13.96	14.01	14.07	14.12	13.80	13.76	13.72
Kirkland Lake TS	T12/T13	57.60	51.84	40.90	40.82	40.79	40.79	40.75	40.77	40.77	40.79	40.75	40.68	40.68	40.69	40.71	40.73	40.83	40.95	41.08	41.20	40.92	40.93	40.94
North Bay TS	T1/T2	64.10	57.69	33.17	31.67	30.16	30.68	31.26	31.83	32.39	32.98	33.53	34.05	34.61	35.20	35.82	36.45	37.10	37.75	38.41	39.06	38.78	39.26	39.74
Ramone TS	T1	20.90	18.81	13.76	13.85	13.93	14.01	14.16	14.29	14.42	14.78	14.90	15.00	15.12	15.26	15.41	15.57	15.73	15.89	16.05	16.21	16.33	16.48	16.62
Timmins TS	T2/T4	113.10	101.79	54.22	54.26	54.38	54.55	54.68	54.89	55.05	55.25	55.35	55.41	55.58	55.77	55.98	56.20	56.55	56.93	57.32	57.70	57.38	57.58	57.77
Dymond TS	T3/T4	62.00	55.80	39.70	39.66	39.66	39.72	39.75	39.84	39.88	39.94	39.93	39.90	43.63	43.70	43.78	43.89	44.08	44.30	44.52	44.73	45.25	45.62	45.99
Trout Lake	T3/T4	209.50	188.55	101.32	100.30	99.38	102.68	103.31	104.03	104.54	105.14	105.90	106.44	107.40	108.19	109.03	110.05	111.22	112.43	113.63	115.89	114.88	115.74	116.59
Calstock DS	-	-	-	8.76	8.75	8.77	8.79	8.80	8.83	8.86	8.91	8.92	8.92	8.95	8.97	9.00	9.01	9.06	9.11	9.17	9.23	9.18	9.21	9.24
CochraneMTS	-	-	-	12.77	12.69	12.63	12.57	12.50	12.44	12.37	12.31	12.25	12.17	12.12	12.08	12.05	12.02	12.02	12.02	12.03	12.03	11.83	11.79	11.74
Cochran West DS	-	-	-	3.71	3.72	3.72	3.73	3.74	3.76	3.76	3.77	3.78	3.78	3.79	3.80	3.82	3.84	3.86	3.89	3.91	3.94	3.91	3.92	3.94
Fauquier DS	-	-	-	2.22	2.23	2.24	2.25	2.26	2.28	2.28	2.29	2.30	2.31	2.32	2.33	2.35	2.37	2.39	2.41	2.43	2.45	2.44	2.45	2.46
Herridge Lake DS	-	-	-	4.00	4.01	4.02	4.03	4.05	4.07	4.08	4.10	4.11	4.12	4.13	4.15	4.17	4.19	4.22	4.26	4.29	4.32	4.30	4.32	4.34
Hoyle DS	-	-	-	8.88	8.88	8.89	8.91	8.93	8.96	8.97	9.00	9.01	9.01	9.03	9.05	9.08	9.12	9.17	9.22	9.28	9.33	9.27	9.30	9.32
Iroquois Falls DS	-	-	-	5.50	5.48	5.46	5.44	5.42	5.40	5.38	5.36	5.34	5.31	5.30	5.29	5.28	5.28	5.28	5.29	5.30	5.31	5.23	5.22	5.21
Laforest Road DS	-	-	-	13.52	13.53	13.56	13.60	13.64	13.69	13.73	13.77	13.80	13.81	13.86	13.91	13.96	14.02	14.11	14.21	14.31	14.41	14.32	14.37	14.42
Mattawa DS	-	-	-	5.16	5.17	5.19	5.21	5.23	5.26	5.27	5.29	5.31	5.32	5.34	5.36	5.39	5.42	5.46	5.50	5.54	5.58	5.55	5.58	5.60
Monteith DS	-	-	-	3.00	3.01	3.02	3.04	3.05	3.07	3.08	3.10	3.11	3.12	3.13	3.15	3.17	3.19	3.22	3.25	3.28	3.31	3.29	3.31	3.33
Moosonee DS	-	-	-	14.63	14.63	14.65	14.69	14.72	14.77	14.81	14.85	14.87	14.88	14.92	14.96	15.01	15.06	15.15	15.24	15.34	15.43	15.34	15.38	15.43
Shiningtree DS	-	-	-	4.62	4.61	4.60	4.60	4.60	4.60	4.60	4.61	4.60	4.59	4.59	4.59	4.60	4.60	4.62	4.63	4.65	4.67	4.63	4.63	4.63
Smooth Rock Falls DS	-	-	-	1.98	1.98	1.98	1.98	1.98	1.99	1.99	1.99	1.99	1.99	2.00	2.00	2.00	2.01	2.02	2.03	2.04	2.05	2.03	2.04	2.04
Temagami DS 2	-	-	-	1.80	1.81	1.82	1.84	1.85	1.86	1.87	1.89	1.90	1.91	1.92	1.93	1.95	1.96	1.98	2.01	2.03	2.05	2.04	2.06	2.07
Verner DS	-	-	-	6.06	6.06	6.06	6.07	6.08	6.10	6.09	6.10	6.10	6.10	6.10	6.12	6.13	6.16	6.19	6.22	6.26	6.29	6.24	6.25	6.26
Warren DS	-	-	-	7.53	7.52	7.52	7.53	7.53	7.55	7.54	7.54	7.53	7.53	7.53	7.54	7.55	7.58	7.61	7.65	7.68	7.72	7.65	7.66	7.67

Table A.3: North & East of Sudbury Region – Summer Coincident – Net Load Forecast

Transformer Station	DESN ID	LTR (MVA)	LTR (MW)	Net Extreme Summer Weather Station Peak Demand Forecast, Coincident to NE of Sudbury Region (MW)																			
				2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Crystal Falls TS	T5/T6	48.40	43.56	14.80	15.18	15.34	15.50	15.64	15.81	15.93	18.48	18.70	18.83	18.99	19.17	19.37	19.70	19.97	20.26	20.55	20.83	21.63	22.02	22.41
Hearst TS	T4	32.90	29.61	12.50	12.63	12.59	12.56	12.51	12.48	12.43	12.39	12.34	12.28	12.26	12.24	12.24	12.26	12.30	12.36	12.41	12.46	12.25	12.24	12.22
Kapuskasing TS	T5/T6	94.20	84.78	36.17	36.03	35.95	35.92	35.85	35.83	35.70	35.64	35.53	35.41	35.38	35.39	35.43	35.54	35.75	35.98	36.21	36.42	35.76	35.76	35.76
Kirkland Lake TS	T12/T13	47.30	42.57	26.02	25.92	25.87	25.84	25.78	25.75	25.72	25.72	25.66	25.59	25.56	25.54	25.52	25.51	25.56	25.63	25.69	25.76	25.51	25.49	25.47
North Bay TS	T1/T2	61.70	55.53	14.98	13.88	12.78	13.21	13.65	14.09	14.53	14.97	15.39	15.81	16.23	16.67	17.14	17.61	18.09	18.58	19.07	19.56	19.40	19.77	20.14
Ramone TS	T1	18.30	16.47	4.96	4.99	5.01	5.03	5.08	5.13	5.18	5.32	5.36	5.40	5.44	5.48	5.54	5.60	5.65	5.71	5.77	5.83	5.87	5.92	5.98
Timmins TS	T2/T4	104.20	93.78	33.45	33.39	33.38	33.43	33.43	33.48	33.49	33.54	33.52	33.48	33.52	33.59	33.68	33.79	34.01	34.26	34.50	34.74	34.31	34.37	34.44
Dymond TS	T3/T4	54.00	48.60	25.93	25.83	25.77	25.76	25.72	25.71	25.65	25.63	25.56	25.48	26.77	26.78	26.80	26.86	26.98	27.13	27.27	27.41	27.31	27.41	27.52
Trout Lake	T3/T4	186.60	167.94	66.13	64.94	63.85	66.78	67.14	67.58	67.79	68.10	68.46	68.76	69.30	69.83	70.42	71.18	72.08	73.03	73.97	75.31	74.44	75.00	75.55
Calstock DS	-	-	-	3.76	3.75	3.75	3.75	3.75	3.75	3.76	3.78	3.78	3.77	3.77	3.78	3.78	3.79	3.81	3.83	3.85	3.88	3.84	3.85	3.85
CochraneMTS	-	-	-	9.99	9.90	9.83	9.77	9.68	9.62	9.53	9.46	9.39	9.31	9.25	9.21	9.17	9.15	9.15	9.16	9.17	9.17	8.94	8.89	8.84
Cochran West DS	-	-	-	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.57	2.57	2.57	2.57	2.57	2.58	2.59	2.61	2.63	2.65	2.67	2.63	2.63	2.64
Fauquier DS	-	-	-	1.92	1.93	1.93	1.93	1.94	1.95	1.95	1.95	1.95	1.95	1.96	1.97	1.98	1.99	2.01	2.03	2.05	2.06	2.04	2.05	2.05
Herridge Lake DS	-	-	-	1.65	1.65	1.65	1.65	1.66	1.66	1.66	1.66	1.66	1.66	1.66	1.67	1.68	1.68	1.70	1.71	1.73	1.74	1.72	1.72	1.73
Hoyle DS	-	-	-	4.47	4.47	4.46	4.46	4.46	4.47	4.46	4.47	4.46	4.45	4.46	4.46	4.47	4.49	4.52	4.55	4.57	4.60	4.54	4.55	4.56
Iroquois Falls DS	-	-	-	4.96	4.93	4.90	4.87	4.84	4.81	4.78	4.75	4.71	4.68	4.66	4.64	4.63	4.63	4.63	4.64	4.65	4.66	4.55	4.53	4.51
Laforest Road DS	-	-	-	11.04	11.02	11.02	11.03	11.03	11.05	11.04	11.05	11.04	11.02	11.04	11.06	11.09	11.14	11.21	11.29	11.38	11.46	11.30	11.32	11.34
Mattawa DS	-	-	-	4.37	4.36	4.37	4.38	4.38	4.39	4.39	4.40	4.40	4.40	4.41	4.42	4.43	4.46	4.49	4.53	4.57	4.60	4.54	4.55	4.57
Monteith DS	-	-	-	1.91	1.91	1.91	1.92	1.92	1.93	1.93	1.93	1.94	1.94	1.94	1.95	1.96	1.97	1.99	2.01	2.03	2.05	2.02	2.03	2.04
Moosonee DS	-	-	-	4.97	4.96	4.95	4.96	4.96	4.96	4.96	4.97	4.97	4.96	4.97	4.97	4.98	4.99	5.02	5.05	5.09	5.12	5.06	5.06	5.07
Shiningtree DS	-	-	-	2.43	2.42	2.41	2.41	2.40	2.40	2.39	2.39	2.38	2.37	2.37	2.37	2.37	2.36	2.37	2.38	2.39	2.40	2.36	2.36	2.36
Smooth Rock Falls DS	-	-	-	1.64	1.64	1.63	1.63	1.63	1.63	1.63	1.63	1.62	1.62	1.62	1.62	1.62	1.62	1.63	1.64	1.65	1.66	1.63	1.63	1.63
Temagami DS 2	-	-	-	0.98	0.98	0.98	0.99	0.99	1.00	1.00	1.01	1.01	1.01	1.02	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.07	1.08	1.08
Verner DS	-	-	-	4.04	4.03	4.02	4.02	4.01	4.01	3.99	3.98	3.97	3.96	3.96	3.96	3.97	3.98	4.01	4.03	4.06	4.08	4.01	4.01	4.01
Warren DS	-	-	-	5.02	5.00	4.99	4.98	4.97	4.97	4.94	4.93	4.91	4.89	4.89	4.89	4.89	4.90	4.93	4.96	4.98	5.01	4.92	4.91	4.91

Table A.4: North & East of Sudbury Region – Summer non-Coincident – Net Load Forecast

Transformer Station	DESN ID	LTR (MVA)	LTR (MW)	Net Extreme Summer Weather Station Peak Demand Forecast, Coincident to NE of Sudbury Region (MW)																			
				2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
Crystal Falls TS	T5/T6	48.40	43.56	23.02	23.61	23.86	24.10	24.33	24.59	24.78	28.74	29.08	29.28	29.53	29.82	30.13	30.63	31.06	31.52	31.96	32.40	33.64	34.24	34.85
Hearst TS	T4	32.90	29.61	14.79	14.95	14.89	14.86	14.80	14.77	14.70	14.66	14.60	14.53	14.50	14.49	14.48	14.50	14.55	14.62	14.68	14.74	14.50	14.48	14.46
Kapuskasing TS	T5/T6	94.20	84.78	64.77	64.52	64.36	64.32	64.18	64.15	63.93	63.82	63.61	63.40	63.35	63.37	63.45	63.64	64.01	64.43	64.84	65.21	64.03	64.03	64.02
Kirkland Lake TS	T12/T13	47.30	42.57	27.37	27.27	27.21	27.18	27.11	27.08	27.05	27.05	26.99	26.91	26.88	26.86	26.85	26.83	26.89	26.96	27.03	27.09	26.83	26.81	26.79
North Bay TS	T1/T2	61.70	55.53	18.22	16.87	15.55	16.06	16.60	17.14	17.67	18.20	18.72	19.22	19.74	20.28	20.84	21.42	22.00	22.60	23.19	23.78	23.59	24.04	24.49
Ramone TS	T1	18.30	16.47	7.20	7.24	7.27	7.31	7.38	7.45	7.51	7.72	7.78	7.83	7.89	7.96	8.04	8.12	8.21	8.29	8.38	8.46	8.52	8.60	8.68
Timmins TS	T2/T4	104.20	93.78	36.64	36.57	36.56	36.61	36.61	36.67	36.68	36.74	36.72	36.67	36.72	36.79	36.89	37.01	37.25	37.52	37.79	38.05	37.58	37.65	37.72
Dymond TS	T3/T4	54.00	48.60	30.08	29.97	29.90	29.89	29.83	29.83	29.76	29.74	29.66	29.56	31.06	31.06	31.09	31.16	31.30	31.47	31.64	31.79	31.68	31.80	31.93
Trout Lake	T3/T4	186.60	167.94	77.61	76.21	74.93	78.37	78.80	79.31	79.55	79.92	80.35	80.69	81.33	81.95	82.65	83.54	84.59	85.71	86.81	88.38	87.36	88.01	88.67
Calstock DS	-	-	-	6.96	6.94	6.93	6.94	6.93	6.94	6.96	6.99	6.99	6.98	6.98	6.99	7.00	7.01	7.05	7.09	7.13	7.18	7.11	7.12	7.13
CochraneMTS	-	-	-	12.44	12.33	12.24	12.16	12.06	11.98	11.87	11.79	11.69	11.59	11.53	11.47	11.42	11.40	11.40	11.41	11.42	11.42	11.14	11.08	11.01
Cochran West DS	-	-	-	2.86	2.86	2.86	2.86	2.86	2.86	2.86	2.85	2.85	2.84	2.85	2.85	2.86	2.87	2.89	2.92	2.94	2.96	2.91	2.92	2.92
Fauquier DS	-	-	-	2.57	2.57	2.57	2.58	2.59	2.59	2.60	2.60	2.60	2.61	2.61	2.62	2.64	2.65	2.68	2.70	2.73	2.75	2.72	2.73	2.74
Herridge Lake DS	-	-	-	2.24	2.24	2.24	2.25	2.25	2.26	2.26	2.26	2.26	2.26	2.26	2.27	2.28	2.29	2.31	2.33	2.35	2.36	2.33	2.34	2.35
Hoyle DS	-	-	-	6.36	6.35	6.34	6.35	6.35	6.35	6.35	6.35	6.34	6.33	6.34	6.35	6.36	6.39	6.42	6.47	6.51	6.54	6.46	6.47	6.48
Iroquois Falls DS	-	-	-	5.47	5.43	5.40	5.37	5.34	5.31	5.27	5.23	5.20	5.16	5.14	5.12	5.11	5.10	5.11	5.12	5.13	5.14	5.02	5.00	4.98
Laforest Road DS	-	-	-	13.27	13.25	13.24	13.26	13.26	13.28	13.27	13.28	13.27	13.25	13.26	13.29	13.33	13.38	13.47	13.57	13.67	13.77	13.58	13.60	13.63
Mattawa DS	-	-	-	5.18	5.18	5.18	5.19	5.20	5.21	5.21	5.22	5.22	5.22	5.23	5.24	5.26	5.29	5.33	5.37	5.42	5.46	5.39	5.40	5.42
Monteith DS	-	-	-	2.24	2.24	2.24	2.25	2.26	2.26	2.26	2.27	2.27	2.27	2.28	2.29	2.30	2.31	2.34	2.36	2.38	2.40	2.37	2.38	2.39
Moosonee DS	-	-	-	8.69	8.67	8.66	8.67	8.66	8.67	8.68	8.69	8.69	8.67	8.68	8.69	8.71	8.73	8.78	8.83	8.89	8.94	8.84	8.85	8.86
Shiningtree DS	-	-	-	3.02	3.00	2.99	2.99	2.98	2.97	2.97	2.97	2.96	2.95	2.94	2.94	2.94	2.93	2.94	2.95	2.96	2.98	2.93	2.93	2.93
Smooth Rock Falls DS	-	-	-	1.93	1.92	1.92	1.92	1.91	1.91	1.91	1.91	1.90	1.90	1.90	1.90	1.90	1.90	1.91	1.93	1.94	1.95	1.92	1.92	1.92
Temagami DS 2	-	-	-	2.65	2.65	2.66	2.68	2.69	2.70	2.71	2.72	2.73	2.74	2.75	2.77	2.79	2.81	2.84	2.87	2.90	2.93	2.90	2.92	2.93
Verner DS	-	-	-	4.56	4.55	4.54	4.54	4.53	4.53	4.52	4.51	4.49	4.48	4.48	4.48	4.49	4.50	4.53	4.56	4.58	4.61	4.53	4.53	4.53
Warren DS	-	-	-	5.57	5.55	5.53	5.53	5.51	5.51	5.48	5.47	5.45	5.43	5.42	5.42	5.42	5.44	5.47	5.50	5.53	5.55	5.46	5.45	5.45

`

Appendix B:

Lists of Step-Down Transformer Stations

Sr. No.	Transformer Stations	Voltages (kV)	Supply Circuits
1.	Ansonville TS	230/115	A9K A94N A5H A4H P91G A93I A8K
2.	Crystal Falls TS	230/44	H23S H24S
3.	Dymond TS	115/44	D4Z D3K D2L W71D
4.	Hearst TS	115/27.6	F1E
5.	Hunta SS	115	H7T A5H A4H H9K H6T D2H D3H
6.	Kapuskasing TS	230/115/28	H9K L21S K38S F1E
7.	Kirkland Lake TS	115/44	A8K A9K D3K K2 K4
8.	Little Long SS	230/44	L20D L21S
9.	Moosonee SS	115	T7M T8M M3K M9K
10.	North Bay TS	230/44	L5H
11.	Otter Rapids SS	115	T7M T8M R21D D6T
12.	Otto Holden TS	230/115/14	L5H D5H H4Z H23S H24S
13.	Pinard TS	500/230/115	L20D H22D R21D D3H D501P D4 D6T D23G D2H
14.	Porcupine TS	500/230/115	P91G P15T P7G D501P P13T P502X
15.	Ramore TS	115/27.6	A9K
16.	Spruce Falls TS	230/115/14	F1E K38S
17.	Timmins TS	115/27.6	H7T T2R H6T P15T T61S P13T
18.	Trout Lake TS	230/44	H24S W71D
19.	Widdifield SS	230	H23S H24S W71D

Lists of Transmission Circuits

Sr. No.	Circuit ID	From Station	To Station	Voltage (kV)
1.	A4H/A5H	Ansonville TS	Hunta SS	115
2.	A8K/A9K	Ansonville TS	Kirkland Lake TS	115
3.	D2H/D3H	Pinard TS	Hunta SS	115
4.	H6T/H7T	Hunta SS	Timmins TS	115
5.	P13T/P15T	Porcupine TS	Timmins TS	115
6.	T7M/T8M	Otter Rapids SS	Moosenee SS	115
7.	D2L	Dymond TS	Crystal Falls TS	115
8.	H9K	Hunta SS	Kapuskasing TS	115
9.	K2	Kirkland Lake TS	Radial	115
10.	K4	Kirkland Lake TS	Radial	115
11.	L1S	Martindale TS	Crystal Falls TS	115
12.	L5H	Crystal Falls TS	Otto Holden TS	115
13.	D3K	Dymond TS	Kirkland Lake TS	115
14.	P7G	Porcupine TS	Radial	115
15.	T61S	Timmins TS	Radial	115
16.	F1E	Kapuskasing TS	Hearst TS	115
17.	T2R	Timmins TS	Radial	115
18.	D23G	Pinard TS	Radial	230
19.	H22D	Pinard TS	Radial	230

20.	H23S/H24S	Martindale TS	Otto Holden TS	230
21.	K38S	Kapuskasing TS	Spruce Falls TS	230
22.	L20D	Pinard TS	Little Long SS	230
23.	L21S	Kapuskasing TS	Little Long SS	230
24.	P91G	Porcupine TS	Ansonville TS	230
25.	R21D	Otter Rapids SS	Radial	230
26.	W71D	Dymond TS	Widdfield SS	230
27.	P502X	Porcupine TS	Hanmer TS	500
28.	D501P	Porcupine TS	Pinard TS	500

Appendix C: Voltage Performance Analysis at Dymond TS

To address the on-going voltage issue due to operation of SC11& SC12 Capacitor banks at Dymond TS under N-1-1 contingency, Hydro One can de-rate the capacitor bank between 14-16MX. The capacitor banks can only be physically de-rated in the steps of 3MX.

Following table shows a PSSE simulation result with both capacitors de-rated to 15MX. (*Hydro One 2022 Winter Base case used for simulation purpose).*

Bus	Contingency														
	N-0					D3K O/S					D3K O/S +W71D				
		24+24 MX Caps		15+15 MX Caps			24+24 MX Caps		15+15 MX Caps			24+24 MX Caps		15+15 MX Caps	
	No Cap	ON	% Change	ON	% Change	No Cap	ON	% Change	ON	% Change	No Cap	ON	% Change	ON	% Change
Dymond TS 220	243.89	246.62	1.12	245.59	0.69	244.44	248.25	1.56	246.80	0.96					
Dymond TS 115	123.49	125.67	1.77	124.84	1.10	124.05	127.08	2.44	125.92	1.50	117.51	131.96	12.30	125.76	7.03
Dymond TS 44	46.35	47.11	1.63	46.82	1.02	46.55	47.59	2.25	47.19	1.39	44.28	49.37	11.50	47.15	6.47
Temagami 115	123.41	124.93	1.22	124.35	0.76	123.98	126.06	1.68	125.27	1.04	119.78	129.21	7.88	125.19	4.52

Capacitor bank switching under the studied scenario is infrequent due to the N-1-1 condition and voltage change limits shall take this into consideration. Sizing the capacitor banks between 14-16MX is shown to reduce the voltage change to reasonable limits based on the in frequent nature of the occurrence. This reduction allows for reactive support at Dymond TS to remain at a level that can still help with normal operations during non-contingency scenarios or system changes such as load growth. Simulation results will continue to be studied to correctly size the capacitor banks.

Appendix D: List of LDC's

Sr. No.	Local Distributor Company	Connection Type (TX/DX)
1.	Hydro One Distribution	TX/DX
2.	North Bay Hydro	DX
3.	Northern Ontario Wires Inc.	TX/DX
4.	Hearst Power Distribution Co.	DX
5.	Greater Sudbury Hydro Inc.	DX

Appendix E: List of Municipalities in the region

Sr. no.	Name of Municipality
1	Town of Hearst
2	Town of Kapuskasing
3	Town of Smooth Rock Falls
4	Town of Cochrane
5	Town of Foleyet
6	Town of Iroquois Falls
7	Town of Kirkland Lake
8	Town of Englehart.
9	Township of Black River
10	Township of Matheson
11	Township of East Ferris
12	City of North Bay
13	City of Temiskaming Shores
14	City of Timmins
15	Municipality of West Nipissing

Appendix F: Acronyms

Acronym	Description
A	Ampere
BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CEP	Community Energy Plan
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
MEP	Municipal Energy Plan
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