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NEEDS ASSESSMENT REPORT

Region: St Lawrence

Date: April 29, 2016

Prepared by St Lawrence Region Study Team



St Lawrence Region Study Team

Company
Hydro One Networks Inc. (Lead Transmitter)
Independent Electricity System Operator
Hydro One Networks Inc. (Distribution)

Disclaimer

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the St Lawrence region and to assess whether those needs require further coordinated regional planning. The potential needs that have been identified through this Needs Assessment Report may be studied further through subsequent regional planning processes and may be reevaluated based on the findings of further analysis. The load forecast and results reported in this Needs Assessment Report are based on the information and assumptions provided by study team participants.

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NEEDS ASSESSMENT EXECUTIVE SUMMARY

REGION	St Lawrence (the “Region”)		
LEAD	Hydro One Networks Inc. (“Hydro One”)		
START DATE	March 1, 2016	END DATE	April 29, 2016
1. INTRODUCTION			
<p>The purpose of this Needs Assessment (NA) report is to undertake an assessment of the St Lawrence Region and determine if there are regional needs that require coordinated regional planning. Where regional coordination is not required, and a “localized” wires solution is necessary, such needs will be addressed between relevant Local Distribution Companies (LDCs) and Hydro One and other parties as required.</p> <p>For needs that require further regional planning and coordination, IESO will initiate the Scoping Assessment (SA) process to determine whether an IESO-led Integrated Regional Resource Planning (IRRP) process, or the transmitter-led Regional Infrastructure Plan (RIP) process (wires solution), or whether both are required.</p>			
2. REGIONAL ISSUE / TRIGGER			
<p>The NA for the St Lawrence Region was triggered in response to the Ontario Energy Board’s (OEB) Regional Infrastructure Planning process approved in August 2013. To prioritize and manage the regional planning process, Ontario’s 21 regions were assigned to one of three groups. The NA for Group 1 and 2 regions is complete and has been initiated for Group 3. The St Lawrence Region belongs to Group 3. The NA for this Region was triggered on March 1, 2016 and was completed on April 29, 2016.</p>			
3. SCOPE OF NEEDS ASSESSMENT			
<p>The scope of the NA study was limited to 10 years as per the recommendations of the Planning Process Working Group (PPWG) Report to the Board. As such, relevant data and information was collected up to the year 2025. Needs emerging over the next 10 years and requiring coordinated regional planning may be further assessed as part of the IESO-led SA, which will determine the appropriate regional planning approach: IRRP, RIP, and/or local planning. This NA included a study of transmission system connection facilities capability, which covers station loading, thermal and voltage analysis as well as a review of system reliability, operational issues such as load restoration, and assets approaching end-of-useful-life.</p>			
4. INPUTS/DATA			
<p>Study team participants, including representatives from LDCs, the Independent Electricity System Operator (IESO) and Hydro One transmission provided information for the St Lawrence Region. The information included: historical load, load forecast, conservation and demand management (CDM) and distributed generation (DG) information, load restoration data, and performance information including major equipment approaching end-of-useful life.</p>			
5. NEEDS ASSESSMENT METHODOLOGY			
<p>The assessment’s primary objective was to identify the electrical infrastructure needs and system performance issues in the Region over the study period (2016 to 2025). The assessment reviewed available information, load forecasts and included single contingency analysis to confirm needs, if and when required. See Section 5 for further details.</p>			

6. RESULTS

Transmission Needs

A. 230/115 kV Autotransformers

The 230/115kV Autotransformers at St Lawrence TS are adequate over the study period for the loss of a single 230/115kV unit

B. Transmission Lines & Ratings

The 230kV lines are adequate over the study period. A Special Protection Scheme is in place to reject generation at Beauharnois GS and/or Saunders GS under post contingency conditions to ensure the loading on the St Lawrence to Hinchinbrooke TS 230KV circuits are within ratings.

The 115kV lines are adequate over the study period to supply the forecasted load. The section of the 115kV lines L2M/L1MB between St Lawrence TS and Lunenburg Jct may be overloaded under light load conditions and high DG and Cardinal Power generation, for the loss of the companion circuit. Since 2012, Morrisburg TS has been restricted and no additional generation is accepted. At the same time, this situation is also mitigated using the Cardinal Power CGS run back scheme or by limiting generation dispatch during these light load conditions. No further action is required.

C. 230 kV and 115 kV Connection Facilities

The 230kV and 115kV connection facilities in this region are adequate over the study period.

Inadvertent breaker operation (IBO) at Cardinal Power on either L1MB or L2M can result in Morrisburg TS transformers exceeding their reverse flow limits and/or cause a transformer to be loaded beyond ratings at Dyno Nobel CTS. Morrisburg TS has been restricted and no additional generation is accepted since 2012. This situation is also mitigated by using Cardinal Power runback scheme. No further action is required.

System Reliability, Operation and Restoration Review

Based on the gross coincident load forecast, the loss of one element does not result in load interruption greater than 150MW. The maximum load interrupted by configuration due to the loss of two elements is below the load loss limit of 600MW by the end of the 10-year study period. No action is required.

Chesterville TS missed its delivery point performance standard in recent years due to momentary outages resulting from severe weather patterns. The delivery point performance at Chesterville TS will be assessed and monitored to determine if corrective actions are required. No further action is required as part of regional planning.

Aging Infrastructure / Replacement Plan

Within the regional planning time horizon, the following sustainment work is currently planned by Hydro One in the region:

- Morrisburg TS: components replacement (2019 in service)
- Smiths Falls TS: components replacement (2021 in service)
- St Lawrence TS: components replacement (2024 in service)

7. RECOMMENDATIONS

Based on the findings of the Needs Assessment, the study team recommends that no further regional coordination or further planning is required. The region will be reassessed within five years as part of the next planning cycle.

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1 INTRODUCTION

This Needs Assessment (NA) report provides a summary of needs that are emerging in the St Lawrence Region (“Region”) over the next ten years. The development of the NA report is in accordance with the regional planning process as set out in the Ontario Energy Board’s (OEB) Transmission System Code (TSC) and Distribution System Code (DSC) requirements and the “Planning Process Working Group (PPWG) Report to the Board”.

The purpose of this NA is to undertake an assessment of the St Lawrence Region to identify any near term and/or emerging needs in the area and determine if these needs require a “localized” wires only solution(s) in the near-term and/or a coordinated regional planning assessment. Where a local wires only solution is necessary to address the needs, Hydro One, as transmitter, with Local Distribution Companies (LDC) or other connecting customer(s), will further undertake planning assessments to develop options and recommend a solution(s). For needs that require further regional planning and coordination, the Independent Electricity System Operator (IESO) will initiate the Scoping Assessment (SA) process to determine whether an IESO-led Integrated Regional Resource Planning (IRRP) process, or the transmitter-led Regional Infrastructure Plan (RIP) process (wires solution), or both are required. The SA may also recommend that local planning between the transmitter and affected LDCs be undertaken to address certain needs if straight forward wires solutions can address a need. Ultimately, assessment and findings of the local plans are incorporated in the RIP for the region.

This report was prepared by the St Lawrence Region NA study team (Table 1) and led by the transmitter, Hydro One Networks Inc. The report captures the results of the assessment based on information provided by LDCs, and the Independent Electricity System Operator (IESO).

Table 1 Study Team Participants for St Lawrence Region

No.	Company
1.	Hydro One Networks Inc. (Lead Transmitter)
2.	Independent Electricity System Operator
3.	Hydro One Networks Inc. (Distribution)

2 REGIONAL ISSUE / TRIGGER

The NA for the St Lawrence Region was triggered in response to the OEB's Regional Infrastructure Planning process approved in August 2013. To prioritize and manage the regional planning process, Ontario's 21 regions were assigned to one of three groups. The NA for Group 1 Regions is complete and has been initiated for Group 2 Regions. The St Lawrence Region belongs to Group 3.

3 SCOPE OF NEEDS ASSESSMENT

This NA covers the St Lawrence Region over an assessment period of 2016 to 2025. The scope of the NA includes a review of transmission system connection facility capability which covers transformer station capacity, thermal capacity, and voltage performance. System reliability, operational issues such as load restoration, and asset replacement plans were also briefly reviewed as part of this NA.

St Lawrence Region Description and Connection Configuration

The St Lawrence Region covers the southeastern part of Ontario bordering the St Lawrence River. The region starts at the Gananoque in the West and extends to the inter-provincial boundary with Quebec in the East.

The western part of the region is supplied from Hydro One owned stations connected to the 230kV network. The remainder of the region is supplied from Hydro One stations connected to the 115kV network except for St Lawrence TS which is supplied from 230kV.

The City of Cornwall is supplied by Fortis Ontario with transmission lines from Quebec and is not included in this Region. A map of the region is shown below in Figure 1.

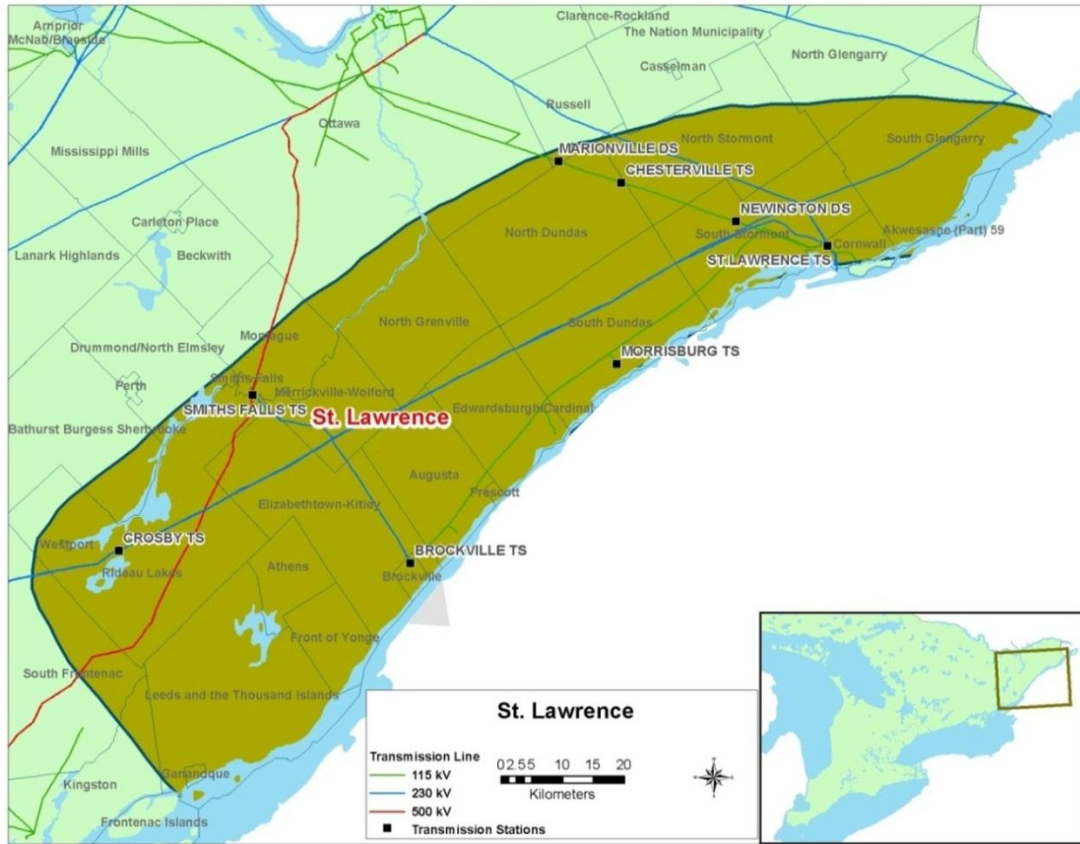


Figure 1 Map of St Lawrence Regional Planning Area

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits. The major source of supply for this region is OPG’s Saunder Hydro Electric station which connects to St Lawrence TS 230kV yard.

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

- Hydro One Networks (Distribution)
- Cooperative Hydro Embrun Inc. (embedded in Hydro One Distribution)
- Rideau St Lawrence Distribution Inc. (embedded in Hydro One Distribution)

Table 2 Transmission Lines in the St Lawrence Region

115kV circuits	230kV circuits	Hydro One Transformer Stations
L1MB, L2M, L5C ¹	L20H, L21H, L22H, L24A ² , B31L ²	Brockville TS, Chesterville TS, Crosby TS, Morrisburg TS, Newington DS, Smith Falls TS, St Lawrence TS*

*Stations with Autotransformers installed

¹ L5C is normally o/s, and used as a backup supply for the City of Cornwall.

² L24A and B31L connect to St Lawrence TS but do not have load customers connection.

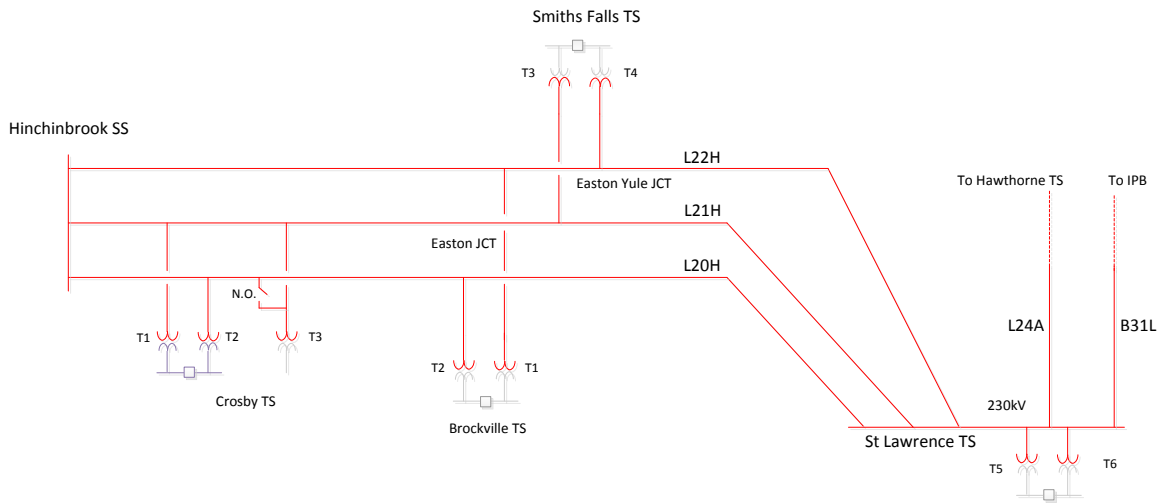


Figure 2 Single Line Diagram 230 kV St Lawrence Regional Planning Area

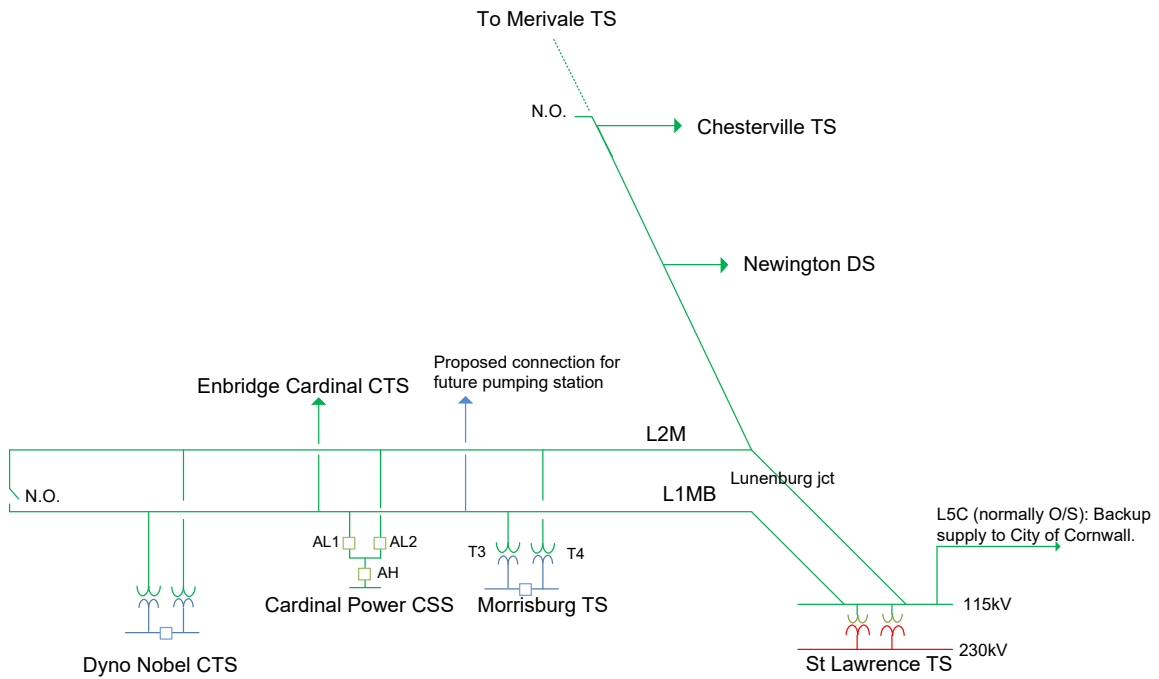


Figure 3 Single Line Diagram 115 kV St Lawrence Regional Planning Area

4 INPUTS AND DATA

In order to conduct this Needs Assessment, study team participants provided the following information and data to Hydro One:

- IESO provided:
 - i. Historical Ontario and regional coincident load station peaks, as well as individual station peaks.
 - ii. List of existing reliability and operational issues
 - iii. Conservation and Demand Management (CDM) and Distributed Generation (DG) data
- LDCs provided historical (2013-2015) net load and gross load forecast (2016-2025).
- Hydro One (Transmission) provided transformer, station, and circuit ratings
- Any relevant planning information, including planned transmission and distribution investments provided by the transmitter and LDCs, etc.

Load Forecast

As per the data provided by the study team, the gross load in region is expected to grow at an average rate of approximately 0.8% annually from 2016-2025.

The net load forecast takes the gross load forecast and applies the planned CDM targets and DG contributions. With these factors in place, the total regional load is expected to increase at an average rate of approximately 0.2% annually from 2016-2025.

Future Project

As shown in Figure 3, there is a proposal to connect a pumping station for the TransCanada Energy East project that will add 18MW of load to the area. The pumping station is planned to be connected to circuit L1MB close to Morrisburg TS. The current in-service date is 2021.

5 NEEDS ASSESSMENT METHODOLOGY

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

1. The Region is winter peaking so this assessment is based on winter peak loads.
2. Saunders GS was assumed to generate at its average 98% of time dependable hydro generation level which is 542MW.
3. Forecast loads are provided by the Region's LDCs

4. Load data was requested from industrial customers in the region. Where data was not provided, the load was assumed to be consistent with historical loads.
5. Accounting for (3), (4), above, the gross load forecast and a net load forecast were developed. The gross load forecast is used to verify each station is within its rating to supply the forecasted load. The net forecast was used for system study.
6. Review and assess impact of any critical/major elements planned/identified to be replaced at the end of their useful life such as autotransformers, cables, and stations.
7. 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 or the historical low voltage power factor, whichever is more conservative. For stations having low-voltage capacitor banks, a 95% lagging power factor was assumed or the historical low-voltage power factor, whichever is more conservative. Normal planning supply capacity for transformer stations in this Region is determined by the winter 10-Day Limited Time Rating (LTR). Winter LTR ratings were reviewed.
8. Extreme weather scenario factor at 1.0582 was also assessed for capacity planning over the study term.
9. To identify emerging needs in the Region and determine whether or not further coordinated regional planning should be undertaken, the study was performed observing all elements in service and only one element out of service.
10. Transmission adequacy assessment is primarily based on, but is not limited to, the following criteria:
 - With all elements in service, the system is to be capable of supplying forecast demand with equipment loading within continuous ratings and voltages within normal range.
 - With one element out of service, the system is to be capable of supplying forecast demand with circuit loading within their winter long-term emergency (LTE) ratings. Thermal limits for transformers are acceptable using winter loading with winter 10-day LTR.
 - All voltages must be within pre and post contingency ranges as per Ontario Resource and Transmission Assessment Criteria (ORTAC) criteria.
 - With one element out of service, no more than 150 MW of load is lost by configuration. With two elements out of service, no more than 600 MW of load is lost by configuration.
 - With two elements out of service, the system is capable of meeting the load restoration time limits as per ORTAC criteria.

6 RESULTS

230/115 kV Autotransformers

The 230/115kV Autotransformers at St Lawrence TS are adequate over the study period for the loss of a single 230/115kV unit

Transmission Lines & Ratings

230kV Lines

The 230 kV circuits supplying the Region are adequate over the study period for the loss of a single 230 kV circuit in the Region.

There is a generation rejection scheme in place that can runback Saunders GS and/or Beauharnois GS under post-contingency conditions. This scheme ensures that the St Lawrence to Hinchinbrooke TS lines are not overloaded under peak summer conditions.

115kV Lines

Under the assumptions made for regional planning, the 115kV lines are adequate over the study period for the loss of a single circuit in the Region.

The following operating issues have been previously in the SIA/CIA done for Cardinal Power G3 Expansion [4, 5]:

Under light load condition and with all distributed generation in the area and the Cardinal Power generation at maximum output the section of the L1MB/L2M line between St Lawrence to Lunenburg JCT can be loaded beyond its short time emergency (STE) rating for loss of either circuit.

To manage the situation, Morrisburg TS has been restricted to accept new generation connection since 2012. In addition, there is Cardinal Power's runback scheme will reduce the plant output following the loss of either circuit and hence reduce the post-contingency loading on either of the L1MB/L2M lines. However since the lines could be loaded beyond their STE, measures such generation re-dispatch is implemented by the IESO as per the Cardinal Power G3 Expansion studies [4, 5].

230 kV and 115 kV Connection Facilities

A station capacity assessment was performed over the study period for the 230 kV and 115 kV transformer stations in the Region using the station winter peak load forecast provided by the study team. All stations in the area have adequate supply capacity for the study period even in the event of extreme weather scenario.

Reverse Power Flow

At Morrisburg TS, under light load condition and high distributed and directly connected generation, a reverse power flow issue was identified in the Cardinal Power G3 Expansion SIA/CIA [4, 5]. This situation occurs if one of the line breakers at Cardinal Power has an inadvertent opening (IBO). This IBO results in all of Cardinal Power's generation being sent to one line, which causes reverse power at Morrisburg TS beyond its maximum limit. As noted previously, since 2012, additional generation connection has been restricted at Morrisburg TS to manage the reverse power flow at the station.

Dyno Nobel CTS

Under the same conditions mentioned above, an IBO at Cardinal Power can also result in power flow through the Dyno Nobel CTS to exceed their rating [4, 5].

For Morrisburg TS and Dyno Nobel CTS transformer loading issues, Cardinal Power run back scheme is triggered to reduce the flows to within equipment ratings as it was outlined in the SIA and CIA [4,5]. No further action is recommended within the scope of this regional planning.

7 SYSTEM RELIABILITY, OPERATION AND RESTORATION

Based on the gross coincident load forecast, the loss of one element does not result in load interruption greater than 150MW. The maximum load interrupted by configuration due to the loss of two elements is below the load loss limit of 600MW for the duration of the 10-year study period.

Chesterville TS and Newington DS are on single supply from L2M for a combined gross load of 50MW in 2025. If the supply from St Lawrence TS becomes unavailable, these two stations can be supplied from Merivale TS.

All loads in the St Lawrence area can be restored within the 8 hour requirement.

IESO indicated in their unsupplied energy report that the 115kV area did not meet its target in the past. Chesterville TS missed its customer delivery point target (frequency of interruption) in recent years due to momentary outages seen as a result of severe weather patterns. Hydro One will review and monitor its supply point performance at Chesterville TS to determine if corrective measures are required. No further actions required as part of regional planning.

8 AGING INFRASTRUCTURE AND REPLACEMENT PLAN OF MAJOR EQUIPMENT

Hydro One reviewed the sustainment initiatives that are currently planned for the replacement of any autotransformers, power transformers and high-voltage cables during the study period. At this time the following sustainment work is planned for the stations in the area:

Morrisburg TS: Protection upgrade, 44kV breakers (2019 in service)

Smiths Falls TS: Protection replacement, battery and charger, switches (2021 in service)

St Lawrence TS: Replacement of oil breakers at 230kV, 115k, and 44kV; replacement of AC/DC station service supplies; and protection upgrade work. (2024 in service)

The facilities at these stations are adequate and there is no need to increase the equipment rating.

9 RECOMMENDATIONS

Based on the findings of the Needs Assessment, the study team recommends that no further regional coordination or further planning is required. The region will be reassessed within five years as part of the next planning cycle.

10 NEXT STEPS

No further Regional Planning is required at this time. The St Lawrence Region Regional Planning will be reassessed during the next planning cycle or at any time should unforeseen conditions or needs warrant to initiate the regional planning for the region.

11 REFERENCES

1. [Planning Process Working Group \(PPWG\) Report to the Board: The Process for Regional Infrastructure Planning in Ontario – May 17, 2013](#)
2. [IESO 18-Month Outlook: March 2014 – August 2015](#)
3. [IESO Ontario Resource and Transmission Assessment Criteria \(ORTAC\) – Issue 5.0](#)
4. [Cardinal Power 15MW Plant Expansion SIA \(2011-432\)](#)
5. Cardinal Power 15MW Plant Expansion CIA

APPENDIX A: Load Forecast

Winter Load: Normal Weather Condition.

Station		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Brockville	Non Coincidental Gross		135.8	136.7	137.9	139.7	141.4	142.5	143.6	144.6	145.6	146.5
	CDM (MW)		1.1	1.9	3.2	4.3	5.4	6.3	7.0	7.5	8.2	8.8
	DG (MW)	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Non Coincidental Net	134.3	132.9	132.8	132.8	133.5	134.2	134.4	134.6	135.2	135.5	135.8
	Coincidental Net	115.6	115.9	115.9	115.9	116.4	117.0	117.2	117.4	117.9	118.2	118.5
Chesterville	Non Coincidental Gross		42.0	42.5	43.2	44.1	45.0	45.7	46.3	46.9	47.6	48.2
	CDM (MW)		0.3	0.6	1.0	1.4	1.7	2.0	2.3	2.4	2.7	2.9
	DG (MW)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Non Coincidental Net	41.2	40.6	40.9	41.2	41.7	42.3	42.7	43.0	43.5	43.9	44.3
	Coincidental Net	41.2	41.6	41.9	42.2	42.8	43.3	43.7	44.1	44.5	44.9	45.3
Crosby	Non Coincidental Gross		28.8	29.0	29.2	29.6	30.0	30.2	30.4	30.6	30.8	31.0
	CDM (MW)		0.2	0.4	0.7	0.9	1.1	1.3	1.5	1.6	1.7	1.9
	DG (MW)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
	Non Coincidental Net	28.5	25.9	25.9	25.9	26.1	26.2	26.2	26.3	26.4	26.5	26.5
	Coincidental Net	18.9	18.9	18.9	18.9	19.0	19.1	19.1	19.2	19.2	19.3	19.3
Morrisburg	Non Coincidental Gross		61.5	61.7	62.1	62.7	63.3	63.7	64.0	64.3	64.6	64.9
	CDM (MW)		0.5	0.9	1.4	1.9	2.4	2.8	3.1	3.3	3.6	3.9
	DG (MW)	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
	Non Coincidental Net	60.0	52.6	52.4	52.3	52.3	52.5	52.4	52.4	52.5	52.5	52.5
	Coincidental Net	53.9	53.9	53.8	53.6	53.7	53.8	53.8	53.8	53.9	53.9	53.9
Newington	Non Coincidental Gross		1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.1
	CDM (MW)		0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	DG (MW)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Non Coincidental Net	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
	Coincidental Net	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Smiths Falls	Non Coincidental Gross		124.2	125.1	126.6	128.1	128.8	129.5	130.2	130.8	131.4	132.1
	CDM (MW)		1.0	1.8	2.9	4.0	4.9	5.7	6.4	6.8	7.4	7.9
	DG (MW)	3.9	4.0	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
	Non Coincidental Net	122.5	119.2	118.8	119.2	119.5	119.4	119.3	119.3	119.5	119.5	119.6
	Coincidental Net	112.7	112.8	112.4	112.7	113.1	113.0	112.9	112.8	113.0	113.1	113.2
St Lawrence	Non Coincidental Gross		44.5	44.7	45.1	45.5	45.6	45.7	45.8	45.9	46.0	46.0
	CDM (MW)		0.4	0.6	1.0	1.4	1.7	2.0	2.2	2.4	2.6	2.8
	DG (MW)	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.6
	Non Coincidental Net	44.2	41.6	41.5	41.5	41.5	41.3	41.1	41.0	40.9	40.8	40.7
	Coincidental Net	43.0	42.9	42.8	42.8	42.8	42.6	42.4	42.3	42.2	42.1	42.0

APPENDIX B: Acronyms

BES	Bulk Electric System
BPS	Bulk Power System
CDM	Conservation and Demand Management
CIA	Customer Impact Assessment
CGS	Customer Generating Station
CTS	Customer Transformer Station
DESN	Dual Element Spot Network
DG	Distributed Generation
DSC	Distribution System Code
GS	Generating Station
HVDS	High Voltage Distribution Station
IESO	Independent Electricity System Operator
IRRP	Integrated Regional Resource Planning
kV	Kilovolt
LDC	Local Distribution Company
LTE	Long Term Emergency
LTR	Limited Time Rating
LV	Low-voltage
MW	Megawatt
MVA	Mega Volt-Ampere
NERC	North American Electric Reliability Corporation
NGS	Nuclear Generating Station
NPCC	Northeast Power Coordinating Council Inc.
NA	Needs Assessment
OEB	Ontario Energy Board
ORTAC	Ontario Resource and Transmission Assessment Criteria
PF	Power Factor
PPWG	Planning Process Working Group
RIP	Regional Infrastructure Planning
SIA	System Impact Assessment
SS	Switching Station
TS	Transformer Station
TSC	Transmission System Code
ULTC	Under Load Tap Changer