Northwest Ontario

REGIONAL INFRASTRUCTURE PLAN

June 9, 2017

hydro one

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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 Working Group.

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 Working Group.

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EXECUTIVE SUMMARY

THIS REGIONAL INFRASTRUCTURE PLAN ("RIP") WAS PREPARED BY HYDRO ONE WITH INPUT AND SUPPORT FROM THE WORKING GROUP IN ACCORDANCE TO THE ONTARIO TRANSMISSION SYSTEM CODE REQUIREMENTS. IT IDENTIFIES INVESTMENTS IN TRANSMISSION FACILITIES, DISTRIBUTION FACILITIES, OR BOTH, THAT SHOULD BE DEVELOPED AND IMPLEMENTED TO MEET THE ELECTRICITY INFRASTRUCTURE NEEDS WITHIN THE NORTHWEST ONTARIO REGION.

The participants of the RIP Working Group included members from the following organizations:

- Hydro One Networks Inc. (Transmission)
- Independent Electricity System Operator
- Hydro One Networks Inc. (Distribution)
- Atikokan Hydro Inc.
- Kenora Hydro Electric Corporation Ltd.
- Thunder Bay Hydro Electricity Distribution Inc.
- Sioux Lookout Hydro Inc.
- Fort Frances Power Corporation

This RIP is the final phase of the regional planning process and it follows the completion of Integrated Regional Resource Plan ("IRRP") by the IESO for the North of Dryden Sub-Region in January 2015, Greenstone-Marathon Sub-Region in June 2016, and West of Thunder Bay in July 2016 and for Thunder Bay Sub-Region in December 2016 [2-5]. This report also references the IESO Draft Remote Community Connection Plan report [6].

This RIP provides a consolidated summary of needs and recommended plans for North of Dryden, Greenstone-Marathon, West of Thunder Bay, and Thunder Bay Sub -Regions that make up the Northwest Ontario Region. The potential needs of the bulk system is not within the scope of the Regional Planning, however, some aspects of the bulk system needs and plans are discussed in this report in the context of regional plans.

The Working Group has reassessed and updated the LDC load forecasts, which have remained consistent with the forecasts used in the IRRPs. Accordingly, this RIP has confirmed the needs and the proposed or recommended infrastructure (wires) plans for the sub-regions as indicated in the IRRP reports.

The needs in the region are largely driven by the industrial load growth, particularly the mining sector. Considering the uncertainties in the forecast of the industrial loads, this RIP uses the forecast scenarios and assumptions developed for the Northwest IRRPs. The connection of remote communities to the electricity grid, as well as the load growth as a result of economic developments, are also contributing factors. Since the development timelines and plans for connection of the mining and other industrial loads are uncertain and frequently depend on the customer decision, the IRRP and RIP have both considered low, medium (or reference) and high load growth scenarios and identified alternatives and recommended plans to address the needs under each scenario in near-term (present-5 years), mid-term (5-10 years) and long term (10-20 years).

The following is the summary of the currently recommended or proposed near/mid/long-term wires plans for the sub-regions under low, medium and high load growth scenarios. The current status of these plans is also indicated in the following.

North of Dryden Sub-Region Wires Plans

No.	Need	Wires Options	Load Growth	Term	Status
1	Circuits E1C and E4D Capacity	A 230 kV transmission line from Dryden/Ignace area to Pickle Lake	Medium[1]	Near-term	Recommended in IRRP. Development has started.
2	Circuits E4D and E2R Capacity	Upgrade of transmission lines E2R and E4D, and additional voltage support	All Scenarios	Near-term	Recommended in IRRP. The need has not materialized.
3		A 115 kV or 230 kV transmission line from Dryden to Ear Falls	High	Long-term	Proposed in IRRP. Not needed in the planning horizon, assuming Projects 1 and 2 proceed.

Greenstone-Marathon Sub-Region Wires Plans

No.	Need	Wires Options	Load Growth	Term	Status
4	Circuit A4L Capacity	Upgrade of sections of transmission line A4L, and dynamic voltage support devices at Geraldton	Medium[2]	Near-term	Recommended in IRRP. Subject to the plans and timelines for connection of a new Geraldton mine.
5		Upgrade of other sections of transmission line A4L	Medium[2]	Mid-term	Recommended in IRRP. Subject to the plans and timelines for connection of a new Beardmore mine.
6	Capacity for Pipeline Project and Ring of Fire	A 230 kV transmission line from Nipigon or Terrace Bay to Geraldton, and voltage support devices	High[2]	Mid/Long-term	Recommended in IRRP. Subject to the plans and timelines for connection of pipeline loads and mines.
7		A 115 kV transmission line from Manitouwadge to Geraldton, and voltage support devices	High[2]	Long-term	Recommended in IRRP. Subject to the plans and timelines for connection of additional pipeline loads.

[1] The Medium growth scenario for North-of-Dryden sub-region corresponds to the "Reference Scenario" in the IRRP

[2] The Low growth scenario for Greenstone-Marathon sub-region corresponds to scenario "A" of the three sub-systems in the IRRP, the Medium growth scenario corresponds to scenario "B" of Greenstone and Marathon and scenario A of Northshore sub-systems in the IRRP, and the High growth scenario corresponds to scenario "D" of Greenstone, scenario "C" of Marathon and scenario "A" of Northshore sub-systems in the IRRP (see section 5 for details of Load Forecast Scenarios).

West of Thunder Bay Sub-Region Wires Plans					
No.	Need	Wires Options	Load Growth	Term	Status
8	Dryden 115 kV System Capacity	A 230/115 kV auto-transformer in Dryden area	High	Mid-term	Proposed in IRRP. Next planning cycle will reassess the need.

Thunder Bay Sub-Region Wires Plans					
No.	Need	Wires Options	Load Growth	Term	Status
9	Thunder Bay 115 kV System Capacity	A 230/115 kV auto-transformer in Thunder Bay area	High	Long-term	Proposed in IRRP. Next planning cycle will reassess the need.
10	Port Arthur TS Transformation Capacity	Upgrade of Low-Voltage equipment at Port Arthur TS	All Scenarios	Long-term	Proposed in IRRP. LV equipment are planned for End-of-Life replacement in mid-term. Next planning cycle will reassess the need.

The IRRP for Thunder Bay sub-region identified a near-term need for upgrading the thermal rating of circuit R2LB between Lakehead TS and Birch TS to that of the companion circuit R1LB. This upgrade has been completed in Q4 2016.

Most of the above plans are highly dependent on the needs of industrial customers in the region. Proceeding to the Development phase for the customer-driven projects requires request by, and agreement with, the customer(s). Currently, only Project No. 1 has proceeded to the Development phase. The only supply point in the region which is presently at its load-meeting capability limit is Pickle Lake and Project No. 1 will address the need at this location.

Additionally, the IESO Draft Remote Community Connection Plan report [6] has recommended the connection of 21 First Nations communities in the northern part of the region to the electricity grid. An Order in Council from the government, dated July 20, 2016, has directed the OEB to amend Wataynikaneyap Power LP's transmitter licence to develop and seek approvals for the connection of sixteen remote communities and the Dryden-Pickle Lake transmission line, i.e. Project No. 1 identified above.

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least every five years. There is adequate time to review the proposed or recommended plans to meet the long-term needs and develop preferred alternatives in the next planning cycle. Should there be a need that emerges prior to the next planning cycle such as but not limited to change in load forecast, the regional planning cycle will be started earlier to address the need.

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1. INTRODUCTION

THIS REPORT PRESENTS THE REGIONAL INFRASTRUCTURE PLAN (“RIP”) TO ADDRESS THE ELECTRICITY NEEDS OF THE NORTHWEST ONTARIO REGION.

The report was prepared by Hydro One Networks Inc. - Transmission (“Hydro One”) with input and on behalf of the Working Group that consists of Hydro One, Hydro One Networks Inc. - Distribution, the Independent Electricity System Operator (“IESO”), Atikokan Hydro Inc., Kenora Hydro Electric Corporation Ltd., Thunder Bay Hydro Electricity Distribution Inc., Sioux Lookout Hydro Inc. and Fort Frances Power Corporation in accordance with the Regional Planning process established by the Ontario Energy Board in 2013.

Northwest Ontario region is divided into 4 sub-regions: City of Thunder Bay, West of Thunder Bay, North of Dryden, and Greenstone-Marathon. The IESO has also assessed the economic case for connecting the Remote Communities north of Red Lake and Pickle Lake to the provincial grid. Electrical supply to the Region is provided by fifty two 230kV and 115kV transmission and distribution stations. Some of the stations are shown in Figure 1-1.

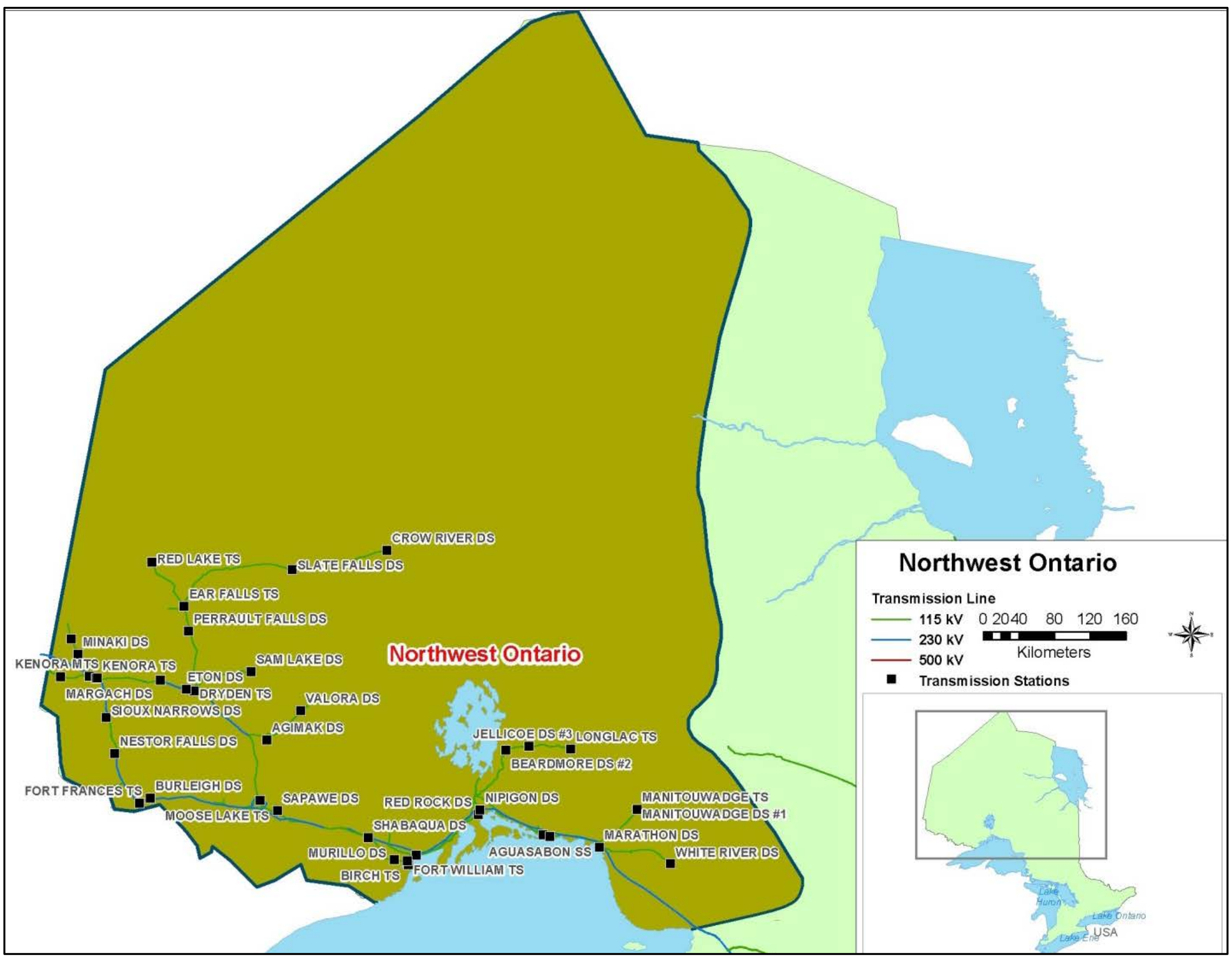


Figure 1-1 Map of Northwest Ontario Region

1.1 Scope and Objectives

This RIP report examines the needs in the Northwest Ontario Region. Its objectives are to:

- Review of needs (near and medium-term) identified through the IRRP process.
- Develop a wires plan to address all needs where wires solution is the most appropriate.
- Discuss long-term needs identified during the planning process

The RIP reviews factors such as the LDC load forecast, transmission and distribution system capability along with any updates with respect to local plans, conservation and demand management ("CDM"), 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 (2015-2025) identified in previous planning phases (Needs Assessment, Local Plan or Integrated Regional Resource Plan);
- Identification of any new needs over the 2015-2025 period;
- Develop an approach to address any longer term needs identified by the Working Group.

1.2 Structure

The rest of the report is organized as follows:

- Section 2 provides an overview of the regional planning process;
- Section 3 describes the region;
- Section 4 describes the transmission work completed over the last ten years;
- Section 5 describes the load forecast used in this assessment;
- Section 6 discusses the needs and provides the alternatives and preferred solutions;
- Section 7 provides the conclusion and next steps.

2. REGIONAL PLANNING PROCESS

2.1 Overview

Planning for the electricity system in Ontario is done at essentially three levels: bulk system planning, regional system planning, and distribution system planning. These levels differ in the facilities that are considered and the scope of impact on the electricity system. Planning at the bulk system level typically looks at issues that impact the system on a provincial level, while planning at the regional and distribution levels looks at issues on a more regional or localized level.

Regional planning looks at supply and reliability issues at a regional or local area level. Therefore, it largely considers the 115 kV and 230 kV portions of the power system that supply various parts of the province

2.2 Regional Planning Process

A structured regional planning process was established by the Ontario Energy Board in 2013 through amendments to the Transmission System Code ("TSC") and Distribution System Code ("DSC"). The process consists of four phases: the Needs Assessment [3] ("NA"), the Scoping Assessment ("SA"), the Integrated Regional Resource Plan ("IRRP"), and the Regional Infrastructure Plan ("RIP").

The regional planning process begins with the NA phase which is led by the transmitter. The NA phase identifies the needs and the Working Group determines whether further regional coordination is necessary to address one or more of the needs. If no further regional coordination is required and localized needs cannot be met by non-wires solutions, further planning is undertaken by the transmitter and the impacted local distribution company ("LDC") or customer and a Local Plan ("LP") is developed to address localized needs. Ultimately, local plans are also incorporated into the RIP report.

In situations where identified needs require coordination at the regional or sub-regional levels, the IESO initiates the 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 alternatives, and makes a decision on the most appropriate regional planning approach. The approach is either a RIP, which is led by the transmitter, or an IRRP, which is led by the IESO. If more than one sub-region was identified in the NA phase, it is possible that a different approach could be taken for different sub-regions and/or different needs.

The IRRP phase will generally assess integrated alternatives consisting of infrastructure (wires) and/or resource (CDM and Distributed Generation). Detailed information regarding wires options may not be available or necessary within the scope of the IRRP. The level of detail for wires options as part of the IRRP will be to a level which is sufficient to permit a comparison of options. If the IRRP phase identifies that infrastructure options may be most appropriate to meet a need, the RIP phase will conduct detailed planning to identify and refine the assessment of specific wires alternatives, and recommend a preferred

[3] Also referred to as Needs Screening.

wires solution. Similarly, resource options which the IRRP identifies as best suited to meet a need are then further planned in greater detail by the IESO. The IRRP phase also includes IESO led stakeholder engagement with municipalities and may establish Local Advisory Committees (LAC) in the region or sub-region. For the Northwest Ontario Region, community engagement through a number of LACs is on-going.

The RIP phase is the final stage of the regional planning process and involves: confirmation of previously identified needs; identification of any new needs that may have emerged since the start of the planning cycle; and development of a wires plan to address the needs where a wires solution would be the best overall approach. This phase is led and coordinated by the transmitter and the deliverable of this stage is a wires plan for the region. Once completed, this report can be referenced in rate filing submissions or as part of LDC rate applications with a planning status letter provided by the transmitter. Reflecting the timelines provisions of the RIP, plan level stakeholder engagement is not undertaken at this stage. However, stakeholder engagement at a project specific level will be conducted as part of the project approval requirement.

To efficiently manage the regional planning process, Hydro One has been undertaking wires planning activities in collaboration with the IESO and LDCs for the region as part of and/or in parallel with:

- Planning activities that were already underway in the region prior to the new regional planning process taking effect;
- The NA, SA, and LP phases of regional planning;
- Participating in and conducting wires planning as part of the IRRP for the region or sub-region.

Figure 2-1 illustrates the various phases of the regional planning process (NA, SA, IRRP, and RIP) and their respective phase trigger, lead, and outcome.

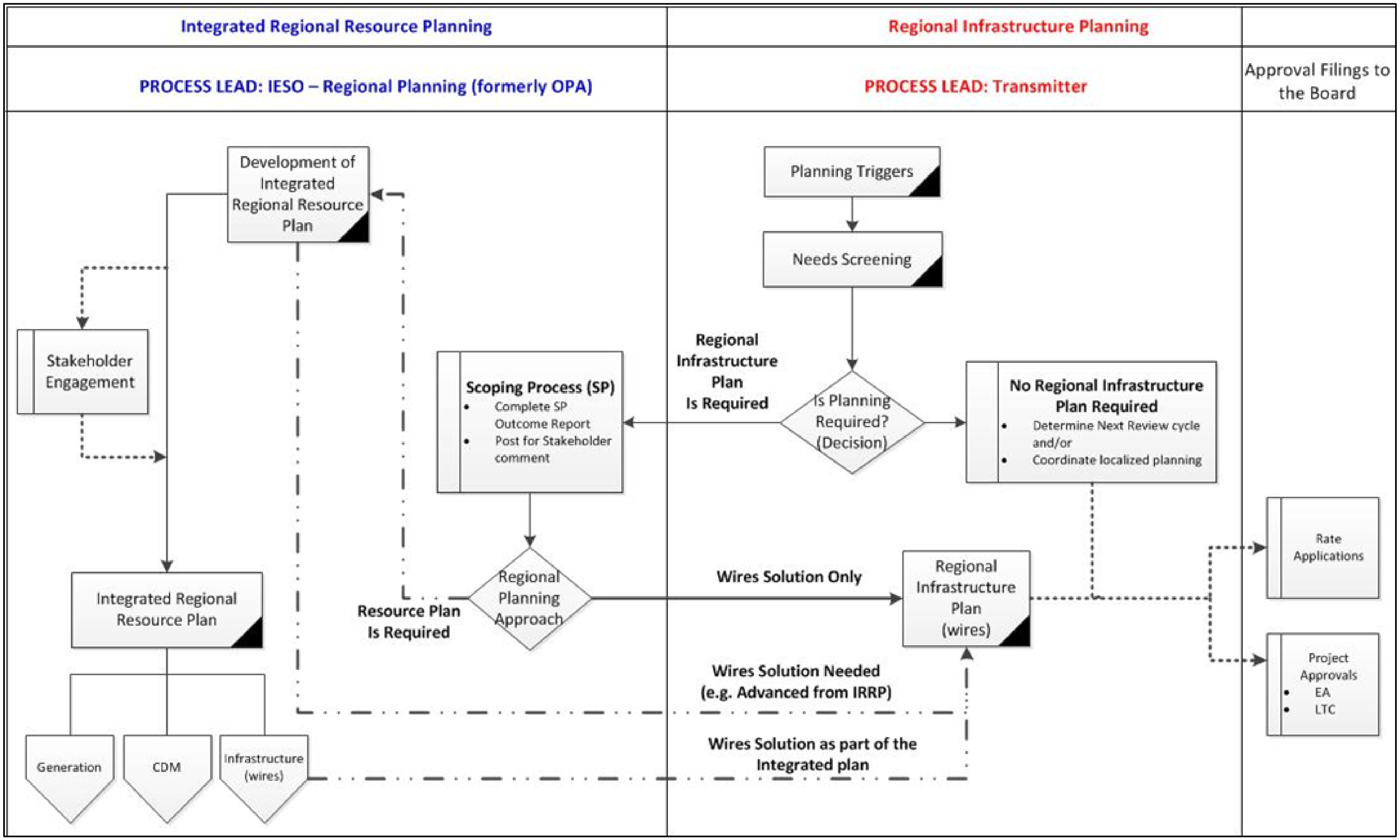


Figure 2-1 Regional Planning Process Flowchart

2.3 RIP Methodology

The RIP phase consists of four steps (see Figure 2-2) as follows:

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 Working Group 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.
   - Existing area network and capabilities including any bulk system power flow assumptions.
   - Other data and assumptions as applicable such as asset conditions; load transfer capabilities, and previously committed transmission and distribution system plans.
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 mid-term needs may be identified at this stage.
3) Alternative Development: The third step is the development of wires options to address the needs and to come up with a preferred alternative based on an assessment of technical considerations, feasibility, environmental impact and costs.
4) Implementation Plan: The fourth and last step is the development of the implementation plan for the preferred alternative.

The extent and scope of each step naturally depends on the outcome of the previous step. The outcome of the previous stage of the regional planning process, i.e., IRRP, also influences the scope of Step 2 to a large extent.

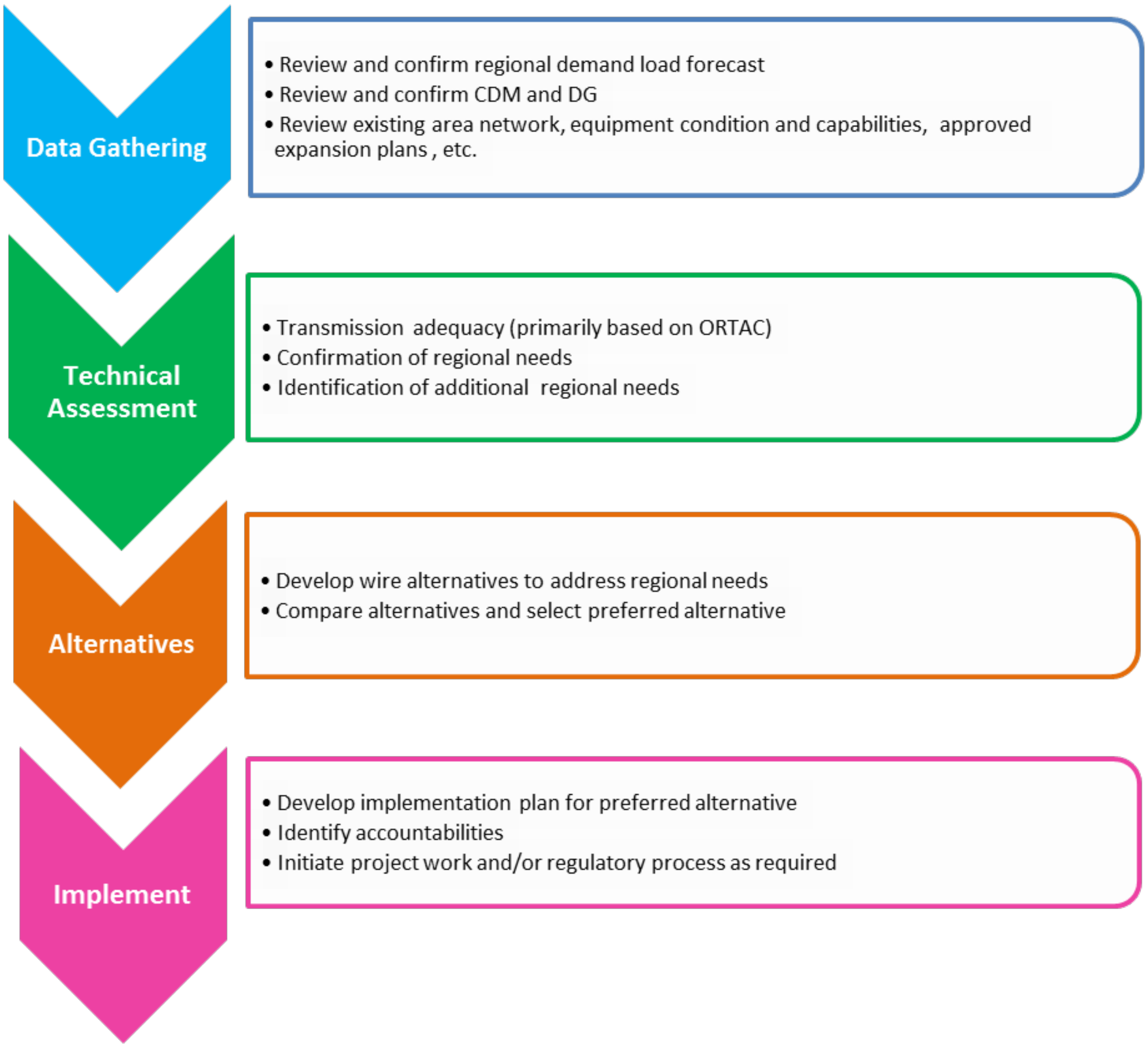


Figure 2-2 RIP Methodology

3. REGIONAL CHARACTERISTICS

NORTHWEST ONTARIO REGION IS ROUGHLY BORDERED BY WEST OF HUDSON BAY AND JAMES BAY, NORTH AND WEST OF THE LAKE SUPERIOR, AND EAST OF THE CANADIAN PROVINCE OF MANITOBA. THE REGION CONSISTS OF THE DISTRICTS OF THUNDER BAY, KENORA AND RAINY RIVER. ALMOST 54 PERCENT OF REGION'S ENTIRE POPULATION LIVES IN THUNDER BAY. THE REGION ACCOUNTS FOR APPROXIMATELY 60 PERCENT OF LAND AREA OF THE PROVINCE AND ABOUT TWO PERCENT OF ONTARIO'S TOTAL POPULATION.

Bulk electrical supply to the Northwest Ontario Region is provided through a combination of local generation stations connected to the 230 kV and 115 kV network, and the East-West Tie transmission corridor.

The Local Distribution Companies ("LDCs") that serve the electricity demands for the Northwest Ontario are Hydro One Networks Inc. (Distribution), Atikokan Hydro Inc., Kenora Hydro Electric Corporation Ltd., Sioux Lookout Hydro Inc., Thunder Bay Hydro Electricity Distribution Inc., and Fort Frances Power Corporation. The LDCs receive power at the step down transformer stations and distribute it to the end users – industrial, commercial and residential customers.

The January 2015 Integrated Regional Integrated Regional Resource Plan ("IRRP") report for North of Dryden Sub-Region, the June 2016 IRRP report for Greenstone-Marathon Sub-Region, the July 2016 IRRP report for West of Thunder Bay Sub-Region, and the December 2016 IRRP report for Thunder Bay Sub-Region focused on northern, eastern, western, and central parts, respectively, of the Region. All IRRP reports were prepared by the IESO in conjunction with Hydro One and the LDC. A map and a single line diagram showing the electrical facilities of the Northwest Ontario Region, consisting of the sub-regions, is shown in Figure 3-1 and Figure 3-2, respectively.

3.1 North of Dryden Sub-Region

A radial single-circuit 115 kV transmission line ("E4D") supplies electricity to the customers in the North of Dryden sub-region from Dryden TS. The major supplying station for this sub-region is Dryden TS, where the voltage is stepped down from the 230 kV to 115 kV, to serve local and industrial customers. Electricity demand in the North of Dryden sub-region is also supplied by local hydroelectric generation.

3.2 Greenstone-Marathon Sub-Region

Electrical supply to the customers in the Greenstone-Marathon Sub-Region comprises of Marathon TS and Alexander Switching Station ("SS"). Located in the town of Marathon, Marathon TS connects the Northwest electrical system to the East Lake Superior electrical system at Wawa TS, with two 230 kV lines - W21M and W22M. Marathon TS steps down 230 kV to 115 kV and supplies customers in the

Town of Marathon, White River and Manitouwadge through a 115 kV single circuit - M2W. Three circuits A5A, A1B, and T1M - in series connect Marathon TS to Alexander SS.

Alexander SS connects Alexander Generating Station ("GS"), Cameron Falls GS, and Pine Portage GS - to the system. A 115 kV single-circuit A4L, connected to the Alexander SS, supplies electricity to the Municipality of Greenstone and its surrounding areas. Nipigon GS is also connected to the circuit A4L.

3.3 West of Thunder Bay Sub-Region

Supply to this Sub-Region is provided from a 230 kV transmission system consisting of the Kenora TS, Fort Frances TS, Dryden TS, and Mackenzie TS. Kenora TS steps down 230 kV to 115 kV and supplies customers in the City of Kenora and surrounding areas. In addition, it also connects Ontario to Manitoba's electrical system through two 230 kV transmission lines – K21W and K22W. Fort Frances TS steps down 230 kV to 115 kV and supplies customers in the City of Fort Frances and surrounding areas. It also connects Ontario to Minnesota's electrical system through a 115 kV transmission line – F3M. Dryden TS steps down 230 kV to 115 kV and supplies customers in the City of Dryden and surrounding areas. It also connects West of Thunder Bay to North of Dryden Sub-Region. Mackenzie TS steps down 230 kV to 115 kV and supplies customers in Atikokan and surrounding areas. It also connects West of Thunder Bay to the Thunder Bay Sub-Region. The West of Thunder Bay Sub-Region is also supplied by many local hydroelectric generation facilities

3.4 Thunder Bay Sub-Region

Thunder Bay Sub-Region consists of the Lakehead TS as the 230 kV step-down transformation facility which steps down 230 kV to 115 kV and supplies customers in the City of Thunder Bay and surrounding areas. The area is served primarily at 115 kV by three step-down transformer stations - Birch TS, Fort William TS, and Port Arthur TS #1.

Please see Figure 3-1 and 3-2 for a map and single line diagram of the Sub-Region facilities.

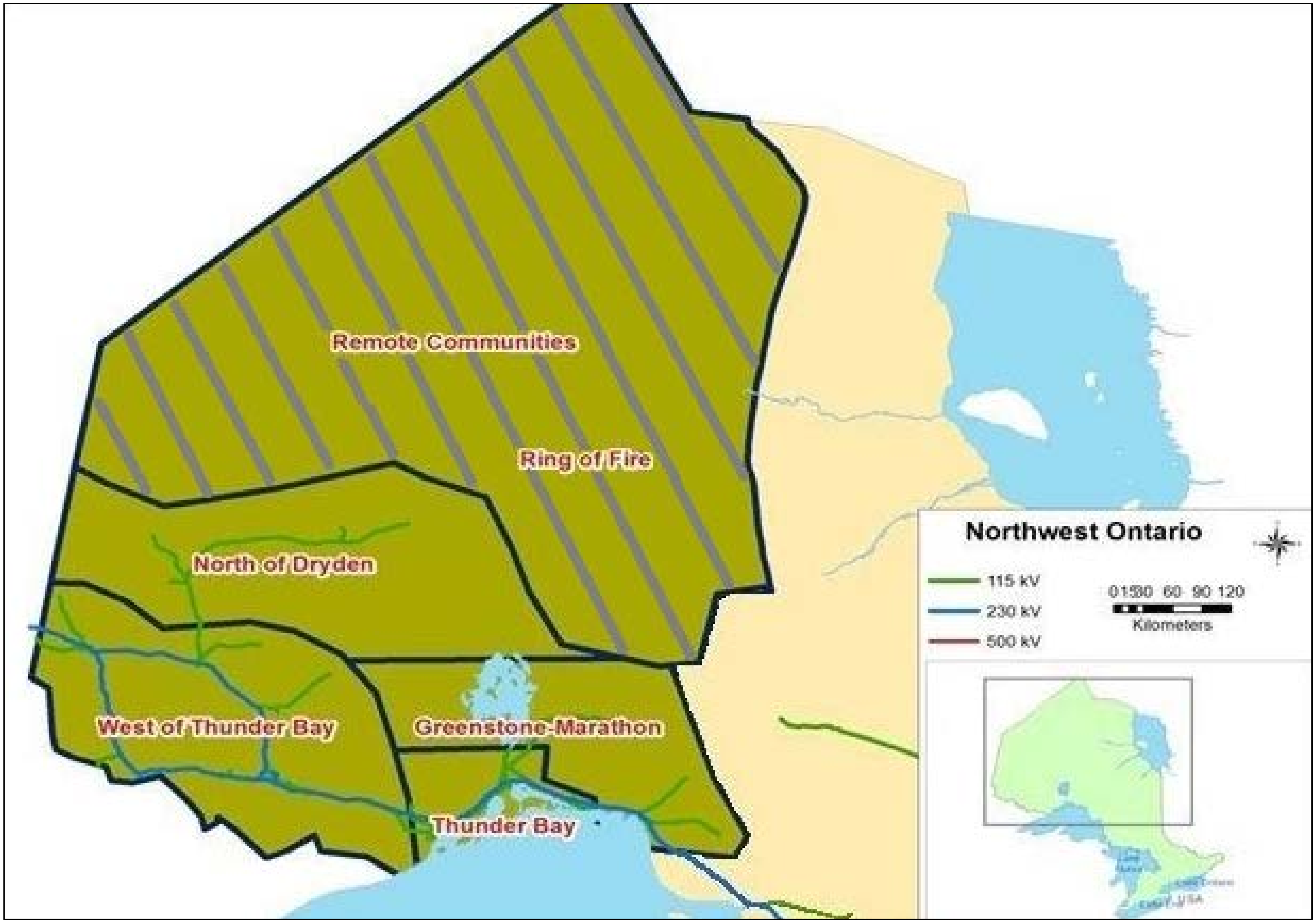


Figure 3-1 Northwest Ontario Region – Supply Areas

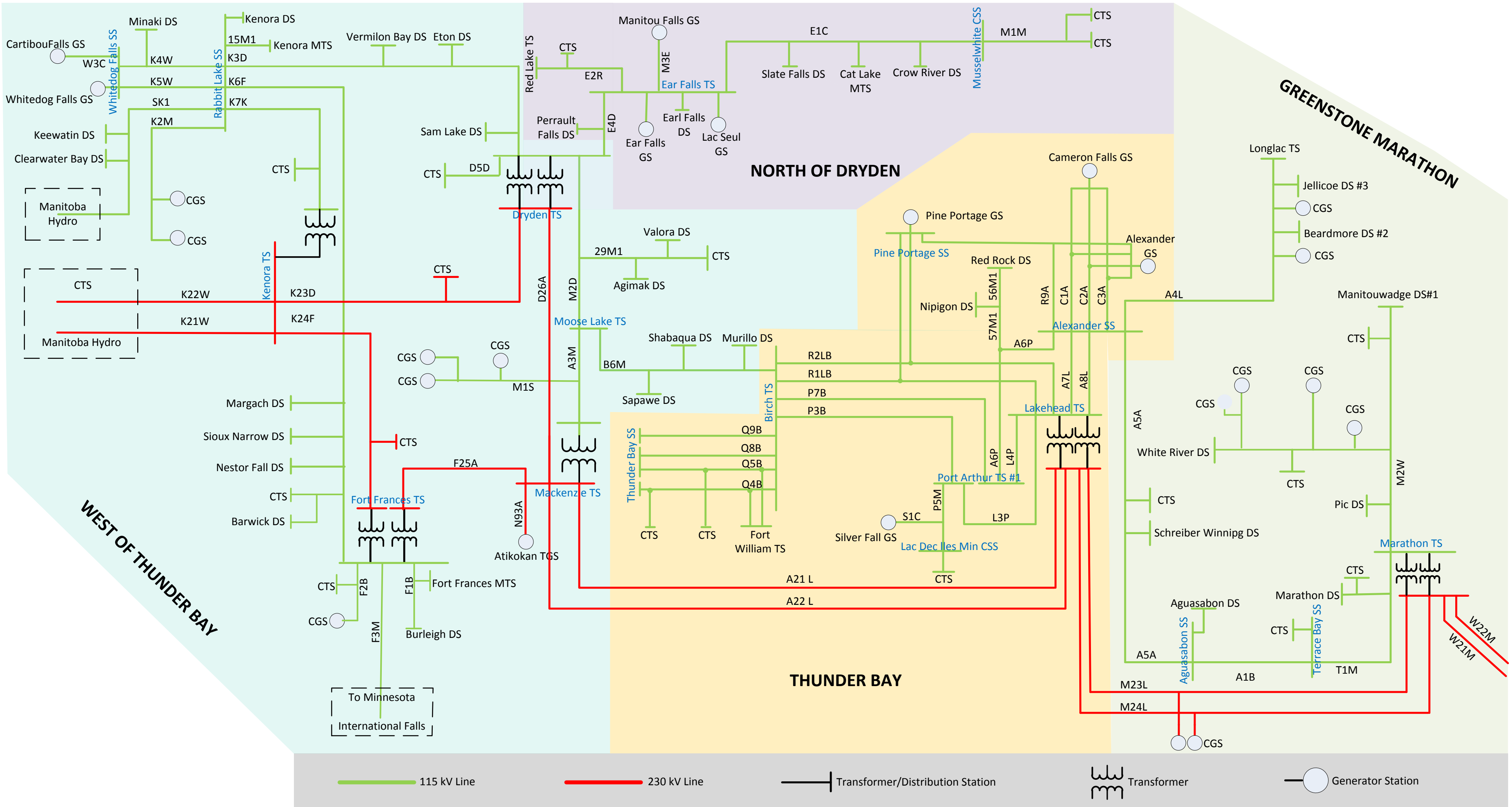


Figure 3-2 Northwest Ontario Region – Single Line Diagram

4. TRANSMISSION FACILITIES COMPLETED OVER THE LAST TEN YEARS AND PLANNED FOR NEAR FUTURE

OVER THE LAST 10 YEARS A NUMBER OF TRANSMISSION PROJECTS HAVE BEEN COMPLETED BY HYDRO ONE, ARE UNDERWAY, OR ARE PLANNED FOR THE COMING YEARS, AIMED AT IMPROVING THE SUPPLY TO THE NORTHWEST ONTARIO REGION IN GENERAL.

This section describes the completed development and sustainment projects in the region, as well as the sustainment projects that are in the execution stage or planned for the coming years.

4.1 Past Major Projects

In the past 10 years, the following are some of the major projects completed in the Northwest Ontario Region.

1. **Barwick TS** –Barwick TS was built in the second and third quarter of 2013 to replace load-serving facilities at Fort Frances TS as majority of these assets were reaching the end of their useful life. The new facilities include: two 42 MVA 115/44 kV transformers and the associated breakers, switches, surge arresters, etc. and two cap banks, each rated 4.9 MVAR at 44 kV, and the associated breakers and switches.

2. **Birch TS –** One of three 42 MVA step down transformers (115/25 kV) at Birch TS was replaced in December 2015.

3. **Dryden TS** – In addition to replacing 5 HV breakers, 2 LV breakers and 12 switches between 2014-2016, 2x40 MVAR Shunt reactors at Dryden TS were installed in Q3 2014.

4. **Fort Frances** – In addition to replacing 2 LV breakers and 8 switches (2010-2016), 21.6 MVAR/13.8 kV capacitor bank was installed at Fort Frances in November 2010.

5. **Kenora TS** – 1 LV breaker and 4 switches were replaced between 2009 and 2015.

6. **Lakehead TS** – 3 HV breakers, 1 LV breaker, 5 switches, and 1 autotransformer (230/13.9 kV) were replaced between 2009 and 2016 as part of the sustainment work. In addition, one synchronous condenser at Lakehead TS was replaced by a +60/-40 MVAR SVC in December 2009.

7. **Longlac TS** –Transformers T2 and T3 were replaced with two 42 MVA 115/44 kV transformers and associated equipment protections i.e. breakers, switches, surge arresters, etc. In addition, four capacitor banks; each rated at 4.9 MVAR at 44 kV with associated breaker and switches were installed. This work was completed mid-2011.

8. **Manitouwadge TS** – 1 LV breaker, 1 switch, and 1 step down transformer (115/44 kV) were replaced in July 2016.

9. **Marathon TS** – In addition to replacing 1 HV breaker, 2 LV breakers, and 4 switches between 2009 and 2016, 2x40 MVAR shunt reactors were installed in December 2013 and March 2014.

10. **Moose Lake TS** – 5 HV breakers were replaced in 2014.

11. **Port Arthur TS #1** – 10 switches were replaced between 2009 and 2015. In addition, 2x0.5 ohms LV current limiting reactors were replaced with 2x1 ohm reactor. Work was completed in December 2014.

12. **Rabbit Lake SS** – 2 HV breakers and 4 switches were replaced between 2011 and 2016.

13. **Red Lake TS** –Five capacitor banks were upgraded by 2.5 MVAR each to 7.4 MVAR (at 44 kV). This work also included upgrading associated breakers and switches and was completed between December 2015 and July 2016.

4.2 Current or Planned Major Sustainment Projects

The following major sustainment projects are currently under execution or planned for the coming years. These projects are based on the assessment of end of life issues of the aging station's equipment and replacing those that represent risk to the security of the bulk transmission system and reliability for connected customers.

1. **Dryden TS**– is located in the city of Dryden and supplies majority of the customers in the area. It consists of three 115/44 kV power transformers rated at 15MVA each, which are non-standard units and are about 69 years old.

   Hydro One has planned to replace the three EOL transformers with two new standard-size transformers, rated at 42MVA each. The scope of work also includes the replacement of other deteriorating infrastructure, such as LV switchyard (which will be built to current standard), 115 kV OCBs, and select switches.

   This project is currently planned to be completed in 2018.

2. **Ear Falls TS** – supplies customers in the city of Ear Falls in the North of Dryden Sub-Region, through a single transformer T5 (115/44 kV, 19 MVA), backed-up by a spare transformer T5SP (115/44 kV, 8 MVA). The 44 kV LV voltage is further stepped-down to 12.5 kV through Ear Falls DS transformer T1 (44/12.5 kV). Ear Falls TS transformers T5 and T5SP are approximately 47 and 69 years old, respectively, while Ear Falls DS T1 is currently 49 years old.

   Hydro One has planned to eliminate the need for 44 kV to 12.5 kV conversion at Ear Falls DS by replacing T5 and T5SP transformers with 115/13.2 kV transformer units (rated at 12.5 MVA each). The scope of work also involves replacing 44kV equipment with 13.2 kV, replacing 115 kV circuit breakers, and replacing EOL protections, controls, and telecom in new relay building to ensure the integrity of power system protection is maintained.

   This project is currently planned to be completed in 2018.

3. **Alexander SS** – is a 115 kV switching station located in the Thunder Bay Sub-Region and was originally built in 1955. The station terminates five 115 kV circuits for the supply of customers in the area and connects 161 MW of generation from the Nipigon River and Cameron Falls. It consists of ten 115 kV breakers, nine of which are non-standard.

Hydro One has planned to replace all non-standard and EOL equipment at the station. The scope of work involves replacing 115 kV oil circuit breakers with new SF6 breakers, replacing select switches, upgrade of all protection & control facilities and AC station service system.

This project is currently planned to be completed in 2019.

4. **Birch TS** – is a 115 kV transmission station located in City of Thunder Bay in the Thunder Bay Sub-Region and was put in-service in 1955. Birch TS is comprised of a DESN station which supplies local load in the port area of Thunder Bay, as well as being a 115 kV bulk station with 9 lines and the three DESN transformers connected to it.

   Due to the criticality of the station to both transmission and distribution systems, protection and control equipment that is presently located in the basement will be relocated to a new relay building. The scope of work involves replacing 115 kV circuit breakers and 25 kV capacitor banks, and replacing/relocating end of life protections in the new relay building.

   This project is currently planned to be completed in 2019.

5. **Pine Portage SS** – is a 115 kV switching station located in the Greenstone-Marathon Sub-Region and was put in-service in 1954. The switching station has three outgoing 115 kV transmission lines connecting to Lakehead TS, Birch TS and Alexander SS. Pine Portage GS is also connected to this switching station.

   Hydro One has planned to replace all end of life equipment at the station. The scope of work involves replacing five 115 kV oil circuit breakers with new 2000A SF6 breakers, associated disconnect switches, protection, control and teleprotection facilities.

   This project is currently planned to be completed in 2020-2023.

6. **Aguasabon SS** – is a 115 kV switching station in Greenstone-Marathon Sub-Region and was put in-service in 1948. The station has two transmission lines connecting to Alexander SS and Terrace Bay SS. The station is also critical to the connection of Aguasabon DS.

   Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing/upgrading AC/DC station service, and replacing equipment protections.

   This project is currently planned to be completed in 2021-2024.

7. **Port Arthur TS #1** – Port Arthur TS #1 is a 115/25 kV station located in the Thunder Bay Sub-Region and was put in-service in 1950.

   Hydro One has planned to replace all end of life equipment at the station. The scope of work involves replacing AC/DC station service systems, 25kV switchyard and associated protection equipment in the new building, and 115 kV associated protection equipment in the existing building

   This project is currently planned to be completed in 2021-2024.

8. **Rabbit Lake SS** – is a 115 kV switching station located in the West of Thunder Bay Sub-Region. The switching station has seven 115 kV transmission lines connecting to three customer generating stations (CGSs) as well as Whitedog Falls SS, Kenora TS, Fort Frances TS, Dryden TS, and the interconnection with Manitoba Hydro. There are six 115 kV oil circuit breakers and two 115 kV SF6 circuit breakers in the yard.

Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing EOL 115 kV circuit breakers, select switches, and equipment protections.

This project is currently planned to be completed in 2021-2024.

9. **Terrace Bay SS** – is located in the Greenstone-Marathon Sub-Region and was put in-service in 1973. The switching station has two 115 kV transmission lines connecting to Marathon TS and Aguasabon SS. The station is also critical to the connection of a Customer Transformer Station (CTS).

   Hydro One has planned to replace all end of life equipment at the station. The scope of work involves replacing protections, controls, telecom, select switches, and AC/DC station service system.

   This project work is currently planned to be completed in 2021-2024

10. **Whitedog Falls SS** – is a 115 kV switching station located in the West of Thunder Bay Sub-Region. The switching station has three 115 kV transmission lines, connecting to Rabbit Lake SS, Caribou Falls GS, and Whitedog Falls GS.

    Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing 115 kV circuit breakers and select switches. In addition, scope of work includes replacing/upgrading of DC station supply system.

    This project is currently planned to be completed in 2021-2024.

11. **Moose Lake TS** – is a 115/44 kV transformer station built in 1948. It is located on Moose Lake near Atikokan in the West of Thunder Bay Sub-Region. Moose Lake TS consists of two non-standard step-down transformers T2 and T3 rated at 8MVA and 15MVA, respectively. In addition, the two transformers are 69 years old.

    Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing the two non-standard power transformers (T2, T3) with standard 110-44 kV, 25/41.7 MVA units, two low voltage oil circuit breakers with new SF6 breakers, and replacing and upgrading the protection, control and AC/DC station service facilities

    This project is currently planned to be completed in 2022-2025

12. **Kenora TS** – is a 230/115 kV station located in the West of Thunder Bay Sub-Region and critical to supply of the city of Kenora and the interconnection with the province of Manitoba.

    Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing/upgrading AC/DC station service systems and replacing protection equipment.

    This project is currently planned to be completed in 2024-2027.

13. **Mackenzie TS** – is a 230/115 kV station is located in the West of Thunder Bay Sub-Region. Mackenzie TS has six 230 kV breakers which are about 46 years old.

Hydro One has planned to replace all EOL equipment at the station. The scope of work involves replacing 230 kV circuit breakers, select protections, and AC/DC station service system.

This project is currently planned to be completed in 2024-2027.

14. **Fort Frances TS** – is located in the Town of Fort Frances and was put in-service in 1947.

    Hydro One has planned to replace the EOL equipment at the station. The scope of work involves replacing high voltage circuit breakers, replacing/upgrading AC/DC station service system and protection equipment.

    This project is currently planned to be completed in 2025-2028.

15. **Lakehead TS** – is a 230/115 kV transformer station located in the Thunder Bay Sub-Region and was put in-service in 1955. The station is critical to the transmission system of the Northwest and a major hub for East-West power transfer.

    Hydro One has planned to replace all EOL equipment at the station to ensure reliability of the transmission system and supply to the customers. The scope of work involves replacing high voltage circuit breakers with new SF6 breakers, replacing four LV circuit breakers with new SF6 breakers, replacing protection equipment associated with 115 kV facilities and the synchronous condenser, replacing select switches, and replacing/upgrading AC station service system.

    This project is currently planned to be completed in 2025-2028.

16. **Marathon TS** – is a 230/115 kV transformer station, located in the City of Marathon in the Greenstone-Marathon Sub-Region. It was put in-serviced in 1970. The station is critical to the transmission system of the Northwest and a major hub for East-West power transfer. All four 115 kV oil circuit breakers at the station are about 40 years old. Whereas, three 230 kV circuit breaker at the station are about 48 years old.

    Hydro One has planned to replace all EOL equipment at the station to ensure reliability of the transmission system and supply to customers. The scope of work involves replacing three EOL 230 kV circuit breakers with new SF6 breakers, and four EOL 115 kV circuit breakers with new SF6 breakers. In addition, the scope of work also includes replacing disconnect switches, protection equipment, and AC station service system.

    This project is currently planned to be completed in 2025-2028.

5. FORECAST AND OTHER STUDY ASSUMPTIONS

5.1 Load Forecast Scenarios

For the purpose of this RIP, the LDCs reviewed their load forecasts and confirmed that they have not changed significantly from the load forecasts reported in the Northwest IRRPs. Based on the load forecasts from the LDCs and the industrial (mining) load forecasts of the Northwest IRRPs, three scenarios of future demand has been considered for each Northwest sub-region in this RIP. Table 5-1, Table 5-2, Table 5-3, and Table 5-4 show the forecasted load for the Low, Medium and High growth scenarios.

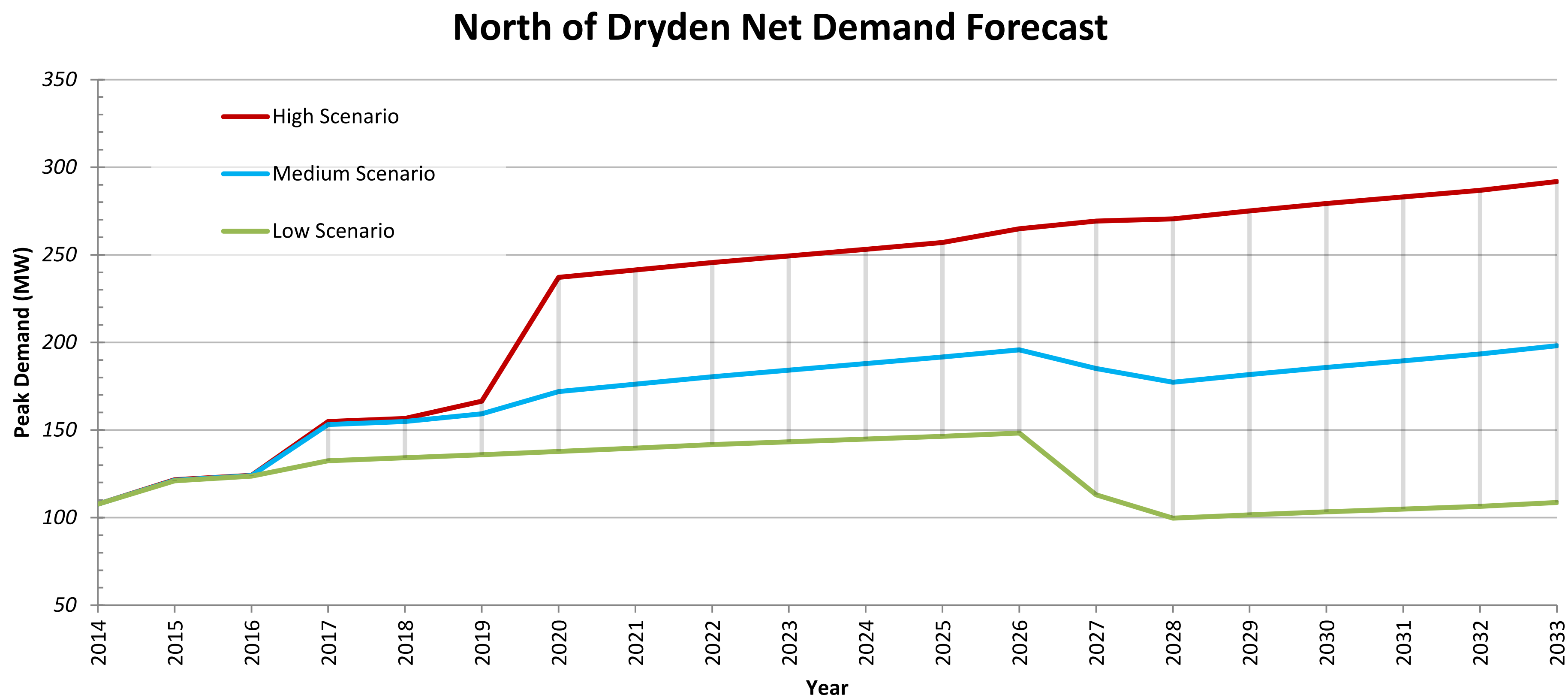
5.2 Other Study Assumptions

The other assumptions made in this RIP report include,

- The study period is 2016-2025.
- All planned facilities for which work has been initiated and are listed in Section 4 are assumed to be available by the specified in-service dates.
- Since in the Northwest region winter peak is more critical than the summer peak, the study is based on winter peak conditions.

Table 5-1 North of Dryden Load Forecast Scenarios

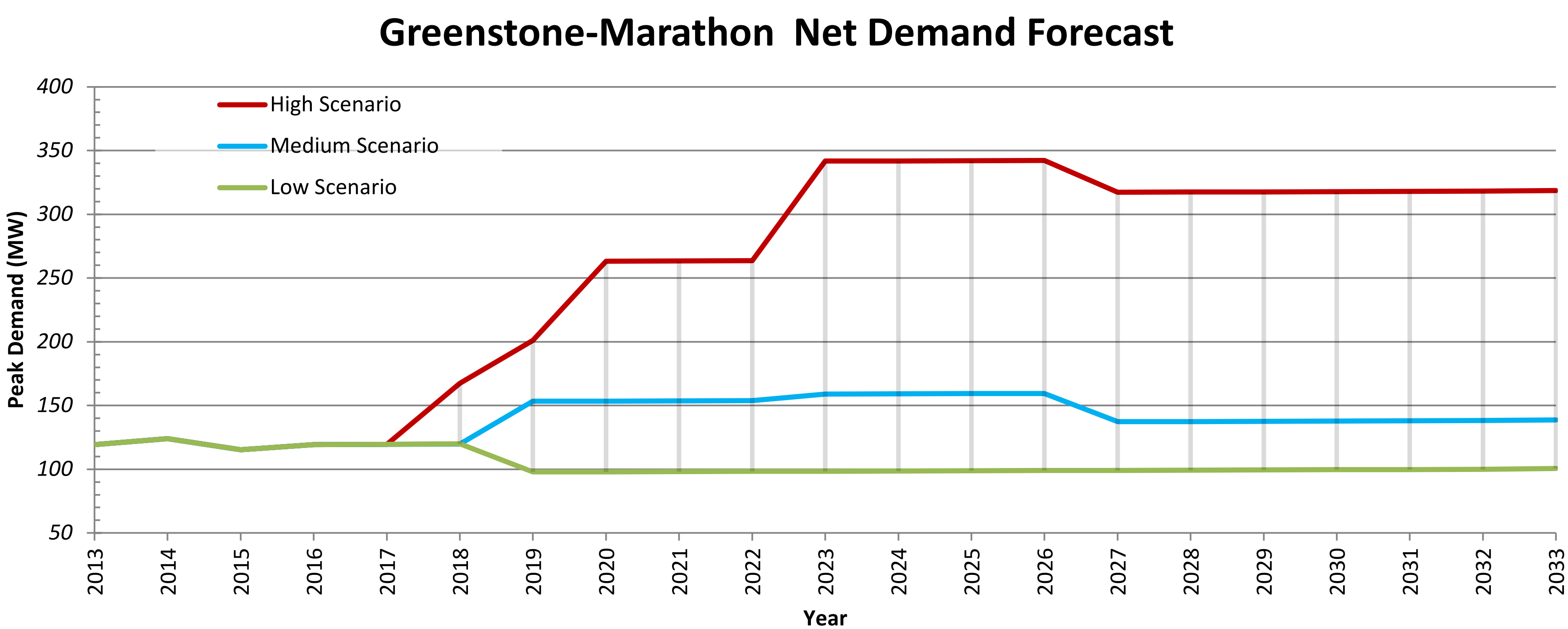
Net Demand Forecast (MW)																				
Scenario	2014 Historic	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Low	107.6	121.1	123.7	132.4	134.1	135.9	137.8	139.7	141.7	143.3	144.8	146.5	148.2	113.0	99.7	101.6	103.3	104.9	106.5	108.7
Medium[5]		121.4	124.0	153.1	154.8	159.3	171.9	176.1	180.3	184.1	187.9	191.7	195.7	185.2	177.3	181.6	185.7	189.5	193.3	198.0
High		121.6	124.2	154.9	156.6	166.5	237.1	241.3	245.5	249.3	253.1	256.9	264.9	269.3	270.6	275.0	279.2	283.1	286.8	291.7



[4] In the North of Dryden IRRP, load forecast starts from year 2015. For consistency, instead of the actual load in 2015 and 2016, the above table shows the IRRP load forecast for these years.
[5] The Medium scenario in the above table corresponds to the Reference scenario in the North of Dryden IRRP

Table 5-2 Greenstone-Marathon Load Forecast Scenarios[7]

Net Demand Forecast (MW)																					
Scenario	2013 Historical	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Low		124.0	115.2	119.3	119.5	120.0	97.9	97.9	98.2	98.3	98.5	98.6	98.8	99.0	99.1	99.3	99.4	99.6	99.8	100.0	100.6
Medium	119.2	124.0	115.2	119.3	119.5	119.9	153.4	153.4	153.7	153.8	159.0	159.1	159.3	159.5	137.3	137.4	137.6	137.8	137.9	138.1	138.7
High		124.0	115.2	119.3	119.5	167.4	201.0	263.3	263.5	263.6	341.8	341.9	342.1	342.2	317.4	317.5	317.6	317.8	317.9	318.1	318.6

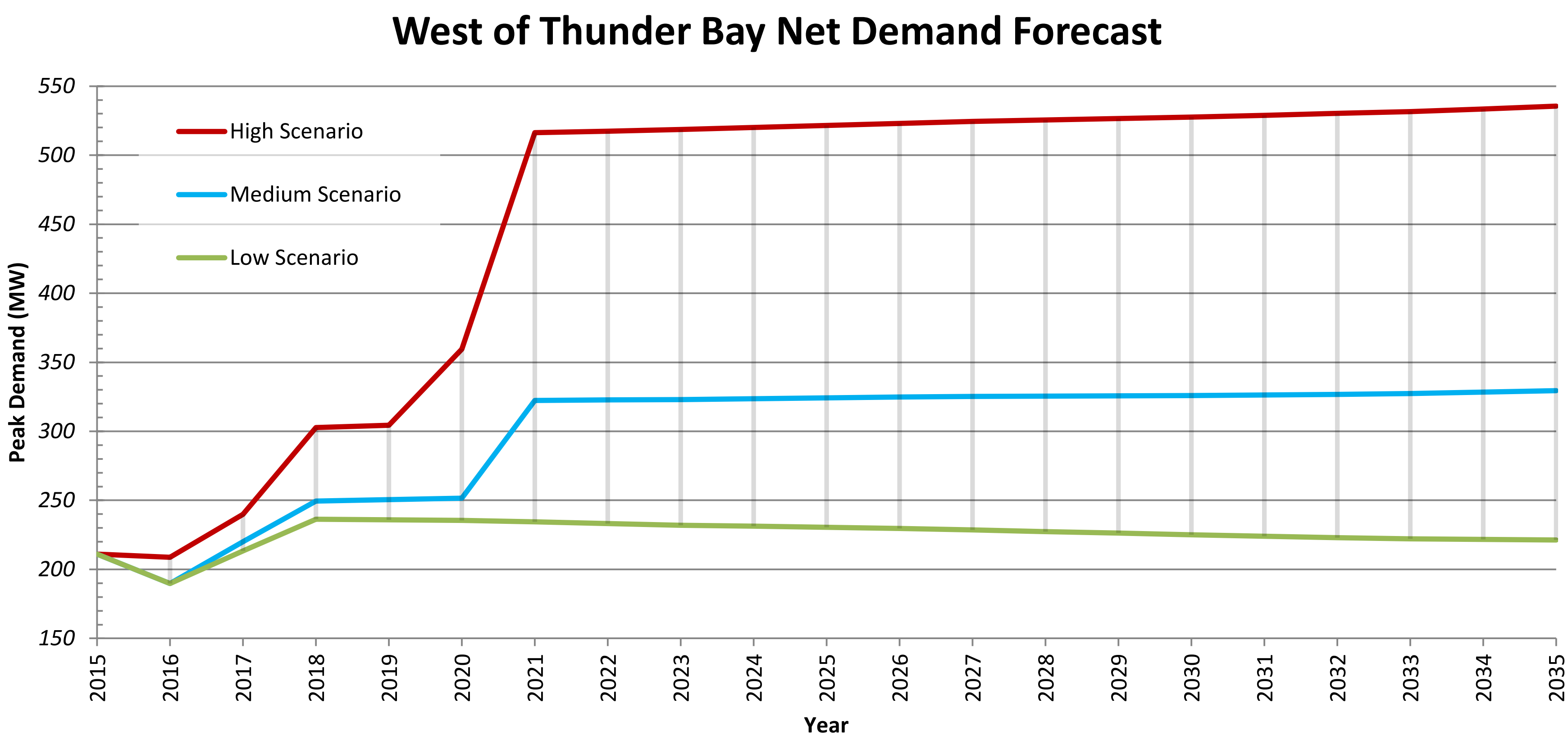


[6] In the Greenstone-Marathon IRRP, load forecast starts from year 2014. For consistency, instead of the actual load in 2014 to 2017, the above table is based on the IRRP load forecast for these years.

[7] . The Low growth scenario for Greenstone-Marathon sub-region corresponds to scenario "A" of the three sub-systems in the IRRP, the Medium growth scenario corresponds to scenario "B" of Greenstone and Marathon and scenario A of Northshore sub-systems in the IRRP, and the High growth scenario corresponds to scenario "D" of Greenstone, scenario "C" of Marathon and scenario "A" of Northshore sub-systems in the IRRP (see section 5 for details of Load Forecast Scenarios).

Table 5-3 West of Thunder Bay Load Forecasts Scenarios

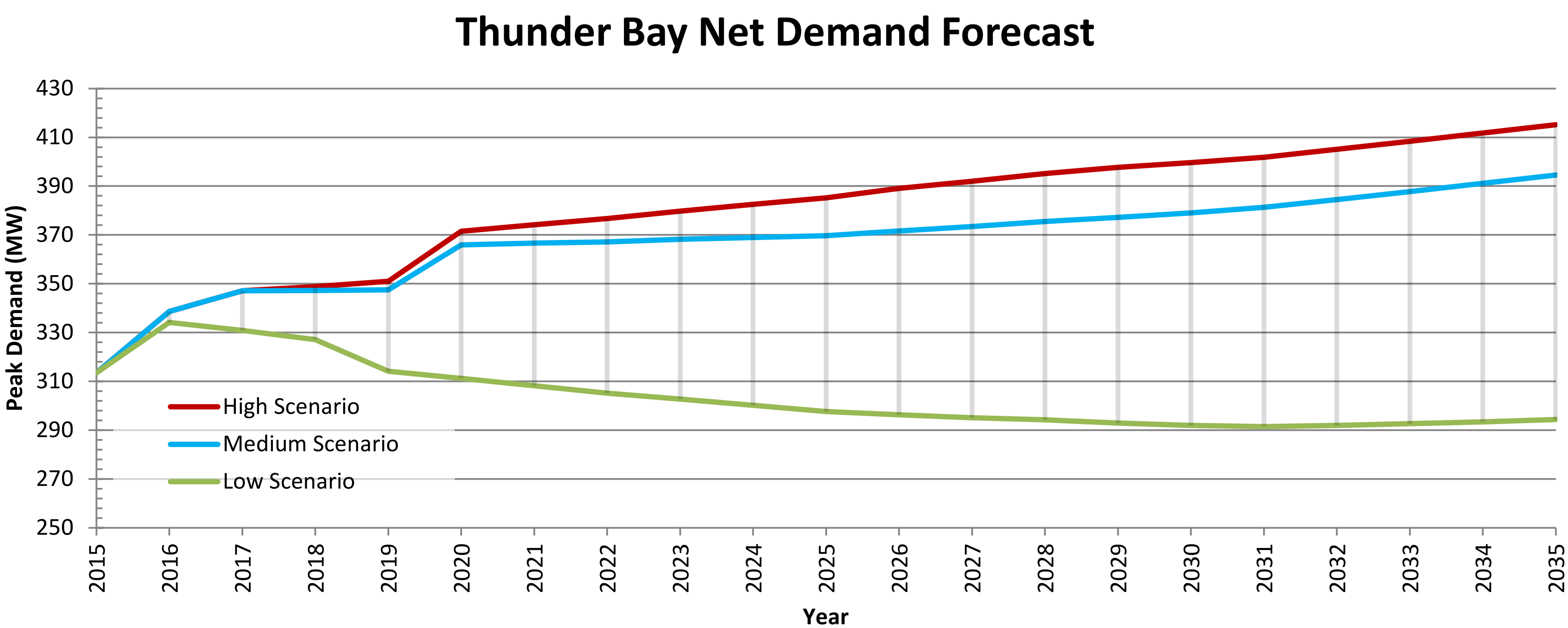
Net Demand Forecast (MW)																					
Scenario	2015 Historical	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Low	211.1	189.7	213.4	236.3	235.9	235.5	234.4	233.2	232.0	231.2	230.4	229.5	228.6	227.4	226.2	225.0	223.9	223.0	222.1	221.7	221.3
Medium		189.8	220.1	249.6	250.5	251.6	322.4	322.7	322.9	323.6	324.2	324.8	325.3	325.4	325.7	325.9	326.3	326.8	327.3	328.3	329.4
High		208.8	239.9	302.6	304.5	359.6	516.3	517.4	518.5	520.0	521.5	523.0	524.4	525.4	526.6	527.6	528.9	530.2	531.6	533.5	535.4



[8] In the West of Thunder Bay IRRP, load forecast starts from year 2016. For consistency, instead of the actual load in 2016, the above table shows the IRRP load forecast for this year.

Table 5-4 Thunder Bay Load Forecast Scenarios

Net Demand Forecast (MW)																					
Scenario	2015 Historical	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Low		334.1	330.9	327.1	314.2	311.2	308.2	305.1	302.7	300.2	297.6	296.4	295.1	294.2	292.9	292.0	291.5	292.0	292.6	293.4	294.3
Medium	313.6	338.7	347.1	347.3	347.5	365.9	366.7	367.1	368.2	369.0	369.7	371.6	373.4	375.5	377.1	379.0	381.3	384.5	387.8	391.2	394.6
High		338.7	347.1	348.8	351.0	371.5	374.2	376.7	379.7	382.5	385.2	389.1	391.9	395.1	397.7	399.6	401.9	405.1	408.4	411.7	415.1



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[9] In the Thunder Bay IRRP, load forecast starts from year 2016. For consistency, instead of the actual load in 2016, the above table shows the IRRP load forecast for this year.

6. SUMMARY OF REGIONAL NEEDS AND PLANS

THIS SECTION DISCUSSES THE WIRE NEEDS FOR THE NORTHWEST ONTARIO REGION AND SUMMARIZES THE RECOMMENDED WIRES PLANS FOR ADDRESSING THE NEEDS.

This section provides a summary of the needs and plans for the four Northwest sub-regions. The load forecasts from the LDCs have not materially changed since the completion of the previous phase (IRRP) of Regional Planning for the Northwest. Therefore, the assumptions and load growth scenario for industrial loads, as well as the needs and plans identified in this RIP are consistent with the Northwest IRRPs. The needs and recommended plans in the region are largely driven by the industrial load growth, particularly the mining sector. Proceeding to the Development phase of the customer-driven projects requires formal request by the customers and commercial agreements between Hydro One and the customers.

6.1 North of Dryden Sub-Region

Most of the demand in the North of Dryden sub-region is from the mining sector. The demand growth is driven by the expansion of this sector, as well as the connection of up to 21 remote communities in the northern parts of the region to Red Lake and Pickle Lake and growth in the mining sector, including potential developments in the Ring of Fire which may be supplied from Pickle Lake.

The North of Dryden IRRP [2] for this sub-region has assumed Low, Medium (referred to as Reference in IRRP [2]) and High load growth scenarios. Based on these scenarios, it has identified the needs and recommended wires plans in near-term, mid-term and long-term. The following are summaries of the needs and recommended plans for this sub-region, which consists of Pickle Lake sub-system, Red Lake sub-system, and Ring of Fire sub-system.

6.1.1 Pickle Lake Needs and Recommended Plans

The North of Dryden IRRP [2] has identified that the existing single supply to Pickle Lake, i.e. the 115 kV circuit E1C, is serving 24 MW of load and is at its capacity. Any load growth in the near-term from the existing mine or connection of remote communities will require increase of LMC. The additional capacity needs, based on the medium (reference) load growth scenario are 18 MW, 28 MW and 47 MW in near-term, mid-term and long-term, respectively.

Pickle Lake LMC is limited by voltage stability. Providing dynamic voltage support, e.g. installing Static VAR Compensator (SVC) at Pickle Lake offers moderate increase in LMC, assuming the remaining capacity of circuit E4D will be available for this load increase. One alternative assessed in the IRRP is to install a new 115 kV single-circuit line from Valora, south of Dryden, to Pickle Lake to provide additional LMC that meets the near-term needs of Pickle Lake and releases some capacity on circuit E4D. However, in the long-term, with the development of new mines and potential for connection of the Ring of Fire to Pickle Lake (one the alternatives identified in the IRRP), an increase of over 130 MW in LMC may be required under the high growth forecast. As a result, the recommendation is to proceed with a plan required to meet the needs of the medium (reference) and high growth scenarios in the long-term. This plan can make the full capacity of circuit E4D available to serve the Red Lake sub-system.

<u>Recommended Plan:</u>

- Install a new 230 kV transmission line to Pickle Lake from either the Dryden area (e.g. Dinorwic) or Ignace area;

- Install a new 230 kV switching station to connect the new line to the existing circuits D26A;
- Install a new 230/115 kV auto-transformer at the end of the new line in Pickle Lake;
- Install new 115 kV switching facilities (circuit breakers) to connect the existing circuit E1C, existing customers at Pickle Lake and the new connections of the remote communities to the new auto-transformer; and
- Install required reactive compensation for voltage control

An Order in Council from the government, dated July 20, 2016, has directed the OEB to amend Wataynikaneyap Power LP's (Watay Power) licence for Watay Power to develop and seek approvals for the Line to Pickle Lake and the connection of sixteen remote communities. Watay Power has initiated the Development phase of the project for these connections. Currently the planned in-service date of the 230 kV line to Pickle Lake is Q2 2020, based on Watay Power's active connection assessment with the IESO.

6.1.2 Red Lake Needs and Recommended Plans

The North of Dryden IRRP [2] has identified that the current LMC of 61 MW at Red Lake, supplied by circuits E2R and E4D, is insufficient to meet the needs of the mining load, based on the expected growth at this location, even in near-term. The additional capacity needs, based on the medium (reference) load growth scenario are 30 MW, 44 MW and 48 MW in near-term, mid-term and long-term, respectively. Additional capacity needs increase to 75 MW under high load growth scenario.

The wires plans to meet the near-term needs are the following.

<u>Recommended Plan:</u>

- Upgrade circuit E4D to a summer rating of 660 A
- Upgrade circuit E2R to a summer rating of 610 A
- Provide additional voltage control at Ear Falls and/or Red Lake

However, since the load increase in the mining sector has not materialized at the same pace as previously anticipated, the initial plans for the upgrade of circuits E4D and E2R have been put on hold, awaiting customer request. A recent System Impact Assessment by the IESO for a load increase at Red Lake has determined that although the existing system can meet the demand, circuit E4D is reaching its thermal limit. Therefore, the above plan for the upgrade of circuit E4D (and E2R) can proceed in case of a request by, and agreement with, customers for additional load. Alternatively, operating measures can be used until additional firm capacity becomes available in the mid-term.

In the mid/long-term, assuming that the planned 230 kV line to Pickle Lake (see the previous section) is completed, which can make the full capacity of circuit E4D available to serve the Red Lake sub-system, there will be sufficient capacity to meet the needs under medium (reference) and high load growth scenarios. Only if the needs exceed the high growth forecast of this planning horizon, or the planned 230 kV line to Pickle Lake is not completed, a new 115 kV or 230 kV line from Dryden to Ear Falls will be one of the alternatives for meeting the demand.

6.1.3 Ring of Fire Sub-system Needs and Potential Options

The North of Dryden IRRP [2] has indicated that as the Ring of Fire sub-system is remote from the existing transmission system, any additional capacity needs would require new facilities. The IRRP has also indicated that transmission supply is the most economic option under all of the forecast scenarios, which considers the five remote communities in the vicinity of the Ring of Fire that have been identified as being economic to connect in the IESO's Remote Community Connection Plan [6] as well as possible mining customers. If mining load does not fully materialize, the North of Dryden IRRP [2] concluded that an east-west supply from the Pickle Lake area was the most economic option. If mining load fully materializes, the IRRP concluded that the economic option is either an east-west supply from the Pickle Lake area or a north-south supply from a point along the East-West Tie. Development in the area is still at an early stage and no firm recommendations can be made at this time.

6.2 Greenstone-Marathon Sub-Region:

The identified needs and recommended wire plans for this sub-region are directly related to a few large industrial developments. Based on the current load meeting capability (LMC) of the sub-region, all circuits except circuit A4L in Greenstone-Marathon sub-region are adequate to meet the projected demand forecast under all scenarios during the planning cycle. Circuit A4L is also adequate under the low demand scenario. The IRRP report [3] has recommended near term (present-5 years), medium term (5-10 years) and long term (10-20 years) actions to address the A4L limitations under the medium and high demand scenarios as described below.

6.2.1 Low Scenario Needs and Recommended Plans

Consistent with the Greenstone-Marathon IRRP, Low Scenario assumptions are as follows:

- Hydro One Distribution customer growth
- Two saw mill re-starts

The existing circuits have sufficient LMC to meet Low Scenario's forecasted demand.

No wire plans are required for this scenario.

6.2.2 Medium Scenario Needs and Recommended Plans

Consistent with the Greenstone-Marathon IRRP, Medium Scenario assumptions are as follows:
- Low Scenario assumptions
- Development of Geraldton mine
- Development of Beardmore mine
- Life extension of the existing Marathon Area mine

Under this scenario, the needs and recommended wires plans are the following.

Accommodate Geraldton mine – Increase Circuit A4L Capacity:

Single-circuit 115 kV line A4L runs from Alexander SS to Longlac TS. A mining development in Geraldton area, with the proposed in-service date of 2019, would increase the near-term demand on circuit A4L to 51 MW, which is higher than its current LMC of approximately 25 MW. The LMC of circuit A4L is limited by voltage.

A major deciding factor in the recommendation for meeting the forecasted demand is the lead time relative to the proposed timelines for the mine development.

Recommended Plan:

If the proposed in service date of 2019 does not change, Installing Reactive Compensation and gas-fired generation in the near term is the recommended solution.

Installing reactive compensation of about +40 MVARs in the form of either synchronous condenser or Static Synchronous Compensators (STATCOM) at the Geraldton mine site would increase the LMC of circuit A4L to 45 MW, making full thermal capability of the circuit available. This form of Reactive Compensation is recommended considering the low short-circuit level at the end of circuit A4L relative to the requirements of the mine. The remaining short fall of approximately 6 MW to meet the needs of the mine can be provided by a customer-based grid-connected gas-fired generation plant with sufficient redundancy, for example, installing two 10 MW gas-fired units.

If the in-service date of the mine is delayed, replacing a section of circuit A4L, between Nipigon and Longlac, along with the installation of the above reactive compensation, would increase the LMC of circuit A4L to about 60 MW. Replacing the section of circuit A4L has a lead time of approximately five years.

Accommodate Beardmore mine – Increase Circuit A4L Capacity

A potential gold mine near Beardmore may be operational within the medium term. If Geraldton mine doesn't connect to circuit A4L as described above, the existing system would be sufficient to support the Beardmore mine.

If the Geraldton mine connects to circuit A4L and the plans for the high-demand scenario (described below) do not proceed, in order to accommodate the Beardmore mine, additional capacity would be required.

Recommended Plan:

Upgrading a section of circuit A4L from Alexander SS to Beardmore Junction is a medium term wires option for supplying the potential mine.

6.2.3 High Scenario Needs and Recommended Plans

Consistent with the Greenstone-Marathon IRRP, High Scenario assumptions are as follows

- Medium Scenario assumptions
- Development of the proposed Energy East pipeline
- Development of additional mines in Marathon Area
- Development of Ring of Fire, with connection to the Greenstone area

Under this scenario, the needs and recommended wires plans are the following.

Accommodate Energy East Pipeline and, potentially, the Ring of Fire – Install New Wires:

Potential Energy East load is subjected to customers' request for connection of the pumping stations to the provincial electricity grid. The medium or long term recommended plans for the High Scenario depend on the Energy East plans and timelines for connecting some or all of the pumping stations, in one or two phases.

The Greenstone-Marathon Sub-Region IRRP [3] also indicates that the Ring of Fire could be potentially connected by an east-west corridor to Pickle Lake or by a north-south corridor to the Nipigon or Marathon areas.

Recommended Plan:

According to the IRRP report [3], the preferred option under the High Scenario, with or without the potential connection of the Ring of Fire, is the following wires plan.

- Install a new 230 kV transmission line to Longlac TS from either from the Nipigon area or from the Marathon (or Terrance Bay) area;
- Install a new 230 kV switching station to connect the new line to the existing circuits M23L-M24L;
- Install a new 230/115 kV auto-transformer at Longlac TS;

- Install required reactive compensation for voltage control and short-circuit level requirements at the mine; and
- Install a new 115 kV Line from Longlac TS to Manitouwadge TS to supply all the pumping stations in the area, possibly in the second phase.

Advancing the plan for the new transmission line and transformer, in order to meet the timelines of the Geraldton mine and the Beardemore mine developments, is an alternative to the upgrade of circuit A4L described under the Medium Scenario above. During outages of the new line or transformer, the new mines and industrial loads need to be interrupted to maintain the loading on circuit A4L below its LMC.

The above plan will improve the reliability for the customers served from Longlac TS by maintaining their supply through the new transmission line and transformer during outages of circuit A4L.

6.3 West of Thunder Bay Sub-Region

This sub-region, as described in the IRRP report [4], consists of four main sub-systems, Moose Lake, Fort Frances, Kenora and Dryden. The West of Thunder Bay Sub-Region is also a source of supply to the North of Dryden sub-region (through the Dryden 115 kV system) and therefore the needs and recommendations from the North of Dryden IRRP (described in the previous sections) were considered in the West of Thunder Bay IRRP.

Similar to the other sub-regions described above, because of the uncertainty in the development plans and connection options, the IRRP has considered low, medium (or reference) and high load growth scenarios in the West of Thunder Bay sub-region and has identified near/mid/long-term needs and recommendations for each scenario.

The low load growth scenario has forecasted a peak demand of close to 240 MW in 2017 (with the startup of a new mine near Rainy River) which will remain fairly flat until 2034.

In the medium load growth scenario, involving new mines and industrial load (pumping stations of the pipeline conversion project), the load forecast increases from 252 MW in 2017 to 345 MW in 2034.

In the high load growth scenario, involving additional mines, the load forecast increases from 305 MW in 2017 to 551 MW in 2034.

6.3.1 Dryden Needs and Plans

The Dryden 115 kV sub-system can provide up to 240 MW of continuous supply to the Dryden and North of Dryden Sub-Region. Under the low and medium (reference) load growth scenarios, this LMC is sufficient to meet the demand of this sub-system.

Under the high load growth scenario, additional capacity of 50 MW will be required on the 115 kV system at Dryden by the mid-2020s. This scenario considers high growth in the North of Dryden Sub-Region, and assumes that all load on circuit E1Cwill be supplied by the proposed 230 kV line to Pickle Lake. The IRRP identified one option for meeting the need of the 115 kV system to install a third autotransformer at Dryden TS. A recommended plan has not been finalized at this time given the long lead time and uncertainty associated with potential developments in the area. The next cycle of Regional Planning will reassess the need.

6.3.2 Kenora Needs and Plans

The transformer station supplying the City of Kenora and surrounding areas ("Kenora MTS") can supply 25 MW. This transformer station currently supplies up to 20 MW. Since the increase in the residential and commercial load in the Kenora area is forecast to be modest over the planning period, the remaining 5 MW margin will be adequate for the Kenora area.

The IRRP has identified that an industrial customer, currently supplied by a local generating station is considering pursuing an alternative supply arrangement from Kenora MTS. Furthermore, potential developments at the former Abitibi mill site may also require additional transformer station capacity in the Kenora area. The magnitude and timing of these developments remains uncertain and is not expected to have major regional implications. No actions were recommended in the IRRP to address the need at this time.

6.3.3 Moose Lake Needs and Plans

The Moose Lake 115 kV sub-system has sufficient supply capacity to meet demand in the planning horizon under each load growth scenario. Therefore, no actions were recommended in the IRRP at this time.

6.3.4 Fort Frances Needs and Plans

The Fort Frances 115 kV sub-system was found to have sufficient supply capacity to meet demand in the planning horizon under each load growth scenario. Therefore, no actions were recommended in the IRRP at this time.

6.4 Thunder Bay Sub-Region

The IRRP for the Thunder Bay sub-region [5] considered low, medium and high load growth scenarios and identified near/mid/long-term needs and recommendations for each scenario. The assessments of this sub-region have assumed that the most impactful scenario in the Greenstone sub-system will materialize, resulting in 60 MW supply need from the Thunder Bay sub-region (i.e. on circuit A4L in case it would be upgraded).

The low load growth scenario has forecast the peak demand of close to 325 MW in 2015 will decline to about 300 MW by 2035 as a result of continuing decline in the pulp and paper sector and without new mining or industrial developments in Thunder Bay.

In the medium load growth scenario, involving new mines and industrial load (one pumping station of the Energy East gas-to-oil pipeline development supplied from the Thunder Bay transmission system) and no change in the pulp and paper sector, the load is forecasted to increase to 400 MW in 2035. This is comparable to the sub-region's historic peak demand in 2006/2007.

In the high load growth scenario, involving additional transmission connected mining developments north of Thunder Bay; the load is forecasted to increase to 415 MW by the end of planning period.

In addition to the potential long-term wires options for medium/high growth scenarios described below, the IRRP for Thunder Bay sub-region identified the near-term need for upgrading the thermal rating of circuit R2LB between Lakehead TS and Birch TS to that of the companion circuit R1LB. This work has been completed.

6.4.1 Long-Term Needs and Plans

Port Arthur TS - Transformation Capacity

The long-term load forecast indicates that the demand from the customers supplied by Port Arthur TS will exceed the station's current capacity by 2033, and additional station capacity will be required if this load growth materializes.

Currently, the low voltage equipment at Port Arthur TS are limiting the station capacity to 55 MW. The station transformers provide up to 59 MW of capacity.

Wires Option:

The low voltage equipment, which are limiting the station capacity are nearing end-of-life and are planned to be replaced and upgraded in mid-term. This upgrade would bring the station capacity up to 59 MW, sufficient to meet the need beyond 2035. No additional plan is required at this time and load at Port Arthur TS will be monitored and supply options will be assessed in the next cycle of Regional Planning.

Lakehead TS and Birch TS - Transformation Capacity

Currently the Thunder Bay 115 kV system can accommodate approximately 150 MW of additional load growth. This capacity is sufficient under the low and medium load growth scenarios in the long-term.

Under the High growth scenario, and assuming the most impactful Greenstone sub-system scenario (60 MW, as described above), the Thunder Bay system would require additional supply capacity of approximately 20 MW by 2030.

The Thunder Bay IRRP indicates that a firm plan to increase the LMC of the Thunder Bay 115 kV system is not required at this time, as the large margin remaining on the system provides significant lead time for the Working Group to monitor demand growth and study options. The IRRP report explored various wires and non-wires options as potential long term solutions to increase the LMC of the system, however no action beyond monitoring is recommended at this time.

The wires options discussed in the Thunder Bay IRRP are described below:

1. Installing a third 230/115 kV 250 MVA autotransformer at Lakehead TS to increase the LMC of Lakehead TS by approximately 240 MW.

2. A new 230 kV line from Lakehead TS to Birch TS and a 230 kV 250 MVA autotransformer at Birch TS to create a supply point for the southern part of Thunder Bay, with a supply capacity of 240 MW. The new 230 kV line would require a new Right-of-Way and would take 5 years or longer to build.

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7. CONCLUSIONS AND NEXT STEPS

THIS REGIONAL INFRASTRUCTURE PLAN REPORT CONCLUDES THE REGIONAL PLANNING PROCESS FOR THE NORTHWEST ONTARIO REGION. THIS REPORT MEETS THE INTENT OF THE PROCESS DESCRIBED IN SECTION 2 WHICH IS ENDORSED BY THE OEB AND MANDATED IN THE TSC AND DSC.

This section provides a summary of the Needs and Plans for the Northwest Region as identified in this RIP.

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least every five years. However, the Region will continue to be monitored and should there be a need that emerges due to a change in load forecast or any other reason, the regional planning cycle will be started earlier to address the need.

North of Dryden Sub-Region Wires Plans

No.	Need	Wires Options	Load Growth	Term	Status
1	Circuits E1C and E4D Capacity	A 230 kV transmission line from Dryden/Ignace area to Pickle Lake	Medium[1]	Near-term	Recommended in IRRP. Development has started.
2	Circuits E4D and E2R Capacity	Upgrade of transmission lines E2R and E4D, and additional voltage support	All Scenarios	Near-term	Recommended in IRRP. The need has not materialized.
3		A 115 kV or 230 kV transmission line from Dryden to Ear Falls	High	Long-term	Proposed in IRRP. Not needed in the planning horizon, assuming Projects 1 and 2 proceed.

Greenstone-Marathon Sub-Region Wires Plans

No.	Need	Wires Options	Load Growth	Term	Status
4	Circuit A4L Capacity	Upgrade of sections of transmission line A4L, and dynamic voltage support devices at Geraldton	Medium[2]	Near-term	Recommended in IRRP. Subject to the plans and timelines for connection of a new Geraldton mine.
5		Upgrade of other sections of transmission line A4L	Medium[2]	Mid-term	Recommended in IRRP. Subject to the plans and timelines for connection of a new Beardmore mine.
6	Capacity for Pipeline Project and Ring of Fire	A 230 kV transmission line from Nipigon or Terrace Bay to Geraldton, and voltage support devices	High[2]	Mid/Long-term	Recommended in IRRP. Subject to the plans and timelines for connection of pipeline loads and mines.
7		A 115 kV transmission line from Manitouwadge to Geraldton, and voltage support devices	High[2]	Long-term	Recommended in IRRP. Subject to the plans and timelines for connection of additional pipeline loads.

West of Thunder Bay Sub-Region Wires Plans					
No.	**Need**	**Wires Options**	**Load Growth**	**Term**	**Status**
8	Dryden 115 kV System Capacity	A 230/115 kV auto-transformer in Dryden area	High	Mid-term	Proposed in IRRP. Next planning cycle will reassess the need.

Thunder Bay Sub-Region Wires Plans					
No.	**Need**	**Wires Options**	**Load Growth**	**Term**	**Status**
9	Thunder Bay 115 kV System Capacity	A 230/115 kV auto-transformer in Thunder Bay area	High	Long-term	Proposed in IRRP. Next planning cycle will reassess the need.
10	Port Arthur TS Transformation Capacity	Upgrade of Low-Voltage equipment at Port Arthur TS	All Scenarios	Long-term	Proposed in IRRP. LV equipment are planned for End-of-Life replacement in mid-term. Next planning cycle will reassess the need.

8. REFERENCES

[1]. Northwest Region Scoping Assessment (SA) Outcome Report
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/Final_Northwest_Scoping_Process_Outcome_Report.pdf

[2]. North of Dryden Sub-Region Integrated Regional Resource Plan (IRRP) Report
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/North_of_Dryden/North-Dryden-Report-2015-01-27.pdf

[3]. Greenstone-Marathon Sub-Region Integrated Regional Resource Planning (IRRP) Report
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/Greenstone_Marathon/2016-Greenstone-Marathon-IRRP-Report.pdf

[4]. West of Thunder Bay Sub-Region Integrated Regional Resource Planning (IRRP) Report
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/West_of_Thunder_Bay/2016-West-of-Thunder-Bay-IRRP.pdf

[5]. Thunder Bay Sub-Region Integrated Regional Resource Planning (IRRP) Report
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/Thunder-Bay-IRRP.pdf

[6]. 2014 Draft Remote Community Connection Plan
http://www.ieso.ca/Documents/Regional-Planning/Northwest_Ontario/Remote_Community/OPA-technical-report-2014-08-21.pdf

Appendix A. Stations in the Northwest Ontario Region

Sub Region	Station	Voltage (kV)	Supply Circuits
North of Dryden	Ear Falls TS	115/44	M3E, E4D, E1C, E2R
	Red Lake TS	115/44	E2R
	Cat Lake MTS	115/25	E1C
	Crow River DS	115/25	E1C
	Perrault Falls DS	115/12.5	E4D
	Slate Falls DS	115/24.9	E1C
Greenstone-Marathon	Longlac TS	115/44	A4L
	Manitouwadge TS	115/44	M2W
	Marathon TS	230/115	T1M, W21M, M23L, M2W, M24L, W22M
	Beardmore DS #2	115/25	A4L
	Jellicoe DS #3	115/12.5	A4L
	Manitouwadge DS #1	115/12.5	M2W
	Marathon DS	115/25	T1M
	Pic DS	115/25	M2W
	Schreiber Winnipeg DS	115/12.5	A5A
	White River DS	115/25	M2W
West of Thunder Bay	Barwick TS	115/44	K6F
	Dryden TS	230/115	K3D, D26A, E4D, D5D, K23D, M2D
	Fort Frances TS	232/115	K24F, F25A, K6F, F1B, F2B, F3M
	Kenora TS	230/115	K24F, K7K, K21W, K23D, K22W
	Mackenzie TS	230/115	D26A, A22L, A3M, F25A, A21L, N93A
	Moose Lake TS	115/44	A3M, M1S, M2D, B6M
	Fort Frances MTS	115/12.47	F1B
	Kenora MTS	115/12.5	15M1
	Agimak DS	115/25	29M1
	Burleigh DS	115/12.5	F1B
	Clearwater Bay DS	115/25	SK1
	Eton DS	115/12.48	K3D
	Keewatin DS	115/12.5	SK1
	Margach DS	115/25	K6F
	Minaki DS	115/25	K4W
	Nestor Falls DS	115/13.2	K6F
	Sam Lake DS	115/26.4	K3D
	Sapawe DS	115/12.5	B6M
	Shabaqua DS	115/12.5	B6M
	Sioux Narrows DS	115/12.5	K6F
	Valora DS	115/25	29M1
	Vermilion Bay DS	115/12.5	K3D
Thunder Bay	Birch TS	115/28.4	Q9B, P7B, Q8B, Q5B, R2LB, P3B, Q4B, R1LB, B6M
	Fort William TS	115/25	Q5B, Q4B
	Lakehead TS	230/115	A22L, M23L, A21L, R2LB, L4P, M24L, A7L, R1LB, A8L, L3P
	Port Arthur TS #1	115/25	P7B, P1T, A6P, L4P, P3B, P5M, L3P
	Murillo DS	115/26.40	B6M
	Nipigon DS	115/4.16	57M1
	Red Rock DS	115/12.5	56M1

Appendix B. Transmission Lines in the Northwest Ontario Region

Circuit(s)	Location	Voltage (kV)
D26A	Mackenzie x Dryden	230
F25A	Mackenzie x Fort Frances	230
K23D	Dryden x TCPL Vermill Bay x Kenora	230
K24F	Fort Frances x Kenora	230
N93A	Mackenzie x Marmion Lake x Atikokan	230
K21W, K22W	Kenora x Whiteshell (Manitoba Hydro)	230
A21L, A22L	Mackenzie x Lakehead	230
M23L, M24L	Marathon x Lakehead	230
15M1	Kenora x Rabbit Lake	115
29M1	Ignace x Camp Lake x Valora x Mattabi	115
A3M	Mackenzie x Moose Lake	115
B6M	Moose Lake x Sapawe x Shabaqua x Stanley x Murillo x Birch	115
D5D	Dryden x Domtar Dryden	115
F1B	Fort Frances x Burleigh	115
F3M	Fort Frances x Internat Fls (Minnesota Power)	115
K2M	Kenora x Norman	115
K3D	Dryden x Sam Lake x Eton x Vermilion Bay x Rabbit Lake	115
K4W	White Dog x Minaki x Rabbit Lake	115
K6F	Fort Frances x Ainsworth x Nestor Falls x Sioux Narrows x Rabbit Lake	115
K7K	Kenora x Weyerhaeuser Ken x Rabbit Lake	115
M1S	Moose Lake x Valerie Falls x Mill Creek	115
M2D	Moose Lake x Ignace x Dryden	115
SK1	Rabbit Lake x Keewatin x Forgie	115
W3C	White Dog x Caribou Falls	115
56M1	Nipignon x Red Rock	115
57M1	Reserve x Nipignon	115
A6P	Alexander x Port Arthur	115
L3P, L4P	Lakehead x Port Arthur	115
P3B, P7B	Port Arthur x Birch	115
P5M	Port Arthur x Conmee	115
Q4B, Q5B, Q8B, Q9B	Thunder Bay x Birch	115
R1LB, R2LB	Lakehead x Pine Portage x Birch	115
S1C	Silver Falls x Lac Des Iles x Conmee	115
A1B	Aguasabon x Terrace Bay	115
A4L	Alexander x Nipignon x Beardmore x Jellicoe x Roxmark x Longlac	115
A5A	Alexander x Minnova x Schreiber x Aguasabon	115
C1A, C2A, C3A	Alexander x Cameron Falls	115
GA1	Upper White River x Lower White River	115
M2W	Marathon x Black River x Umbata Falls x Hemlo Mine x White River	115
R9A	Alexander x Pine Portage	115
E1C	Ear Falls x Selco x Slate Falls x Cat Lake x Crow River x Musselwhite	115
E2R	Ear Falls x Balmer x Red Lake	115
E4D	Ear Falls x Scout Lake x Dryden	115
M3E	Manitou Falls x Ear Falls	115
T1M	Terrace Bay x Marathon	115

Appendix C. Distributors in the Northwest Ontario Region

Distributor Name	Station Name	Connection
ATIKOKAN HYDRO INC.	Moose Lake TS	Tx
FORT FRANCES POWER CORPORATION	Fort Frances MTS	Tx
HYDRO ONE NETWORKS INC.	Agimak DS	Tx
	Aguasabon GS	Tx
	Barwick TS	Tx
	Beardmore DS #2	Tx
	Burleigh DS	Tx
	Cat Lake MTS	Tx
	Clearwater Bay DS	Tx
	Crow River DS	Tx
	Dryden TS	Tx
	Ear Falls DS	Tx
	Ear Falls TS	Tx
	Eton DS	Tx
	Fort Frances TS	Tx
	H2O Pwr SturgFls CGS	Tx
	Jellicoe DS #3	Tx
	Keewatin DS	Tx
	Kenora DS	Tx
	Longlac TS	Tx
	Manitouwadge DS #1	Tx
	Manitouwadge TS	Tx
	Marathon DS	Tx
	Margach DS	Tx
	Minaki DS	Tx
	Murillo DS	Tx
	Nestor Falls DS	Tx
	Nipigon DS	Tx
	Perrault Falls DS	Tx
	Pic DS	Tx
	Port Arthur TS #1	Tx
	Red Lake TS	Tx
	Red Rock DS	Tx
	Sam Lake DS	Tx
	Sapawe DS	Tx
	Schreiber Winnipg DS	Tx
	Shabaqua DS	Tx
	Sioux Narrows DS	Tx
	Slate Falls DS	Tx
	Valora DS	Tx
	Vermilion Bay DS	Tx
	White River DS	Tx
	Whitedog Falls GS	Tx
	Whitedog DS	Tx
KENORA HYDRO ELECTRIC CORPORATION	Kenora MTS	Tx
SIOUX LOOKOUT HYDRO INC.	Sam Lake DS	Dx
THUNDER BAY HYDRO ELECTRICITY DISTRIBUTION INC.	Birch TS	Tx
	Fort William TS	Tx
	Port Arthur TS #1	Tx

Appendix D. Northwest Ontario Stations Non Coincident Load Forecast (2016-2025)

Table D-1 Stations Non Coincident Net Load Forecast (MW)

Station LDCs
Atikokan Hydro
Fort Frances Power Corp
Kenora Hydro
Thunder Bay Hydro
Hydro One Distribution

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
West of Thunder Bay	*Moose Lake TS*	Non Coincidental Gross						6.10	6.16	6.22	6.28	6.35	6.38	6.41	6.44	6.48	6.51
		CDM						0.04	0.07	0.12	0.17	0.21	0.24	0.28	0.31	0.33	0.37
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	4.50	4.30	4.53	4.93	6.06	6.06	6.09	6.10	6.11	6.14	6.13	6.13	6.13	6.14	6.13
West of Thunder Bay	*Fort Frances MTS*	Non Coincidental Gross						17.10	17.02	16.93	17.10	17.27	17.45	17.62	17.80	17.97	18.15
		CDM						0.11	0.18	0.32	0.46	0.56	0.66	0.76	0.85	0.92	1.03
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	16.93	16.29	17.17	17.92	16.79	16.99	16.83	16.61	16.64	16.70	16.78	16.85	16.95	17.05	17.11
West of Thunder Bay	*Fort Frances TS*	Non Coincidental Gross						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		CDM						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	15.60	16.37	16.73	16.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
West of Thunder Bay	*Barwick TS*	Non Coincidental Gross						17.07	17.07	17.29	17.56	17.69	17.81	17.93	18.04	18.19	18.33
		CDM						0.11	0.19	0.32	0.47	0.58	0.68	0.78	0.86	0.93	1.04
		DG						1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Non Coincidental Net					14.00	15.96	15.88	15.96	16.08	16.11	16.13	16.15	16.18	16.25	16.28
West of Thunder Bay	*Kenora MTS*	Non Coincidental Gross						21.45	21.66	21.88	22.10	22.10	22.32	22.32	22.54	22.76	22.99
		CDM						0.14	0.24	0.41	0.59	0.72	0.85	0.97	1.07	1.17	1.31
		DG						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Non Coincidental Net	20.49	20.77	21.27	21.62	20.57	21.30	21.41	21.46	21.49	21.37	21.46	21.34	21.45	21.58	21.66
Thunder Bay	*Birch TS*	Non Coincidental Gross						77.88	78.54	78.80	79.31	79.81	80.32	80.55	81.34	81.96	82.52
		CDM						0.51	0.85	1.48	2.13	2.60	3.06	3.50	3.87	4.21	4.70
		DG						0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
		Non Coincidental Net	70.48	70.02	86.01	87.04	74.01	77.33	77.64	77.28	77.14	77.17	77.22	77.01	77.43	77.71	77.77

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Thunder Bay	*Fort Williams TS*	Non Coincidental Gross						77.90	78.14	80.46	81.23	83.61	87.49	91.88	91.11	89.64	89.29
		CDM						0.51	0.85	1.51	2.18	2.73	3.33	3.99	4.33	4.60	5.09
		DG						4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45	4.45
		Non Coincidental Net	74.99	73.18	80.22	80.81	79.20	72.94	72.84	74.50	74.59	76.43	79.70	83.44	82.33	80.59	79.76
Thunder Bay	*Port Arthur TS#1*	Non Coincidental Gross						37.00	37.40	37.90	38.50	39.10	39.60	40.20	40.90	41.50	42.20
		CDM						0.24	0.41	0.71	1.03	1.27	1.51	1.74	1.94	2.13	2.40
		DG						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Non Coincidental Net	34.92	35.73	35.36	39.98	30.70	36.74	36.98	37.18	37.45	37.81	38.08	38.44	38.94	39.36	39.78
Thunder Bay	*Port Arthur TS #1*	Non Coincidental Gross						8.54	8.65	8.77	8.80	8.94	9.10	9.19	9.28	9.36	9.44
		CDM						0.06	0.09	0.16	0.24	0.29	0.35	0.40	0.44	0.48	0.54
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	8.12	7.48	8.52	8.52	7.90	8.49	8.56	8.60	8.56	8.65	8.76	8.79	8.84	8.88	8.90
West of Thunder Bay	*Agimak DS*	Non Coincidental Gross						3.32	3.33	3.39	3.46	3.50	3.53	3.57	3.60	3.65	3.69
		CDM						0.02	0.04	0.06	0.09	0.11	0.13	0.15	0.17	0.19	0.21
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.96	3.04	3.24	3.70	4.30	3.30	3.30	3.33	3.36	3.38	3.40	3.41	3.43	3.46	3.48
Greenstone-Marathon	*Beardmore DS #2*	Non Coincidental Gross						1.23	1.23	1.25	1.28	1.29	1.30	1.31	1.33	1.34	1.36
		CDM						0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.06	0.07	0.08
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	1.19	1.30	1.21	1.17	1.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
West of Thunder Bay	*Burleigh DS*	Non Coincidental Gross						4.12	4.12	4.18	4.24	4.27	4.30	4.33	4.35	4.39	4.42
		CDM						0.03	0.04	0.08	0.11	0.14	0.16	0.19	0.21	0.23	0.25
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	3.63	3.80	4.10	4.05	3.70	4.09	4.08	4.10	4.13	4.13	4.14	4.14	4.14	4.16	4.17
North of Dryden	*Cat Lake MTS*	Non Coincidental Gross						0.82	0.83	0.85	0.86	0.88	0.89	0.90	0.91	0.92	0.94
		CDM						0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.79	0.69	0.80	0.72	0.74	0.82	0.82	0.83	0.84	0.85	0.85	0.86	0.87	0.88	0.88
West of Thunder Bay	*Clearwater Bay DS*	Non Coincidental Gross						5.47	5.47	5.54	5.61	5.65	5.68	5.71	5.74	5.78	5.83
		CDM						0.04	0.06	0.10	0.15	0.18	0.22	0.25	0.27	0.30	0.33
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	4.66	4.94	5.38	5.32	4.50	5.43	5.41	5.43	5.46	5.47	5.47	5.46	5.47	5.49	5.49
West of Thunder Bay	*Crilly DS*	Non Coincidental Gross						2.17	2.21	2.25	2.29	2.33	2.36	2.40	2.43	2.46	2.49
		CDM						0.01	0.02	0.04	0.06	0.08	0.09	0.10	0.12	0.13	0.14
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.02	1.98	2.02	1.99	2.05	2.15	2.19	2.21	2.23	2.25	2.27	2.29	2.32	2.33	2.35

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
North of Dryden	*Crow River DS*	Non Coincidental Gross						2.70	2.70	2.74	2.79	2.81	2.84	2.86	2.88	2.90	2.93
		CDM						0.02	0.03	0.05	0.07	0.09	0.11	0.12	0.14	0.15	0.17
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.89	2.52	2.64	2.58	2.12	2.68	2.68	2.69	2.72	2.72	2.73	2.73	2.74	2.75	2.76
West of Thunder Bay	*Dryden TS*	Non Coincidental Gross						21.14	21.33	21.80	22.31	22.65	22.99	23.31	23.63	24.02	24.41
		CDM						0.14	0.23	0.41	0.60	0.74	0.88	1.01	1.12	1.23	1.39
		DG						0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
		Non Coincidental Net	18.66	19.07	20.21	19.94	19.61	20.59	20.69	20.99	21.31	21.51	21.71	21.89	22.10	22.38	22.62
North of Dryden	*Ear Falls DS*	Non Coincidental Gross						4.29	4.32	4.34	4.37	4.39	4.42	4.44	4.46	4.49	4.51
		CDM						0.03	0.05	0.08	0.12	0.14	0.17	0.19	0.21	0.23	0.26
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.43	2.46	2.74	4.23	4.55	4.26	4.27	4.26	4.25	4.25	4.25	4.25	4.25	4.26	4.25
West of Thunder Bay	*Eton DS*	Non Coincidental Gross						5.04	5.04	5.10	5.17	5.21	5.24	5.27	5.30	5.34	5.38
		CDM						0.03	0.05	0.10	0.14	0.17	0.20	0.23	0.25	0.27	0.31
		DG						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Non Coincidental Net	4.06	4.16	4.00	3.97	3.74	5.00	4.98	5.00	5.03	5.03	5.03	5.04	5.04	5.06	5.07
Greenstone-Marathon	*Jellicoe DS #3*	Non Coincidental Gross						0.47	0.47	0.48	0.49	0.49	0.50	0.50	0.50	0.51	0.51
		CDM						0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.48	0.47	0.46	0.45	0.33	0.47	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.48	0.48
West of Thunder Bay	*Kenora DS*	Non Coincidental Gross						6.88	6.88	6.97	7.10	7.17	7.24	7.30	7.37	7.44	7.51
		CDM						0.05	0.07	0.13	0.19	0.23	0.28	0.32	0.35	0.38	0.43
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	11.44	12.50	6.73	6.67	5.93	6.83	6.80	6.84	6.90	6.93	6.96	6.98	7.02	7.06	7.08
West of Thunder Bay	*Keewatin DS*	Non Coincidental Gross						5.55	5.55	5.62	5.73	5.79	5.84	5.89	5.95	6.00	6.06
		CDM						0.04	0.06	0.11	0.15	0.19	0.22	0.26	0.28	0.31	0.35
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net		5.29	5.43	5.41	4.62	5.51	5.49	5.52	5.57	5.60	5.62	5.64	5.66	5.70	5.72
Greenstone-Marathon	*Longlac TS*	Non Coincidental Gross						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		CDM						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	9.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Greenstone-Marathon	*Longlac TS*	Non Coincidental Gross						12.79	13.00	18.00	18.19	18.38	18.57	18.76	18.96	19.15	19.35
		CDM						0.08	0.14	0.34	0.49	0.60	0.71	0.81	0.90	0.98	1.10
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	9.80	10.78	12.66	12.60	11.94	12.70	12.86	17.66	17.70	17.78	17.86	17.95	18.06	18.17	18.25

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Greenstone-Marathon	*Manitouwadge DS #1*	Non Coincidental Gross						1.56	1.56	1.59	1.61	0.00	0.00	0.00	0.00	0.00	0.00
		CDM						0.01	0.02	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.86	1.36	1.54	1.34	1.29	1.55	1.55	1.56	1.56	0.00	0.00	0.00	0.00	0.00	0.00
Greenstone-Marathon	*Manitouwadge TS*	Non Coincidental Gross						11.07	11.10	11.28	11.48	13.21	13.33	13.44	13.55	13.69	13.83
		CDM						0.07	0.12	0.21	0.31	0.43	0.51	0.58	0.64	0.70	0.79
		DG						7.84	7.84	7.84	7.84	7.84	7.84	7.84	7.84	7.84	7.84
		Non Coincidental Net	9.48	10.37	10.79	9.66	9.05	3.15	3.14	3.23	3.33	4.94	4.98	5.02	5.06	5.15	5.20
Greenstone-Marathon	*Marathon DS*	Non Coincidental Gross						11.16	11.21	11.42	11.64	11.78	11.91	12.03	12.16	12.31	12.47
		CDM						0.07	0.12	0.21	0.31	0.38	0.45	0.52	0.58	0.63	0.71
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	7.22	8.08	10.71	10.57	7.56	11.08	11.09	11.20	11.33	11.39	11.45	11.51	11.58	11.68	11.76
West of Thunder Bay	*Margach DS*	Non Coincidental Gross						9.60	9.60	9.73	9.88	9.95	10.01	10.07	10.12	10.21	10.29
		CDM						0.06	0.10	0.18	0.27	0.32	0.38	0.44	0.48	0.52	0.59
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	8.77	9.38	9.44	9.37	8.82	9.53	9.50	9.55	9.61	9.62	9.63	9.63	9.64	9.68	9.70
West of Thunder Bay	*Minaki DS*	Non Coincidental Gross						0.99	0.99	1.00	1.02	1.02	1.03	1.03	1.04	1.05	1.06
		CDM						0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.94	1.06	0.97	0.93	1.00	0.98	0.98	0.98	0.99	0.99	0.99	0.99	0.99	0.99	1.00
Thunder Bay	*Murillo DS*	Non Coincidental Gross						19.37	19.61	19.88	19.95	20.27	20.64	20.84	21.03	21.21	21.39
		CDM						0.13	0.21	0.37	0.54	0.66	0.79	0.90	1.00	1.09	1.22
		DG						0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.12	0.12
		Non Coincidental Net	12.12	12.93	12.43	11.34	15.35	19.22	19.37	19.48	19.39	19.59	19.83	19.91	20.01	20.00	20.05
West of Thunder Bay	*Nestor Falls DS*	Non Coincidental Gross						3.36	3.36	3.41	3.46	3.48	3.50	3.52	3.54	3.56	3.59
		CDM						0.02	0.04	0.06	0.09	0.11	0.13	0.15	0.17	0.18	0.20
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	3.22	3.32	3.33	3.29	3.05	3.34	3.33	3.34	3.36	3.36	3.37	3.36	3.37	3.38	3.39
Thunder Bay	*Nipigon DS*	Non Coincidental Gross						2.21	2.24	2.27	2.29	2.33	2.38	2.41	2.44	2.47	2.50
		CDM						0.01	0.02	0.04	0.06	0.08	0.09	0.10	0.12	0.13	0.14
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.32	2.19	2.31	2.23	2.17	2.19	2.21	2.23	2.23	2.26	2.29	2.31	2.32	2.34	2.36
North of Dryden	*Perrault Falls DS*	Non Coincidental Gross						0.79	0.80	0.81	0.83	0.83	0.84	0.85	0.86	0.87	0.88
		CDM						0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.05
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.89	0.91	0.78	0.86	0.86	0.79	0.79	0.79	0.80	0.81	0.81	0.81	0.82	0.82	0.83

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Greenstone-Marathon	*Pic DS*	Non Coincidental Gross						6.57	6.58	6.67	6.78	6.84	6.89	6.94	6.98	7.05	7.11
		CDM						0.04	0.07	0.12	0.18	0.22	0.26	0.30	0.33	0.36	0.41
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	4.96	6.94	6.37	6.50	6.38	6.52	6.50	6.55	6.60	6.61	6.62	6.63	6.65	6.68	6.71
North of Dryden	*Red Lake TS*	Non Coincidental Gross						26.58	26.81	27.04	27.27	27.41	27.64	27.88	28.12	28.36	28.61
		CDM						0.18	0.29	0.51	0.73	0.89	1.05	1.21	1.34	1.46	1.63
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	45.06	47.55	48.55	49.17	50.28	26.40	26.52	26.53	26.54	26.51	26.59	26.67	26.78	26.91	26.98
Thunder Bay	*Red Rock DS*	Non Coincidental Gross						4.01	4.02	4.04	4.02	4.06	4.09	4.10	4.10	4.11	4.11
		CDM						0.03	0.04	0.08	0.11	0.13	0.16	0.18	0.20	0.21	0.23
		DG						0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.23	0.23
		Non Coincidental Net	3.97	3.87	4.08	4.09	4.02	3.95	3.94	3.93	3.88	3.88	3.90	3.88	3.87	3.67	3.64
West of Thunder Bay	*Sam Lake DS*	Non Coincidental Gross						23.97	24.05	24.44	24.88	25.12	25.36	25.57	25.79	26.07	26.36
		CDM						0.16	0.26	0.46	0.67	0.82	0.97	1.11	1.23	1.34	1.50
		DG						0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Non Coincidental Net	19.80	22.25	23.23	23.00	23.42	23.80	23.78	23.98	24.20	24.30	24.38	24.46	24.56	24.73	24.85
West of Thunder Bay	*Sapawe DS*	Non Coincidental Gross						0.95	0.95	0.97	0.98	0.99	1.00	1.01	1.01	1.02	1.03
		CDM						0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.95	0.80	0.94	0.92	2.61	0.95	0.94	0.95	0.96	0.96	0.96	0.96	0.97	0.97	0.97
Greenstone-Marathon	*Schreiber Winnipg DS*	Non Coincidental Gross						5.19	5.20	5.29	5.38	5.43	5.48	5.52	5.57	5.63	5.69
		CDM						0.03	0.06	0.10	0.14	0.18	0.21	0.24	0.26	0.29	0.32
		DG						0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
		Non Coincidental Net	4.47	5.21	5.19	5.07	5.32	5.15	5.15	5.19	5.22	5.24	5.26	5.27	5.29	5.33	5.35
West of Thunder Bay	*Shabaqua DS*	Non Coincidental Gross						2.80	2.81	2.85	2.89	2.92	2.94	2.96	2.98	3.01	3.04
		CDM						0.02	0.03	0.05	0.08	0.10	0.11	0.13	0.14	0.15	0.17
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.64	2.83	2.83	2.81	2.74	2.78	2.77	2.79	2.81	2.82	2.83	2.83	2.84	2.85	2.86
West of Thunder Bay	*Sioux Narrows DS*	Non Coincidental Gross						4.49	4.49	4.55	4.62	4.65	4.68	4.71	4.73	4.77	4.81
		CDM						0.03	0.05	0.09	0.12	0.15	0.18	0.20	0.23	0.25	0.27
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	4.09	4.25	4.37	4.34	4.22	4.46	4.44	4.46	4.49	4.50	4.50	4.50	4.51	4.53	4.54
North of Dryden	*Slate Falls DS*	Non Coincidental Gross						0.64	0.64	0.65	0.66	0.67	0.67	0.68	0.68	0.69	0.70
		CDM						0.00	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.56	0.63	0.62	0.61	0.61	0.64	0.63	0.64	0.64	0.65	0.65	0.65	0.65	0.65	0.66

IRRP	Transformer Station Name	Customer Data (MW)	Peak Load (MW)														
			Historical Data					Near Term Forecast					Medium Term Forecast Provided			Medium Term Forecast Est.	
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
West of Thunder Bay	*Valora DS*	Non Coincidental Gross						0.77	0.78	0.79	0.81	0.83	0.84	0.85	0.86	0.88	0.89
		CDM						0.01	0.01	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0.05
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	0.64	0.70	0.74	0.73	0.69	0.77	0.77	0.78	0.79	0.80	0.81	0.81	0.82	0.83	0.84
West of Thunder Bay	*Vermilion Bay DS*	Non Coincidental Gross						3.95	3.97	4.01	4.06	4.09	4.12	4.15	4.18	4.21	4.25
		CDM						0.03	0.04	0.08	0.11	0.13	0.16	0.18	0.20	0.22	0.24
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	2.22	2.36	2.37	2.43	2.10	3.93	3.92	3.94	3.95	3.96	3.96	3.97	3.98	3.99	4.00
West of Thunder Bay	*Whitedog DS*	Non Coincidental Gross						2.37	2.39	2.41	2.44	2.46	2.49	2.51	2.54	2.56	2.59
		CDM						0.02	0.03	0.05	0.07	0.08	0.09	0.11	0.12	0.13	0.15
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	1.97	2.19	2.30	2.40	2.31	2.35	2.36	2.37	2.37	2.38	2.39	2.40	2.42	2.43	2.44
Greenstone-Marathon	*White River DS*	Non Coincidental Gross						7.02	7.06	7.18	7.32	7.41	7.49	7.56	7.64	7.73	7.83
		CDM						0.05	0.08	0.13	0.20	0.24	0.29	0.33	0.36	0.40	0.45
		DG						0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Non Coincidental Net	3.20	3.20	6.80	6.74	6.44	6.98	6.98	7.05	7.13	7.16	7.20	7.23	7.28	7.34	7.38

Appendix E. Past Sustainment Activities in Northwest Ontario

Station	I/S Date	Asset Class
ALEXANDER SS	8-Dec-16	Breaker: SF6_115 kV
BIRCH TS	3-Dec-15	Transformer: Step-down_115 kV
DRYDEN TS	29-Aug-16	Breaker: SF6_115 kV
	14-Jul-16	Breaker: SF6_115 kV
	20-Oct-16	Breaker: SF6_115 kV
	10-Nov-16	Breaker: SF6_115 kV
	29-May-16	Breaker: SF6_115 kV
	23-Jul-14	Breaker: SF6_13.8 kV
	4-Sep-14	Breaker: SF6_13.8 kV
	29-Aug-16	Switch: Air Break_115 kV
	29-Aug-16	Switch: Air Break_115 kV
	14-Jul-16	Switch: Air Break_115 kV
	14-Jul-16	Switch: Air Break_115 kV
	31-Aug-16	Switch: Air Break_115 kV
	20-Oct-16	Switch: Air Break_115 kV
	10-Nov-16	Switch: Air Break_115 kV
	20-Oct-16	Switch: Air Break_115 kV
	29-May-16	Switch: Air Break_115 kV
	1-Nov-16	Switch: Air Break_115 kV
	23-Jul-14	Switch: Air Break_13.8 kV
	4-Sep-14	Switch: Air Break_ 13.8 kV
FORT FRANCES TS	23-Nov-10	Breaker: SF6_13.8 kV
	2-Sep-10	Breaker: SF6_13.8 kV
	2-Oct-13	Switch: Air Break_115 kV
	27-Nov-15	Switch: Air Break_230 kV
	2-Oct-13	Switch: Ground_115 kV
	27-Nov-15	Switch: Ground_230 kV
	2-Sep-10	Switch: Air Break_ 13.8 kV
	2-Oct-16	Switch: Air Break_115 kV
	12-Sep-14	Switch: Ground_ 44 kV
	23-Nov-10	Switch: Air Break_ 13.8 kV
LAKEHEAD TS	27-Sep-11	Breaker: SF6_115 kV
	14-Dec-11	Breaker: SF6_115 kV
	14-Dec-11	Breaker: SF6_115 kV
	1-Dec-09	Breaker: SF6_13.8 kV
	4-Apr-12	Switch: Ground_ 13.8 kV
	16-Nov-09	Switch: Ground_ 13.8 kV
	16-Nov-09	Switch: Air Break_ 13.8 kV
	21-Oct-09	Switch: Ground_ 13.8 kV
	21-Oct-09	Switch: Air Break_ 13.8 kV
	12-Sep-16	Transformer: Autotransformer_230 kV

Station	I/S Date	Asset Class
KENORA TS	15-Jul-2009	Breaker: SF6_13.8 kV
	29-May-2015	Switch: Air Break_230 kV
	29-May-2015	Switch: Ground_230 kV
	26-Feb-2013	Switch: Air Break_230 kV
	15-Jul-2009	Switch: Air Break_ 13.8 kV
MACKENZIE TS	17-Jun-2010	Breaker: SF6_13.8 kV
MANITOUWADGE TS	2-Jul-2016	Breaker: SF6_27.6 kV
	10-Jul-2016	Switch: Air Break_ 44 kV
	9-Jul-2016	Transformer: Step-down_115 kV
MARATHON TS	25-May-2009	Breaker: SF6_230 kV
	26-Mar-2014	Breaker: SF6_13.8 kV
	18-Dec-2013	Breaker: SF6_13.8 kV
	23-Dec-2016	Switch: Air Break_230 kV
	23-Dec-2016	Switch: Ground_230 kV
	26-Mar-2014	Switch: Air Break_ 13.8 kV
	18-Dec-2013	Switch: Air Break_ 13.8 kV
MOOSELAKE TS	8-Sep-2014	Breaker: SF6_115 kV
	31-Jul-2014	Breaker: SF6_115 kV
	29-May-2014	Breaker: SF6_115 kV
	8-Sep-2014	Breaker: SF6_115 kV
	11-Jul-2014	Breaker: SF6_115 kV
PORT ARTHUR TS #1	11-Aug-2015	Switch: Air Break_115 kV
	25-Nov-2009	Switch: Air Break_115 kV
	11-Nov-2009	Switch: Air Break_115 kV
	21-Sep-2012	Switch: Air Break_115 kV
	20-Nov-2009	Switch: Air Break_115 kV
	6-Nov-2009	Switch: Air Break_115 kV
	22-Jun-2015	Switch: Air Break_115 kV
	2-Jun-2015	Switch: Air Break_115 kV
	21-Sep-2012	Switch: Air Break_115 kV
	21-Sep-2012	Switch: Ground_115 kV
RABBIT LAKE SS	16-Dec-2011	Breaker: SF6_115 kV
	10-Nov-2011	Breaker: SF6_115 kV
	22-Oct-2011	Switch: Air Break_115 kV
	25-Nov-2016	Switch: Air Break_115 kV
	15-Nov-2016	Switch: Ground_115 kV
	23-Oct-2011	Switch: Air Break_115 kV

Appendix F. List of Acronyms

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