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NEEDS ASSESSMENT REPORT

Peterborough to Kingston Region

Date: February 10, 2020

Prepared by: Peterborough to Kingston Region Study Team

Disclaimer

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

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Executive Summary

REGION Peterborough to Kingston Region (the "Region")

LEAD Hydro One Networks Inc. ("HONI")

START DATE: December 09, 2019 **END DATE:** February 10, 2020

1. INTRODUCTION

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

This is the second cycle of regional planning starting from Needs Assessment ("NA"). The purpose of this NA is a) to identify any new needs and/or to reaffirm needs identified in the previous PtoK Regional Planning cycle and b) recommend which need may be a) addressed by developing a preferred plan as part of NA phase and b) identify needs requiring further assessment and/or regional coordination.

2. REGIONAL ISSUE/TRIGGER

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

3. SCOPE OF NEEDS ASSESSMENT

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

The scope of this NA includes:

- Review and reaffirm needs/plans identified in the previous RIP; and
- Identification and assessment of system capacity, reliability, operation, and aging infrastructure needs in the region: and
- Develop options for need(s) and/or a preferred plan or recommend which needs require further assessment/regional coordination.

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

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

4. INPUTS/DATA

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

In addition, community energy plans in the region have also been scanned and reviewed (Section 9 for references). Federal and Provincial agencies either operate and/or subsidize facilities, such as Canadian Forces Bases, Corrections Institutions and Post-Secondary Institutions in the region and similarly, municipal agencies operate many facilities in the study region; water, wastewater and recreation arenas to name a few. All these agencies are contemplating to reduce Green House Gas (GHG) emissions and to achieve carbon neutrality by no later than 2050 through renewable resources, energy efficiency and/or electrification of heating and transportation. At this time, there is insufficient data available for input into the load forecast for this Needs Assessment study however, the Study Team should monitor the evolving climate action plans of federal, provincial and municipal agencies as they are expected to lead climate action over the next five years.

5. ASSESSMENT METHODOLOGY

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

A technical assessment of needs was undertaken based on:

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

6. NEEDS

I. Update on plan implementation of identified needs from previous cycle

a. The load supplied by Gardiner TS DESN 1 T1/T2 exceeded its summer 10 day Limited Time Rating (LTR) of 125 MW. As recommended in the previous NA, Hydro One Distribution has completed the transfer of load from DESN 1 to lightly loaded DESN 2 with excess capacity resulting in a load relief for Gardiner TS DESN 1.

II. Newly identified needs in the region

a. Line / Station Capacity

i. The 2018 summer peak loading on Frontenac TS was 113 MW, which is above its 10 day summer LTR of 111 MW. Based on the submitted load forecast, the Frontenac TS will be loaded more than 125 MW by year 2028. Load relief is required at the Frontenac TS in the near term.

ii. As per submitted load forecast, the loading on Gardiner TS DESN 1 will be exceeded by its 10 day summer LTR of 125 MW by year 2025. However the combined capacity of Gardiner TS DESN 1 and DESN 2 is 209 MW and total current load is 154 MW.

iii. The 2018 summer peak loading on Belleville TS is 159 MW, which is close to its 10 day summer LTR of 161 MW. In addition to normal load growth in the area, Elexicon Energy Inc. has recently received approximately 30 MW of load connection inquiries to be connected at the Belleville TS. There is insufficient existing capacity in the area to supply these potential future connections.

b. Aging Infrastructure Transformer replacements

- **i.** Lennox TS – 230kV & 500kV Breaker Replacements (2020)
- **ii.** Port Hope TS: Transformer Replacement (2023)
- **iii.** Havelock TS: Transformer Replacement (2027)
- **iv.** Belleville TS: Transformer Replacement (2021)

7. RECOMMENDATIONS

The Study Team recommends the following -

a. Over loading at Frontenac TS shall be managed by Hydro One Transmission by coordinate with Hydro One Distribution and Kingston Hydro to undertake distribution load transfers between Gardiner TS and Frontenac TS over the near term.

b. An integrated regional resource planning (IRRP) and/or Regional Infrastructure Planning (RIP) process should be undertaken for the Peterborough-Kingston region to further assess the needs discussed above in section a.i), a.ii), and a.iii) as well as any addition needs identified in the area.

c. Replacement of end of life asset with similar equipment does not require further regional coordination (see further details in Section 7.1). The implementation and execution plan for these needs will be coordinated by Hydro One with affected LDCs:

i. Lennox TS: 230kV & 500kV Breaker Replacements (Bulk System)
ii. Port Hope TS: Transformer Replacement - EOL replacement of transformers T3 / T4
iii. Havelock TS: Transformer Replacement – EOL replacement of transformers T1 / T2
iv. Belleville TS: Transformer Replacement - EOL replacement of transformer T2

d. IRRP and/or RIP should monitor the potential impact of Federal, Provincial and/or Municipal climate change and/or energy plans for this region.

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List of Tables and Figures

1 INTRODUCTION

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

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

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

Table 1: PtoK Region Study Team Participants

Company
Elexicon Energy Inc.
Kingston Hydro
Peterborough Distribution Inc.
Lakefront Utilities Inc.
Eastern Ontario Power Inc.
Hydro One Networks Inc. (Distribution)
Independent Electricity System Operator ("IESO")
Hydro One Networks Inc. (Lead Transmitter)

2 REGIONAL ISSUE/TRIGGER

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

3 SCOPE OF NEEDS ASSESSMENT

The scope of this NA covers the PtoK region and includes:

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

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

4 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The PtoK Region includes Frontenac County, City of Kingston, Hasting County, Northhumberland County, Peterborough County, and Prince Edward County. The boundaries of Peterborough to Kingston Region is shown below in Fig. 1.

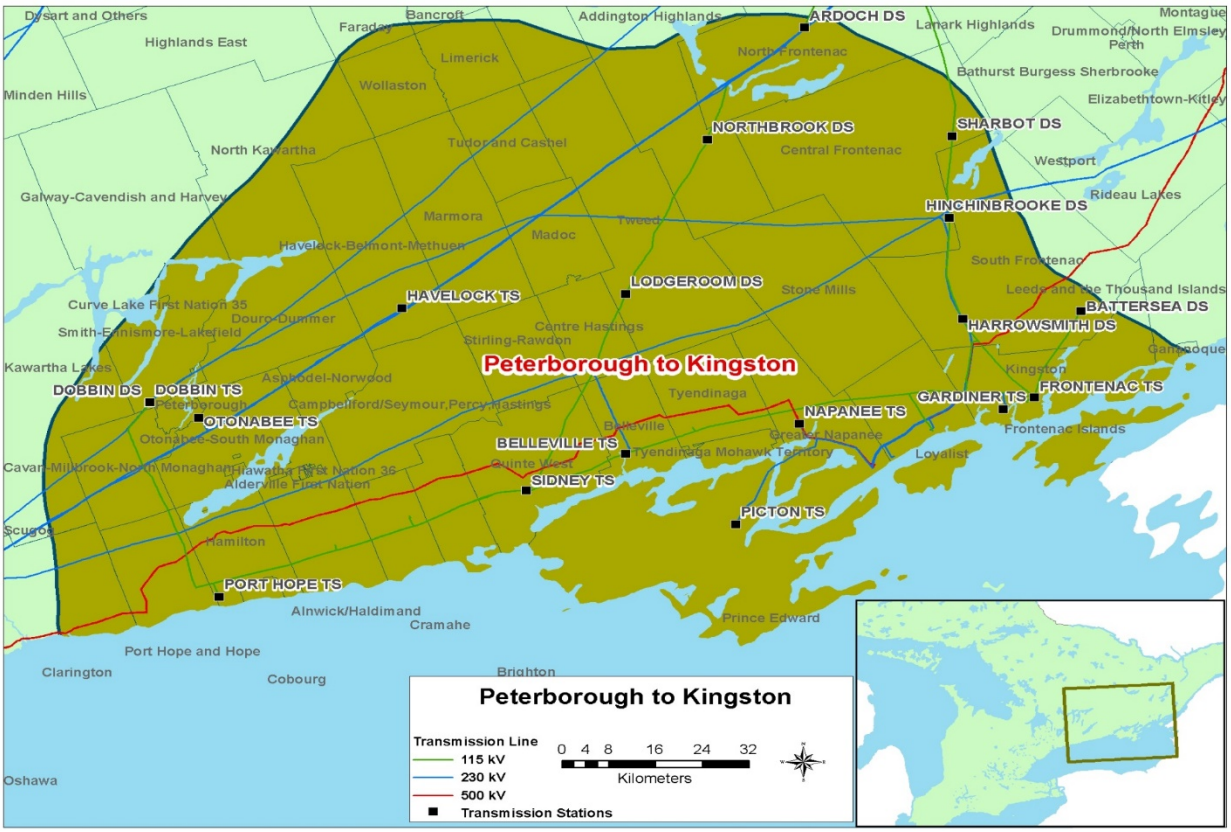

Figure 1: Geographical Area of PtoK Region with Electrical Layout

Electrical supply to the Peterborough to Kingston Region is provided through a network of 230 kV and 115 kV circuits supplied by 500/230 kV autotransformers at Lennox Transformer Station (TS) and 230/115 kV autotransformers at Cataraqui TS and Dobbin TS. There are ten Hydro One step-down TS's, eight high voltage distribution stations (HVDS), and five other direct transmission connected load

customers in the Region. The main generation facility in the Region is the 2000 MW Lennox Generation Station (GS) connected to Lennox TS.

The existing facilities in the Region are summarized below and depicted in the single line diagram shown in Figure 2. The 500kV system is part of the bulk power system and is not studied as part of this Needs Assessment:

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

- Cataraqui TS and Dobbin TS are the transmission stations that connect the 230kV network to the 115kV system via 230/115 kV autotransformers.

- Ten step-down transformer stations supply the Peterborough to Kingston load: Dobbin TS, Port Hope TS, Sidney TS, Picton TS, Otonabee TS, Havelock TS, Belleville TS, Napanee TS, Gardiner TS, and Frontenac TS. There are also eight HVDS that supply load in the Region: Dobbin DS, Ardoch DS, Northbrook DS, Lodgeroom DS, Hinchinbrooke DS, Harrowsmith DS, Sharbot DS, and Battersea DS.

- Five Customer Transformer Stations (CTS) are supplied in the Region: TransCanada Pipelines Cobourg CTS, TransCanada Pipelines Belleville CTS, Enbridge Pipelines Hilton CTS, Lafarge Canada Bath CTS, and Novelis CTS.

- There are 7 existing Transmission connected generating stations in the Region as follows:
    - Lennox GS is a 2000 MW natural gas-fired station connected to Lennox TS
    - NPIF Kingston GS is a 130 MW gas-fired cogeneration facility that connects to 230 kV circuits X1H and X2H near Lennox TS
    - Wolfe Island GS is a 198 MW wind farm connected to circuit X4H near Gardiner TS
    - Napanee GS is a 910 MW gas-fired plant connected to Lennox TS at the 500 kV system.
    - Kingston Solar CGS is a 100 MW solar generation facility connected to 230 kV circuit X2H
    - Stone Mills CGS is a 60 MW solar generation facility connected to 230 kV circuit H23B
    - Amherst Island CGS is a 76 MW wind farm connected to 115kV circuit Q6S

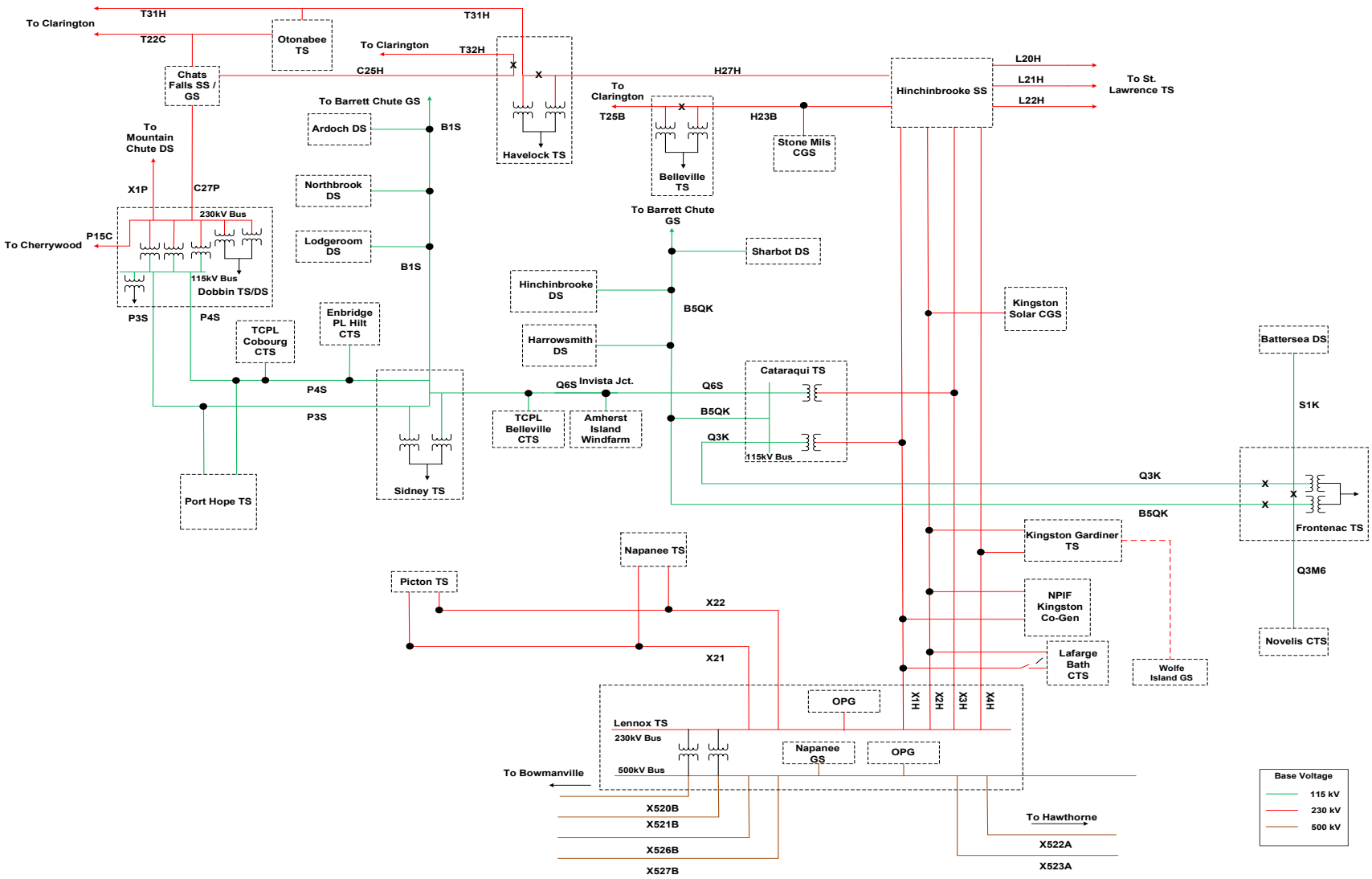

Figure 2: Single Line Diagram of Peterborough to Kingston Region

5 INPUTS AND DATA

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

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

6 ASSESSMENT METHODOLOGY

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

Information gathering included:

i. Load forecast: The LDCs provided load forecasts for all the stations supplying their loads in the PtoK region for the 10 year study period. The IESO provided a Conservation and Demand Management ("CDM") and Distributed Generation ("DG") forecast for the PtoK region. The region's extreme summer non-coincident peak gross load forecast for each station were prepared by applying the LDC load forecast load growth rates to the actual 2018 summer and 2018/19 winter peak extreme weather corrected loads. The extreme summer / winter weather correction factors were provided by Hydro One. The net extreme weather summer load forecasts were produced by reducing the gross load forecasts for each station by the % age CDM and then by the amount of effective DG capacity provided by the IESO for that station. It is to be noted that in the mid-term (5 to 10 year) time frame, contracts for existing DG resources in the region begin to expire, at which point the load forecast indicates a decreasing contribution from local DG resources, and an increase in net demand. These extreme weather corrected net summer / winter load forecast for the individual stations in the PtoK region is given in Appendix A;

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

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

A technical assessment of needs was undertaken based on:

- Current and future station capacity and transmission adequacy;

- System reliability and operational concerns; and
- Any major high voltage equipment reaching the end of life.

7 NEEDS

This section describes emerging needs identified in the Peterborough to Kingston Region, and also reaffirms the near, mid, and long-term needs already identified in the previous regional planning cycle. The recent load forecast prepared for this report is higher than that of the previous cycle of regional planning. This is attributed to the load growth in Belleville, Kingston and other parts of the regions as well as lower CDM and DG targets in the region. A contingency analysis was performed for the region and no new system needs were identified.

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

Table 2: Needs Identified in the Previous Regional Planning Cycle

Type of Needs identified in the previous RP cycle	Needs Details	Current Status
Transformation capacity relief at Gardiner TS DESN 1.	Gardiner TS DESN 1 load exceeded its normal supply capacity. Hydro One Dx agreed to transfer load from Gardiner TS DESN 1 to Gardiner TS DESN 2.	The work completed in summer 2019.

7.1 End-Of-Life (EOL) Equipment Needs

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

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

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

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

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

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

a. Lennox TS – 230 kV & 500 kV Breaker Replacement

This project is outside the scope of regional planning being part of part of Bulk System. A description is provided for information purpose only. Lennox Transformer Station (TS) is located in Eastern Ontario and is a major hub for 500 kV Central-East power flow that forms part of the Hydro One Bulk Power System (BPS). The station also connects 2000 MW of generation from Lennox GS on both the 500 kV and 230 kV systems. Furthermore, it also connects 900 MW of Napanee GS. The 230 kV and 500 kV switchyard at Lennox TS contain 14 X Air Blast Circuit Breakers (ABCBs) and 2 X OIL Circuit Breakers (OCBs). The existing 500kV and 230kV ABCBs are obsolete and at end of life. The age, condition and very poor performance present significant difficulties in maintaining these breakers and the associated high pressure air system.

The scope of this project is to replace the existing six (6) 500kV and eight (8) 230kV air-blast circuit breakers. In addition, 2 X 230 kV oil circuit breakers, AC/DC station service and associated protection, control and telecom facilities will be replaced to meet current standards and to fully comply with NPCC BPS requirements. The targeted in-service for the final phase is in year 2020.

b. Port Hope TS – Transformers Replacement

Port Hope Transformer Station supplies the City of Port Hope, City of Cobourg and other surrounding area via two DESN, T1/T2 & T3/T4. Each transformer is 50/83 MVA in size and step down 115 kV to 44 kV voltages. The Port Hope TS DESN 1 and DESN 2 summer 10 day LTR is 125 MW and 104 MW, respectively. The stations 2018 actual non-coincident summer peak load (adjusted for extreme weather) was about 114 MW and is forecasted to be 136 MW in the next 20 years. Transformer T3 / T4 are 61 years old and have reached their end of life. In addition, 44 kV switchyard associated with transformer T3 / T4 is also at the end of life and need to be replaced.

The scope of this project is to replace transformers T3 and T4 and associated 44 kV switchyard assets with the current standard equipment. Replacing transformer with lower size rating is not recommended as the load is increasing. Moreover, the current LTR rating of the transformers is adequate to serve the forecasted load for the next 20 years and therefore, the preferred option is to replace the transformer with the similar size transformer. The targeted in-service for this project is in year 2023.

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

c. Havelock TS – Transformers Replacement

Havelock TS is located into Central East Ontario and supplies the surrounding area via T1/T2 DESN. Each transformer is 83.3 MVA in size and step down 230 kV to 44 kV feeder voltages. The station summer 10 day LTR is 88 MW. The stations 2018 actual non-coincident summer peak load (adjusted for extreme weather) was about 75 MW and is forecasted to be 90 MW in the next 20 years. Transformers T1/T2 are 56 years old and have reached their end of life and need to be replaced.

The scope of this project is to replace transformers T1 and T2 with new transformers. The newer similar size 50/83 MVA transformer will have a 10 day LTR rating greater than 100 MW and would serve the expected load forecast for the next 20 years

Transformer cost difference based on its size only is minimal. Hence, replacing transformer with lower size rating is not recommended as the load is increasing and downsizing the capacity today and then later upgrading it with larger transformers will be significantly more costly. Moreover, the current LTR rating of the transformers is adequate to serve the forecasted load. Therefore, the preferred option is to replace the transformer with the similar size transformer. The targeted in-service is in year 2027.

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

d. Belleville TS – Transformer Replacement

Belleville TS supplies City of Belleville and surrounding area via T1/T2 DESN. Each transformer is 125 MVA in size and step down 230 kV to 44 kV feeder voltages. The station summer 10 day LTR is 161 MW. The stations 2018 actual non-coincident summer peak load (adjusted for extreme weather) was about 158 MW and is forecasted to be 189 MW in the next 20 years. Transformer T2 and T1 are 52 years and 45 years old respectively, and have reached their end of life and requires to be replaced. In addition, Station Service Transformers (SSTs), 230 kV switches and associated EOL equipment with transformer T2 and T1 are also require to be replaced.

The scope of this project is to replace the transformer T2 and T1. Replacing them with lower size transformer rating is not recommended as the load is increasing and downsizing the capacity today and then later upgrading it with larger transformers will be significantly more costly. Moreover, these transformers are already the highest standard size transformer, 75/100/125 MVA size, and since the load at Belleville

TS is not expected to decrease in future, the preferred option is to replace these transformer with the similar size transformer. The targeted in-service for transformer T2 is year 2021 and transformer T1 is in year 2025.

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

7.2 Station and Transmission Capacity Needs in the Peterborough to Kingston Region

The following Station and Transmission supply capacities needs have been identified in the PtoK region during the study period of 2019 to 2028.

7.2.1 230/115 kV Autotransformers

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

7.2.2 230 kV Transmission Lines

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

7.2.3 115kV Transmission Lines

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

7.2.4 230 kV and 115 kV Connection Facilities

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

a. Frontenac TS

The 2018 actual non-coincident summer peak load on Frontenac TS was 113 MW which is above its 10 day summer LTR of 111 MW. Based on the submitted load forecast, the Frontenac TS will be loaded more than 125 MW in the mid term.

Upgrading the transformers at Frontenac TS is not economically feasible as the transformers are already the largest size for a 115 kV connection. In addition, preliminary studies indicate that there is voltage and thermal constraints on 115 kV line circuits when adding a new DESN on these lines. Also, the cost of upgrading 115 kV transmission line to 230 kV has been a deterrent due to low load growth in the area. As per the current configuration, Kingston Hydro indicated to Hydro One that it may have up to 12 MW of emergency load transfer capability between Gardiner TS DESN 1 T1/T2 and Frontenac TS T3/T4.

Based on the above, the Study Team recommends that in the near term, Hydro One Transmission work with the Hydro One Distribution and Kingston Hydro for load transfer options to Gardiner TS to provide load relief at Frontenac TS.

b. Gardiner TS DESN 1

The 2018 actual non-coincident summer peak for Gardiner TS DESN 1 T1/T2 was 129 MW. The summer peak for year 2019 was reduced from 129 MW to 119 MW due to load transfer work completed by Hydro One Distribution. As per submitted load forecast, the loading on Gardiner TS DESN 1 will be exceeded by its 10 day summer LTR of 125 MW by year 2025.

Gardiner TS DESN 2 is located in the same area and has 10 day summer LTR of 84 MW. Based on the submitted load forecast, Gardiner TS DESN 2 will have at least 42 MW of excess capacity available by year 2028.

Based on the above, the Study Team recommends that the mid to long-term area supply capacity for city of Kingston and nearby area should be further assessed as part of the IRRP and/or RIP.

c. Belleville TS

The 2018 actual non-coincident summer peak load (adjusted for extreme weather) on Belleville TS T1/T2 was about 159 MW and is at close to its 10 day summer LTR of 161 MW. In addition to normal load growth in the area, Elexicon Energy Inc. has recently received approximately 30 MW of load connection inquiries to be connected at the Belleville TS.

Belleville TS has space for second DESN. However, preliminary studies undertaken by Hydro One indicate that there may be voltage and/or thermal constraints on the transmission lines supplying Belleville TS. Based on these assessments, following options may be available to address the need for additional capacity at Belleville TS -

- Install an additional 3rd 75/125 MVA transformer at Belleville TS and assess transmission line capacity
- Install a new DESN with two 75/125 MVA and assess transmission line capacity

In addition, reactive support may also be required at the station. Study team recommends that further assessment should be undertaken as part of the integrated regional resource planning process and/or RIP to develop a preferred plan. The integrated regional resource planning process, which includes stakeholder and community engagement activities, will examine the technical feasibility, economic implications and required timing of options for long-term, reliable electricity supply to the area based on a demand forecast prepared by the Working Group at the outset of the process.

d. Other TSs and HVDSs in the Region

All the other TSs and HVDSs in the Region are forecasted to remain within their normal supply capacity during the study period and therefore, the capacity needs for these TSs and HVDSs will be reviewed in the next planning cycle.

7.3 System Reliability, Operation and Restoration Review

No new significant system reliability and operating issues identified for this Region. Based on the net coincident load forecast, the loss of one element will not result in load interruption greater than 150MW. The maximum load interrupted by configuration due to the loss of two elements is below the load loss limit of 600MW by the end of the 10-year study period.

For the loss of circuits X2H and X4H, the load interrupted by configuration at Gardiner TS will exceed 150 MW threshold marginally based on the coincident load forecast. As per the current configuration, Kingston Hydro indicated to Hydro One that it may have up to 12 MW of emergency load transfer capability between 230 kV connected Gardiner TS DESN 1 and 115 kV connected Frontenac TS T3/T4. As such, no action is required at this time and this will be reviewed in the next planning cycle.

There are other operating considerations on the Bulk System related to the 230 kV that may need further assessment as part of Bulk System Planning in the region. For example , the Dobbin TS Auto Transformers are legacy transformers and the tap changers on all 3 units are limited in their voltage regulation capability that prevents the voltage on the 230kV tap of the transformer to be operated at higher voltages up to 264 kV.

7.4 Other Planning Considerations in the Peterborough to Kingston Region

In addition, community energy plans in the region have also been scanned and reviewed (Section 9 for references). Federal and Provincial agencies either operate and/or subsidize facilities, such as Canadian Forces Bases, Corrections Institutions and Post-Secondary Institutions in the region and similarly, municipal agencies operate many facilities in the study region; water, wastewater and recreation arenas to name a few. All these agencies are contemplating to reduce Green House Gas (GHG) emissions and to achieve carbon neutrality by no later than 2050 through renewable resources, energy efficiency and/or electrification of heating and transportation. At this time, there is insufficient data available for input into the load forecast for this Needs Assessment study however, the Study Team should monitor the evolving

climate action plans of federal, provincial and municipal agencies as they are expected to lead climate action over the next five years.

8 CONCLUSION AND RECOMMENDATIONS

In conclusion, the Gardiner TS DESN 1 station capacity need identified in the previous planning cycle has already been addressed. It is recommended that the newly identified needs shall be assessed in the current cycle of regional planning.

The Study Team recommends the following -

a. Over loading at Frontenac will be managed by Hydro One Transmission by coordinate with Hydro One Distribution and Kingston Hydro to undertake distribution load transfers between Gardiner TS and Frontenac TS over the near term.

b. An integrated regional resource planning (IRRP) and/or Regional Infrastructure Planning (RIP) process should be undertaken for the Peterborough-Kingston region to further assess the needs discussed above in section 7.2.4 a, b, and c as well as any addition needs identified in the area.

c. Replacement of end of life asset with similar equipment does not require further regional coordination (see further details in Section 7.1). The implementation and execution plan for these needs will be coordinated by Hydro One with affected LDCs:

i. Lennox TS: 230kV & 500kV Breaker Replacements (Bulk System)
ii. Port Hope TS: Transformer Replacement - EOL replacement of transformers T3 / T4
iii. Havelock TS: Transformer Replacement – EOL replacement of transformers T1 / T2
iv. Belleville TS: Transformer Replacement - EOL replacement of transformer T2

d. IRRP and/or RIP should monitor the potential impact of Federal, Provincial and/or Municipal climate change and/or energy plans for this region. .

9 REFERENCES

[1] RIP Report – Peterborough to Kingston Region – July 2016

[2] Local Planning Report – Gardiner TS Load Balancing – October 2015

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

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

[5] 2017 Long Term Energy Plan – Ontario Government

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

[7] Queen's University - Climate Action Plan dated January 2016

[8] St. Lawrence College 2018-2019 Business Plan & Energy Plan

[9] City of Kingston Municipal Energy Study – June 2018

[10] City of Kingston Declares Climate Emergency – March 2018

[11] City of Kingston – October 2019 Report to Council Number 19-261

Appendix A: Extreme Weather Adjusted Non-Coincident Summer / Winter Load Forecast

Table A.1: Peterborough to Kingston Region Summer Non-Coincident Load Forecast

Transformer Station		Summer 10 Day LTR (MW)	Type	Actual	Forecasted									
Name	DESN ID			2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Ardoch DS	T1	12	Gross	3	3	3	3	3	3	3	3	3	3	3
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	3	3	3	3	3	3	3	3	3	3	3
Battersea DS	T1/T2	12	Gross	8	8	8	9	9	9	9	9	9	9	9
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	8	8	8	8	8	8	8	8	8	8	8
Belleville TS	T1/T2	161	Gross	159	159	160	161	162	163	164	167	168	170	172
			CDM	0	2	3	3	4	5	5	6	6	7	8
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	159	157	157	158	158	158	159	161	162	163	164
Dobbin DS	T1/T2	24	Gross	10	15	15	15	15	15	15	15	15	16	16
			CDM	0	0	0	0	0	0	0	0	0	1	1
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	10	15	15	15	15	15	15	15	15	15	15
Dobbin TS	T3/T4	160	Gross	95	96	98	99	100	101	102	103	104	104	105
			CDM	0	1	2	2	2	2	3	3	3	4	4
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	95	95	96	97	98	99	99	100	100	101	101

Frontenac TS	T3/T4	111	Gross	113	115	118	120	123	124	124	125	125	126	126
			CDM	0	1	2	2	2	3	3	4	4	5	5
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	113	114	116	118	121	121	121	121	121	121	121
Gardiner TS	T1/T2	125	Gross	119*	119	122	123	125	127	128	129	130	131	132
			CDM	0	1	2	2	3	3	3	4	4	5	5
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	119*	118	120	121	122	124	125	125	126	126	127
Gardiner TS	T3/T4	84	Gross	35*	35	41	41	42	42	43	43	43	44	44
			CDM	0	0	1	1	1	1	1	1	1	2	2
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	35*	35	40	41	41	41	41	42	42	42	42
Harrowsmith DS	T1/T2	12	Gross	14	14	15	15	15	15	15	16	16	16	16
			CDM	0	0	0	0	0	0	0	0	1	1	1
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	14	14	15	15	15	15	15	15	15	15	15
Havelock TS	T1/T2	88	Gross	75	76	78	79	80	81	81	82	83	84	84
			CDM	0	1	1	1	2	2	2	2	3	3	3
			DG	0	1	1	1	1	1	1	1	1	1	1
			Net	75	74	75	76	77	78	78	78	79	79	80
Hinchinbrooke DS	T1	6	Gross	6	6	6	6	7	7	7	7	7	7	7
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	6	6	6	6	6	6	6	6	6	7	7
Lodgeroom DS	T1/T2	11	Gross	8	8	8	8	8	8	8	8	9	9	9
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG M	0	0	0	0	0	0	0	0	0	0	0
			Net	8	8	8	8	8	8	8	8	8	8	8

Napanee TS	T1	104	Gross	62	63	65	66	67	69	69	70	71	72	73
			CDM	0	1	1	1	1	2	2	2	2	3	3
			DG	0	0	0	0	0	0	0	0	0	0	-7
			Net	62	62	64	65	66	67	68	68	69	70	78
Northbrook DS	T1	12	Gross	6	6	7	7	7	7	7	7	7	7	7
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	6	6	6	6	7	7	7	7	7	7	7
Otonabee TS	T1/T2 (44kV)	97	Gross	65	60	61	61	66	70	71	73	74	75	76
			CDM	0	1	1	1	1	2	2	2	2	3	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	65	59	59	60	64	68	69	70	71	72	73
Otonabee TS	T1/T2 (27.6kV)	105	Gross	51	53	54	55	51	47	47	48	49	49	50
			CDM	0	0	1	1	1	1	1	1	2	2	2
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	51	53	53	54	50	45	46	47	47	48	48
Picton TS	T1/T2	78	Gross	59	60	62	63	64	65	66	67	68	69	70
			CDM	0	1	1	1	1	2	2	2	2	2	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	59	60	61	62	63	64	64	65	65	66	67
Port Hope TS	T1/T2	125	Gross	44	45	46	46	47	48	48	48	49	49	50
			CDM	0	0	1	1	1	1	1	1	2	2	2
			DG	0	0	1	1	1	1	1	1	1	1	1
			Net	44	44	45	45	46	46	46	46	47	47	47
Port Hope TS	T3/T4	104	Gross	70	70	72	73	73	74	75	76	76	77	78
			CDM	0	1	1	1	1	2	2	2	2	3	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	70	70	71	71	72	73	73	73	74	74	75

Sharbot DS	T1	6	Gross	4	4	4	4	4	4	4	4	4	4	4
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	4	4	4	4	4	4	4	4	4	4	4
Sidney TS	T1/T2	112	Gross	78	79	81	82	83	84	84	85	85	86	87
			CDM	0	1	1	1	2	2	2	3	3	3	3
			DG	0	0	0	0	0	0	0	-5	-5	-5	-5
			Net	78	78	79	80	81	82	82	88	88	89	89
LaFarge Canada CTS			Net	21	21	21	21	21	21	21	21	21	21	21
Enbridge PL Hilt CTS			Net	2	2	2	2	2	2	2	2	2	2	2
TCPL Cobourg CTS			Net	0	0	0	0	0	0	0	0	0	0	0
TCPL Belleville CTS			Net	0	0	0	0	0	0	0	0	0	0	0
Novelis CTS			Net	9	10	10	10	10	10	10	10	10	10	10

** The 2018 summer peak load adjusted for 10 MW of load transfer from Gardiner TS DESN 1 to DESN 2 by Hydro One Distribution.*

Table A.2: Peterborough to Kingston Region Winter Non-Coincident Load Forecast

Transformer Station		Winter 10 Day LTR (MW)	Type	Actual	Forecasted									
Name	**DESN ID**			**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**
Ardoch DS	T1	12	Gross	2	2	2	2	2	2	2	2	3	3	3
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	2	2	2	2	2	2	2	2	2	2	2
Battersea DS	T1/T2	12	Gross	11	10	10	10	11	11	11	11	11	11	11
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	11	10	10	10	10	10	10	10	10	10	10

Belleville TS	T1/T2	181	Gross	159	158	160	162	165	167	169	171	173	175	178
			CDM	0	2	3	3	4	5	5	6	6	7	8
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	159	156	157	159	161	162	164	165	167	169	170
Dobbin DS	T1/T2	24	Gross	10	16	17	17	17	17	17	17	17	17	17
			CDM	0	0	0	0	0	0	0	1	1	1	1
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	10	16	16	16	17	17	17	17	17	17	17
Dobbin TS	T3/T4	177	Gross	73	70	72	72	73	74	74	75	75	76	77
			CDM	0	1	1	1	1	2	2	2	2	3	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	73	70	71	71	72	72	72	73	73	73	74
Frontenac TS	T3/T4	122	Gross	117	117	120	123	126	127	128	129	129	130	131
			CDM	0	1	2	2	2	3	3	3	3	4	4
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	117	116	118	121	124	124	125	126	126	126	127
Gardiner TS	T1/T2	143	Gross	128*	128	130	132	133	135	136	137	138	139	140
			CDM	0	1	2	2	3	3	4	4	4	5	5
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	128*	127	128	130	130	132	132	133	134	134	135
Gardiner TS	T3/T4	84	Gross	37*	37	43	43	44	44	44	45	45	45	46
			CDM	0	0	1	1	1	1	1	1	1	2	2
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	37*	37	42	42	43	43	43	43	44	44	44
Harrowsmith DS	T1/T2	12	Gross	18	18	18	18	18	18	19	19	19	19	19
			CDM	0	0	0	0	0	0	0	1	1	1	1
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	18	17	18	18	18	18	18	18	18	18	18

Havelock TS	T1/T2	97	Gross	65	63	64	65	65	66	67	67	68	68	69
			CDM	0	1	1	1	1	2	2	2	2	2	3
			DG	0	1	1	1	1	1	1	1	1	1	1
			Net	65	61	62	62	63	63	64	64	64	65	65
Hinchinbrooke DS	T1	6	Gross	7	6	6	6	7	7	7	7	7	7	7
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	7	6	6	6	6	6	6	6	7	7	7
Lodgeroom DS	T1/T2	11	Gross	10	9	10	10	10	10	10	10	10	10	10
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	10	9	9	9	10	10	10	10	10	10	10
Napanee TS	T1	117	Gross	72	70	72	73	74	75	76	77	78	79	80
			CDM	0	1	1	1	1	2	2	2	3	3	3
			DG	0	0	0	0	0	0	0	0	0	0	-7
			Net	72	69	71	72	73	74	74	75	76	77	85
Northbrook DS	T1	12	Gross	7	6	7	7	7	7	7	7	7	7	7
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	7	6	6	7	7	7	7	7	7	7	7
Otonabee TS	T1/T2 (44kV)	109	Gross	78	75	76	77	77	78	78	79	79	80	80
			CDM	0	1	1	1	2	2	2	2	3	3	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	78	74	75	75	75	76	76	76	76	76	77
Otonabee TS	T1/T2 (27.6kV)	115	Gross	62	60	61	62	62	63	63	63	64	64	64
			CDM	0	1	1	1	1	1	2	2	2	2	2
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	62	60	60	61	61	61	61	61	62	62	62

Picton TS	T1/T2	89	Gross	57	56	57	58	59	60	60	61	62	63	64
			CDM	0	1	1	1	1	1	2	2	2	2	2
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	57	55	56	57	57	58	59	59	60	60	61
Port Hope TS	T1/T2	140	Gross	67	65	66	67	68	68	69	69	70	71	71
			CDM	0	1	1	1	1	2	2	2	2	3	3
			DG	0	0	1	1	1	1	1	1	1	1	1
			Net	67	64	65	65	66	66	67	67	67	68	68
Port Hope TS	T3/T4	116	Gross	76	75	76	77	78	79	79	80	80	81	81
			CDM	0	1	1	1	2	2	2	2	3	3	3
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	76	74	75	76	76	77	77	77	78	78	78
Sharbot DS	T1	6	Gross	4	4	4	4	4	4	4	4	4	4	4
			CDM	0	0	0	0	0	0	0	0	0	0	0
			DG	0	0	0	0	0	0	0	0	0	0	0
			Net	4	4	4	4	4	4	4	4	4	4	4
Sidney TS	T1/T2	112	Gross	84	82	83	84	85	86	87	87	88	89	89
			CDM	0	1	1	1	2	2	2	3	3	3	3
			DG	0	0	0	0	0	0	0	-5	-5	-5	-5
			Net	84	81	82	83	83	84	84	90	90	91	91
LaFarge Canada CTS			Net	21	21	21	21	21	21	21	21	21	21	21
Enbridge PL Hilt CTS			Net	2	2	2	2	2	2	2	2	2	2	2
TCPL Cobourg CTS			Net	0	8	8	8	8	8	8	8	8	8	8
TCPL Belleville CTS			Net	0	5	5	5	5	5	5	5	5	5	5
Novelis CTS			Net	9	9	10	10	10	10	10	10	10	10	10

** The 2018 winter peak load adjusted for 10 MW of load transfer from Gardiner TS DESN 1 to DESN 2 by Hydro One Distribution.*

Appendix B: Lists of Step-Down Transformer Stations

Sr. No.	Transformer Stations	Voltages (kV)
1.	Ardoch DS (T1)	115/12.5
2.	Battersea DS (T1/T2)	115/12.5
3.	Belleville TS (T1/T2)	230/44
4.	Dobbin DS (T1/T2)	115/27.6
5.	Dobbin TS (T3/T4)	115/44
6.	Frontenac TS (T3/T4)	115/44
7.	Gardiner TS (T1/T2)	230/44
8.	Gardiner TS (T3/T4)	230/44
9.	Harrowsmith DS (T1/T2)	115/12.5
10.	Havelock TS (T1/T2)	230/44
11.	Hinchinbrooke DS (T1)	115/12.5
12.	Lodgeroom DS (T1/T2)	115/12.5
13.	Napanee TS (T1)	230/44
14.	Northbrook DS (T1)	115/12.5
15.	Otonabee TS (T1/T2)	230/44
16.	Otonabee TS (T1/T2)	230/27.6
17.	Picton TS (T1/T2)	230/44
18.	Port Hope TS (T1/T2)	115/44
19.	Port Hope TS (T3/T4)	115/44
20.	Sharbot DS (T1)	230/12.5
21.	Sidney TS (T1/T2)	115/44
22.	LaFarge Canada CTS	230/13.8
23.	Enbridge PL Hilt CTS	115/4.16
24.	TCPL Cobourg CTS	115/4.16
25.	TCPL Belleville CTS	115/4.16
26.	Novelis CTS	115/13.2

Appendix C: Lists of Transmission Circuits

Sr. No.	Circuit ID	From Station	To Station	Voltage (kV)
1.	X1H, X2H, X3H, X4H	Hinchinbrooke SS	Lennox TS	230
2.	X21, X22	Picton TS	Lennox TS	230
3.	H23B	Belleville TS	Hinchinbrooke SS	230
4.	H27H	Hinchinbrooke SS	Havelock TS	230
5.	X1P	Dobbin TS	Chenaux TS	230
6.	C27P	Dobbin TS	Chat Falls GS	230
7.	T32H	Clarington TS	Havelock TS	230
8.	C25H	Chat Falls GS	Havelock TS	230
8.	T22C	Clarington TS	Chat Falls GS	230
9.	P15C	Cherrywood TS	Dobbin TS	230
10.	T25B	Clarington TS	Belleville TS	230
11.	P3S, P4S	Dobbin TS	Sidney TS	115
12.	Q6S	Cataraqui TS	Sidney TS	115
13.	B1S	Barrett Chute TS	Sidney TS	115
14.	Q3K	Cataraqui TS	Frontenac TS	115
15.	B5QK	Cataraqui TS	Frontenac TS to Barrett Chute TS	115

Appendix D: Lists of LDCs in the PtoK Region

Sr. No.	Company	Connection Type
1.	Peterborough Distribution Inc.	TX / DX
2.	Elexicon Energy Inc.	TX / DX
3.	Hydro One Distribution	TX
4.	Kingston Hydro	TX / DX
5	Lakefront Utilities Inc.	DX
6.	Eastern Ontario Power Inc.	DX

Appendix E: Acronyms

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