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NEEDS ASSESSMENT REPORT

Niagara Region

Date: May 24, 2021

Prepared by: Niagara Region Study Team

Disclaimer

This Needs Assessment (NA) Report was prepared for the purpose of identifying potential needs in the Niagara 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 Niagara (the "Region")

LEAD Hydro One Networks Inc. ("HONI")

START DATE: March 25th 2021 **END DATE:** May 24th 2021

1. INTRODUCTION

The first cycle of the Regional Planning process for the Niagara Region was completed in April 2016 with the publication of the Needs Assessment Report. As no further regional coordination or planning was required, the NA identified needs to be addressed between relevant Local Distribution Companies (LDCs) and Hydro One and other parties as required.

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

2. REGIONAL ISSUE/TRIGGER

In accordance with the Regional Planning process, the regional planning cycle should be triggered at least once every five years.

3. SCOPE OF NEEDS ASSESSMENT

This assessment's primary objective is to identify the electrical infrastructure needs over the study period (2021 – 2030) and recommend which needs require further regional coordination.

The scope of this NA includes:

- Review and reaffirm needs/plans identified in the previous NA;
- Identification and assessment of system capacity, reliability, operation, and aging infrastructure needs in the region; and
- Identify needs that can be addressed at the local level directly by Hydro One and the area LDCs. Other regional needs requiring further coordination can be studied by the Study Team during the other stages of the Regional Planning process.

4. INPUTS/DATA

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

5. ASSESSMENT METHODOLOGY

The assessment methodology includes review of planning information such as load forecast, conservation and demand management ("CDM") forecast and available distributed generation ("DG") information, 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. RESULTS

I. Needs Identified from Previous Cycle

- The previous needs assessment had identified the need to upgrade the Sir Adam Beck SS #1 x Portal Junction section of 115kV circuit Q4N. This upgrade work was completed in 2019.
- A few instances (<54 hours / year) of power factor below 0.9 (between 0.89 - 0.9) were observed at the HV side of Thorold TS. It was decided to. continue to monitor the power factors. Further detail is provided in Section 8.

II. Results of Current Review

- 230/115 kV Autotransformers and 230kV and 115kV Transmission lines

All 230kV and 115kV transmission line facilities are adequate over ths study period for the loss of a single circuit.

- 230 kV and 115 kV Connection Facilities

A station capacity assessment was performed over the study period for the 230 kV and 115 kV transformer stations in the Region using the station summer peak load forecast provided by the study team. All stations, except for Beamsville TS and Crowland TS, in the area have adequate supply capacity for the study period. These are further discussed in Section 8.2.4.

- System Reliability, Operation and Restoration

Load restoration is adequate in the area and meet the ORTAC load restoration criteria.

The needs assessment did not identify any additional issues with meeting load restoration as per the ORTAC load restoration criteria.

III. Newly Identified Needs in the region

- Beamsville TS - This station will exceed its normal supply capacity by 2027 based on the summer demand forecast. A solution is required to address the upcoming station capacity need.

- Crowland TS - Based on the summer demand forecast, this station will exceed supply in 2028 after the station refurbishment project where Hydro One will be upgrading the transformers with two new 115/27.6kV 83MVA units in 2024. A solution is required to address the midterm station capacity need.

7. RECOMMENDATIONS

- Beamsville TS – Hydro One will coordinate with the connected LDCs and their embedded customers (as needed) to address the immediate supply capacity constraints that may appear within 2027. Solution(s) will require further regional coordination to verify if non-wires options would be beneficial. All identified wire options needs will be best addressed through local planning led by Hydro One.

- Crowland TS – The station transformer replacement is presently underway and scheduled to be in service in 2024. Hydro One will try to expedite the replacement as quickly as possible to manage overloading risk to the existing end-of-life transformers. The Working Group will continue to develop supply capacity solution(s) for the Welland area load growth.

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2 INTRODUCTION

The first cycle of the Regional Planning process for the Niagara Region was completed in April 2016 with the publication of the Needs Assessment ("NA") Report.

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

This report was prepared by the Niagara 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: Niagara Region Study Team Participants

Niagara Study Team
Hydro One Networks Inc. (Lead Transmitter)
Alectra Utilities
Canadian Niagara Power Inc.
Grimsby Power Inc.
Hydro One Networks Inc. (Distribution)
Independent Electricity System Operator
Niagara on the Lake Hydro Inc.
Niagara Peninsula Energy Inc.
Welland Hydro Electric System Corp.

3 REGIONAL ISSUE/TRIGGER

In accordance with the Regional Planning process, the Regional Planning cycle should be triggered at least every five years. As such, the 2nd Regional Planning cycle was triggered for the Niagara region.

4 SCOPE OF NEEDS ASSESSMENT

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

- Review the status of needs/plans identified in the previous NA; 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"), Integrated Regional Resource Plan ("IRRP"), and/or Regional Infrastructure Plan ("RIP").

5 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

For regional planning purposes, the Niagara region includes the City of Port Colborne, City of Welland, City of Thorold, City of Niagara Falls, Town of Niagara-on-the-Lake, City of St. Catharines, Town of Fort Erie, Town of Lincoln, Township of West Lincoln, Town of Grimsby, Township of Wainfleet, and Town of Pelham. Haldimand County has also been included in the regional infrastructure planning needs assessment for Niagara region.

The boundaries of the Niagara Region is shown below in Fig. 1.

Electrical supply for this region is provided through a network of 230kV and 115kV transmission circuits supplied mainly by the local generation from Sir Adam Beck #1, Sir Adam Beck #2, Decew Falls GS, Thorold GS and the 230kV/115kV autotransformers at Allanburg TS.

Bulk supply is provided through the 230kV circuits (Q23BM, Q24HM, Q25BM, Q26M, Q28A, Q29HM, Q30M, and Q35M) from Sir Adam Beck #2 SS. These circuits connect this region to Hamilton/Burlington.

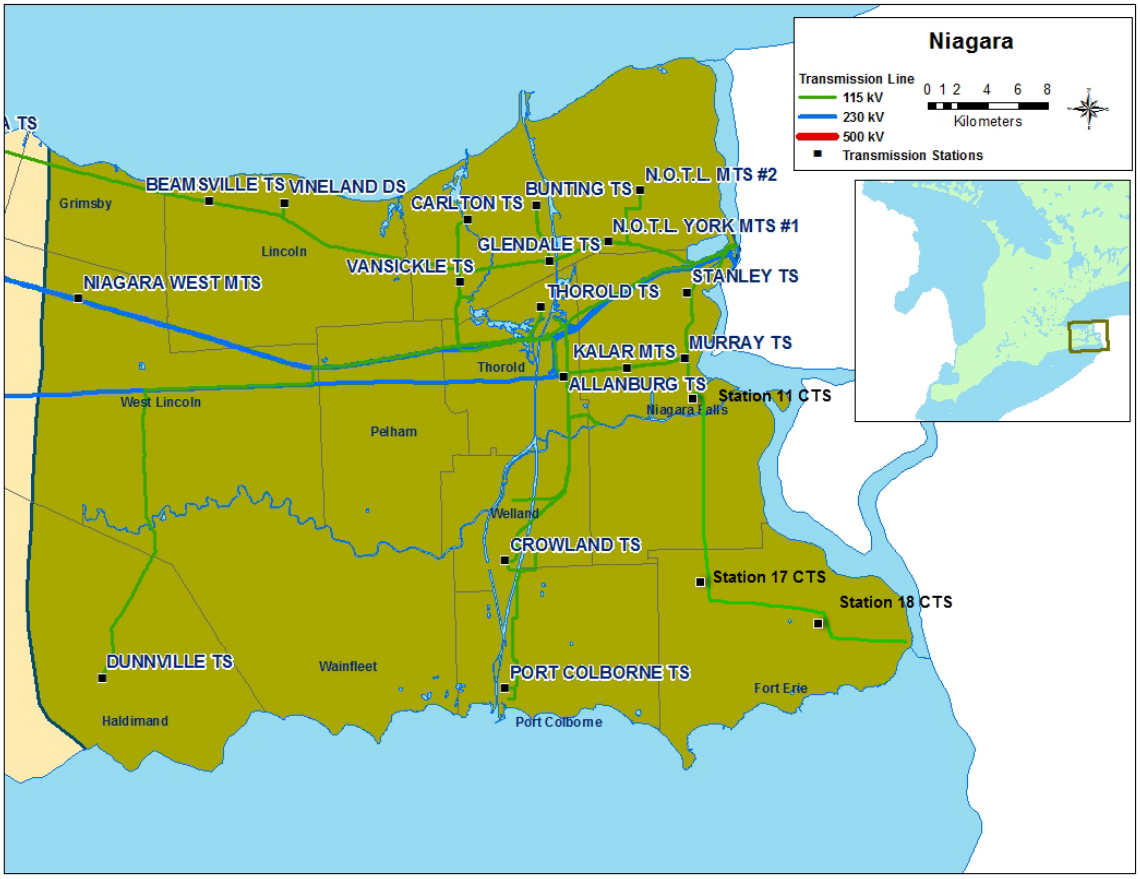

Figure 1: Geographical Area of Niagara Region with Electrical Layout

Winona TS is not included in the Niagara Region, as this is included in the Nanticoke/Burlington Region.

The existing facilities in the Region are summarized below and depicted in the single line diagram shown in Figure 2. The 230kV system is part of the bulk power system and is not studied as part of this Needs Assessment.

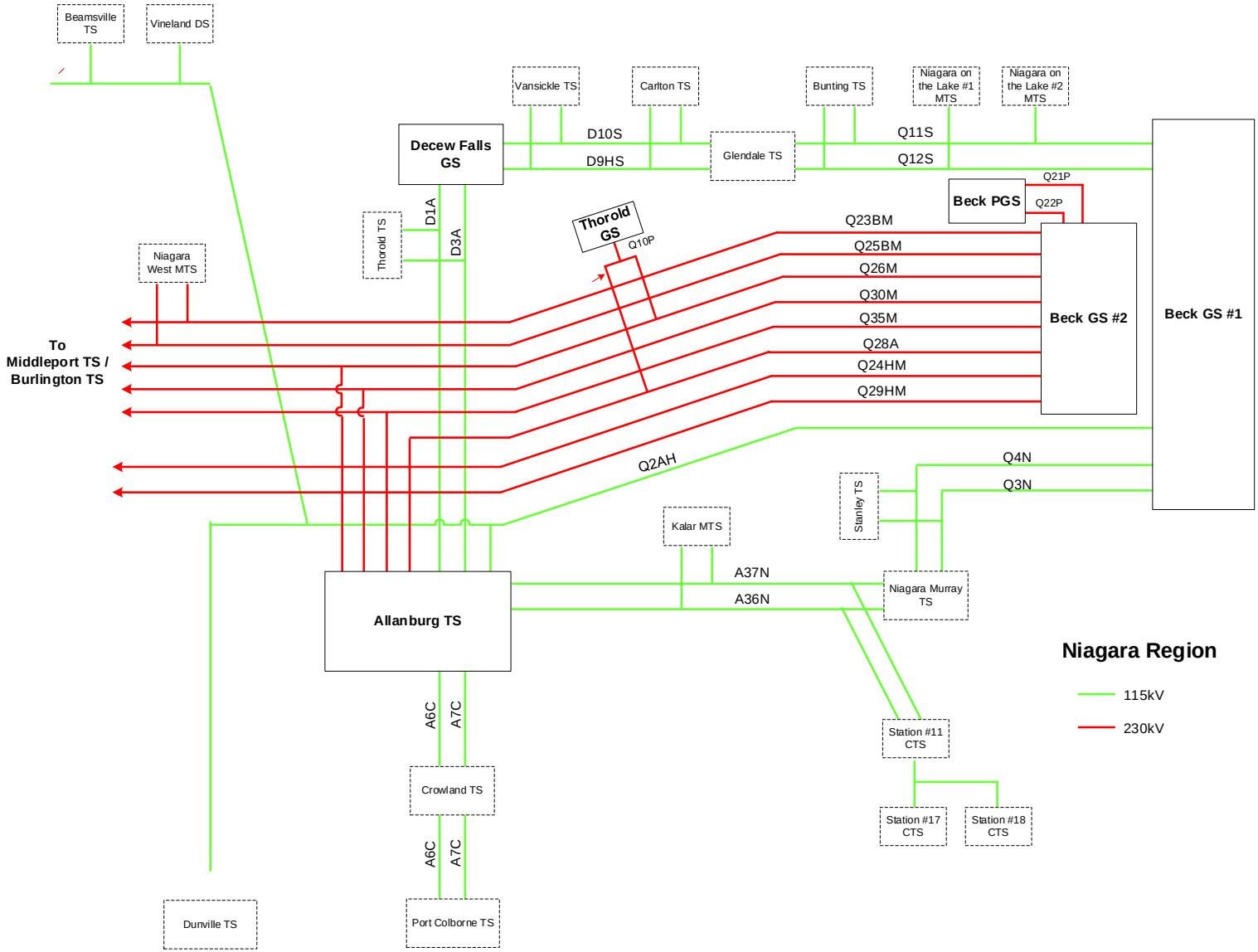

Figure 2: Single Line Diagram of Niagara Region

6 INPUTS AND DATA

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

- Niagara 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 Niagara Region.

7 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 Niagara region for the 10-year study period. The IESO provided a Conservation and Demand Management ("CDM") and Distributed Generation ("DG") forecast for the Niagara 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 2020 summer peak weather corrected loads. The summer weather correction factors were provided by Hydro One. The net weather summer load forecasts were produced by reducing the gross load forecasts for each station by the percentage CDM and then by the amount of effective DG capacity provided by the IESO for that station. It is to be noted that in the mid-term (5 to 10 year) time frame, contracts for existing DG resources in the region begin to expire, at which point the load forecast indicates a decreasing contribution from local DG resources, and an increase in net demand. These load forecasts for the individual stations in the Niagara region is given in Appendix A;

ii. Extreme weather scenario factor for 2020 of 0.9835 was also assessed for capacity planning over the study term[1];

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

iv. 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, and overhead lines.

A technical assessment of needs was undertaken based on:

[1]The extreme weather correction factor for 2020 was calculated to be of less than 1, given 2020 peak weather was already more than extreme. With the Covid-19 pandemic, the load was more weather sensitive than usual as many people were working from home and Industrial Conservation Initiative (ICI) was not in effect. The latter conditions is not expected to be repeated in the future (e.g., ICI is back in 2021)

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

8 NEEDS

This section describes emerging needs identified in the Niagara Region, and also reaffirms the near, mid, and long-term needs already identified in the previous regional planning cycle.

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

Table 2: Needs Identified in the Previous Regional Planning Cycle

Needs identified in the previous RP cycle	Needs Details	Current Status/Recommended Action	In-Service
Line Rating	Under high generation scenarios at Sir Adam Beck GS #1, the loading on the *Beck SS #1 x Portal Junction* section (egress out from the GS) of 115kV circuit Q4N can exceed circuit ratings.	This line section has been upgraded.	2019
	A few instances (<54 hours / year) of power factor below 0.9 (between 0.89 - 0.9) were observed at the HV side of Thorold TS. Hydro One will investigate these instances and work with Distribution customers to address.	Less than 3 MVAR required to bring power factor to 0.9. Correction required at the Distribution feeder level. Hydro One to continue monitoring with LDC.	-

8.1 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:

- Power transformers
- HV breakers
- Line conductor

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

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

Station	Proposed I/S	Description
Port Colborne TS: T61, T62 & Switchyard Refurbishment	**2022**	• Complete station refurbishment that will replace all assets including transformers T61, T62, medium voltage switching facilities and station protection and control equipment
Thorold TS: T1 & MV Switchgear Replacement	**2024**	• Replace T1 transformer with a new 45/60/75 MVA unit and the existing low voltage (LV) E/Q and B/Y metalclad switchgear
Crowland TS: T5, T6 & Component Replacement	**2024**	• Replace transformers T5 and T6 with 50/66.7/83.3 MVA units
D1A/D3A Tx Line Refurbishment	**2024**	• Line refurbishment of 2.6km route length between Gibson JCT x Thorold TS
Q2AH Tx Line Refurbishment	**2025**	• Line refurbishment of 11.2km between Rosedene JCT X St.Anns JCT
Murray TS: T14, T13 & Component Replacement	**2025**	• Replacement of T13 and T14 power transformers and metalclad at Murray TS. .
Bunting TS: T3 & MV Switchgear Replacement	**2026**	• Replacement of transformer T3, all station medium voltage switching facilities considered legacy and non-standard along with deploying a new protection and control protocol for all station protection and control equipment
Carlton TS: Switchyard Refurbishment and Reconfig.	**2026**	• Replace existing H/K metalclad switchgear with current Hydro One standard indoor air insulated (AIS) metalclad switchgear • Replace the existing B/Y switchyard with current Hydro One standard indoor air insulated (AIS) metalclad switchgear
Glendale TS: Station Refurbishment and Reconfiguration	**2027**	• Replace the existing 45/60/75 MVA T1 transformer with a new 45/60/75 MVA unit • Replace the existing 45/60/75 MVA T2 transformer with a new 45/60/75 MVA unit • Replace and reconfigure the LV switching facilities with current Hydro One standard air insulated (AIS) metalclad switchgear.
Vansickle TS: : MV Switchgear Replacement	**2027**	• Replacement of the 14.2kV BY metalclad.

Murray TS: T11, T12 & Component Replacement	**2029**	• Replacement of T11 and T12 power transformers at Murray TS.

8.2 Station and Transmission Capacity Needs in the Niagara Region

The following Station and Transmission supply capacities needs have been identified in the Niagara region during the study period of 2021 to 2030.

8.2.1 230/115 kV Autotransformers

The 230kV/115kV autotransformers at Allanburg TS (T1/T2/T3/T4) remain within limits for the study period based on both and summer demand forecast.

8.2.2 230 kV Transmission Lines

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

8.2.3 115kV Transmission Lines

The 115kV circuits supplying the Region are adequate over the study period for the loss of a single 115kV circuit in the Region.

8.2.4 230 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 summer station peak load forecasts provided by the study team. The results are as follows:

a. Beamsville TS

Beamsville TS has a summer 10-day LTR of 60.3MW and will exceed its normal supply capacity by 2027 based on the summer demand forecast. Between 2019 and 2020, there has been a 12% surge (6.6MW) in load between the historical peak demand. It is uncertain if this temporary increase is a result of the current pandemic with more residents working from home, as the 10 year load forecast is only expecting a modest 5% growth (3.1MW).

The Working Group has agreed to further monitor the load growth and substantiate if the one year increase is attributed to the pandemic. Furthermore, the Working Group will investigate transferring load to nearby stations, and possible CDM/DG initiatives to provide the capacity relief needed to meet the upcoming demand. It is worthwhile to note that the existing 115/27.6kV transformers were installed in 2003 and if needed, can be upgraded to larger units in agreement with the connected LDCs.

b. Crowland TS

Crowland TS presently has a 10-Day LTR of 102MW which will exceed its normal supply capacity in the year 2026 based on the summer demand forecast. The Crowland TS project to replace the two EOL transformers T5 and T6 is currently underway. The two new 115/27.6kV 83MVA transformers are expected to increase the station supply capacity to at least 107 MW based on minimum 10-day LTR capability of new transformers. With the new units installed, station LTR will be exceeded in the summer 2028 and additional supply capacity will be required.

Although capacity does appear to be available for the near and mid-term, Welland Hydro and Hydro One distribution also see a supply capacity constraint at the 27.6kV feeder level by 2028. The Working Group will further evaluate a new station east of the Welland Canal if nearby transformer stations cannot alleviate the demand of the new area load.

c. Other TSs in the Region

All the other transformer stations (TSs) in the region are forecasted to remain within their normal supply capacity during the study period. Capacity needs for these stations will be reviewed in the next planning cycle.

8.3 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.

9 CONCLUSION AND RECOMMENDATIONS

The Study Team recommends the following –

a. Beamsville TS – Hydro One will coordinate with the connected LDCs and their embedded customers (as needed) to address the immediate supply capacity constraints that may appear within 2027. Hydro One will continue to monitor the load to see if any load transfers are required. Solution(s) will require further regional coordination to verify if non-wires options would be beneficial. All identified wire options needs will be best addressed through local planning led by Hydro One.

b. Crowland TS – The station transformer replacement is presently underway and scheduled to be in service in 2024. Hydro One will try to expedite the replacement as quickly as possible to manage overloading risk to the existing transformers. The Working Group will continue to develop supply capacity solution(s) for the Welland area load growth.

Appendix A: Weather Adjusted Non-Coincident Summer Forecast

Transformer Station	DESN ID	Transformer Size	10 Day LTR MVA	10 Day LTR MW	Customer Data (MW)	Summer Peak Load											
						Historical Data (MW)			Near Term Forecast (MW)					Medium Term Forecast (MW)			
						2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Allanburg TS	*T7/T8*	*25/33/42*	*61.1*	*58.0*	Total Gross Peak Forecast				39.3	39.9	40.5	40.9	41.4	41.8	42.3	42.8	43.2	43.7
					Historical Load	34.3	35.2	40.0										
					Extreme Weather Correction			39.3	38.7	39.2	39.9	40.3	40.7	41.1	41.6	42.1	42.6	43.0
					DG				0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**37.9**	**38.2**	**38.4**	**38.5**	**38.7**	**39.1**	**39.4**	**39.8**	**40.2**	**40.6**
Beamsville TS	*T3/T4*	*25/33/42*	*62.8*	*60.3*[2]	Total Gross Peak Forecast				61.1	61.7	62.4	63.0	63.6	64.2	64.9	65.5	66.2	66.8
					Historical Load	56.1	53.4	60.0										
					Extreme Weather Correction			59.0	60.1	60.7	61.4	62.0	62.6	63.2	63.9	64.5	65.2	65.9
					DG				0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**59.3**	**59.4**	**59.4**	**59.5**	**59.8**	**60.3**	**60.7**	**61.3**	**61.8**	**62.4**
Bunting TS	*T3/T4*	*45/60/75*	*83.2*	*74.9*	Total Gross Peak Forecast				55.0	55.5	56.1	56.6	57.2	58.1	58.9	59.8	60.7	61.6
					Historical Load	50.6	47.4	54.7										
					Extreme Weather Correction			53.8	54.1	54.6	55.2	55.7	56.3	57.2	58.0	58.9	59.8	60.7
					DG				3.21	3.21	3.21	3.21	3.21	3.21	3.21	3.21	0.25	0.25
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**50.5**	**50.6**	**50.6**	**50.7**	**51.0**	**51.7**	**52.3**	**53.1**	**56.9**	**57.7**
Carlton TS	*T1/T2*	*45/60/75*	*104.8*	*99.6*	Total Gross Peak Forecast				79.4	80.2	81.0	81.8	82.6	83.9	85.1	86.4	87.7	89.0
					Historical Load	83.7	74.2	78.6										
					Extreme Weather Correction			77.3	78.1	78.9	79.7	80.5	81.3	82.6	83.8	85.1	86.4	87.7
					DG				5.96	9.07	9.07	9.07	9.07	9.07	9.07	9.07	9.07	3.74
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**71.6**	**68.6**	**68.6**	**68.8**	**69.2**	**70.2**	**71.2**	**72.3**	**73.4**	**80.0**
Crowland TS	*T5/T6*	*50/60/83*	*107*	*101.7*	Total Gross Peak Forecast				97.4	99.5	101.7	103.8	105.9	115.5	117.6	119.7	121.8	123.9
					Historical Load	83.9	76.4	85.1										
					Extreme Weather Correction			83.7	95.9	98.1	100.3	102.4	104.5	114.1	116.2	118.3	120.4	122.5
					DG				5.36	5.36	5.36	5.36	5.36	5.36	5.36	5.36	5.36	5.36
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**89.9**	**91.3**	**92.4**	**93.7**	**95.1**	**104.1**	**105.9**	**107.8**	**109.7**	**111.6**
Dunnville TS	*T1/T2*	*25/33/42*	*62*	*55.8*	Total Gross Peak Forecast				29.7	30.2	30.7	31.1	31.4	31.7	32.1	32.5	32.9	33.3
					Historical Load	27.0	25.8	30.2										
					Extreme Weather Correction			29.7	29.2	29.7	30.2	30.6	30.9	31.2	31.6	32.0	32.4	32.8
					DG				4.30	4.30	4.30	4.30	4.30	4.30	4.30	4.30	3.46	3.46

[2] @ 0.96 power factor, as per historical loading

					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**24.7**	**25.0**	**25.2**	**25.3**	**25.4**	**25.7**	**26.0**	**26.3**	**27.5**	**27.8**
Glendale TS	*T1/T2*	*45/60/75*	*103.6*	*93.2*	Total Gross Peak Forecast				25.0	25.3	25.5	25.8	26.0	26.4	26.8	27.2	27.6	28.1
					Historical Load	40.4	37.7	24.8										
					Extreme Weather Correction			24.4	24.6	24.9	25.1	25.4	25.6	26.0	26.4	26.8	27.2	27.6
					DG				0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**24.2**	**24.2**	**24.2**	**24.3**	**24.4**	**24.7**	**25.0**	**25.4**	**25.8**	**26.1**
Glendale TS	*T3/T4*	*11/15*	*20.1*	*18.1*	Total Gross Peak Forecast				13.6	13.7	13.8	14.0	14.1	14.3	14.6	14.8	15.0	15.2
					Historical Load	14.1	20.0	13.4										
					Extreme Weather Correction			13.2	13.4	13.5	13.6	13.8	13.9	14.1	14.3	14.5	14.8	15.0
					DG				0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**13.0**	**13.0**	**13.0**	**13.1**	**13.1**	**13.3**	**13.5**	**13.7**	**13.9**	**14.1**
Kalar MTS	*T1/T2*	*45/60/75*	*75*	*67.5*	Total Gross Peak Forecast				40.7	41.2	41.6	42.0	42.4	42.8	43.3	43.7	44.1	44.6
					Historical Load	38.9	38.4	39.2										
					Extreme Weather Correction			38.5	40.1	40.5	40.9	41.3	41.8	42.2	42.6	43.0	43.5	43.9
					DG				1.04	1.04	1.04	1.04	1.04	1.04	1.04	0.00	0.00	0.00
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**38.8**	**38.9**	**38.9**	**39.0**	**39.1**	**39.4**	**39.7**	**41.1**	**41.5**	**41.9**
Murray TS	*T11/T12*	*45/60/75*	*79.6*	*71.6*	Total Gross Peak Forecast				64.6	65.3	65.9	66.6	67.2	67.9	68.6	69.3	70.0	70.7
					Historical Load	64.0	63.6	58.0										
					Extreme Weather Correction			57.1	63.7	64.3	65.0	65.6	66.3	67.0	67.6	68.3	69.0	69.7
					DG				0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**63.0**	**63.2**	**63.2**	**63.3**	**63.6**	**64.1**	**64.6**	**65.1**	**65.7**	**66.4**
Murray TS	*T13/T14*	*45/60/75*	*85.8*	*81.5*	Total Gross Peak Forecast				41.9	42.4	42.9	43.3	43.7	44.1	44.5	44.9	45.4	45.8
					Historical Load	40.8	44.1	37.2										
					Extreme Weather Correction			36.6	41.3	41.8	42.3	42.7	43.1	43.5	43.9	44.3	44.8	45.2
					DG				0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**40.8**	**41.0**	**41.0**	**41.1**	**41.3**	**41.5**	**41.8**	**42.2**	**42.6**	**42.9**
Niagara West MTS	*T1/T2*	*40/53.3/66.7*	*66.7*	*60.0*	Total Gross Peak Forecast				45.0	45.4	45.9	46.3	46.8	47.3	47.8	48.2	48.7	49.2
					Historical Load	37.7	36.5	41.4										
					Extreme Weather Correction			40.7	44.3	44.8	45.2	45.7	46.1	46.6	47.1	47.5	48.0	48.5
					DG				4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24	4.24
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**39.7**	**39.8**	**39.8**	**39.9**	**40.1**	**40.5**	**40.8**	**41.2**	**41.6**	**42.1**
NOTL York MTS	*T1/T2*		*56*	*50.4*	Total Gross Peak Forecast				22	22	23	23	24	24	25	25	25	26
					Historical Load	20.0	17.0	20.0										
					Extreme Weather Correction			19.7	21.7	21.7	22.7	22.7	23.7	23.7	24.7	24.7	24.7	25.7
					DG				1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	0.32

					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**19.7**	**19.5**	**20.3**	**20.1**	**21.0**	**20.9**	**21.8**	**21.8**	**21.8**	**24.2**
NOTL #2 MTS	*T1/T2*		*70*	*63*	Total Gross Peak Forecast				31	32	32	33	33	34	34	34	35	35
					Historical Load	30.0	32.0	36.0										
					Extreme Weather Correction			35.4	30.4	31.4	31.4	32.4	32.4	33.4	33.4	33.4	34.4	34.4
					DG				0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.44
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**29.4**	**30.2**	**29.8**	**30.6**	**30.4**	**31.3**	**31.2**	**31.2**	**32.1**	**32.4**
Port Colborne TS	*T61/T62*	*28/37/47*	*52.9*	*47.6*	Total Gross Peak Forecast				36.7	37.1	37.5	37.9	38.2	38.6	39.0	39.4	39.8	40.2
					Historical Load	35.8	33.6	34.8										
					Extreme Weather Correction			34.3	36.2	36.5	36.9	37.3	37.7	38.0	38.4	38.8	39.2	39.6
					DG				0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**35.4**	**35.5**	**35.5**	**35.6**	**35.8**	**36.0**	**36.3**	**36.6**	**37.0**	**37.3**
Stanley TS	*T1/T2*	*45/60/75*	*110.2*	*99.2*	Total Gross Peak Forecast				60.6	61.2	61.8	62.5	63.1	63.7	64.4	65.0	65.6	66.3
					Historical Load	57.5	56.9	57.5										
					Extreme Weather Correction			56.5	59.7	60.3	60.9	61.5	62.1	62.8	63.4	64.0	64.7	65.4
					DG				0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**59.0**	**59.1**	**59.1**	**59.3**	**59.5**	**60.0**	**60.5**	**61.0**	**61.6**	**62.2**
Thorold TS	*T1/T2*	*45/60/75*	*98.2*	*88.4*	Total Gross Peak Forecast				22.9	23.2	23.4	23.6	23.7	23.8	24.0	24.1	24.3	24.4
					Historical Load	23.3	21.1	23.4										
					Extreme Weather Correction			23.1	22.6	22.8	23.1	23.2	23.3	23.4	23.6	23.8	23.9	24.0
					DG				0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**22.3**	**22.4**	**22.4**	**22.4**	**22.3**	**22.4**	**22.5**	**22.6**	**22.8**	**22.9**
Vansickle TS	*T5/T6*	*45/60/75*	*108.2*	*97.4*	Total Gross Peak Forecast				47.5	48.0	48.4	48.9	49.4	50.1	50.9	51.7	52.4	53.2
					Historical Load	52.1	48.0	51.0										
					Extreme Weather Correction			50.2	46.6	47.1	47.6	48.1	48.6	49.3	50.1	50.8	51.6	52.4
					DG				0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**45.9**	**46.1**	**46.1**	**46.2**	**46.4**	**47.0**	**47.6**	**48.2**	**48.9**	**49.7**
Vineland DS	*T1/T2*	*15/20/25*	*27.8*	*25.0*	Total Gross Peak Forecast				21.8	21.6	20.3	22.2	22.0	20.7	22.5	23.1	22.6	25.2
					Historical Load	21.6	18.4	19.5										
					Extreme Weather Correction			19.2	21.5	21.3	20.0	21.8	21.7	20.4	22.2	22.8	22.3	24.9
					DG				0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**20.7**	**20.4**	**18.9**	**20.5**	**20.3**	**19.0**	**20.7**	**21.2**	**20.7**	**23.2**
CNPI Station #17 MTS	*TF*	*37.5/50/62.5*	*62.5*	*56.3*	Total Gross Peak Forecast				45.3	45.7	46.2	46.6	47.1	47.6	48.0	48.5	49.0	49.5
					Historical Load	39.4	20.5	42.0										
					Extreme Weather Correction			41.3	44.6	45.0	45.5	45.9	46.4	46.9	47.3	47.8	48.3	48.8
					DG				0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**44.2**	**44.3**	**44.3**	**44.4**	**44.6**	**44.9**	**45.3**	**45.7**	**46.1**	**46.5**
CNPI Station #18 MTS	*TF1/TF2*	*37.5/50/62.5*	*62.5*	*56.3*	Total Gross Peak Forecast				39.9	40.3	40.7	41.1	41.5	42.0	42.4	42.8	43.2	43.7
					Historical Load	36.0	32.5	35.6										
					Extreme Weather Correction			35.0	39.3	39.7	40.1	40.5	41.0	41.4	41.8	42.2	42.6	43.1
					DG				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
					CDM				0.7%	1.5%	2.5%	3.2%	3.8%	4.0%	4.3%	4.4%	4.5%	4.6%
					Net Load Forecast				**39.0**	**39.1**	**39.1**	**39.2**	**39.4**	**39.7**	**40.0**	**40.4**	**40.7**	**41.1**

Appendix B: Lists of Step-Down Transformer Stations

Sr. No.	Transformer Stations	Voltages (kV)
1.	Allanburg TS	230/115/27.6
2.	Beamsville TS	115/27.6
3.	Bunting TS	115/13.8
4.	Carlton TS	115/13.8
5.	Crowland TS	115/27.6
6.	Dunnville TS	115/27.6
7.	GlendaleTS	115/13.8
8.	Kalar MTS	115/13.8
9.	Murray TS	115/13.8
10.	Niagara West MTS	230/27.6
11.	NOTL York MTS	115/27.6
12.	NOTL #2 MTS	115/27.6
13.	Port Colborne TS	115/27.6
14.	Stanley TS	115/27.6
15.	Thorold TS	115/13.8
16.	Vansickle TS	115/13.8
17.	Vineland DS	115/27.6
18.	CNPI Station #11 MTS	115/27.6
19.	CNPI Station #17 MTS	115/27.6
20.	CNPI Station #18 MTS	115/27.6

Appendix C: Lists of Transmission Circuits

Sr. No.	Circuit ID	From Station	To Station	Voltage (kV)
1.	Q3N/Q4N	Sir Adam Beck SS #1	Murray TS	115
2.	Q11S/Q12S	Sir Adam Beck SS #1	Glendale TS	115
3.	Q2AH	Sir Adam Beck SS #1	Allanburg TS / Beamsville TS / Dunnville TS	115
4.	A36N/A37N	Murray TS	Allanburg TS / Station #18 CTS	115
5.	A6C/A7C	Allanburg TS	Port Colborne TS	115
6.	D1A/D3A	Allanburg TS	Decew Falls SS	115
7.	D9HS/D10S	Glendale TS	Decew Falls SS	115

Appendix D: Lists of LDCs in the Niagara Region

Sr. No.	Company	Connection Type (TX/DX)
1.	Hydro One Networks Inc. (Distribution)	TX/DX
2.	Alectra Utilities	DX
3.	Canadian Niagara Power Inc.	TX/DX
4.	Grimsby Power Inc.	TX/DX
5	Niagara on the Lake Hydro Inc.	TX
6.	Niagara Peninsula Energy Inc.	TX/DX
7.	Welland Hydro Electric System Corp.	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
ICI	Industrial Conservation Initiative
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