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# NEEDS ASSESSMENT REPORT

## Windsor-Essex Region

**Date: October 24, 2017**

**Prepared by: Windsor-Essex Study Team**

**Disclaimer**

This Needs Assessment Report was prepared for the purpose of identifying potential needs in the Windsor-Essex Region and to recommend which needs may require 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.

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# Executive Summary

| | | | |
|---|---|---|---|
| **REGION** | Windsor-Essex | | |
| **LEAD** | Hydro One Networks Inc. ("HONI") | | |
| **START DATE** | June 29, 2017 | **END DATE** | October 24, 2017 |

## 1. INTRODUCTION

The first cycle of the regional planning process in the Windsor-Essex region was completed in 2015, with an Integrated Regional Resource Plan (IRRP) published in April 2015, followed by the publication of the Windsor-Essex Regional Infrastructure Plan (RIP) in December 2015. The RIP provided a summary of needs identified in the region through the IRRP process and provided further details regarding the wires plans identified to address the near-term and mid-term needs. The RIP also identified some long-term needs that will be reviewed during this planning cycle.

## 2. REGIONAL ISSUE/TRIGGER

In accordance with the regional planning process, a regional planning cycle should be triggered every five years, or less if there is emerging needs. This NA was triggered as the result of significant load growth and a new load forecast in the Kingsville-Leamington area, largely driven by expansion in the greenhouse sector, which may require changes to the existing recommended plans as set out in the previous RIP (December 2015), and/or development of new plans.

## 3. SCOPE OF NEEDS ASSESSMENT

The scope of this Needs Assessment covers the Windsor-Essex region, and includes:

- Identification of new needs based on updated information provided by the Study Team in the context of the ongoing work for the region being implemented as a result of the previous cycle and
- Confirmation of scope and timing of plans identified in the previous planning cycle in the IRRP and RIP.

The Study Team may also re-examine needs during the next phases of the planning process, namely Scoping Assessment (SA), Integrated Regional Resource Plan (IRRP) and RIP, based on updated information available at that time which may impact the magnitude or timing of the needs.

## 4. INPUTS/DATA

The Study Team, including representatives from Local Distribution Companies (LDCs), the Independent Electricity System Operator (IESO), and Hydro One (lead transmitter), provided inputs and any relevant information for the Windsor-Essex region regarding system reliability, capacity needs, operational issues, and major assets/facilities approaching end-of-life essential for regional planning.

## 5. ASSESSMENT METHODOLOGY

The assessment's primary objective is to identify the electrical needs in the region over the study period (2017-2026). The assessment reviewed available information including historical loading, future load forecast, forecast

impacts of planned conservation and demand management (CDM) programs, expected distributed generation (DG) capacity based on existing contracts, system reliability and operation issues in the region along with major high voltage equipment identified to be at the end of their useful life and requiring replacement/refurbishment.

## 6. RESULTS

Based on the new and updated information, a summary of the results of this Needs Assessment is provided below:

**Autotransformer and Transmission Line Capacity Needs**

- The 230/115kV autotransformers at Keith TS and Lauzon TS, providing supply to the J3E/J4E subsystem, are adequate over the study period for the loss of a single autotransformer based on available information on load growth and installed/contracted generation.

- The 230kV and 115kV transmission lines in the region are adequate over the study period for the loss of a single circuit based on available information on load growth and installed/contracted generation.

**Station Capacity Needs**

- **Kingsville TS**
  - As a result of significant load growth in the Kingsville-Leamington area, the peak load at Kingsville TS is expected to reach 73MW (in the summer) and 100MW (in the winter) within the next 5 years. This would exceed the Kingsville TS LTR, if the 4x42 MVA station were to be downsized to a 2x42MVA station in 2018 as per the 2015 RIP plan.
  - In light of this new information, Hydro One and the LDC (Hydro One Distribution) have agreed that larger standard size units (2x83MVA) should be used. The sustainment work is expected to be completed in 2019, and therefore no further action is required to address Kingsville TS capacity need.

- **Belle River TS** and **Lauzon TS (T5/T6 DESN)** could exceed their station supply capacity within the study period if the effects of installed capacitor banks are not considered.

- **Leamington TS** could exceed the station winter supply capacity within the study period when the effect of installed capacitor banks is not considered. The station winter peak may occur at a time of high voltages in the broader region which may prevent the deployment of the capacitor banks. Further study is required for Leamington TS winter capacity need.

**Load Restoration Needs**

- With the incorporation of Leamington TS in 2018 and the transfer of load from Kingsville TS to the new station, the system meets the requirement to restore power within 8 hours to customers in the J3E/J4E subsystem at peak times following the loss of circuits C23Z/C24Z. Based on the updated demand forecast, by the year 2026 up to 40MW of the interrupted load will remain to be restored

through maintenance crew work or recall of existing outage. This is expected to be accomplished within 8 hours of the initial contingency and hence meet the ORTAC restoration requirement. The amount of load requiring maintenance crew work for restoration is expected to increase in the long-term considering expiration of existing generation contracts in the next 10-15 years.

- Load restoration requirement for C21J/C22J, K2Z/K6Z, and Z1E/Z7E contingencies is expected to be met over the study period. With the incorporation of Leamington TS in 2018, post-contingency load transfers would be made to reduce the amount of load requiring maintenance crew work for restoration to below 150 MW. This balance of load is expected to be restored within 8 hours of the initial contingency and hence meet the ORTAC requirement for load restoration.

**System Operational Issues**

For the purposes of the Needs Assessment, the IESO identified issues related to overvoltage or thermal overload for select breaker failure and multiple element contingencies. The IESO will conduct a separate bulk planning study to determine if these events warrant changes to the Windsor Area Remedial Action Scheme to ensure the system can adequately handle these low probability events.

**Aging Infrastructure**

- End-of-life assets have been identified at the following stations: Kingsville TS (T1/T2/T3/T4 Transformers), Keith TS (Auto-Transformer), Crawford TS (T3 Transformer), Lauzon TS (T1/T2 Autotransformers, T6/T7 Step Down Transformers), and Malden TS (LV Breakers)

**Previously Identified Needs**

The following needs were identified in the previous regional planning cycle, and the recommended action should continue:

- Supply to Essex County Transmission Reinforcement (SECTR)
- 230kV/115kV circuit and 27.6kV feeder reconfiguration at Keith TS due to Gordie Howe International Bridge (GHIB) Project
- Additional feeder position at Malden TS
- Decommission of Tilbury TS and transfer of serviced load to a different supply point
- Decommission of T1 Transformer at Keith TS
- Replacement and upsizing of the Keith autotransformers to 250 MVA units[1]

## 7. RECOMMENDATIONS

The Study Team recommendations are as follows:

[1] Recent discussion between Hydro One and the IESO have confirmed that the previously identified need to replace the Keith autotransformers should be used as an opportunity to upsize the units based on their current utilization and known information about installed/contracted generation and load in the region.

a) Hydro One and relevant LDCs will develop an implementation plan for the following needs:
   - Replacement /refurbishment of EOL station equipment at Kingsville TS, Crawford TS, Malden TS, and Keith TS with similar type of equipment with same or higher ratings.
   - Station capacity needs at Kingsville TS, by replacing transformers with 2x83MVA units (as planned) to provide sufficient capacity over the study period.

b) Station capacity needs identified at Belle River TS and Lauzon TS (T5/T6 DESN) have been confirmed to be addressed by existing capacitor banks. No further investments are required.

c) Further assessment is required for the following needs via the coordinated regional planning process:
   - Station capacity need identified for Leamington TS if capacitor banks are not deployed.
   - Long-term restoration need for J3E/J4E subsystem for the loss of the circuits from Chatham to Lauzon.
   - Potential mid- to long-term load restoration needs for C21J/C22J, K2Z/K6Z, and Z1E/Z7E contingencies.
   - Sustainment needs at Lauzon TS which may lead to configuration changes/non-like-for-like replacement.

d) The IESO will undertake a bulk system study to further assess any changes that maybe needed to the Windsor Area Remedial Action Scheme to respect certain breaker failure or multiple element contingencies which may result in overvoltage or thermal overload.

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# 1 INTRODUCTION

The first cycle of the regional planning process in the Windsor-Essex region was completed in December 2015, with the publication of the Windsor-Essex Regional Infrastructure Plan ("RIP"). The RIP provides description of the identified needs and recommendations of preferred wires plans to address near-term and mid-term needs. The RIP also identified some long-term needs that will be reviewed during this planning cycle.

The purpose of this Needs Assessment ("NA") is to identify new needs, and confirm the needs and/or plans identified in the previous planning cycle. Since the first regional planning cycle, several new needs in the region have been identified. The majority of these needs are a result of load growth in the Kingsville-Leamington area which needs to be addressed over the next 10 years period.

This report captures the results of the assessment based on input provided by the Windsor-Essex Study Team listed below.

***Table 1. Windsor-Essex Study Team Participants***

| Company |
|---|
| Hydro One Networks Inc. (Lead Transmitter) |
| Independent Electricity System Operator ("IESO") |
| E.L.K. Energy Inc. |
| Entegrus Powerlines Inc. |
| EnWin Utilities Ltd. |
| Essex Powerlines Corporation |
| Hydro One Networks Inc. (Distribution) |

# 2 REGIONAL ISSUE/TRIGGER

In accordance with the regional planning process, the regional planning cycle should be triggered at least every five years, or when a new need emerges. This NA was triggered as the result of significant forecast load growth in the Kingsville-Leamington area, largely driven by expansion in the greenhouse sector.

The load at Kingsville TS was expected to be maintained under 50 MW as indicated in the previous RIP. Load beyond this limit would be transferred to the new Leamington TS (expected in-service date 2018). However, the recent load forecast updates provided by the LDCs shows that load in the Kingsville-Leamington area is growing significantly faster, and will become winter-peaking from 2019, as shown below. In particular, the Kingsville TS load will be well over the previously planned limit. This therefore negates the previous plan to downsize the station to 2 x 42 MVA transformers.

***Table 2. Kingsville-Leamington Area Load Forecast Comparison (Year 2019 Net)***

| Station | Old Load Forecast | New Load Forecast | |
|---|---|---|---|
| | | Summer | Winter |
| Kingsville TS | Limited to 50 MW | 82 | 110 |
| Leamington TS | 107 | 133 | 139 |

# 3 SCOPE OF NEEDS ASSESSMENT

The scope of this Needs Assessment includes:

- Identification of new needs based on latest information provided by the Study Team, and
- Confirmation of existing needs and/or plans identified in the previous planning cycle.

The Study Team determined that a comprehensive update of the load forecast is necessary for the second cycle due to greenhouse and grow light expansion in the Kingsville-Leamington area. The LDCs were requested to provide an update for all stations and is provided in Appendix A. The updated load forecast will be taken into account during the next phases of regional planning, i.e. SA, Integrated Regional Resource Plan ("IRRP") and RIP.

# 4 REGIONAL DESCRIPTION AND CONNECTION CONFIGURATION

The Windsor-Essex Region comprises the City of Windsor, Town of Amherstburg, Town of Essex, Town of Kingsville, Town of Lakeshore, Town of LaSalle, Municipality of Leamington, Town of Tecumseh, the western portion of the Municipality of Chatham-Kent and the Township of Pelee Island. The map of the region is shown in Figure 1 below.

The region's 115kV network connects to the 230kV transmission system at Keith TS and Lauzon TS via two auto-transformers in each station. About 60% of the area load is supplied by fourteen step-down transformer stations connected to the 115kV network, while the balance is supplied by three step-down transformer stations connected to the 230kV network.

The transmission system in the region can be divided into two "nested" subsystems:

- The Kingsville-Leamington subsystem: customers supplied from Kingsville TS and Leamington TS
- The J3E-J4E subsystem: customers supplied from stations connected to the Windsor-Essex 115 kV system, as well as customers supplied from the 230/27.6 kV Lauzon DESN.

As can be noted in Figure 2 below, the Kingsville-Leamington subsystem is nested within the J3E-J4E subsystem. Therefore, increasing supply to the Kingsville-Leamington subsystem or transferring load from the existing Kingsville TS to a new 230 kV TS will impact the supply and demand balance in the J3E-J4E subsystem.

Most of the load growth in the region is in the Kingsville-Leamington area and is largely driven by expansion in the greenhouse sector and the expanded use of grow light in the sector. The consequence of this use of grow light is that both Kingsville TS and Leamington TS will become winter peaking stations as per the load forecast (Appendix A).

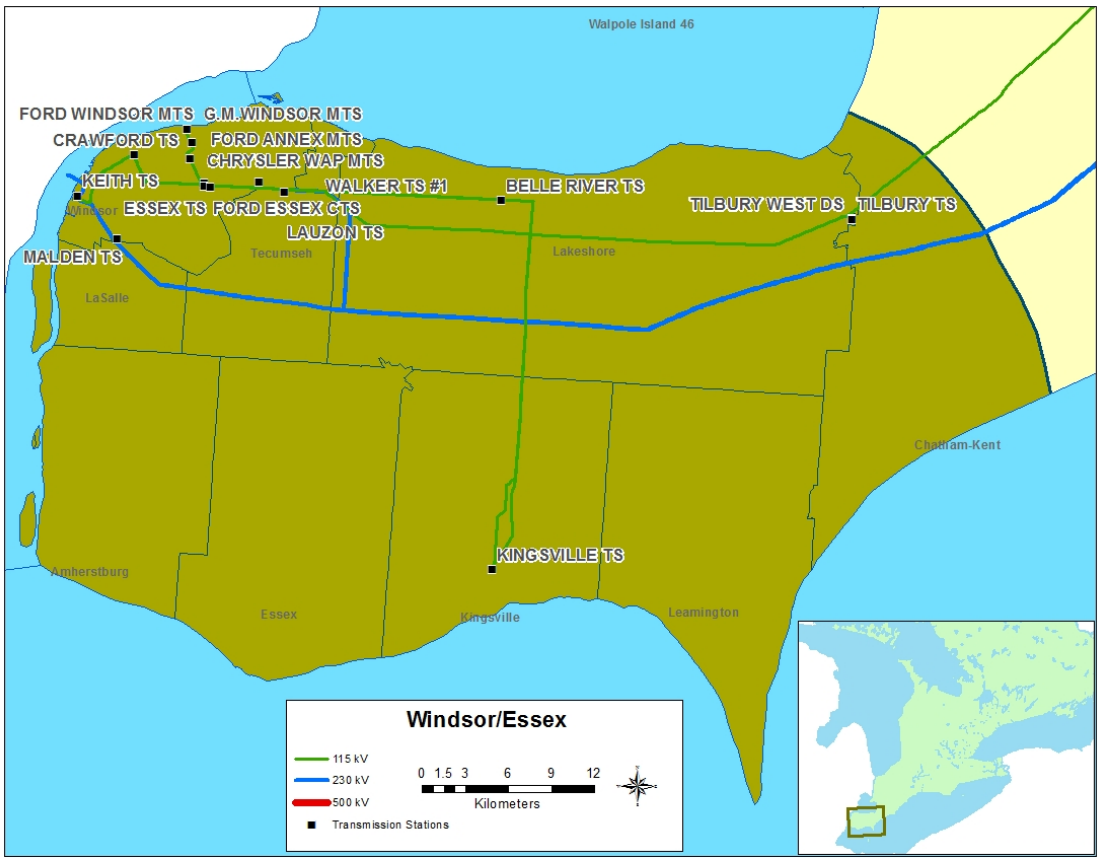



***Figure 1. Geographical Map of Windsor-Essex Region***

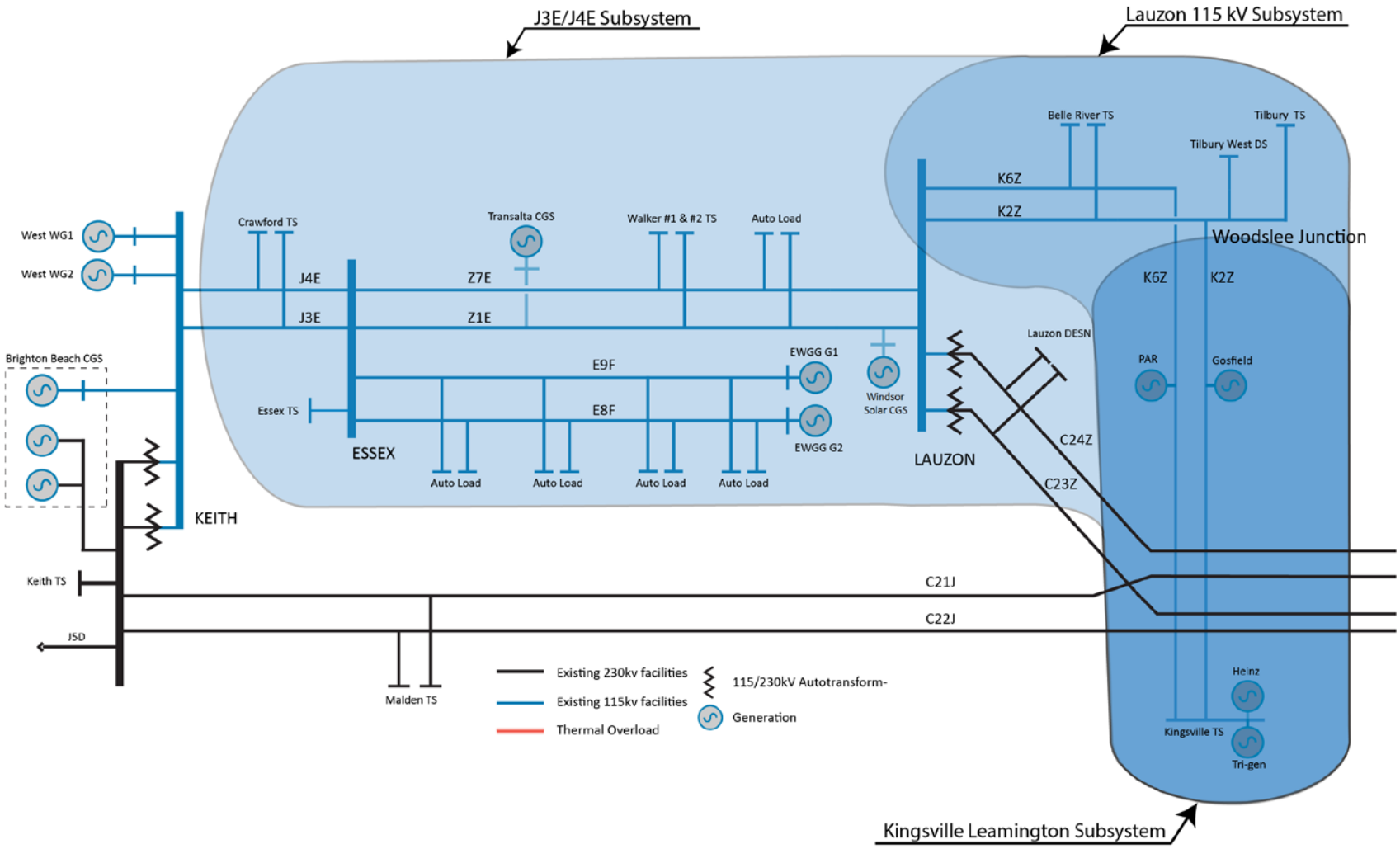



***Figure 2. Windsor-Essex Region Subsystems/Single Line Diagram***

# 5 INPUTS AND DATA

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

- Known capacity and reliability needs, operating issues, and/or major assets approaching the end of their useful life ("EOL"); and,
- Planned/foreseen transmission and distribution investments that are relevant to regional planning for the Windsor-Essex Region.

# 6 ASSESSMENT METHODOLOGY

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

Information gathering included:

i. New Load forecast was developed in view of the additional load growth.

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

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

Technical assessment of needs is based on:

i. Station capacity and Transmission Adequacy Assessment.

   a. The assessment is based on summer and winter peak loads. The study period for the adequacy assessment is 2017-2026.
   b. Station capacity adequacy is assessed by comparing the non-coincident peak load with the station's normal planning supply capacity, assuming a 90% lagging power factor.
   c. Normal planning supply capacity for Hydro One transformer stations in this Region is determined by the summer 10-Day Limited Time Rating (LTR).

ii. System reliability and operation assessment.

iii. End-of-life equipment: high-level assessment with respect to replacing equipment with similar type versus higher rating /downsizing/elimination of equipment or maintaining status quo.

# 7 RESULTS

This section summarizes the results of the Needs Assessment in the Windsor-Essex region.

## 7.1 Transmission System Capacity Needs

The 230/115kV autotransformers at Keith TS and Lauzon TS, providing supply to the J3E/J4E subsystem, are adequate based on existing transformers over the study period for the loss of a single autotransformer.

The 230kV and 115kV transmission lines in the region are adequate over the study period for the loss of a single circuit.

These assessments were conducted based on current load forecast for the region and information on installed/contracted generation.

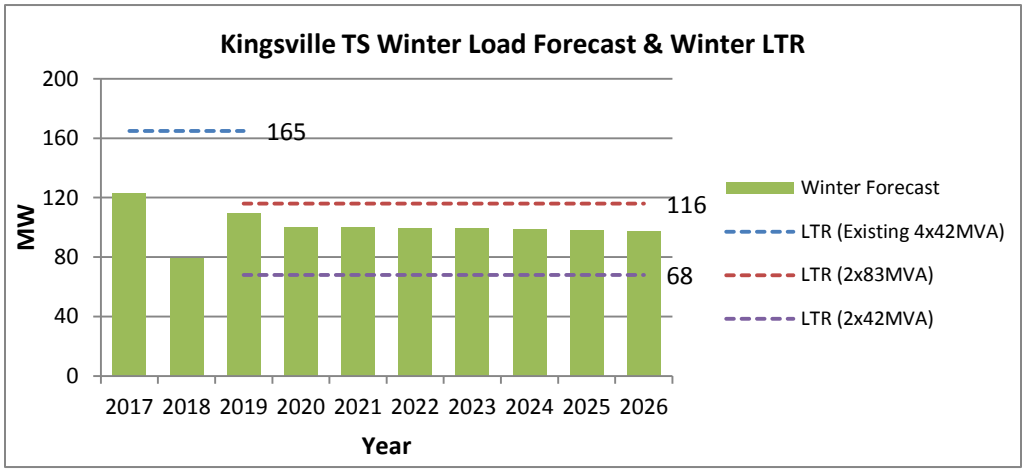
## 7.2 Transformer Station Capacity Needs

### 7.2.1 Kingsville TS

As the result of significant load growth in the Kingsville-Leamington area, peak load at Kingsville TS is expected to reach 73MW in the summer and 100MW in the winter within the next 5 years. The winter peak load would be well over the Kingsville TS LTR, if the 4x42 MVA station were to be downsized to a 2x42MVA station in 2018 as per the 2015 RIP plan.

In light of this new load forecast information, Hydro One and the LDC (Hydro One Distribution) have agreed that best alternative is to install larger units (2x83MVA) with relatively small incremental cost. The work is expected to be completed in 2019, and no further action is required to address Kingsville TS. The installation of 2x83MVA units would provide adequate transformation capacity as shown below.

***Figure 3. Kingsville TS Winter Load Forecast & Winter LTR***



### 7.2.2 Belle River TS, Lauzon TS (T5/T6 DESN)

Based on the summer forecast, Belle River TS and Lauzon TS (T5/T6 DESN) may exceed their station capacity within the study period. Table 3 below highlights the timing of the capacity need for each station.

***Table 3. Station Capacity Needs Based on Summer Load Forecast***

| Station/DESN | Summer LTR (MW)* | Historical (MW) | Summer Load Forecast (Net) (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Belle River TS | 53.7 | 45.2 | 46.0 | 46.7 | 47.6 | 48.4 | 49.5 | 50.5 | 51.5 | 52.5 | 53.6 | 54.6 |
| Lauzon TS T5/T6 | 100.8 | 95.5 | 105.1 | 103.6 | 102.7 | 102.0 | 101.5 | 101.0 | 100.8 | 100.4 | 100.0 | 99.6 |

Note *: at 0.9 power factor

However, there are capacitor banks installed at Belle River TS and Lauzon TS T5/T6, rated at 21.6MVar and 46.8 MVar, respectively. Further assessments determine that higher power factor resulting from the installed capacitor banks have effectively addressed the capacity needs identified above by increasing the LTR at Belle River TS and Lauzon TS to about 59MW and 112MW, respectively. As a result, the Study Team determines that no additional investments/plans are required.

### 7.2.1 Leamington TS

Based on the winter load forecast, Leamington TS may exceed its station supply capacity (LTR) by 2021, as shown in Table 4 below.

***Table 4. Station Capacity Needs Based on Winter Load Forecast***

| Station/DESN | Winter LTR (MW)* | Historical (MW) | Winter Load Forecast (Net) (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Leamington TS | 194.8 | 0.0 | 0.0 | 73.9 | 139.3 | 161.8 | 204.9 | 204.5 | 204.6 | 204.3 | 204.2 | 204.0 |

Note *: at 0.9 power factor

Capacitor banks, rated at 43.2MVar, are planned to be installed at Leamington TS when it comes into service. Higher power factor resulting from the capacitor banks will imply that Leamington TS will have sufficient capacity over the study period (about 209MW), and no additional investments/plans are required. However, the station winter peak may occur at a time of high voltages in the region due to significantly lower demand in the broader Windsor-Essex region. In this case, the capacitor banks may not be deployed so as not to further aggravate the voltage situation. The Study Team recommends further evaluation of the Leamington TS capacity need through the Scoping Assessment.

## 7.3 Load Restoration Needs

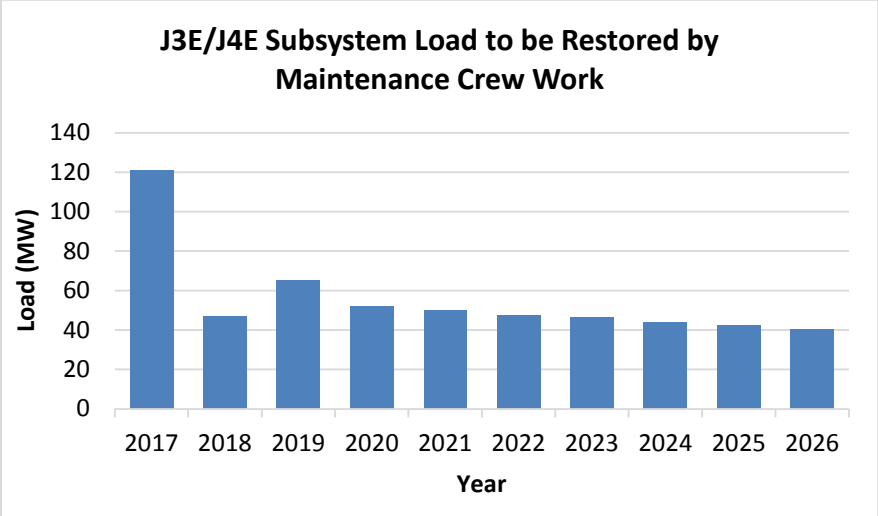
### 7.3.1 J3E/J4E Subsystem

Following the loss of 230kV double-circuit C23Z/C24Z, the entire load in the J3E/J4E subsystem would have to be met only through the path consisting of the Keith 230/115 kV autotransformers and J3E/J4E 115 kV circuits, by generation within the subsystem, and by load transfers out of the subsystem. Any balance of load would have to be restored through maintenance crew work or recall of an existing outage. This is expected to be accomplished within 8 hours.

Given the load forecast, generator effective capacity and contracts, load transfer limit, and ratings of circuits J3E/J4E and the Keith autotransformers, for the C23Z/C24Z contingency, Figure 4 shows the load that remains to be restored at summer peak through maintenance crew work or recall of existing outage. This load restoration is expected to be accomplished within 8 hours of the initial contingency. The large drop in load requiring maintenance crew work for restoration between 2017 and 2018 is due to the incorporation of Leamington TS and the transfer of load from Kingsville TS to the new station. From 2018 to the end of the study period, the level of load to be restored following the work of maintenance crew is of the order of about 40 MW. Restoration of this level of load within 8 hours meets the ORTAC restoration requirement. (It is assumed that the existing Keith autotransformers are replaced with 2x250MVA units in 2023, as per current sustainment plan.)

Considering the existing generation contracts expiring in the next 10-15 years, the amount of load that would require maintenance crew work for restoration could increase significantly and may exceed 150MW beyond the study period. The Study Team recommends that this need be further assessed in the next phases of the regional planning process, i.e. SA, IRRP and RIP.

***Figure 4. J3E/J4E Subsystem Load to be Restored by Maintenance Crew Work***



### 7.3.2 Other Restoration Needs

C21J/C22J, K2Z/K6Z and Z1E/Z7E contingencies will require some load to be restored within 4 hours as per ORTAC. In all cases (post-contingency) and with the new Leamington TS in-service in 2018, interrupted load can be restored by transfer below 150 MW within 4 hours. Remaining load below 150 MW can be restored within 8 hours through maintenance crew work. This would meet the ORTAC restoration requirement in the near- to mid-term. Whether further study of this issue is required, for the mid- to long-term, should be determined in the Scoping Assessment.

## 7.4 System Operational Issues

For the purposes of the Needs Assessment, the IESO identified issues related to overvoltage or thermal overload for select breaker failure and multiple element contingencies. The IESO will conduct a separate bulk planning study to determine if these events warrant changes to the Windsor Area Remedial Action Scheme to ensure the system can adequately handle these low probability events.

## 7.5 Aging Infrastructure

Hydro One has identified the following equipment to be reaching the end of their useful life in the next 10 years:

***Table 5. Equipment Reaching End-of-Life in the Next 10 Years***

| Equipment | Replacement/ Refurbishment Timing |
|---|---|
| Crawford TS: T3 Transformer | 2017 |
| Malden TS: LV Breakers | 2018 |
| Kingsville TS: T1/T2/T3/T4 Transformers | 2019 |
| Keith TS: Autotransformers | 2023 |
| Lauzon TS: T1/T2 Autotransformers, T6 & T7 Step-Down Transformers | 2025 |

Note that at this time, no other equipment in the region has been identified for major replacement/refurbishment. The scope of work, timing, and prioritization are under review/development and are subject to change.

The end-of-life equipment assessment for the above assets considered the following options:

1. Maintaining status quo
2. Downsizing equipment with lower ratings and built to current standards
3. Eliminating equipment
4. Replacing equipment with similar equipment with same ratings and built to current standards
5. Replacing equipment with similar equipment with higher ratings and built to current standards

With respect to (1), maintaining status quo for these assets is not an option due to the risk of equipment failure, customer outages and increased maintenance cost.

With respect to (2) and (3), downsizing or eliminating transformation capacity is not an option for the following reasons:

- Upgrading to higher capacity with similar type of equipment where there is forecast load growth or good utilization of current assets has little incremental cost. For example, it may cost $200-$300 thousand versus $5-$10 million in the future.
- Downsizing capacity today in areas where long-term load growth may be uncertain and then later upgrading due to eventual load growth would be significantly more costly (i.e. may result in incremental costs of $5-$10 million if additional capacity is needed within the lifetime of the new assets).
- In scenarios where facilities are well utilized or load is forecast to increase, maintaining or upgrading capacity to the maximum at the station is the most effective and efficient use of land and infrastructure for little incremental cost, if any. It also provides additional flexibility and reliable supply in emergency situations.

Therefore, for the assets currently identified in the region options (4) and (5) are considered preferred options.

### 7.5.1 Crawford TS

Crawford TS is in Essex County located North West of Windsor. It is supplied by 115 kV J3E and J4E circuits, that runs between Keith TS and Essex TS via Crawford junction. The station is comprised of two (2) step down transformers (T3/T4) in standard DESN configuration rated at 83 MVA with summer 10 day LTR of 91.2 MVA and supplies EnWin Utilities Ltd.

Hydro One has identified that T3 has reached the end of its useful life and in need of replacement in the near term. Considering Crawford TS is forecasted to be fully utilized throughout the study period, downsizing the station capacity is not a viable option given the capacity requirement of this station. The work involves replacement of T3 with the similar unit, 83MVA, removal of grounding transformers units GT3 and GT4, grounding the LV neutrals through Neutral Grounding Reactors, and upgrade of associated P&C system.

This near-term project is planned to be completed by the end of 2017.

### 7.5.2 Malden TS

Malden TS is located in North West of Windsor and supplied by the 230kV C21J and C22J circuits. The station is comprised of two (2) step down transformers (T1/T2) rated at 125 MVA with summer 10 day LTR of 203.8 MVA. Out of the twelve (12) feeders, six (6) supplies Hydro One Distribution and six (6) supplies EnWin Utilities Ltd. and embedded customer Essex Powerlines Corporation. These feeders supply power to downtown Windsor and the surrounding area.

The two (2) 27.6kV feeder breakers have reached end of life and Hydro One has planned to replace them with SF6 equivalents. Furthermore, AC station service system is also at end of its useful life which is also scheduled to be replaced with upgrade to associated P&C system.

The equipment replacements at Malden TS is planned to be completed by the end of 2018.

### 7.5.3 Kingsville TS

Kingsville TS is a major station in Essex County located south east of Windsor. It is supplied by double circuit 115kV line, K2Z and K6Z. The station is comprised of four non-standard transformers (T1/T2/T3/T4) rated at 42 MVA with the summer 10 day LTR of 158 MVA. The station supplies Hydro One Networks and embedded customers include several large farms, Local Distribution Companies (LDCs) such as E.L.K Energy Inc., Entegrus Powerlines Inc., Essex Powerlines Corporation and other large retail customers in Essex County.

T1, T2, and T4 transformers along with five LV breakers have reached the end of their useful life. Hydro One has planned to reconfigure the non-standard four-transformer DESN to standard two-transformer DESN. The end of life breakers will also be replaced with upgrade to associated P&C system and station service.

In the previous RIP, Hydro One had planned to downsize and reconfigure Kingsville TS from 4x42MVA to 2x42MVA, and reduce the Kingsville load to about 50 MW, and transfer the rest to Leamington TS.

As a result of the significant increase in load in the Kingsville area, Hydro One is proceeding with a plan to replace the 4x42 MVA transformers with 2x83 MVA units. In addition, it will help to manage the risk of failure of transformers T4 and T2. The state of these transformers is being monitored regularly. The replacement is planned to be in-service in November 2019, but may be sooner depending on the state of T4 and T2.

This project will be coordinated with the SECTR project, in that, some loads at Kingsville will be transferred to the new Leamington TS once the new station is placed in service in 2018.

### 7.5.4 Keith TS

Keith TS is located in the City of Windsor and is in service since 1952. It is comprised of two 230/115 kV 125 MVA autotransformers (T11/T12) connecting Chatham SS, Malden TS, Lauzon DS and Essex DS. Keith TS consists of one DESN (230/27.6 kV) with two power transformers (T22/T23) and another DESN (115/27.6 kV) with single power transformer (T1), supplying Hydro One Distribution, EnWin Utilities Ltd., and embedded customer Essex Powerlines Cooperation.

It was identified in the previous RIP that the autotransformers have neared the end of their useful life and in need of replacement. There is also operating flexibility limitations due to lack of self-cooled rating of the Keith autotransformers, as they would have to be taken out of service following the loss of station service. It was recommended in the previous RIP to replace with similar unit size (125 MVA), this

however, has been revisited and the unit size will be upgraded to 250 MVA. The upgrade will provide long-term value at minimal cost increase, and will address the operating limitations as the new autotransformers will have self-cooled rating.

This project is currently planned to be completed in 2023.

### 7.5.5 Lauzon TS

Lauzon TS is a major station located in the North West of Windsor and comprised of two 230/115kV autotransformers (T1/T2) and two 230/27.6kV DESN (T5/T6 and T7/T8), rated at 83MVA with 10 day LTR of 112 MVA and 114.7 MVA respectively. This station supplies Hydro One Distribution and EnWin Utilities Ltd and embedded customers include E.L.K Energy Inc. and Essex Powerlines Corporation.

There are several station equipment that are at the end of its useful life including the autotransformers, T6/T7 step down transformers, HV breakers, etc. Considering load growth expected downstream in the 115kV subsystem, as well as the fact that Lauzon TS DESN is forecasted to be near capacity throughout the study period, Hydro One is currently planning to replace the autotransformers and the step transformers with similar size unit. Due to deteriorating condition, the station service transformer, SS2, one 115kV breaker, two LV breakers will be replaced with upgrade to associated ancillary equipment.

There may be opportunities to re-configure the station to improve system restoration following the loss of the circuits from Chatham to Lauzon and to consider if any upsizing would be merited based on future load and or changes to installed/contracted generation in the region. As such, it is recommended that this end-of-life need be considered further in the Scoping Assessment as it may benefit from more comprehensive planning through the IRRP process.

This work is tentatively planned to be complete in 2025.

## 7.6 Previously Identified Needs

The following needs were previously identified in the RIP, but no impacts/changes are recommended to the associated plan. These needs are listed below for reference only.

- SECTR Project
- 230kV/115kV circuit and 27.6kV feeder reconfiguration at Keith TS due to Gordie Howe International Bridge (GHIB) Project
- Additional feeder position at Malden TS
- Decommission of Tilbury TS and transfer of serviced load to a different supply point
- Decommission of T1 Transformer at Keith TS
- Replacement and upsizing of the Keith autotransformers to 250 MVA units

# 8 RECOMMENDATIONS

The Study Team recommendations are as follows:

a) Hydro One and relevant LDCs will develop an implementation plan for the following needs:
   - Replacement /refurbishment of EOL station equipment at Kingsville TS, Crawford TS, Malden TS, and Keith TS with similar type of equipment with same or higher ratings.
   - Station capacity needs at Kingsville TS, by replacing transformers with 2x83MVA units (as planned) to provide sufficient capacity over the study period.

b) Station capacity needs identified at Belle River TS and Lauzon TS (T5/T6 DESN) have been confirmed to be addressed by existing capacitor banks. No further investments are required.

c) Further assessment is required for the following needs via the coordinated regional planning process:
   - Station capacity need identified for Leamington TS if capacitor banks are not deployed.
   - Long-term restoration need for J3E/J4E subsystem for the loss of the circuits from Chatham to Lauzon.
   - Potential mid- to long-term load restoration needs for C21J/C22J, K2Z/K6Z, and Z1E/Z7E contingencies.
   - Sustainment needs at Lauzon TS which may lead to configuration changes/non-like-for-like replacement.

d) The IESO will undertake a bulk system study to further assess any changes that maybe needed to the Windsor Area Remedial Action Scheme to respect certain breaker failure or multiple element contingencies which may result in overvoltage or thermal overload.

The SA Study Team will decide if a regional or sub-regional approach is required for the needs recommended to be assessed and scoped in Scoping Assessment. The Scoping Assessment is expected to be completed by Q2 2018.

# 9 REFERENCES

[1] Planning Process Working Group (PPWG) Report to the Board: The Process for Regional Infrastructure Planning in Ontario. May 17, 2013

[2] IESO Ontario Resource and Transmission Assessment Criteria (ORTAC) – Issue 5.0

[3] Hydro One Networks Inc. Windsor-Essex Regional Infrastructure Plan. December 22, 2015

# APPENDIX A: NON-COINCIDENT NET LOAD FORECAST (MW)

**Summer**

| Station/DESN | LTR (MW) | Historical (MW) | Summer Net Forecast (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Belle River TS | 53.7 | 45.2 | 46.0 | 46.7 | 47.6 | 48.4 | 49.5 | 50.5 | 51.5 | 52.5 | 53.6 | 54.6 |
| Chrysler WAP MTS | 58.5 | 34.4 | 34.1 | 33.7 | 33.4 | 33.1 | 32.9 | 32.7 | 32.6 | 32.4 | 32.2 | 32.1 |
| Crawford TS | 91.5* | 78.5 | 89.3 | 88.0 | 87.0 | 86.2 | 85.6 | 85.0 | 84.6 | 84.1 | 83.7 | 83.2 |
| Essex TS | 106.7 | 53.9 | 69.9 | 68.8 | 68.0 | 67.3 | 66.9 | 66.4 | 66.0 | 65.6 | 65.2 | 64.8 |
| Ford Annex MTS | 38.7 | 7.2 | 7.1 | 7.1 | 7.0 | 6.9 | 6.9 | 6.8 | 6.8 | 6.8 | 6.8 | 6.7 |
| Ford Essex CTS | 38.7 | 3.7 | 3.6 | 3.6 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.4 | 3.4 | 3.4 |
| Ford Windsor MTS | 58.5 | 10.9 | 10.9 | 10.7 | 10.6 | 10.5 | 10.5 | 10.4 | 10.4 | 10.3 | 10.3 | 10.2 |
| G.M.Windsor MTS | 38.7 | 0.0 | 13.0 | 12.9 | 12.7 | 12.6 | 12.6 | 12.5 | 12.5 | 12.4 | 12.4 | 12.3 |
| Keith TS T1 | 37.5 | 8.6 | 8.5 | 8.4 | 8.3 | 8.2 | 8.2 | 8.2 | 8.1 | 8.1 | 8.0 | 8.0 |
| Keith TS T22/T23 | 104.8 | 72.6 | 70.7 | 69.7 | 69.0 | 68.4 | 69.2 | 68.8 | 68.5 | 68.2 | 67.9 | 67.6 |
| Kingsville TS | ** | 124.4 | 125.5 | 58.6 | 82.0 | 72.6 | 72.8 | 72.4 | 72.0 | 71.7 | 71.3 | 71.0 |
| Lauzon TS T5/T6 | 100.8 | 95.5 | 105.1 | 103.6 | 102.7 | 102.0 | 101.5 | 101.0 | 100.8 | 100.4 | 100.0 | 99.6 |
| Lauzon TS T7/T8 | 103.2 | 86.6 | 87.5 | 86.6 | 85.8 | 84.2 | 83.8 | 83.4 | 83.1 | 82.8 | 82.5 | 82.2 |
| Leamington TS | 183.4 | 0.0 | 0.0 | 78.1 | 132.7 | 116.4 | 119.4 | 119.5 | 119.9 | 120.1 | 120.4 | 120.6 |
| Malden TS | 183.4 | 114.1 | 122.0 | 121.9 | 120.9 | 121.1 | 120.7 | 120.3 | 121.0 | 121.6 | 122.2 | 121.9 |
| Tilbury TS | 7.2 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Tilbury West DS | 30.6 | 19.1 | 18.9 | 18.8 | 18.6 | 19.3 | 19.2 | 19.2 | 19.2 | 19.2 | 19.3 | 19.3 |
| Walker MTS #2 | 89.1 | 87.7 | 81.1 | 79.8 | 79.1 | 78.5 | 78.1 | 77.7 | 77.4 | 77.1 | 76.8 | 76.5 |
| Walker TS #1 | 90.4 | 65.0 | 70.8 | 69.8 | 69.1 | 68.6 | 68.3 | 67.9 | 67.7 | 67.4 | 67.2 | 66.9 |

**Winter**

| Station/DESN | LTR (MW) | Historical (MW) | Winter Net Forecast (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Kingsville TS | ** | 108.0 | 123.2 | 79.3 | 109.6 | 100.0 | 100.1 | 99.5 | 99.1 | 98.5 | 98.1 | 97.5 |
| Leamington TS | 194.8 | 0.0 | 0.0 | 73.9 | 139.3 | 161.8 | 204.9 | 204.5 | 204.6 | 204.3 | 204.2 | 204.0 |

Notes:
*: Crawford TS LTR after T3 replacement in 2017
**: Kingsville TS:

- LTR of existing configuration (4x42MVA): Summer: 145MW, Winter: 165MW
- LTR after replacement (2x83MVA): Summer: 104MW, Winter: 116MW

# APPENDIX B: NON-COINCIDENT GROSS LOAD FORECAST (MW)

**Summer**

| Station/DESN | LTR (MW) | Historical (MW) | Summer Gross Forecast (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Belle River TS | 53.7 | 45.2 | 46.6 | 47.9 | 49.3 | 50.6 | 52.0 | 53.3 | 54.7 | 56.0 | 57.4 | 58.8 |
| Chrysler WAP MTS | 58.5 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 | 34.4 |
| Crawford TS | 91.5* | 78.5 | 90.1 | 90.2 | 90.3 | 90.4 | 90.5 | 90.6 | 90.7 | 90.8 | 90.9 | 90.9 |
| Essex TS | 106.7 | 53.9 | 70.7 | 70.8 | 70.9 | 71.0 | 71.0 | 71.1 | 71.2 | 71.2 | 71.3 | 71.4 |
| Ford Annex MTS | 38.7 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 | 7.2 |
| Ford Essex CTS | 38.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 | 3.7 |
| Ford Windsor MTS | 58.5 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 | 10.9 |
| G.M.Windsor MTS | 38.7 | 0.0 | 13.1 | 13.1 | 13.1 | 13.1 | 13.1 | 13.2 | 13.2 | 13.2 | 13.2 | 13.2 |
| Keith TS T1 | 37.5 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 | 8.6 |
| Keith TS T22/T23 | 104.8 | 72.6 | 71.3 | 71.3 | 71.3 | 71.4 | 72.6 | 72.6 | 72.6 | 72.7 | 72.7 | 72.7 |
| Kingsville TS | ** | 124.4 | 126.9 | 60.3 | 84.9 | 85.8 | 86.5 | 86.6 | 86.6 | 86.7 | 86.7 | 86.8 |
| Lauzon TS T5/T6 | 100.8 | 95.5 | 106.5 | 106.7 | 106.8 | 107.0 | 107.1 | 107.3 | 107.4 | 107.6 | 107.7 | 107.9 |
| Lauzon TS T7/T8 | 103.2 | 86.6 | 88.4 | 88.5 | 88.6 | 87.6 | 87.7 | 87.8 | 88.0 | 88.1 | 88.2 | 88.3 |
| Leamington TS | 183.4 | 0.0 | 0.0 | 79.5 | 136.5 | 143.8 | 147.8 | 148.8 | 149.8 | 150.9 | 151.9 | 152.9 |
| Malden TS | 183.4 | 114.1 | 123.3 | 124.6 | 124.9 | 126.2 | 126.5 | 126.8 | 128.1 | 129.4 | 130.6 | 131.0 |
| Tilbury TS | 7.2 | 0.9 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| Tilbury West DS | 30.6 | 19.1 | 19.2 | 19.3 | 19.4 | 20.2 | 20.3 | 20.4 | 20.5 | 20.6 | 20.7 | 20.8 |
| Walker MTS #2 | 89.1 | 87.7 | 82.4 | 82.5 | 82.6 | 82.6 | 82.7 | 82.8 | 82.9 | 83.0 | 83.0 | 83.1 |
| Walker TS #1 | 90.4 | 65.0 | 71.3 | 71.4 | 71.4 | 71.5 | 71.6 | 71.7 | 71.7 | 71.8 | 71.9 | 71.9 |

**Winter**

| Station/DESN | LTR (MW) | Historical (MW) | Winter Gross Forecast (MW) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 |
| Kingsville TS | ** | 108.0 | 124.6 | 81.3 | 113.3 | 114.2 | 115.0 | 115.0 | 115.1 | 115.1 | 115.2 | 115.2 |
| Leamington TS | 194.8 | 0.0 | 0.0 | 75.2 | 143.3 | 191.0 | 237.1 | 238.1 | 239.1 | 240.1 | 241.2 | 242.2 |

Notes:
*: Crawford TS LTR after T3 replacement in 2017
**: Kingsville TS:

- LTR of existing configuration (4x42MVA): Summer: 145MW, Winter: 165MW
- LTR after replacement (2x83MVA): Summer: 104MW, Winter: 116MW

# APPENDIX C: 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 |
| CSS | Customer Switching Station |
| CTS | Customer Transformer Station |
| DCF | Discounted Cash Flow |
| 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 |
| NGS | Nuclear Generating Station |
| 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 |