# BRANT AREA
# INTEGRATED REGIONAL RESOURCE PLAN - APPENDICES

Part of the Burlington-Nanticoke Planning Region | April 28, 2015

ieso
Independent Electricity System Operator

# Brant Area IRRP

# Appendix A: Demand Forecasts

# Appendix A: Demand Forecasts

## A.1 Gross Demand Forecasts

Appendices A.1.1 describes the methodology used by LDCs to prepare the gross demand forecast used in this IRRP. Gross forecasts by subsystem are provided in Appendix A.1.2.

### A.1.1 LDCs Gross Forecast Methodology

To produce the gross forecast, the peak demand for previous years is reviewed to determine the load increase percentage from year to year. A trend is established based on the load increase percentage by the LDCs to determine average load increase percentage.

To account for block loads, Brantford Power communicates with the city's planning department and Brantford Power's internal servicing department to determine if there are any known large customers or planned subdivisions coming into the service territory. If possible, loading is estimated based on information provided by the customer to these departments. If detailed customer information is not available, estimates are based on the type of loading, such as industrial or residential. If the customer type is commercial or industrial, square footage is used to estimate loading. If the customer type is residential the loading is estimated based on the number of homes being built and using loading of houses of similar size.

Thus, load increases for the forecast are established by using the average load increase along with known load increases from the city and Brantford Power's servicing department.

### A.1.2 Gross Demand by Sub-system

| Brant Area<br>Gross Demand (MW) | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brant-Powerline Sub-system | | 141 | 142 | 153 | 155 | 157 | 158 | 160 | 162 | 163 | 165 | 166 | 168 | 170 | 172 | 174 | 177 | 179 | 180 | 182 |
| Brantford TS Sub-system | | 147 | 151 | 157 | 162 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 173 | 174 | 176 | 177 | 178 | 179 | 181 |

Note: The gross demand forecast considers weather normal condition.

## A.2 Conservation

The forecast conservation savings included in the demand forecasts for the Brant Area IRRP were derived from the provincial conservation forecast, which aligns with the conservation targets described in the 2013 LTEP: "Achieving Balance: Ontario's Long Term Energy Plan". The LTEP set an electrical energy conservation target of 30 TWh in 2032, with about 10 TWh of the energy savings coming from codes and standards ("C&S"), and the remaining 20 TWh from energy efficiency ("EE") programs. The 30 TWh energy savings target will also lead to associated peak demand savings. Time-of-Use ("TOU") rate impacts and Demand Response (DR) resources are focused on peak demand reduction rather than energy savings and, as such, are not reflected in the 30 TWh energy target and are considered separately in forecasting.

To assess the peak demand savings from the provincial conservation targets, two demand forecasts are developed. A gross demand forecast is produced that represents the anticipated electricity needs of the province based on growth projections, for each hour of the year. This forecast is based on a model that calculates future gross annual energy consumption by sector and end use. Hourly load shape profiles are applied to develop province-wide gross hourly demand forecasts. Natural conservation impacts are included in the provincial gross demand forecast, however the effects of the planned conservation are not included. A net hourly demand forecast is also produced, reflecting the electricity demand reduction impacts of C&S, EE programs, and TOU. The gross and net forecasts were then compared in each year to derive the peak demand savings. In other words, the difference between the gross and net peak demand forecasts is equal to the demand impacts of conservation at the provincial level.

The above methodology was used to derive the combined peak demand savings, which was further broken down to three categories as shown in Figure A-1. Peak demand savings associated with load shifting in response to TOU rates were estimated using an econometric model based on customers' elasticity of substitution and the TOU price ratio. The remaining peak savings were allocated between C&S and EE programs based on their energy saving projections, with about 1/3 attributed to C&S and 2/3 to EE programs.

The resulting peak demand savings in each year are represented as a percentage of total provincial peak demand in Figure A-1, using 2013 as a base year.

### Figure A-1: Peak Demand Impacts of Targeted Conservation (percent of gross load)

| | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C&S | 0.0% | 0.2% | 0.5% | 0.6% | 1.1% | 1.6% | 1.9% | 2.3% | 2.5% | 2.6% | 2.8% | 2.9% | 3.1% | 3.6% | 4.1% | 4.4% | 4.8% | 5.1% | 5.4% | 5.4% |
| TOU | 0.2% | 0.3% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% | 0.4% |
| EE programs | 0.5% | 0.8% | 1.0% | 1.1% | 1.3% | 2.1% | 3.1% | 3.2% | 3.6% | 4.2% | 5.0% | 5.3% | 5.8% | 6.0% | 6.5% | 6.6% | 6.9% | 7.4% | 7.8% | 7.8% |
| Total | 0.8% | 1.3% | 1.9% | 2.2% | 2.7% | 4.1% | 5.4% | 5.9% | 6.5% | 7.1% | 8.1% | 8.6% | 9.3% | 10.0% | 11.0% | 11.4% | 12.1% | 12.8% | 13.5% | 13.5% |

These percentages were applied to the gross demand forecasts provided by the Brant Area LDCs at the transformer station level to determine the peak demand savings assumed in the planning forecast. This allocation methodology relies on the assumption that the peak demand savings from the provincial conservation will be realized uniformly across the province. Actions recommended in the Brant area IRRP to monitor actual demand savings, and to assess conservation potential in the region, will assist in developing region-specific conservation assumptions going forward.

Existing Demand Response ("DR") resources are included in the base year and gross demand forecasts. Additional DR resources can be considered as potential options to meet regional needs.

## A.2.1 Conservation by Sub-system for the Brant Area

| Brant Area / Conservation (MW) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brant-Powerline Sub-system | 2 | 3 | 3 | 4 | 6 | 9 | 9 | 10 | 12 | 13 | 14 | 16 | 17 | 19 | 20 | 21 | 23 | 24 | 25 |
| Brantford TS Sub-system | 2 | 3 | 3 | 4 | 7 | 9 | 10 | 11 | 12 | 14 | 15 | 16 | 17 | 19 | 20 | 21 | 23 | 24 | 25 |
| Total | 4 | 6 | 7 | 9 | 13 | 17 | 19 | 21 | 23 | 27 | 29 | 32 | 34 | 38 | 40 | 43 | 46 | 49 | 49 |

## A.3 Distributed Generation

As of February 2015, the IESO (then OPA) had awarded approximately 22 MW (installed capacity) of distributed generation contracts within the Brant Area. Since LDCs were producing their demand forecasts to align with actual peak demand, any DG already in service during the most recent year's peak hour would already be accounted for in gross forecasts. As a result, only contracts for projects which had not yet reached commercial operation at the time the forecasts were produced needed to be incorporated.

Contract information provided the rated (installed) capacsity, generation fuel type (solar and natural gas), connecting station, and maximum commercial operation date ("MCOD") for each project. For the purposes of this study, it was assumed that all active contracts would be connected on their MCOD. This was a conservative assumption, as some attrition would normally be expected. While natural gas, bio and hydro projects can be assumed to contribute their full installed capacity during summer peak, local weather conditions can greatly impact the contribution of solar and wind projects to meeting demand. For planning purposes, the following capacity factors were used in order to estimate the dependable capacity of these resources under peak conditions.

| Source | Capacity Factors |
|---|---|
| Solar | 0.4 |
| Wind | 0.16 |
| Hydro | 0.99 |
| Bio | 0.98 |

The Brant Area is made up of dominantly solar resources with the exception of a single Bio RESOP project at Brantford TS.

### Existing and Committed Distribution Generation

The table below illustrates the existing and committed distribution generation in the Brant Area IRRP. The DG is broken down to the TS level. The totals at the bottom represent all of the generation associated with each of the transformer stations.

### Forecast Distributed Generation

In 2013 the OPA received a directive from the Minister of Energy to continue procuring additional renewable generation as part of the FIT program until 2017. These FIT procurements are subject to annual procurement targets of 200 MW from 2014 to 2017. Based on recently completed FIT procurements, the table below shows the estimates of DG will be contracted through the FIT program in the Brant Area.

| Forecast FIT | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|
| Brant TS + Powerline MTS | 0.64 | 1.22 | 1.80 | 2.38 | 2.96 |
| Brantford TS | 0.55 | 1.05 | 1.55 | 2.04 | 2.54 |

In total, approximately 18 MW of effective capacity is expected from DG resources in the Brant Area by 2033. This contribution is added to the net forecast to generate the planning forecast.

### A.3.1 Effective Capacity of DG by Sub-system in the Brant Area

| Brant Area | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Distributed Generation (MW) | | | | | | | | | | | | | | | | | | | |
| Brant-Powerline Sub-system | 7.0 | 7.6 | 8.2 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 |
| Brantford TS Sub-system | 8.1 | 8.6 | 9.1 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 | 9.6 |
| Total | 15 | 16 | 17 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |

## A.4 Planning Forecasts

The near and medium-term planning forecast was developed consistent with the growth assumptions embodied in the government's provincial energy plan and is also called the expected-growth scenario for the long-term forecast. The expected-growth scenario represents a future with lower electricity demand growth, due to higher electricity prices, increased electricity conservation, and lower energy intensity of the economy. The forecast population is based on the Ministry of Finance Spring 2013 population projection for the Brant Census Division that includes the City of Brantford and the County of Brant. Additionally these forecasts were aligned on area municipal growth plans. Other considerations included known connection applications such as new industrial load and industrial expansion applications.

Two scenarios were considered for the 11-20 year or long-term time period. One was the expected-growth forecast which is a continuation of the near and medium-term forecast, while the other was based on growth assumptions in the *Places to Grow Act, 2005* as applicable to the Brant Area and referred to as the higher-growth scenario.

The final expected-growth and higher-growth forecasts are provided in Appendices A.4.1 and A.4.2, respectively.

### A.4.1 Expected-Growth Forecast by Sub-Area and Station

| Brant Area<br>Planning Forecast (extreme weather) (MW) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brant-Powerline Susbystem | 141 | 140 | 150 | 151 | 151 | 150 | 151 | 151 | 152 | 152 | 152 | 153 | 154 | 154 | 155 | 156 | 156 | 157 | 158 |
| Brantford TS Subsystem | 146 | 148 | 153 | 158 | 157 | 156 | 156 | 156 | 156 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 155 | 156 |

| Total Demand<br>Planning Forecast (weather normal) (MW) | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | 281 | 282 | 298 | 302 | 301 | 299 | 301 | 301 | 301 | 300 | 301 | 302 | 303 | 302 | 304 | 305 | 305 | 305 | 308 |

Note: Coincident factor has been applied to area total.

### A.4.2 Higher-Growth Forecast by Sub-Area and Station

| Brant Area<br>Planning Forecast (extreme weather) (MW) | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|
| Brant-Powerline Sub-system | 157 | 159 | 160 | 163 | 164 | 167 | 169 | 173 | 174 | 177 |
| Brantford TS Sub-system | 165 | 167 | 168 | 170 | 171 | 173 | 175 | 178 | 179 | 182 |

| Total Demand<br>Planning Forecast (weather normal) (MW) | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | 2033 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total | 316 | 319 | 321 | 326 | 328 | 333 | 337 | 344 | 346 | 352 |

Note: Coincident factor has been applied to area total.

# Brant Area IRRP

# Appendix B: Technical Studies

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# <u>BRANT AREA</u>

## OPTIONS FOR TRANSMISSION REINFORCEMENT

April 21, 2015

**Prepared by Hydro One Networks Inc. in Consultation with the Brant Area Study Team**

## Foreword and Acknowledgement

The study by Hydro One Networks Inc. is based on the input provided by the Brant Area Study Team comprising of Brant County Power Inc., Brantford Power Inc., Horizon Utilities Corp., Hydro One Distribution, Ontario Power Authority, and Independent Electricity System Operator. Further planning and development of these wires options will be carried out between Hydro One Networks Inc. and affected Local Distribution Companies (LDCs).

The study team members were:

| | |
|---|---|
| Brant Count Power | Michael Desroches<br>Glen Fuller |
| Brantford Power Inc | Mark Simpson<br>Steve Faulkner<br>William Burden |
| Horizon Utilities Corp | Richard Bassindale<br>David Haddock |
| Hydro One Distribution | Charlie Lee |
| Ontario Power Authority (former) | Bob Chow<br>Kun Xiong<br>Wajiha Shoaib |
| Independent Electricity Operator | Peter Drury |
| Hydro One | Ajay Garg<br>Devinder Bahra<br>Dhvani Shah |

Hydro One thanks all team members for their support in this study.

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# 1. OBJECTIVE

The objective of this technical assessment is to develop alternatives and recommend a wires solution to address the capacity needs of the LDCs in the subregion.

# 2. STUDY AREA

The Brant Study Area transmission facilities consist of Brant TS, Brantford TS, and Powerline MTS. Brant TS and Powerline MTS are supplied radially by 115kV circuits B12 and B13. Circuits B12 and B13 also supply Dundas TS#2 and Newton TS. 230kV circuits M32W and M33W supply Brantford TS. Figure 1 shows a single line diagram of the Brant Study Area and neighbouring stations. The Brant Study Area is circled below.

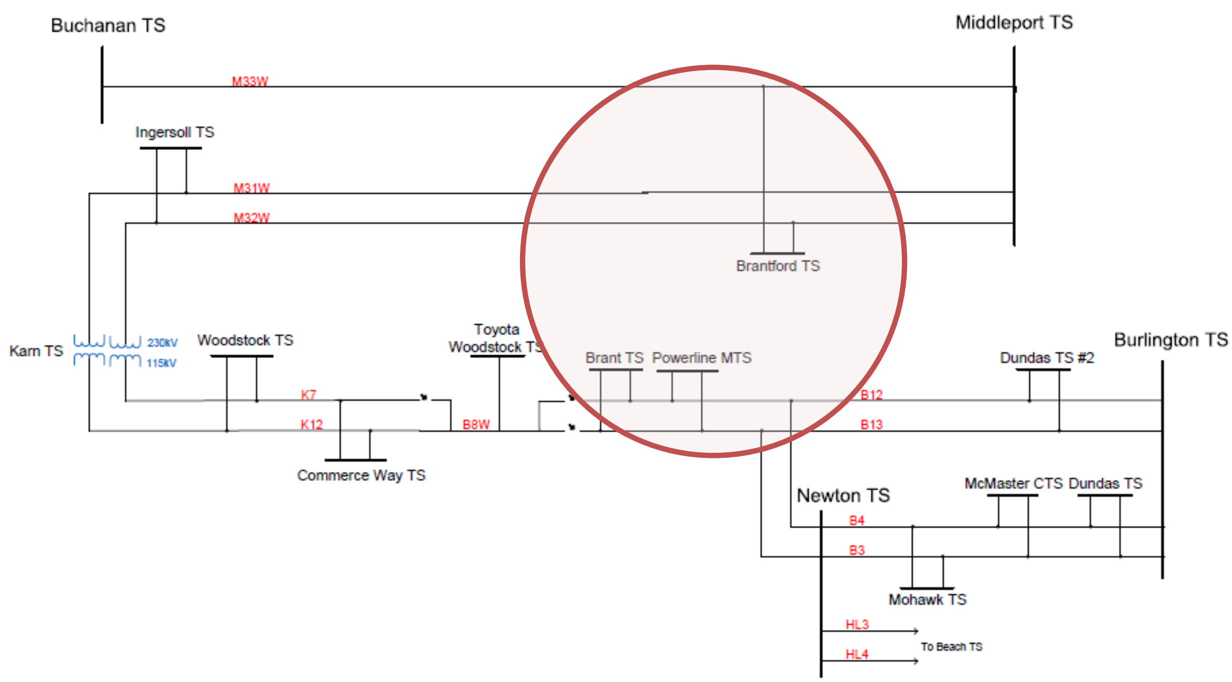



**Figure 1: Brant Study Area**

# 3. ASSESSMENT METHODOLOGY

## 3.1. Study Assumptions

The following assumptions were used in performing the assessments:

i) The area is summer peaking and accordingly loadflow analyses in the Brant Area study used the Summer 2013 Peak Load PSSE base case published by the IESO.

ii) Existing load for the Brant Area Study is the coincident load at Brant TS, Brantford TS, Dundas TS #2, Newton TS, and Powerline MTS in Year 2013.
iii) The base case assumes that the voltage at Burlington TS 115kV bus is 124kV.
iv) OPA, Brant County Power Inc., Brantford Power Inc., and Hydro One Distribution developed a set of load forecasts for the stations that are a part of the Brant Area study. The resulting forecasts account for extreme weather, CDM and DG. The "Brant Area Planning (Extreme Weather)", "Brantford TS Planning (Extreme Weather)" and "Brant TS + Powerline TS Planning (Extreme Weather)" load forecasts in the "Reference Scenario" are used for these planning studies.
v) Station loading levels at each station have been assessed against each station's respective Summer 10 Day Limited Time Ratings (LTRs).
vi) Line loading levels for the circuits were assessed based on ratings established using summer 35C, 4km/hr wind speed. Pre-contingency and post-contingency flows were compared against the continuous rating and long-term emergency rating, respectively.
vii) Power factor for the loads is assumed as 0.9 lagging.
viii) The area assessment is in accordance with the Ontario Resource and Transmission Assessment Criteria (ORTAC).

## 3.2. Load Forecast

The following load forecast was developed by the working group at the time this study was completed and used for the technical analysis performed in this report.

**Table 1: Load Forecast**

| Year | Brant TS + Powerline TS Planning (Extreme Weather) (in MW) | Brantford TS Planning (Extreme Weather) (in MW) |
|---|---|---|
| 2014 | 123 | 138 |
| 2015 | 140 | 146 |
| 2016 | 140 | 148 |
| 2017 | 150 | 153 |
| 2018 | 151 | 158 |
| 2019 | 151 | 157 |
| 2020 | 150 | 155 |
| 2021 | 151 | 156 |
| 2022 | 151 | 156 |
| 2023 | 152 | 156 |
| 2024 | 152 | 155 |
| 2025 | 152 | 155 |
| 2026 | 153 | 155 |
| 2027 | 154 | 155 |
| 2028 | 154 | 155 |
| 2029 | 155 | 155 |
| 2030 | 156 | 155 |

| | | |
|---|---|---|
| 2031 | 156 | 155 |
| 2032 | 157 | 155 |
| 2033 | 158 | 156 |

## 3.3. Data Modelling

The system conditions for Brant Area were studied in accordance with the load forecast developed by the study team. Contingencies studied were consistent with the requirements of ORTAC and included the 115kV and 230kV circuits in the Brant Study Area. The most impactive contingencies studied are listed below.

**Table 2: Major Contingencies in Brant Area Study**

| No. | Line Designation | Line Voltage (kV) | From Bus | To Bus |
|---|---|---|---|---|
| 1 | B12 | 115 | Burlington TS | Brant TS |
| 2 | B13 | 115 | Burlington TS | Brant TS |
| 3 | M32W | 230 | Middleport TS | Buchanan TS |
| 4 | M33W | 230 | Middleport TS | Buchanan TS |

# 4. NEEDS ANALYSIS

This section provides the results on the adequacy and reliability of the existing transmission facilities supplying the Brant Area. It also determines the load meeting capability (LMC) of the area.

## 4.1. Area Capability

### 4.1.1) Station Loading

Area is summer peaking and accordingly station capacity is considered to be the summer 10-day Limited Time Ratings (LTR) for that station. A 0.9 lagging power factor is used to derive the Station LTR in MW from Station LTR in MVA. Brant TS and Powerline MTS have a combined station capacity of 193 MW and Brantford TS has a station capacity of 178 MW. Based on the existing load and load forecast, it is expected that no stations will be overloaded beyond their respective Summer 10 day LTR during the study period.

Conclusion: There is installed transformation capacity in the Brant Area to supply load for the next 20 years. However, this transformation capacity may not be fully utilized to supply the new load growth due to other limitations described in sections 3.1.2 and 3.1.3.

### 4.1.2) Voltage Analysis

Based on the existing load, the following bus voltages will violate the ORTAC voltage limit criteria post-contingency:

**Table 3: Voltage Violations**

| Station Name | Bus Name | Voltage (kV) | Type of Voltage Violation | | Starting Year Requiring Relief | Triggering Contingency | Comments |
|---|---|---|---|---|---|---|---|
| | | | Max/Min Limit | Deviation Limit | | | |
| Brant TS | | 115 | X | | Immediate | Single circuit B12 or B13 | Significant voltage drop observed at Brant TS and Powerline MTS 115kV buses post-contingency. |
| Powerline MTS | | 115 | X | | Immediate | Single circuit B12 or B13 | |
| Powerline MTS | BY | 27.6 | | X | Immediate | Single circuit B12 or B13 | |

There are no voltage issues on 230kV circuits M32W and M33W at Brantford TS.

Conclusion: Voltage profile of the 115kV radial system, encompassing Brant TS and Powerline MTS, is compromised. Since Brant TS already has a 20 MVAR capacitor bank, there is an immediate need to provide voltage compensation at Powerline MTS to correct the post-contingency voltage declines.

#### 4.1.3) Thermal Analysis

Based on the existing load and load forecast, thermal loading on the following assets will exceed their respective ratings post-contingency:

**Table 4: Thermal Overloading: Line Facilities**

| Circuit | Line Section | | Starting Year Requiring Relief | Triggering Contingency | Comments |
|---|---|---|---|---|---|
| | From Bus | To Bus | | | |
| B12/B13 | Horning Jct | Brant Jct | Immediate | Single circuit B12 or B13 | The long-term emergency rating of these circuit sections is 680 Amps. There is thermal capacity to support load until Year 2015 with additional compensation. |

There is ample thermal capacity on 230kV circuits M32W and M33W for the load growth projected at Brantford TS.

Conclusion: The thermal capacity of the existing B12 and B13 line sections can be better utilized by adding voltage support to that radial 115kV pocket. Beyond 2015, the B12 and B13 line sections will be overloaded, even with extra voltage support. Therefore, there is an immediate need to consider options to mitigate line overloading.

## 4.2. Load Meeting Capability (LMC)

As described in this report, the most limiting facilities in the Brant Study Area are the radial 115kV lines feeding Brant TS and Powerline MTS. The graph in Figure 2 below shows the 115kV area station load forecast as well as the lines and station load meeting capability. The lines LMC is based on Burlington TS 115kV bus voltage maintained at 124kV and using load power factor of 0.9 lagging.

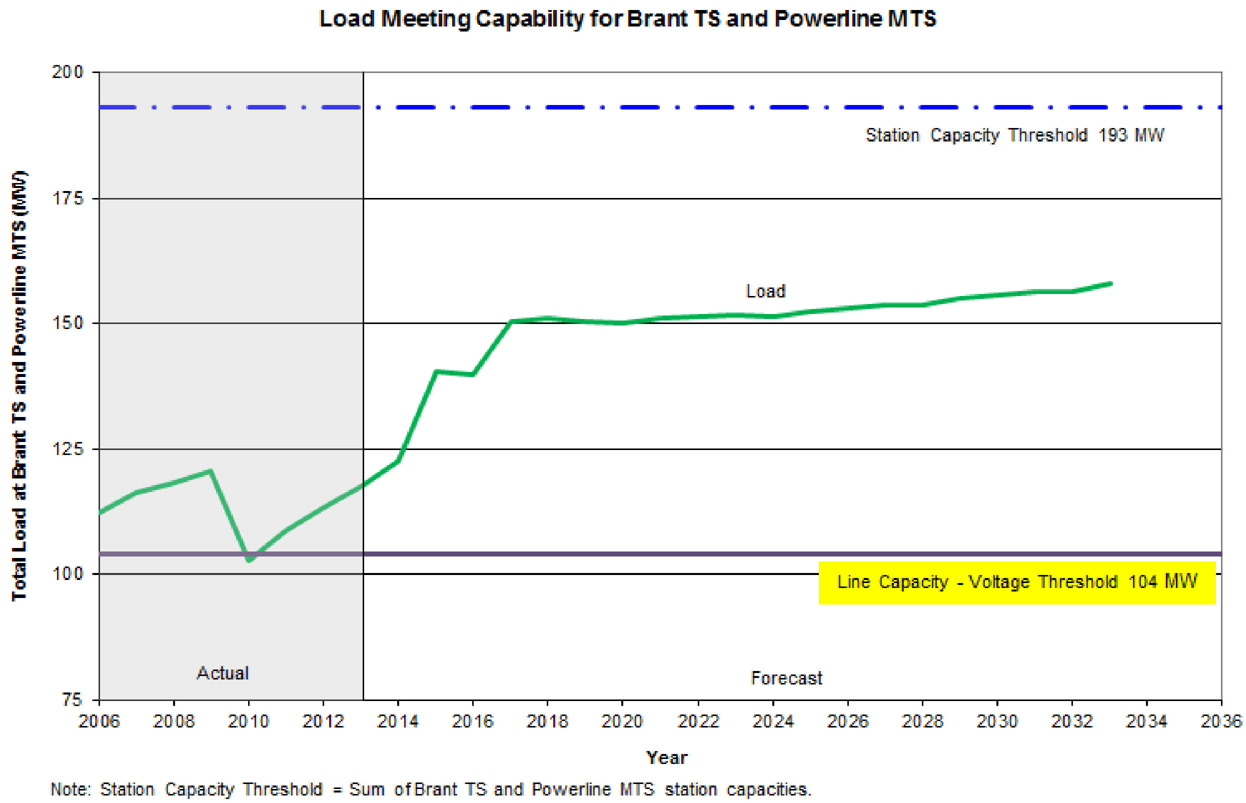



**Figure 2: Load Meeting Capability of the 115kV System**

The graph shows the actual load data until Year 2013 and the forecasted load as per the OPA reference scenario after Year 2013. The LMC of the 115kV radial circuits is 104MW and, as shown here, there is an immediate need for voltage support in the area. The station capacity is 193MW and, as shown, there is sufficient station capacity at both stations to meet the forecast load.

A similar analysis was done for the existing 230kV system in the Brant Study Area. The resulting graph is displayed in Figure 3. There is ample capacity at Brantford TS to support its forecasted load.

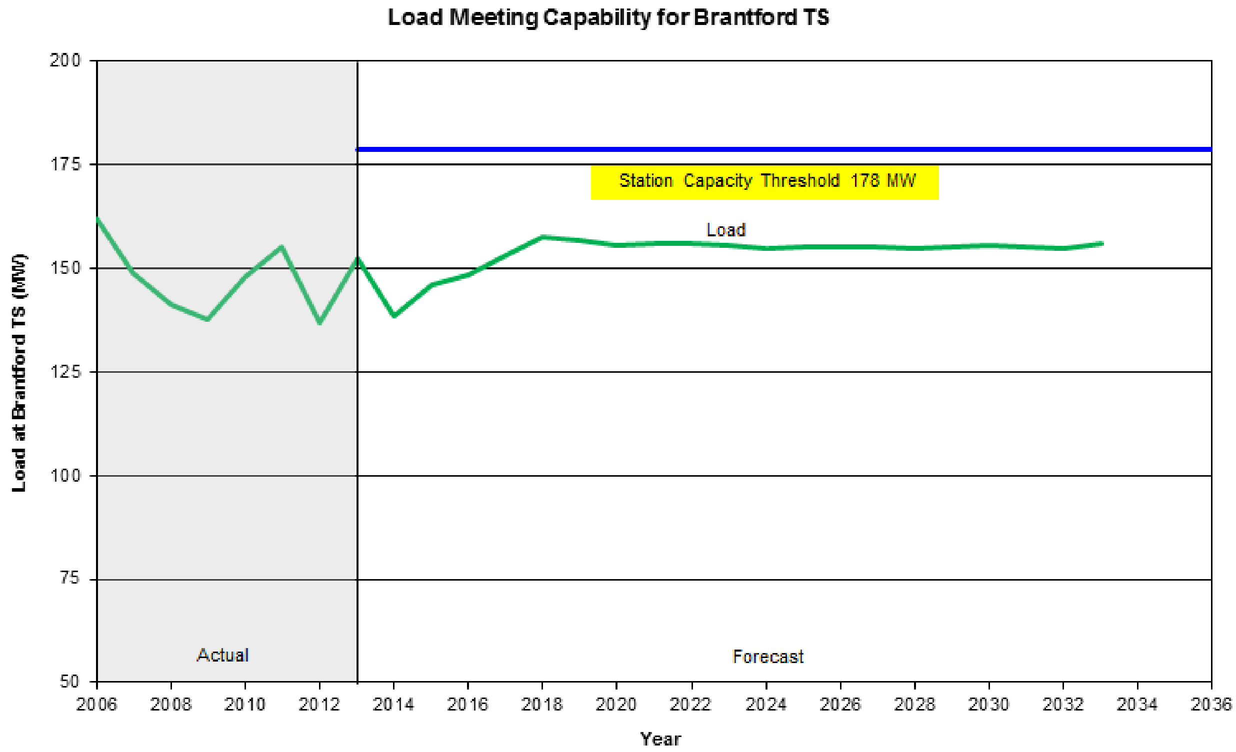



**Figure 3: Load Meeting Capability of 230kV System**

## 4.3. Reliability Analysis

The study team members provided the transmission and distribution load restoration capability for Brant Study Area.

Transmission load transfer capability:
- Brant TS load of upto 60 MW can be supplied by Karn TS via B8W, when both circuits B12 and B13 are out of service (load transfer capacity is dependent on loading of the stations on circuits B8W, K7, and K12 at the time)
- Newton TS has alternate supply via circuits B3 and B4.
- Dundas TS #2 has feeder load transfer capability of upto 10 MW to Dundas TS.

The distribution load transfer capability is shown in Table 5 below. The normal load transfer capability is the load transfer capability under normal system and planned outage conditions. The emergency load transfer capability is the load transfer capability available under forced outage conditions.

**Table 5: Distribution Load Transfer Capability**

| LDCs Involved | Stations Involved | Normal Load Transfer Capability (MW) | Time Required for Transfer | Emergency Load Transfer Capability (MW) | Time Required for Transfer |
|---|---|---|---|---|---|
| Brantford Power | Brant TS to Brantford TS | 15 | 15 mins (planned) | 30 | 45-60 min |
| Brantford Power | Powerline MTS to Brant TS | 30 | 15 mins (planned) | 40* | 45-60 min |
| Brantford Power | Powerline MTS to Brantford TS | 20 | 15 mins (planned) | 40 | 45-60 min |
| Hydro One Distribution | Brant TS to Wolverton DS | | | 2 | 4 hours |

* This transfer is between two stations supplied by the same 115kV circuits, B12 and B13. It does not directly help with restoration under double-circuit B12 and B13 outage, but may help indirectly by first transferring load transfer from Powerline MTS to Brant TS and then transferring some of that load from Brant TS onto Brantford TS.

Section 7.2 Load Restoration Criteria of the ORTAC states:
"The *IESO* has established load restoration criteria for high voltage supply to a *transmission customer*. The load restoration criteria below are established so that satisfying the restoration times below will lead to an acceptable set of *facilities* consistent with the amount of load affected.

The *transmission system* must be planned such that, following design criteria contingencies on the *transmission system,* affected loads can be restored within the restoration times listed below:

a. All load must be restored within approximately 8 hours.
b. When the amount of load interrupted is greater than 150MW, the amount of load in excess of 150MW must be restored within approximately 4 hours.
c. When the amount of load interrupted is greater than 250MW, the amount of load in excess of 250MW must be restored within 30 minutes.

These approximate restoration times are intended for locations that are near staffed centres. In more remote locations, restoration times should be commensurate with travel times and accessibility."

Based on the criteria and load transfer capabilities given in Table 5 and input from Brantford Power Inc., the following conclusions can be made:

a. Loss of 115kV circuits B12 and B13: a maximum of 100MW of load from Brant TS and Powerline MTS may be restored through transmission and distribution load transfers, assuming that both transformers at Brantford TS are in-service.
b. Loss of 230kV circuits M32W and M33W: up to 30 MW of load may be transferred out of Brantford TS to 115kV circuits B12 and B13, provided there is no contingency on circuits B12 and B13, Brant TS and Powerline MTS.

It is anticipated that manual actions can be undertaken to restore load restoration in 8 hours.

# 5. OPERATIONAL MEASURES

Hydro One conducted studies and concluded that post-contingency voltage decline limits and DESN transformer tap limits constrain Brant TS and Powerline MTS. As a result, the Hydro One OGCC has activated three alarms in the Network Management System to facilitate monitoring this situation:

1. The first stage alarm will notify the Hydro One control room that loading is in excess of 90MW and the controllers shall place the Brant TS capacitor in service and maintain the Burlington TS voltage above 123kV.
   - If this is not feasible, the controllers shall split the Powerline MTS LV bus.
   - If the capacitor is in service and the voltage at Burlington TS is greater than 123kV, the alarm will disappear and the controller will not split the Powerline MTS LV bus.
2. The second stage alarm will notify the Hydro One control room that loading is in excess of 110MW and the Powerline MTS LV bus shall be split.
3. Once the Powerline MTS LV bus is split, the third alarm will notify the Hydro One control room that loading has dropped below 85MW and the controller can close the LV bus.

These operating measures will help to temporarily mitigate existing voltage issues arising during forced outages. Meanwhile, transmission and distribution options are required to resolve these issues.

# 6. LOCAL PLANNING OPTIONS UNDERWAY

## 6.1. Brantford TS Transformer Replacement – Completed

The transformers at Brantford TS were replaced in summer 2013, which increased the Brantford TS capacity to 198 MVA (or 178 MW, assuming 0.9 lagging pf). The LDCs load forecasts illustrate that the load at Brantford TS will increase initially, and then remain relatively constant over the next 20 years, with the maximum load approaching 158 MW in 2018, as illustrated in Figure 3. There will be approximately 20 MW of extra station capacity available.

## 6.2. Install 2 x 15 MVAR Capacitor Banks at Powerline MTS – Implementation In Progress

There are various options that can be implemented in this area to resolve voltage issues, however, many have long implementation times and high costs associated with them. The fastest and the most cost-efficient option to resolve existing voltage declines on the 115kV system is the installation of additional capacitor banks at Powerline MTS.

Brant TS has an existing 20 MVAR capacitor bank. A need for a 20 MVAR capacitor bank at Powerline MTS was listed in the System Impact Assessment (SIA) for Powerline MTS completed by IESO in Year 2005.

Load flow analyses from the study for the Brant Area IRRP showed that the LMC of the 115kV radial pocket of the Brant Study Area could be increased to up to 125 MW from the existing LMC of 104 MW with the addition of 30 MVAR of capacitor banks at Powerline MTS.

The Ontario Power Authority issued a hand-off letter to Hydro One on April 17, 2014, to work with Brantford Power and Brant County Power for the installation of capacitor bank at Powerline MTS as the near-term wire(s) solution. Hydro One requested the LDCs to proceed with the installation of capacitor bank(s) at Powerline MTS and develop a project implementation plan. Hydro One and the LDCs have informed the working group that installation of 2 capacitor banks, each 15 MVAR in size, is planned to be in-service by the end of Q2 of 2015.

The graph in Figure 4 displays the new LMC of the 115kV system after the installation of a 30 MVAR capacitor bank at Powerline MTS. As observed, the new LMC increased to 125 MW, which resolves existing voltage decline problems. This option also better utilizes the thermal capacity of the 115kV circuit sections. However, additional solutions need to be planned to meet forecasted future load growth expected in this area.

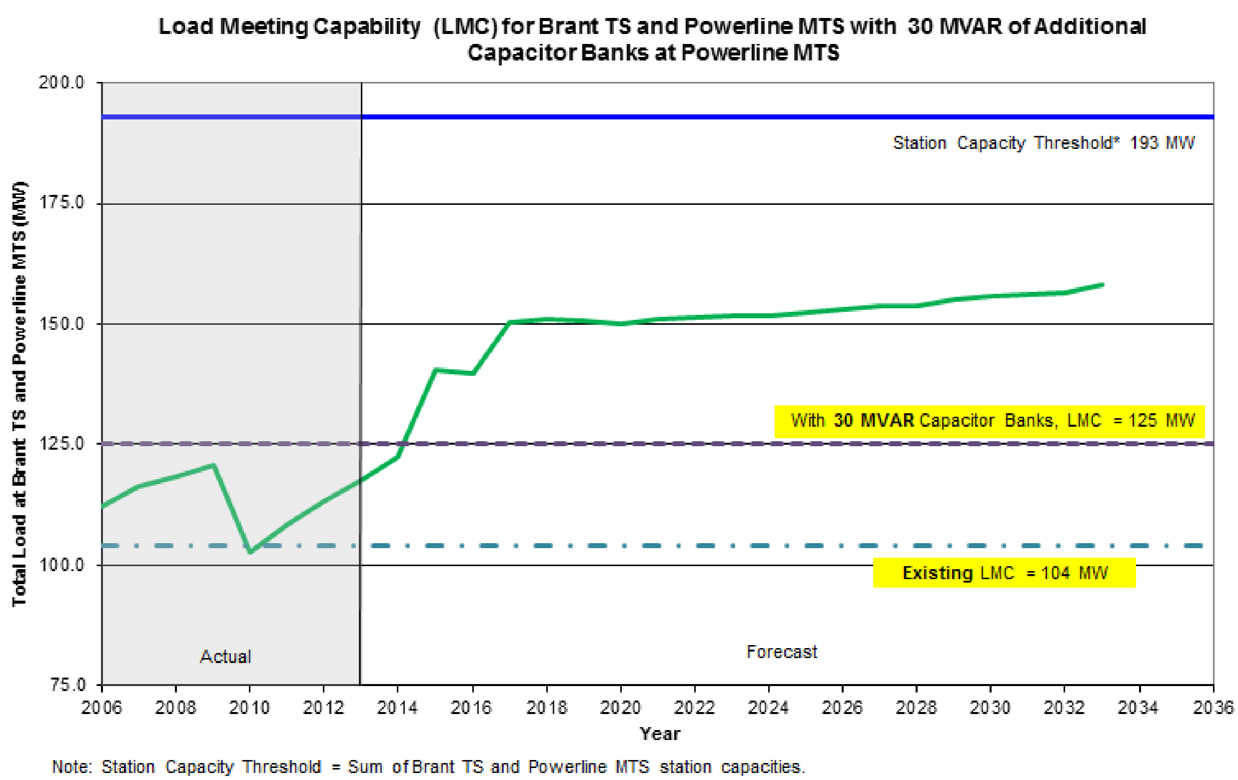



**Figure 4: Load Meeting Capability of 115kV System**

# 7. "WIRES" ALTERNATIVES

From the analysis explained in this report, installing capacitor banks at Powerline MTS will resolve existing voltage issues, but due to the high projected load growth at Brant TS and Powerline MTS over the next five years, the need arises again as early as next year. There is at least 20 MW of station capacity available at Brantford TS. Brantford Power Inc. has the capability to transfer loads between Brant TS, Powerline MTS and Brantford TS, as illustrated in Table 5. It is recommended that to manage the load growth until an integrated solution is determined, when the total load at Brant TS and Powerline MTS is expected to be above the LMC, Brantford Power Inc. will temporarily transfer the extra load to Brantford TS.

To meet the long-term needs in the Brant Area, a combination of additional transmission, distribution, conservation, and generation options are being reviewed. The “wires” alternatives being considered are summarized below.

## 7.1. Install Autotransformers to Supply 115kV Station from 230kV Supply

The preliminary estimates for this alternative ranges from $80M to $95M. The cost is dependent on the location of the autotransformer station and the associated line upgrades. This alternative will require a Class EA and Section 92 and will take a minimum of two years before construction approval to start.

This plan will involve, but not be limited to:
i) installing 2 x 250 MVA 230kV/115kV autos with 115kV switching arrangement,
ii) installing circuit switchers at or near Alford Jct,
iii) uprating existing 115kV circuit sections between Alford Jct and Powerline Jct, and
iv) installing new double-circuit line between Alford Jct and Brantford TS on the existing idle 115kV right-of-way, currently used for distribution.

The two locations considered for this alternative were Brantford TS and Alford Junction area.

## 7.2. New 230 kV DESN

The preliminary estimates for this alternative ranges from $42M to $70M. The cost is dependent on the location of the new station and its distance from the 230kV circuits in the area, namely M32W/M33W and M20D/M21D. This alternative will require a Class EA and Section 92 and will take a minimum of two years before construction approval to start.

This plan will involve, but not be limited to:
i) typical DESN station with 2 x 50/83 MVA 230kV/27.6kV transformers, with
ii) 6 x 27.6kV breakers and 5 distribution feeders

If the DESN is located within 2 km of one of the 230kV lines in the area, the total cost of this option, including distribution feeders, is estimated to be ~ $42M. However, if the DESN is located close to the load centre, at Alford Junction, the cost is estimated to be ~ $70M, as it will involve longer tranmission lines, with some sections underground.

## 7.3. Switching Station at Brant TS

The preliminary estimates for this alternative ranges from $12M to $15M. The cost is dependent on the condition assessment of the lines and the location of the equipment inside the existing station.

This plan will involve, but not be limited to:

i) installing 3 x 115kV circuit breakers, one on each circuit, B8W, B12, and B13,

ii) installing disconnect switches at appropriate locations, and

iii) closing normally open bus-tie between circuits B8W and B12/B13.

# 8. CONCLUSION

Implementation of the near-term wires plan is already underway, with the LDCs implementing CDM plans consistent with the Conservation First policy. Consistent with the objective(s) of the IRRP to identify CDM/DG and infrastructure solutions to address the electricity needs in the region, incremental CDM and DG options in the sub-region being considered such as the DR pilot program cannot fully or partially defer the needs of the sub-region.

Listed above are some of the "wires" alternatives assessed to address the needs in this area over the study period. Hydro One will continue to work with the LDCs to further develop the wires plan.

# Brant Area IRRP

# Appendix C: Ontario Resource and Transmission Assessment Criteria

# Appendix C: Ontario Resource and Transmission Assessment Criteria

In accordance with ORTAC, the system must be designed to provide continuous supply to a local area under specific transmission and generation outage scenarios. The performance of the system in meeting these conditions is used to determine the load meeting capability or LMC of an area.. The LMC is expressed in terms of the maximum load that can be supplied in the local area with no interruptions in supply or, under certain permissible conditions, with limited controlled interruptions as specified by ORTAC.

With respect to supply interruptions ORTAC requires that the transmission system be designed to minimize the impact to customers of major outages, such as a contingency on a double-circuit tower line resulting in the loss of both circuits. The following excerpt of Section 7.2 from ORTAC, lays out the restoration criteria:

The IESO has established load restoration criteria for high voltage supply to a transmission customer. The load restoration criteria below are established so that satisfying the restoration times below will lead to an acceptable set of facilities consistent with the amount of load affected.

The transmission system must be planned such that, following design criteria contingencies on the transmission system, affected loads can be restored within the restoration times listed below:

a. All load must be restored within approximately 8 hours.
b. When the amount of load interrupted is greater than 150 MW, the amount of load in excess of 150MW must be restored within approximately 4 hours.
c. When the amount of load interrupted is greater than 250 MW, the amount of load in excess of 250MW must be restored within 30 minutes.

These approximate restoration times are intended for locations that are near staffed centres. In more remote locations, restoration times should be commensurate with travel times and accessibility.

# Brant Area IRRP

# Appendix D: Conservation

# Appendix D: Conservation

## D.1 LDC Conservation Plans

LDCs are required to submit their CDM Plans by May 1, 2015 for the years 2015-2020, required as part of the Conservation First Framework. The CDM plans are still under development and additional details will be available on each LDCs' respective website once the plans have been completed.

## D.2 Conservation Potential

The IESO is currently undertaking an Achievable Potential Study to develop of an updated forecast for conservation potential in Ontario. The Study will be used to inform:

- the 2015-2020 Conservation First Framework mid-term review, including developing aggregate and LDC-specific achievable potential estimate in 2020;
- the short-term and long-term planning and program design; and
- the 2016 Long-Term Energy Plan (LTEP), including developing a 20-year provincial economic potential and achievable potential estimates.

The study is scheduled for to be completed by June 1, 2016. It will provide useful information to consider the potential for conservation to address identified needs in Brant Area in the next iteration of the plan.

# Brant Area IRRP

# Appendix E:  Transmission

# Appendix E: Transmission

The information below contains the transmission options that were considered to meet the needs of the Brant Area in the long term.

## Group 1. 230kV / 115kV Autos

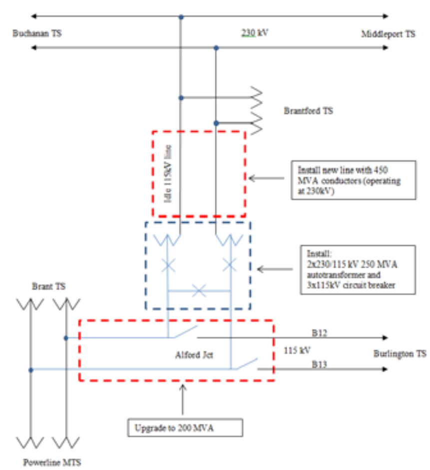
**OPTIONS**

1. Autotransformers at Brantford TS with 115kV double-circuit line connecting to Alford Junction (~10km)
2. Autotransformers at Alford Junction with 230kV double-circuit line connecting to Brantford TS (~10km)

- Utilize existing station capacity
- Improve restoration in the area
- Utilize existing ROW

**CONS**

- Expensive
- EA / Section 92 may be required, so implementation time may be long




## Group 2. New 230kV DESN

**OPTIONS**

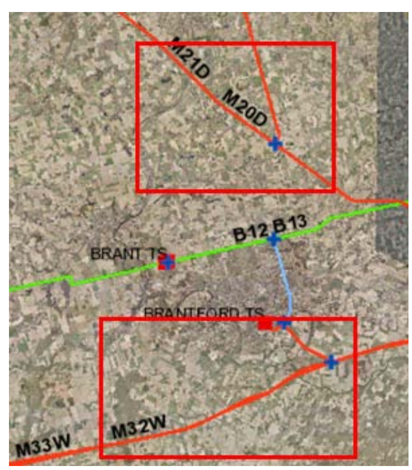
1. New DESN tapped of double-circuit 230kV M32W/M33W
2. New DESN tapped of double-circuit 230kV M20D/M21D

**PROS**

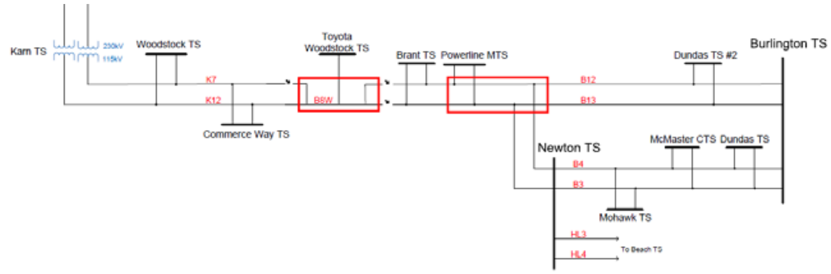
- Increase overall station capacity
- Cheaper?

**CONS**

- May need new ROW and/or property



# Group 3. Upgrade Existing 115kV Infrastructure




| OPTIONS |
|---|
| 1. Upgrade circuits B12/B13 from Horning Junction to Powerline MTS (~34km) |
| 2. Use existing circuit B8W and add new circuit in parallel to supply Brant TS through a double-circuit line from Woodstock TS (~32km) |

**PROS**

- Utilize more station capacity than present, but may not reach 100%

**CONS**

- Expensive
- Load meeting capability of the area may be limited by voltage criteria, due to long radial circuits

# Next Steps

- OPA to issue a “Hand-Off Letter” to Hydro One to start the development of transmission options to meet long term needs.
- Hydro One will provide high-level cost estimates for each of the groups of options.
- Hydro One will continue working with the study team to develop a preferred solution.

## Transmission Options and Budgetary Estimates

In the previous meeting, we discussed the following groups of transmission options for the Brant Area:

1. Reinforce 115kV system using 230/115 kV autotransformers
    - Budgetary Cost: $80M-$90M
2. A new DESN tapped off a 230kV double-circuit line
    - Budgetary Cost for Greenfield DESN: $40M-$45M (assuming line tap is <2km)
3. Upgrade existing 115kV line capacity

hydro one

## Current Status

- Budgetary estimates are being developed/reviewed.
    - Budgetary estimate ranges provided highlight risks associated with expanding existing ROWs and/or expropriation of property.

hydro one

## Next Steps

- Study team to decide whether the preferred plan will be "wires-only" or a combination of "wires and non-wires" options.

  - If wires solution is a preferred approach, OPA will issue a "Hand-Off Letter" to Hydro One to develop transmission options which will become part of RIP.

# Brant Area IRRP

# Appendix F: Community Engagement

# Appendix F: Community Engagement

The information below contains the update that was provided to the Brant Area municipal planners in March 2015 regarding the Brant Area IRRP.

## F.1 Update to Brant County and City of Brantford Planners

## Purpose

- To provide an update on your electricity needs and the plan to address those needs;
- To provide a status update on the development and preparation of the plan

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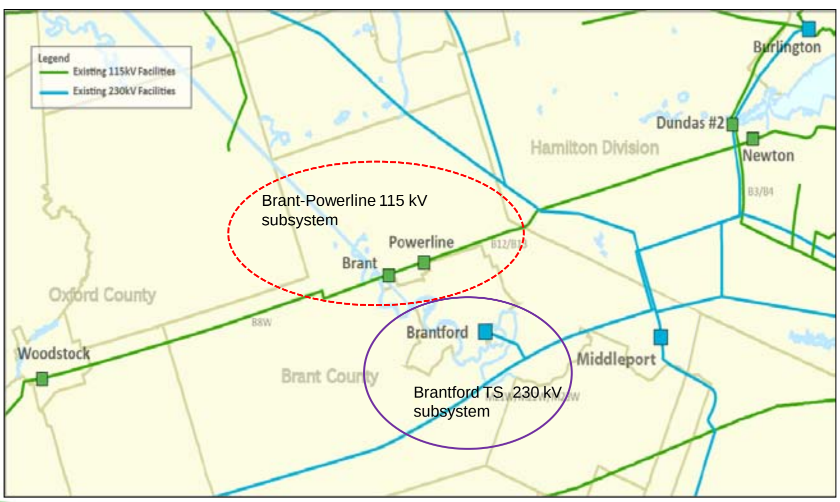
## Existing Electricity Supply to the Brant Area

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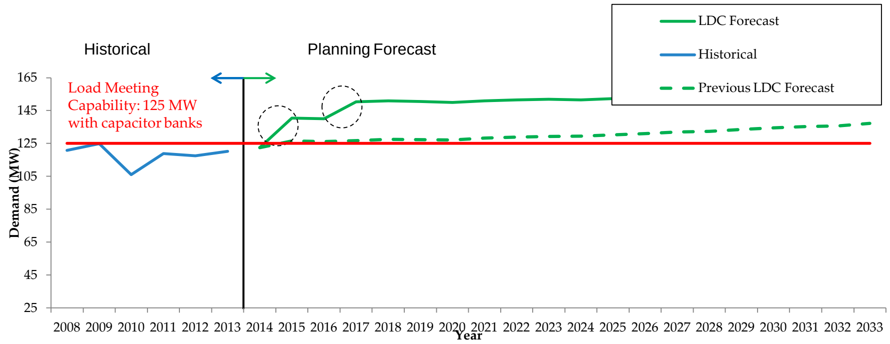
# Load Forecast Update – 115 kV Subsystem




- Loads that were added since last year
- Only loads at Brant TS and Powerline MTS are shown is the graph above

| Proposed Connection Station | LDCs | Estimated Size (MW) |
|---|---|---|
| Brantford TS | Brantford Power Inc. | 16 |
| Brant TS | Brantford Power Inc. | 6 |
| Powerline MTS | Brant County Power Inc. | 8 |
| Brantford TS | Brant County Power Inc. | 4 |
| Brant TS | Brant County Power Inc. | 3 |

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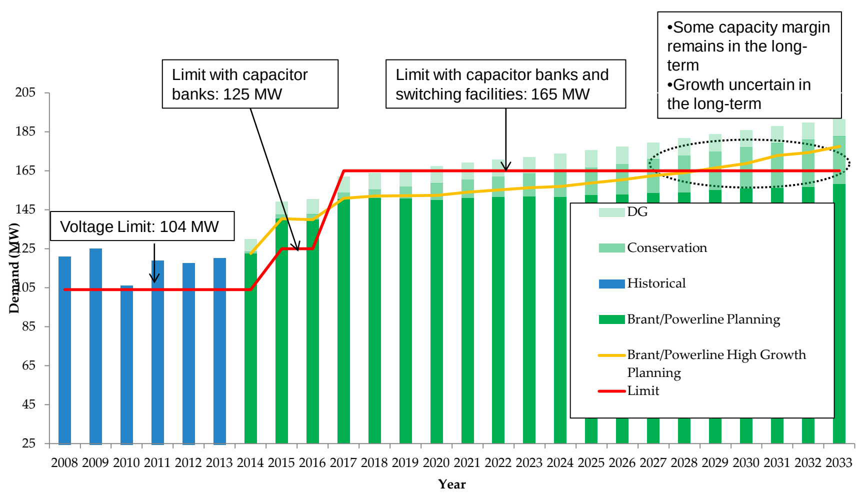
# Brant-Powerline 115 kV Subsystem Update

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## Capacitor Banks and 115 kV Breakers

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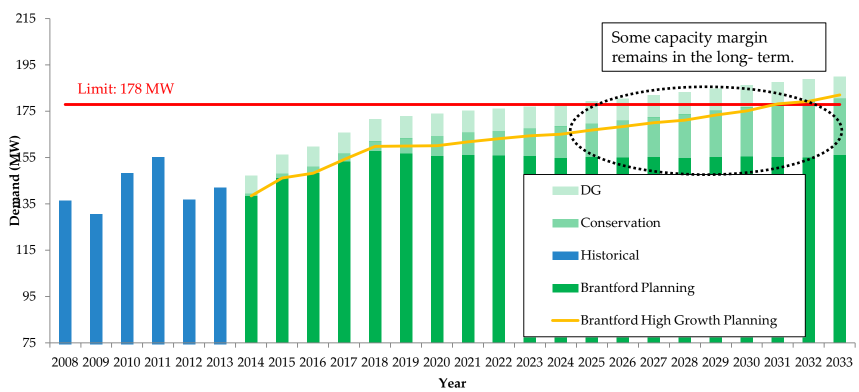
## Brantford TS 230 kV subsystem

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## Plan Actions

- Near and Medium-term Plan:
  - Implement CDM and DG (IESO & LDCs)
  - Capacitor banks at Powerline MTS (LDCs & Hydro One)
  - Switching facilities at Brant TS (Hydro One & LDCs)
  - Consider a DR pilot in the area (IESO & LDCs)
- Actions to prepare for the Long-term:
  - Monitor load growth and CDM achievement (LDCs & IESO)
    - If necessary initiate development of options to meet higher growth
  - Undertake community engagement on the plan (IESO)

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## Development and Preparation of the Plan

- IESO is currently drafting the IRRP with support from the Working Group
- In accordance with the OEB process, the IRRP for the Brant area is to be completed by end of April 2015
- Final IRRP will be posted on IESO's website
- Next planning cycle will be initiated in 5 years, or earlier if required

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## Community Engagement Next Steps

- IRRP Posted
  - Advanced notice to municipal contacts that report is being posted
  - Email to subscribers to advise report is posted

- Webinar – public webinar following the posting of the IRRP

- Local Advisory Committee – decision on formation pending

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