Hydro One Networks Inc.
483 Bay Street
Toronto, Ontario
M5G 2P5

LOCAL PLANNING REPORT

L7S Thermal Overload
Region: Greater Bruce - Huron

Date: November 14, 2016
Revision: Final

This report is prepared on behalf of the study team with the participation of representatives from the following organizations:

Distribution

Transmission

Disclaimer

This Local Planning Report was prepared for the purpose of developing transmission and distribution options and recommending a preferred solution(s) to address the local needs identified in the Needs Assessment for the Greater Bruce/Huron Region that do not require further coordinated regional planning. The preferred solution(s) that have been identified through this Local Planning Report may be reevaluated based on the findings of further analysis. The load forecast and results reported in this Local Planning Report are based on the information and assumptions provided by study team participants.

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EXECUTIVE SUMMARY

REGION	Greater Bruce-Huron Region (the "Region")		
LEAD	Hydro One Networks Inc. ("Hydro One")		
START DATE	May 18, 2016	**END DATE**	November 14, 2016

1. INTRODUCTION

The purpose of this Local Planning ("LP") report is to evaluate options and develop a Plan to mitigate the thermal overload on circuit L7S as identified in the Greater Bruce-Huron Regional Planning Needs Assessment report (Needs Assessment).

2. THE NEED

Based on the Region's gross load forecast, circuit L7S will become loaded beyond both its Short-Term Emergency (STE) and Long-Term Emergency (LTE) ratings in year 2019. Utilizing the Region's net load forecast, the Need is deferred to year 2025. Due to the limited recorded effectiveness of Conservation and Demand Management (CDM) uptake in this Region, identification of a mitigation Plan was deemed prudent.

3. OPTIONS EVALUATED

The following options were evaluated:

- Option 1: Status Quo and Monitor Load Growth
- Option 2: Increase L7S Circuit Ratings
- Option 3: Load Transfer –> Pre-contingency control action
- Option 4: Load Rejection + Load Transfer –> Post-contingency control actions

4. PREFERRED SOLUTION

Option 1 is the preferred option. As the summer 2016 historical load was substantially lower that the forecasted 2016 load the status quo and monitor load growth option is deemed the most prudent in order to defer costs. The Region will continue to monitor load growth and when required, the preferred option to mitigate the thermal overload on circuit L7S is Option 2: Increase L7S Circuit Ratings.

5. RECOMMENDATIONS

The recommended Plan to mitigate the thermal overload on circuit L7S is:

Step 1 Review historical load and flow on circuit L7S after each summer and winter season

Step 2 When historical station load supplied by L7S reaches 99 MW or historical flow on L7S reaches 94% of the circuit's ampacity rating, refresh gross load forecast

Step 3 When refreshed gross load forecast indicates 105 MW of station load supplied by L7S OR simulated flow on L7S will reach 100% of the circuit's ampacity rating within the next 3 years proceed to increase circuit ratings. Capacity cost allocation will be as per the Transmission System Code.

Provided the station load and/or circuit flow meets the predetermined MW or % thresholds within the specified timeframe, the Plan can be implemented prior to subsequent cycles of Regional Planning. If the Plan is not already under implementation, it is to be reviewed and reaffirmed in subsequent cycles of Regional Planning.

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1.0 Introduction

As part of the Ontario Energy Board's (OEB) Regional Planning requirements, a Needs Assessment was performed for the Greater Bruce / Huron Region. There were four (4) needs identified in the 2016 Needs Assessment for this Region (Needs Assessment), one of them being the thermal overload on circuit L7S.

The purpose of this Local Planning assessment is to evaluate options and develop a Plan to mitigate the thermal overload on circuit L7S.

1.1 Description of Need

Figure 1 illustrates 115 kV circuit L7S runs between Seaforth Transformer Station (TS) and St. Marys TS and is connected to 115 kV circuit D8S that runs between St. Marys TS and Detweiler TS, through the St. Marys TS low voltage bus-tie breaker. For the loss of D8S, L7S will exceed its short-term emergency (STE) and long-term emergency (LTE) ratings in the near term (summer 2019), under summer *gross* peak load conditions. Under summer *net* peak load conditions, the flow on L7S decreases to ~97% of its emergency ratings at the end of the study period (summer 2025). Table 1 is the amount of forecasted load supplied from circuit L7S when circuit D8S is unavailable. The forecast is as per the 2016 Needs Assessment for the Region.

The segments of circuit explicitly over their ratings are a few spans within the Seaforth Junction x Goshen Junction x Kirkton Junction sections. The emergency ratings of these spans are limited by substandard clearances due to ground topology and a rural distribution line. Due to the limited recorded effectiveness of Conservation and Demand Management (CDM) uptake in this Region, identification of a mitigation plan for the thermal overload is deemed prudent.

2.0 Options to Address the Need

Several options were considered in order to address the L7S thermal overload need. Table 2 lists and describes each option. There are several measures that can be utilized to compare and evaluate options. Measures utilized in this analysis were estimated cost, required approvals, long-term benefits and impact to customers. These measures were deemed most important in order to select the preferred option(s).

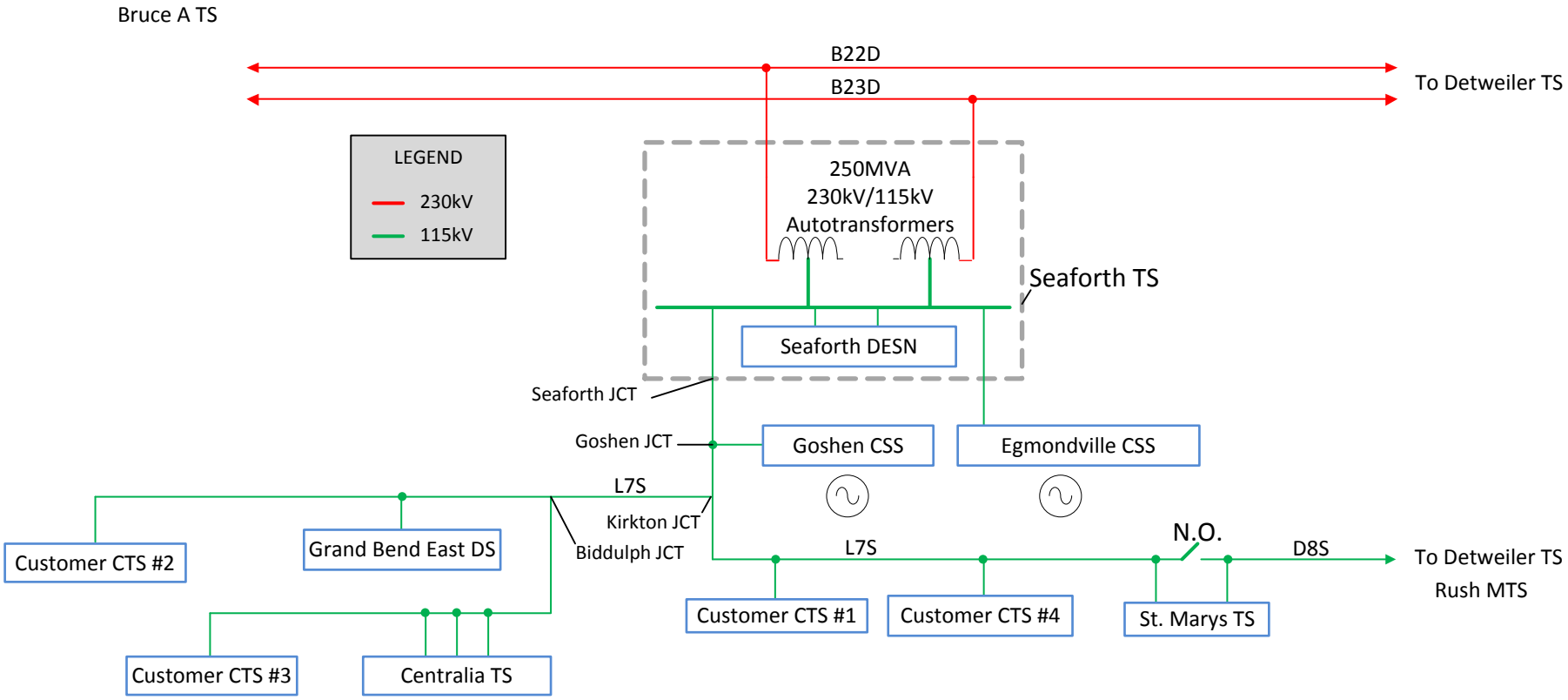

Figure 1 – Single Line Diagram of circuit L7S

Table 1 – Regional-Coincident Summer Peak Load Forecast supplied by circuit L7S[1]

Type of Forecast	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Total Gross Load on L7S [MW]	100	101	102	104	105	106	106	107	108	108
Total Net Load on L7S [MW]	99	99	99	100	101	101	101	102	102	102

[1] For the loss of circuit D8S, the following stations are supplied from circuit L7S: Centralia TS, Grand Bend East DS, St. Marys TS, Customer CTS #1, Customer CTS #2, Customer CTS #3 and Customer CTS #4. The forecast is a summation of the forecasted station loading. Actual flow on circuit L7S would be the summation of station load with it respective power factor plus line losses.

Table 2 – Options to Address the L7S Thermal Overload

	Options	Description	Cost[2]	Required Approvals	Long-Term Benefits	Impact to Customers
1	Status Quo & Monitor Load Growth	Monitor load growth and CDM targets; when historical load approaches the forecasted load proceed with mitigation; see Figure 2: Load Growth at Stations Supplied by Circuit L7S	0	None	Defers costs until forecasted load begins to materialize.	None provided load growth is closely monitored to ensure mitigation is in place before the Need arise.
2	Increase L7S Circuit Ratings	Uprate limiting sections of the circuit to have emergency ratings that can accommodate the forecasted load; Increase the maximum sag temperature from 83°C to 110°C. Initial assessment indicates 3 spans require tower replacements and/or modifications.	$550 k	Environmental Approval Screen-out	Uprating will improve continuous and emergency ratings to accommodate the 10 year load forecast; no voltage issues with 10 year load forecast	A temporary outage during the construction of the project may be required; otherwise there is no negative impact to customers.
3	Load Transfer: Pre-contingency control action	During peak L7S loading conditions, ~8.5 MW is required to be transferred off circuit L7S from Centralia TS to Seaforth TS over the distribution system via remote switching from Hydro One Distribution's "Modernized" Grid. However, the distribution system is capable of transferring only *4.4 MW* due to end-of-line voltage limitations.	$300 k	None	A 4.4 MW load transfer would only defer the Need for additional mitigation as the load grows. However depending on the pace of load growth, the 4.4 MW of load transfer may be enough to satisfy the 10 year study period.	There is reduced reliability to load that is transferred due to the increase in distribution line distance creating additional exposure to interruptions.
4	Load Rejection + Load Transfer: Post-contingency control actions	Implement a Load Rejection (L/R) scheme for the loss of circuit D8S. During peak L7S loading conditions, OGCC will arm the scheme. Upon loss of D8S, the armed load will be rejected / unsupplied. The L/R scheme will mitigate against the immediate overload of circuit L7S until such time as the load can be transferred from Centralia TS to Seaforth TS. At that time, the rejected load can be resupplied.	$500 k[3] - $700 k[4]	Load Rejection scheme may be classified as a Special Protection Scheme and require approval from NPCC	A 4.4 MW load transfer would only defer the Need for additional mitigation as the load grows. However depending on the pace of load growth, the 4.4 MW of load transfer may be enough to satisfy the 10 year study period.	There is risk to being unsupplied for load that is armed for rejection. There is also reduced reliability to load that is transferred due to the increase in distribution line distance creating additional exposure to interruptions.

[2] Costs are budgetary and of +/- 50% accuracy and do not include interest and overhead. Detailed estimate would be required prior to project execution.
[3] $400 k* for L/R scheme + $100 k for manual switching (2 hr.) = $500 k, *If load is to be rejected at stations other than St. Marys TS, additional telecom circuits are required (at a minimum) and this will increase the cost
[4] $400 k* for L/R scheme + $300 k for remote switching (15 min.) = $700 k, *If load is to be rejected at stations other than St. Marys TS, additional telecom circuits are required (at a minimum) and this will increase the cost

3.0 Discussion of the Preferred Options

Based on the forecasted load supplied by circuit L7S, the circuit will become overloaded for the loss of circuit D8S within the 10-year study period.

Of the four options, option #1 "Status Quo and Monitor Load Growth" is the preferred option to satisfy the Need as it will defer costs until the forecasted load begins to materialize. The 2016 summer coincident peak for stations supplied by circuit L7S occurred on August 10, 2016 and totaled 91.4 MW as shown in Figure 2. This loading translates to about 460 Amperes flow on circuit L7S between Seaforth TS and Kirkton Junction when circuit D8S is out of service which is approximately 87% of the circuit's rating (530 Amperes). In Figure 2, L7S's circuit rating is illustrated as 105 MW of total station load supplied by L7S.

Once the historical load begins to approach the thermal limit of the circuit, option #2 "Increase L7S Circuit Ratings", is the preferred option to mitigate against the overload. Option #2 is a permanent capacity improvement as opposed to ongoing control actions required with options #3 and #4. As well, option #2 does not place customer load at an increased risk to being unsupplied when armed for L/R (option #4) nor does it reduce customer reliability due to long distribution lines (options #3 & #4) and therefore it is the preferred option.

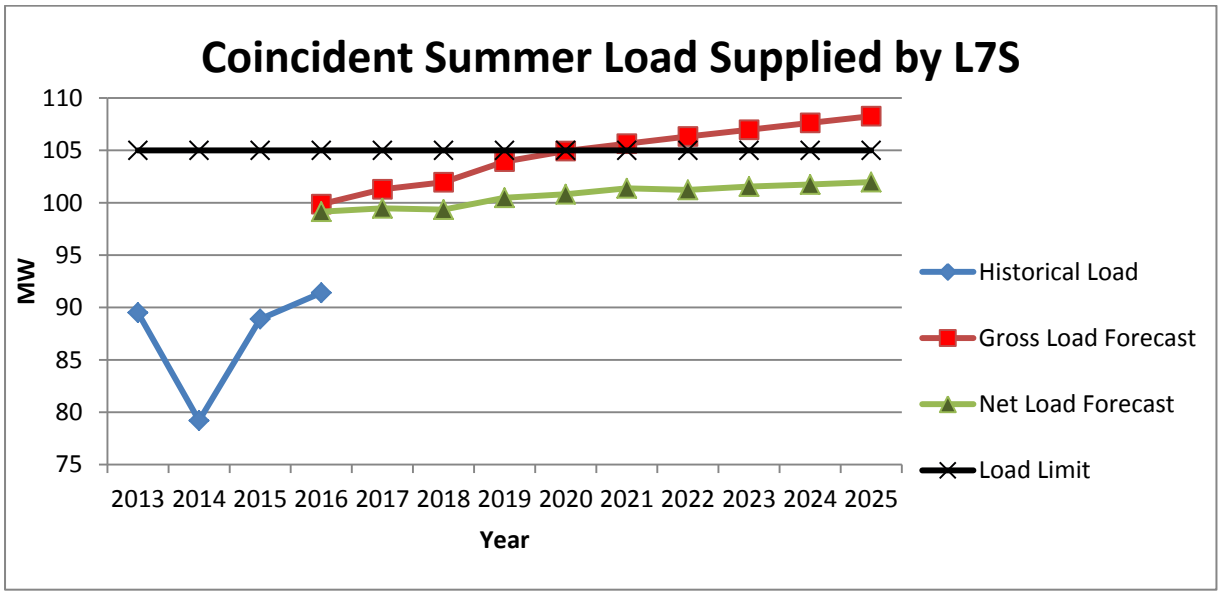

Figure 2 – Load Growth at Stations Supplied by Circuit L7S[5]

[5] The historical values and forecasts are a summation of station loading.

4.0 Development Plan

The transmission infrastructure development plan for the L7S thermal overload need is:

Step 1 Review coincident peak load on circuit L7S after each winter and summer season

- Action: IESO to provide historical data to Hydro One Transmission for review.

Step 2 Historical Load Analysis to determine if Trigger #1 met.

Trigger #1: when the historical load indicates that, for the loss of D8S, coincident peak station load supplied by circuit L7S reaches 99 MW OR historical flow on L7S out of Seaforth TS reaches 94% of the circuits' ampacity rating, a refreshed load forecast is to be provided by the LDC's and other connected customers.

- Action: Hydro One Transmission to review historical station load and flow; and when Trigger #1 is met, request a refreshed gross load forecast from LDC's and other connected customers.

- Action: LDC's and other connected customers to provide a refreshed gross load forecast within 45 days of the request to Hydro One Transmission.

Step 3 Load Forecast Analysis to determine if Trigger #2 met.

Trigger #2: when the refreshed gross load forecast indicates that, for the loss of D8S, coincident peak station loading of 105 MW is supplied by circuit L7S OR flow on L7S out of Seaforth TS reaches 100% of the circuits' ampacity rating within the next 3 years, Hydro One Transmission to proceed with mitigation.

- Action: Hydro One Transmission to review refreshed gross load forecast and flow; and if Trigger #2 is met, increase the thermal ratings of the limiting sections of circuit L7S. Capacity cost allocation will be as per the Transmission System Code.

The plan can be reviewed and reaffirmed in subsequent cycles of Regional Planning if not already under execution.

5.0 Recommendations

The following recommendations are to address the L7S thermal overload Need:

1. Continue to monitor load growth and refresh gross load forecasts according to the Development Plan outlined in Section 4.0.

2. When the loading on circuit L7S is expected to exceed its limits within the next 3 years, Hydro One Transmission to increase the thermal ratings of the limiting spans of circuit L7S. Capacity cost allocation will be as per the Transmission System Code.