IESO_REP_0827

Feasibility Study

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# North of Dryden and Remote Communities Study

## Final Report

## Issue 1.0

**(A study to determine the system enhancements required for different transmission reinforcement options to accommodate new load in the area north of Dryden)**

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This document may contain a summary of a particular *market rule*. Where provided, the summary has been used because of the length of the *market rule* itself. The reader should be aware, however, that where a *market rule* is applicable, the obligation that needs to be met is as stated in the "Market Rules". To the extent of any discrepancy or inconsistency between the provisions of a particular *market rule* and the summary, the provision of the *market rule* shall govern.


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# Table of Contents

# List of Figures

# List of Tables

# 1. Executive Summary

The IESO conducted this Feasibility Study at the Ontario Power Authority (OPA)'s request to investigate four transmission reinforcement options that would increase the supply capability to the North of Dryden area, as well as enable twenty-one First Nations communities to connect to the grid. The results are based on the assumptions listed in Section 3.2, including the dependable water levels under which the OPA requested the study be performed. The test cases are as follows:

1. 230 kV Ignace Junction
    - A new 300 km 230 kV single circuit overhead line to Pickle Lake, tapped off of the Dryden-to-Mackenzie 230 kV circuit D26A at Ignace Junction, to accommodate 190 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 5 of Appendix A. Ear Falls area configuration assumptions are listed in Table 1.
2. 230 kV Dinorwic Junction
    - A new 300 km 230 kV single circuit overhead line to Pickle Lake, tapped off of D26A at Dinorwic Junction, to accommodate 190 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 6 of Appendix A. Ear Falls area configuration assumptions are listed in Table 1.
3. 115 kV Valora Junction
    - A new 226 km 115 kV single circuit overhead line to Pickle Lake, tapped off of radial circuit 29M1 at Valora Junction, which is supplied from the Dryden-to-Mackenzie 115 kV circuit M2D, to accommodate 130 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 7 of Appendix A. Ear Falls area configuration assumptions are listed in Table 1.
4. 115 kV Dinorwic Junction
    - A new 300 km 115 kV single circuit overhead line to Pickle Lake, tapped off of M2D at Dinorwic Junction, to accommodate 130 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in
    - Figure 8 of Appendix A. Ear Falls area configuration assumptions are listed in Table 1.

Table 1 summarizes key Ear Falls Area system configuration assumptions for each test case.

**Table 1 : Ear Falls Area System Configurations**

| Test Case # | Circuit to Pickle Lake | E1C loop | E4D upgrade | E2R upgrade |
|---|---|---|---|---|
| **1** | 230 kV from Ignace Jct. | Open - Radial out of Pickle Lake with Ear Falls load on E1C | Max-Rated (665 A) | New Parallel circuit |
| **2** | 230 kV from Dinorwic Jct. | Open – Radial out of Pickle Lake with Ear Falls load on E1C | Max-Rated (665 A) | New Parallel circuit |
| **3** | 115 kV from Valora Jct. | Open – Radial out of Ear Falls | New Parallel circuit | New Parallel circuit |
| **4** | 115 kV from Dinorwic Jct. | Open – Radial out of Ear Falls | New Parallel circuit | New Parallel circuit |

# 1.1 Major Findings and Recommendations

The following lists the major findings for each of the test cases based on the study assumptions listed in Section 3.2. This study determined the transmission system enhancements required to accommodate new load, focusing on the impact on the Mackenzie, Dryden, Ear Falls and north of Dryden areas.

## 1.1.1 230 kV Test Cases

### Reactive Compensation Requirements

Table 2 and Table 3 summarize the additional reactive compensation required for the 230 kV test cases.

SVCs are needed at Ear Falls, Mackenzie, Pickle Lake, McFaulds, Esker and Musselwhite to provide fast-acting reactive support to the system. The total reactive compensation of these SVCs is 395/ -135 MVar for test case 1, and 413/ -135 MVar for test case 2.

For all other locations, an auto-switching shunt device will be required. The total reactive compensation of these shunt devices is 100/ -23 MVar for both test cases. Further analysis is needed to determine the required switching speed of the shunt devices, as it is beyond the scope of this study.

The overall reactive compensation requirements are similar for both the Ignace and Dinowic Junction cases. It was observed that as the junction point moves further from Mackenzie (from Ignace to Dinorwic), the reactive requirement at Mackenzie increases from 123 MVar to 141 MVar.

**Table 2: Reactive Compensation Requirements – 230 kV Ignace Jct Test Case 1**

| Bus Name | Test Case 1 – 230 kV Ignace Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| **Ear Falls** | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| **Dryden** | Switched Capacitor | 220 | 1 | 2 | 20 MVar | 40 MVar |
| **Mackenzie** | SVC * | 220 | 1 | 123 MVar * or 123/ -35 MVar * | | 123 MVar * or 123/ -35 MVar * |
| **Pickle Lake** | SVC | 220 | 2 | 40/ -35 MVar | | 80/ -70 MVar |
| **Kingfisher Jct** | Switched Reactor | 118.05 | 5 | 1 | -3 MVar | -15 MVar |
| **Neskantaga** | Switched Capacitor | 118.05 | 2 | 3 | 4 MVar | 24 MVar |
| **Webequie** | Switched Capacitor<br>Switched Reactor | 118.05 | 2<br>1 | 3<br>2 | 3 MVar<br>-3 Mvar | 18 MVar<br>-6 MVar |
| **McFaulds** | SVC | 44 | 1 | 48 MVar | | 48 MVar |
| **Esker** | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| **Musselwhite** | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| **Balmer** | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| **Deer Lake** | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| **Sandy Lake** | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages. Step size is based on the maximum step size at the device's location, while the number of blocks is determined by the maximum permissible reactive compensation behind a single breaker.

* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

**Table 3: Reactive Compensation Requirements – 230 kV Dinorwic Jct Test Case 2**

| Bus Name | Test Case 2 – 230 kV Dinorwic Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| **Ear Falls** | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| **Dryden** | Switched Capcatior | 220 | 1 | 2 | 20 MVar | 40 MVar |
| **Mackenzie** | SVC * | 220 | 1 | 141 MVar * or 141/ -35 MVar * | | 141 MVar * or 141/ -35 MVar * |
| **Pickle Lake** | SVC | 220 | 2 | 40/ -35 MVar | | 80/ -70 MVar |
| **Kingfisher Jct** | Switched Reactor | 118.05 | 5 | 1 | -3 MVar | -15 MVar |
| **Neskantaga** | Switched Capcatior | 118.05 | 2 | 3 | 4 MVar | 24 MVar |
| **Webequie** | Switched Capacitor<br>Switched Reactor | 118.05 | 2<br>1 | 3<br>2 | 3 MVar<br>-3 MVar | 18 MVar<br>-6 MVar |
| **McFaulds** | SVC | 44 | 1 | 48 MVar | | 48 MVar |
| **Esker** | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| **Musselwhite** | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| **Balmer** | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| **Deer Lake** | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| **Sandy Lake** | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages. Step size is based on the maximum step size at the device's location, while the number of blocks is determined by the maximum permissible reactive compensation behind a single breaker.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

Furthermore, as per OPA request, a sensitivity study was performed on test case 1 with the load at McFaulds reduced from 60 MW to 30 MW. Results for the sensitivity are provided in Table 4.

This eliminated the need for reactive compensation at Mackenzie, Dryden and Neskantaga, resulting in a total dynamic reactive requirement of 200/ -112 MVar, and a total static reactive requirement of 18/ -26 MVar.

**Table 4: Sensitivity – Reactive Compensation Requirements – 230 kV Ignace Jct Test Case 1**

| Bus Name | Test Case 1 Sensitivity- 230 kV Ignace Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| **Ear Falls** | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| **Pickle Lake** | SVC | 220 | 2 | 18/ -41 MVar | | 36/ -82 MVar |
| **Kingfisher Jct** | Switched Reactor | 118.05 | 6 | 1 | -3 MVar | -18 MVar |
| **Webequie** | Switched Reactor | 118.05 | 1 | 2 | -3 MVar | -6 MVar |
| **McFaulds** | SVC | 44 | 1 | 20 MVar | | 20 MVar |
| **Esker** | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| **Musselwhite** | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| **Balmer** | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| **Deer Lake** | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| **Sandy Lake** | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages. Step size is based on the maximum step size at the device's location, while the number of blocks is determined by the maximum permissible reactive compensation behind a single breaker.

## Thermal Limitations

For both 230 kV test cases, the only thermal limitation observed was on 115 kV Dryden-to-Ear Falls circuit E4D, for the loss of one Manitou Falls unit. This circuit was loaded post-contingency over its LTE and STE rating by approximately 5%. Line upgrades to achieve a LTE rating of about 700 A, or pre-contingency control actions, such as generation re-dispatch if available, are recommended to reduce post-contingency flows to within acceptable limits. Otherwise, pre-contingency load curtailment may have to be implemented during low water conditions.

## Local Voltage Limitations

For both test cases, under peak load conditions, the following post-contingency voltage limitations were observed:

- The 115 kV bus voltage at Sapawe DS was above 127 kV following the loss of the Mackenzie-to-Lakehead 230 kV line and subsequent opening of the 115 kV Birch-to-Moose Lake circuit (B6M) at Moose Lake from protection (cross-trip) as listed in one of the assumptions in section 3.2.2. The overvoltage is marginal and can be mitigated through post-contingency control actions (if acceptable to Hydro One) or by installing a small reactor at the station. Alternatively, B6M can be entirely cross-tripped rather than having it open at Moose Lake. A West of Thunder Bay single line diagram is provided in Figure 9 of Appendix A.

- The 230 kV bus voltages at Mackenzie and Lakehead were above 250 kV following the simultaneous loss of D26A and Fort Frances-to-Mackenzie 230 kV circuit F25A, and cross-trip of 115 kV circuit M2D as listed in one of the assumptions in section 3.2.2. To mitigate this overvoltage concern, it is recommended to either install an additional reactor at Mackenzie or to eliminate the contingency from consideration by separating the circuits from common structures shared by D26A and F25A, such that the circuits share at most 4 structures. A West of Thunder Bay single line diagram is provided in Figure 9 of Appendix A.

## Transmission Losses

Table 5 summarizes the impact that adding up to 190 MW of load has on transmission losses in the region west of Marathon. For test case 1, the active power losses west of Marathon increased by 76.8 MW, from 35 MW to 111.8 MW, while the reactive power losses increased by 454.9 MVar, from 192 MVar to 646.9 MVar. These losses are slightly higher in test case 2 as the junction points moves further from Mackenzie. If the McFaulds load reduces from 60 MW to 30 MW, the active power losses west of Marathon are reduced from 111.8 MW to 76.3 MW, and the reactive power losses are reduced from 646.9 MVar to 466.6 MVar.

**Table 5: Summary of Transmission Losses West of Marathon for the 230 kV Test Cases**

| Case | Active Power Losses | Reactive Power Losses | Total New Load | ΔMW losses/Δload (%) |
|---|---|---|---|---|
| Reference Case - Base Case with no new load | 35 MW | 192 MVar | 0 MW | N/A |
| Test Case 1 - 230 kV Ignace Junction | 111.8 MW | 646.9 MVar | 190 MW | 40% |
| Test Case 2 - 230 kV Dinorwic Junction | 117.2 MW | 676.4 MVar | 190 MW | 43% |
| Sensitivity - 230 kV Ignace Junction with 30 MW McFaulds Load | 76.3MW | 466.6 MVar | 160 MW | 26% |

## 1.1.2 115 kV Test Cases

### Reactive Compensation Requirements

Tables 6 and 7 summarize the additional reactive compensation required for the 115 kV test cases.

SVCs are needed at Ear Falls, Mackenzie, Pickle Lake, Esker, Musselwhite and Valora Junction (for test case 3) to provide fast-acting reactive support to the system. The total reactive compensation of these SVCs is 265/ -119 MVar for test case 3, and 222/ -129 for test case 4.

For all other locations, an auto-switching shunt device is required. The total reactive compensation of these shunt devices is 27/ -33 MVar for test case 3, and 137/ -33 MVar for test case 4. Further analysis is needed to determine the required switching speed of these devices, as it is beyond the scope of this study.

The overall reactive requirement for the Dinorwic Junction case is higher than that of the Valora Junction case. This is primarily due to the fact that reactive support for the Valora case was directly connected at the junction since there is an existing station, Valora DS. Whereas in the Dinorwic Junction case, it was assumed that since there is no existing station at the junction, reactive support would need to be supplied from neighboring stations, ultimately increasing the requirement.

**Table 6: Reactive Compensation Requirements – 115 kV Valora Jct Test Case 3**

| Bus Name | Test Case 3 – 115 kV Valora Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| **Ear Falls** | SVC | 118.05 | 2 | 33/ -22 MVar | | 66/ -44 MVar |
| **Mackenzie** | SVC * | 220 | 1 | 85 MVar * or<br>85/ -35 MVar * | | 85 MVar * or<br>85/ -35 MVar * |
| **Pickle Lake** | SVC | 118.05 | 2 | 11/ -20 MVar | | 22/ -40 MVar |
| **Kingfisher Jct** | Switched Reactor | 118.05 | 11 | 1 | -2 MVar | -22 MVar |
| **Valora Jct** | SVC | 118.05 | 2 | 38 MVar | | 76 MVar |
| **Thierry Mine** | Switched Reactor<br>Switched Capacitor | 118.05<br>4.16 | 1<br>1 | 3<br>3 | -3 MVar<br>3 MVar | -9 MVar<br>9 MVar |
| **Esker** | SVC | 13.8 | 1 | 12 MVar | | 12 MVar |
| **Musselwhite** | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| **Balmer** | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| **Deer Lake** | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| **Sandy Lake** | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages. Step size is based on the maximum step size at the device's location, while the number of blocks is determined by the maximum permissible reactive compensation behind a single breaker.

* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

**Table 7: Reactive Compensation Requirements – 115 kV Dinorwic Jct Test Case 4**

| Bus Name | Test Case 4 – 115 kV Dinorwic Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| **Ear Falls** | SVC | 118.05 | 2 | 33/ -22 MVar | | 66/ -44 MVar |
| **Dryden** | Switched Capacitor | 220 | 1 | 3 | 25 MVar | 75 MVar |
| **Mackenzie** | SVC * | 220 | 1 | 100 MVar * or 100/ -35 MVar * | | 100 MVar * or 100/ -35 MVar * |
| **Pickle Lake** | SVC | 118.05 | 2 | 20/ -25 MVar | | 40/ -50 MVar |
| **Kingfisher Jct** | Switched Reactor | 118.05 | 11 | 1 | -2 MVar | -22 MVar |
| **Valora Jct** | Switched Capacitor | 118.05 | 1 | 5 | 7 MVar | 35 MVar |
| **Thierry Mine** | Switched Reactor<br>Switched Capacitor | 118.05<br>4.16 | 1<br>1 | 3<br>3 | -3 MVar<br>3 MVar | -9 MVar<br>9 MVar |
| **Esker** | SVC | 13.8 | 1 | 12 MVar | | 12 MVar |
| **Musselwhite** | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| **Balmer** | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| **Deer Lake** | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| **Sandy Lake** | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages. Step size is based on the maximum step size at the device's location, while the number of blocks is determined by the maximum permissible reactive compensation behind a single breaker.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

## Thermal Limitations

### Valora Junction – Test Case 3

The following thermal limitations were observed:

- The line section between Ignace Junction and Ignace DS Junction on 29M1 was overloaded by 44% of its continuous rating pre-contingency. In addition, this section was overloaded by 20% of its LTE rating for the loss of D26A. It is recommended to upgrade this line section to achieve a continuous rating of 462 A and a LTE rating of 479 A.

- The line section between Moose Lake and Ignace Junction on M2D was overloaded by 24% of its LTE rating for the loss of D26A. It is recommended to upgrade this line section to achieve a LTE rating of 680 A.

### Dinorwic Junction – Test Case 4

The following post-contingency thermal limitations were observed for the loss of D26A:

- The line section between Moose Lake and Ignace Junction on M2D was overloaded by 7% of its LTE rating. It is recommended to upgrade this section to achieve a LTE rating of 590 A.

- The line section between Ignace Junction and Dryden on M2D was overloaded by 33% of its LTE rating. It is recommended to upgrade this section to achieve a LTE rating of 557 A.

## Local Voltage Limitations

The only voltage limitations observed for both cases was for the loss of D26A + F25A followed by the cross-tripping of M2D as listed in one of the assumptions in section 3.2.2, resulting in the 230 kV bus voltages at Mackenzie and Lakehead to be above 250 kV. To mitigate this overvoltage concern, it is recommended to either install an additional reactor at Mackenzie or to eliminate the contingency from consideration by separating common structures such that the circuits share at most 4 structures.

## Transmission Losses

Table 8 summarizes the impact that the new load of 130 MW has on transmission losses in the region west of Marathon. For test case 3, the active power losses west of Marathon increased by 56.6 MW, from 35 MW to 91.6 MW, while the the reactive power losses increased by 296.3 MVar from 192 MVar to 488.3 MVar. The active power losses are slightly higher in test case 3 as the resulting path to Pickle Lake has a higher resistance than in test case 4. However, the reactive power losses are higher in test case 4 as the overall impedance to Pickle Lake is higher than in test case 3.

**Table 8: Summary of Transmission Losses West of Marathon for the 115 kV Test Cases**

| Case | Active Power Losses | Reactive Power Losses | Total New Load | ΔMW losses/Δload (%) |
|---|---|---|---|---|
| Reference Case: Summer 2011 Base Case | 35 MW | 192 MVar | 0 MW | N/A |
| Test Case 3 - 115 kV Valora Junction | 91.6 MW | 488.3 MVar | 130 MW | 44% |
| Test Case 4 - 115 kV Dinorwic Junction | 82.7 MW | 508.7 MVar | 130 MW | 37% |

**– End of Section –**

# 2. Introduction

## 2.1 Reason for the Study

The IESO conducted this Feasibility Study at the OPA's request to investigate four transmission reinforcement cases that would increase the supply capability to the North of Dryden area, as well as enable twenty-one First Nations communities to connect to the grid.

## 2.2 Specific Questions Addressed

This assessment was performed to determine the transmission system enhancements required to accommodate new load, focusing on the impact in the Mackenzie, Dryden, Ear Falls and north of Dryden areas. In each of the proposed options, the technical studies determined the system reinforcements needed to address the following:

- Thermal loading and voltage levels
- Voltage change
- Steady state voltage stability
- Reactive element switching
- Location, size and type of reactive compensation devices

## 2.3 Standards and Criteria

The assessment in this study was based on the Ontario Resource and Transmission Assessment Criteria (ORTAC) document. A new Bulk Electricity System definition is currently under development by NERC which will likely result in the Northwest System being re-classified from a local area to being part of the bulk power system. However, the current local area classification of the Northwest was assumed for the study with the understanding that reinforcements for full compliance of the NERC TPL-001-2 standards associated with bulk power system definition would be dealt with in a separate study.

The specific criteria used for this study are listed below:

- Section 4.2: Pre-contingency voltage limits and Section 4.3: Voltage change limits
    - Pre-contingency voltages on the 230 kV nominal voltage buses should be within 220 - 250 kV, and on the 115 kV nominal voltage buses should be within 113 - 132 kV.
    - Post-contingency voltage change limits on the 230 kV and 115 kV nominal voltage buses should not exceed 10% before and after tap action post-contingency. Voltages on the 230 kV nominal voltage buses should be within 207 - 250 kV, and on the 115 kV nominal voltage buses should be within 108 - 132 kV.

- Section 4.3.1: Reactive Element Switching Change
  - Reactive devices should be sized to ensure that voltage declines or rises at delivery point buses on switching operations will not exceed 4% of the steady state rms voltage before tap changer action using a voltage dependent load model.
- Section 4.3.2: Capacitive Element Switching Change
  - Capacitive devices should be sized to ensure that voltage declines or rises at delivery point buses on switching operations will not exceed 4% of the steady state rms voltage for line switching operations per Chapter 4 of the Market Rules. This 4% is based on load flows before tap changer action using a voltage dependent load model.

- Section 4.5.1: Power-Voltage (P-V) curves
  - The maximum acceptable pre-contingency power transfer must be the lesser of:
    - a pre-contingency power transfer that is 10% lower than the voltage instability point of the pre-contingency P-V curve (pre-contingency switching of capacitor banks to improve the limit is allowed), and
    - a pre-contingency transfer that results in a post-contingency power flow that is 5% lower than the voltage instability point of the pre-contingency curve. (Post-contingency switching of capacitor banks is not permitted)

- Section 4.7.2: Loading Criteria
  - All line and equipment loads shall be within their continuous ratings with all elements in service and within their long-term emergency ratings with any one element out of service. Immediately following contingencies, lines may be loaded up to their short-term emergency ratings where control actions such as re-dispatch, switching, etc. are available to reduce the loading to the long-term emergency rating (within a maximum of 15-minutes).

- Section 7.1: Load security criteria
  - The *transmission system* must be planned to satisfy *demand* levels up to the extreme weather, median-economic forecast for an extended period with any one transmission element out of service. The *transmission system* must exhibit acceptable performance, as described below, following the design criteria contingencies defined in sections 2.7.1 and 2.7.2. For the purposes of this section, an element is comprised of a single zone of protection.
  - With all transmission *facilities* in service, equipment loading must be within continuous ratings, voltages must be within normal ranges and transfers must be within applicable normal condition stability limits. This must be satisfied coincident with an outage to the largest local generation unit.
  - With any one element out of service, equipment loading must be within applicable long-term *emergency* ratings, voltages must be within applicable *emergency* ranges, and transfers must be within applicable normal condition stability limits. Planned load *curtailment* or load rejection, excluding voluntary *demand* management, is permissible only to account for local generation outages. Not more than 150 MW of load may be interrupted by configuration and by planned load *curtailment* or load rejection, excluding voluntary *demand* management.
  - With any two elements out of service, voltages must be within applicable *emergency* ranges, equipment loading must be within applicable short-term *emergency* ratings and transfers must be within applicable *emergency* condition stability limits. Equipment loading must be reduced to the applicable long-term *emergency* ratings in the time afforded by the short-time ratings. Planned load *curtailment* or load rejection

exceeding 150 MW is permissible only to account for local generation outages. Not more than 600 MW of load may be interrupted by configuration and by planned load *curtailment* or load rejection, excluding voluntary *demand* management.

**– End of Section –**

# 3. Assumptions and Study Procedure

## 3.1 Proposed Connection Options

The following connection options were prepared for evaluation to increase the supply capability of the transmission system north of Dryden to Pickle Lake:

1. 230 kV Ignace Junction
    - A new 300 km 230 kV single circuit overhead line to Pickle Lake, tapped off of the Dryden-to-Mackenzie 230 kV circuit D26A, at Ignace Junction, to accommodate 190 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 5 of Appendix A.

2. 230 kV Dinorwic Juction
    - A new 300 km 230 kV single circuit overhead line to Pickle Lake, tapped off of D26A at Dinorwic Junction, to accommodate 190 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 6 of Appendix A.

3. 115 kV Valora Junction
    - A new 226 km 115 kV single circuit overhead line to Pickle Lake, tapped off of radial circuit 29M1 at Valora Junction, which is supplied from the Dryden-to-Mackenzie 115 kV circuit M2D, to accommodate 130 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in Figure 7 of Appendix A.

4. 115 kV Dinorwic Junction
    - A new 300 km 115 kV single circuit overhead line to Pickle Lake, tapped off of M2D at Dinorwic Junction, to accommodate 130 MW of new load. The load distribution is presented in Table 10 of Section 3.3, and the single line diagram is presented in
    - Figure 8 of Appendix A.

In addition to system upgrades 1 to 4 above, the study also considers:

- A new 115 kV single circuit overhead line from Ear Falls to Red Lake in parallel with E2R (parallel circuit) to support the load growth and Remote Communities in the Red Lake area.
- Upgrading the existing 115 kV E4D circuit from Dryden to Ear Falls to max-rated (665 A) in options 1 and 2.
- Installing a new 115 kV single circuit overhead line from Dryden to Ear Falls in parallel with E4D (parallel circuit), and having similar characteristics with E4D in option 3 and 4.

The following 115 kV circuits and transformer stations were proposed to connect the Remote Communities north of Red Lake and Pickle Lake. The proposed load to be supplied at each station is presented in Table 10 of section 3.3.

Red Lake Line:

- Pikangikum TS, connecting the Pikangikum and Poplar Hill communities
- Deer Lake TS, connecting the Deer Lake and North Spirit Lake communities
- Sandy Lake TS, connecting the Sandy Lake and Kee-Way-Win communities

Pickle Lake:

- Muskrat Dam Line:
  - North Caribou Lake TS, connecting the North Caribou Lake community
  - Muskrat Dam TS, connecting the Bearskin Lake, Sachigo Lake and Muskrat Dam communities
- Big Trout Line:
  - Kingfisher Lake TS, connecting the Kingfisher Lake community (and the Wunnumin Lake community for options 1 and 2)
  - Wapekeka TS, connecting the Big Trout Lake, Wapekeka, Kasabonika Lake and Wawakapewin communities
- Webequie Line:
  - Wunnumin Lake TS, connecting the Wunnumin Lake community in for options 3 and 4
  - Nibinamik TS, connecting the Nibinamik (Summer Beaver) and Webequie communities for options 3 and 4
- Ebanes Line:
  - Neskantaga TS, connecting the Neskantaga (Lansdowne House) and Eabametoong (Fort Hope) communities
  - Webequie TS, connecting the Nibinamik (Summer Beaver) and Webequie communities in options 1 and 2. In addition, if Pickle Lake option 1 or 2 is considered, the new mining loads at the Ring of Fire (McFaulds) would be supplied by extending the Ebanes line past Webequie.

Figure 1 and Figure 2 illustrate the supply configuration from Pickle Lake to the Remote Communities for connection options 1-4.

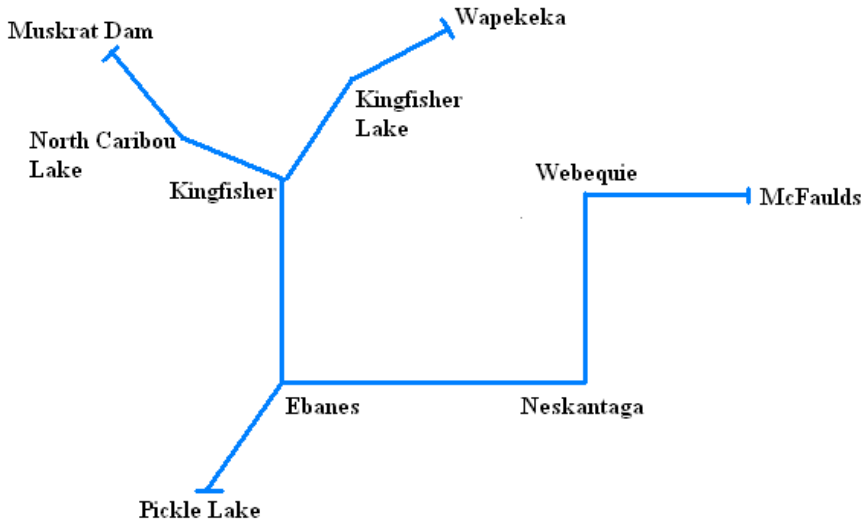


**Figure 1: Pickle Lake Supply to Remote Communities under Options 1 or 2**

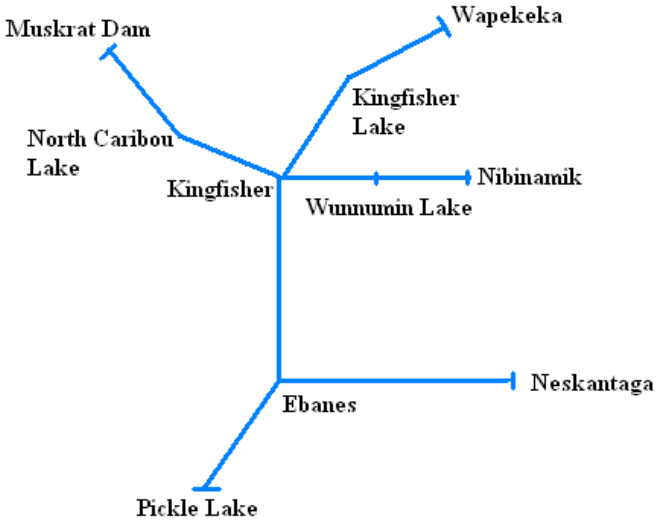


**Figure 2: Pickle Lake Supply to Remote Communities under Options 3 or 4**

## 3.2 Study Assumptions

### 3.2.1 Area Assumptions

Steady state and voltage analysis simulations were performed using PSS/E base cases. A summer 2011 scenario including all existing and committed projects was used to develop the study scenarios with the following assumptions:

- Hydro-electric generation at drought levels. Table 9 lists the dependable water conditions for Hydro-electric stations in the area under which the OPA requested the study be performed.
- Load levels corresponding to the connection year (2016-2019), 2020 and 2031 provided by the OPA for both peak and light load conditions.
- No imports from Manitoba and Minnesota.
- The East-West Transfer West (E-W-TR-W) upgrades as per the feasibility study: *An Assessment of the Westward Transfer Capability of Various Options for Reinforcing the East-West Tie*.
- Atikokan TGS out of service.
- Balmer, Esker and Thierry Mine in-service.
- All proposed 115 kV circuits had line characteristics equivalent to that of a 477 kcmil ACSR conductor, with the exception of the new 115 kV single circuit overhead line from Dinorwic Junction in option 4, which had line characteristics equivalent to that of a 795 kcmil ACSR conductor. All proposed 230 kV circuits had line characteristics equivalent to that of a 795 kcmil ACSR conductor, as per OPA's instructions.
- The 115 kV/LV transformers at McFaulds were assumed to be similar to the existing Red Lake transformers. Other 115 kV/LV transformers were assumed to be similar to the existing Crow River transformer for loads greater than 3 MVA, or the Slate Falls transformer for loads smaller than 3 MVA. The Pickle Lake 230/115 kV autotransformer was assumed to be similar to the existing Lakehead autotransformers.
- The thermal line ratings in the north of the Dryden area were verified through the Hydro One database, and were assumed to be at 30 $^{o}$C ambient temperature at 4 km/hr wind velocity. The new line ratings were provided by the OPA.
- The load power factor is assumed to be 0.95 at the LV busbar so to comply with the Market Rule of 0.90 at the defined meter point at the HV Busbar.
- For steady state and voltage assessment, the loads are modeled as constant megavolt-ampere (MVA).

**Table 9: Dependable Water Conditions for Area Hydro Facilities**

| 98 % Dependable Water - Summer | |
|---|---|
| **Hydro Unit** | **Generation (MW)** |
| Lac Seul | 0 |
| Ear Falls (G1) | 3 |
| Ear Falls (G2) | 0 |
| Ear Falls (G3) | 0 |
| Ear Falls (G4) | 0 |
| Manitou Falls (G1) | 9.3 |
| Manitou Falls (G2) | 0 |
| Manitou Falls (G3) | 0 |
| Manitou Falls (G4) | 0 |
| Manitou Falls (G5) | 0 |
| White Dog (G1) | 12.4 |
| White Dog (G2) | 0 |
| White Dog (G3) | 0 |
| Caribou Falls (G1) | 19.8 |
| Caribou Falls (G2) | 0 |

### 3.2.2 New Facility Assumptions

The following study assumptions were made regarding the availability and design of future facilities:

- Load Rejection (LR) schemes were assumed to be implemented for all the test cases to address any potential E2R (and parallel circuit) or E4D (and parallel circuit) overload issues following the loss of their companion circuit. Based on simulation results, the loss of one E4D circuit would result in the need to reject approximately 70 MW of load in the Red Lake Area. Similarly, the loss of one E2R circuit would result in the need to reject up to 60 MW of load in the Red Lake Area.
- Special Protection Scheme (SPS) were available to reject load with any two major elements out of service.
- An auto-tripping scheme for Lakehead capacitor SC11 was in place when Lakehead 230 kV bus voltage exceeds 250 kV. Studies have shown that the Lakehead 230 kV bus voltage could exceed 250 kV while the Lakehead 115 kV bus voltage is below 125.5 kV, which would not trigger the current auto-tripping scheme for Lakehead SC11.
- It was assumed that the loss of shunt devices connected at load stations (McFaulds, Esker, Musselwhite, Red Lake, Balmer, Sandy Lake, Thierry Mine) would also result in the loss of the associated load.
- The maximum continuous voltage for the 115 kV system that connects to new transmission areas was assumed to be 132 kV. The maximum continuous voltages for existing stations was based on the ORTAC and the 115 kV Bus Voltages System Control Order (SCO).

- The post-contingency SPS and auto-switching action happened before the ULTC actions.
- For the LR in the 230 kV test cases, the Pickle Lake load could be rejected by tripping the new 230 kV single circuit overhead line from Ignace or Dinorwic Junction to Pickle Lake using a single breaker at the tap point. The line could also be left radial given that the Pickle Lake SVC would regulate the 230 kV voltage to 230 kV as a part of the SPS scheme.
- For the LR in the 115 kV test cases, the Pickle Lake load could be rejected by tripping the new 115 kV single circuit overhead line from Valora or Dinorwic Junction to Pickle Lake using a single breaker at the tap point. The line could also be left radial given that the Pickle Lake SVC would regulate the 115 kV voltage to 120 kV for the Valora configuration and 117 kV for the Dinorwic configuration to neutralize the charging on the line.
- Circuits E2R and M3E are currently terminating at the same terminal at Ear Falls. It was assumed for the purpose of this study that the station would be upgraded such that each line would have its own terminal.
- It was assumed that circuit B6M would be opened at Moose Lake for the double-circuit contingency on A21L and A22L to avoid overloads on circuit B6M.
- It was assumed that circuit M2D would be cross-tripped for the double-circuit contingency on D26A and F25A to avoid overloads on circuit M2D.
- It was assumed that an auto-switching scheme for Fort Frances capacitors SC1 and SC2 is in place when Fort Frances 115 kV bus voltage reaches 112 kV.
- A single breaker configuration was assumed at Ignace and Dinorwic Junction.
- Reconfiguration of Mackenzie was assumed to be in place. Under the current station configuration at Mackenzie, as shown in Figure 3, the loss of double-circuit contingency A21L and A22L would split the Mackenzie 230 kV bus. In order to avoid this bus splitting at Mackenzie, which results in worse post-contingency voltages, a new station configuration was assumed by adding a new diameter between the P and H buses as shown in Figure 4. Circuits A21L and D26A were placed on the new diameter, with circuit F25A and the new Mackenzie SVC on the other diameter to prevent the possibility of losing D26A and the Mackenzie SVC for a breaker failure.

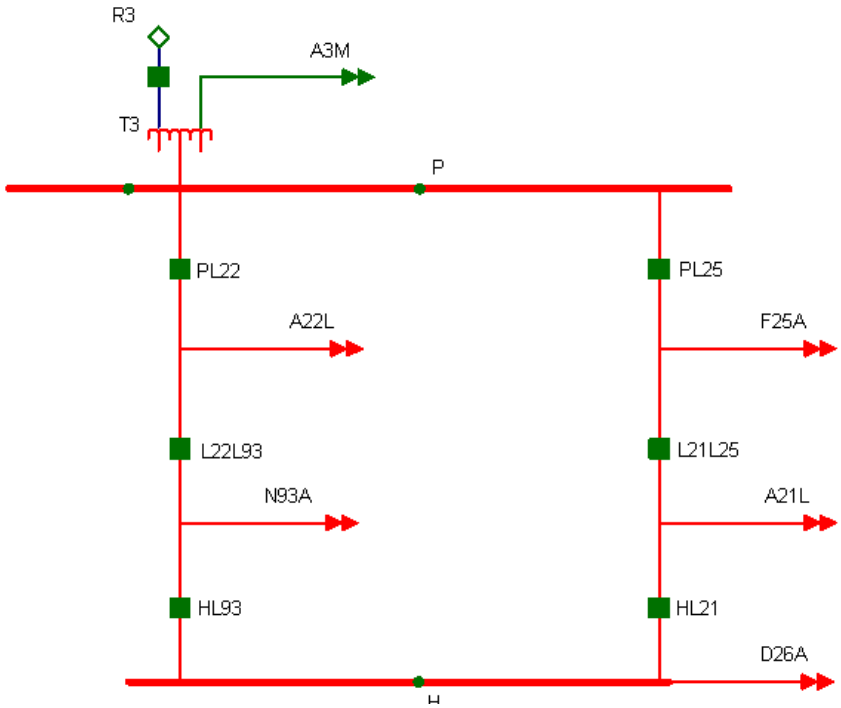


**Figure 3: Existing configuration at Mackenzie TS**

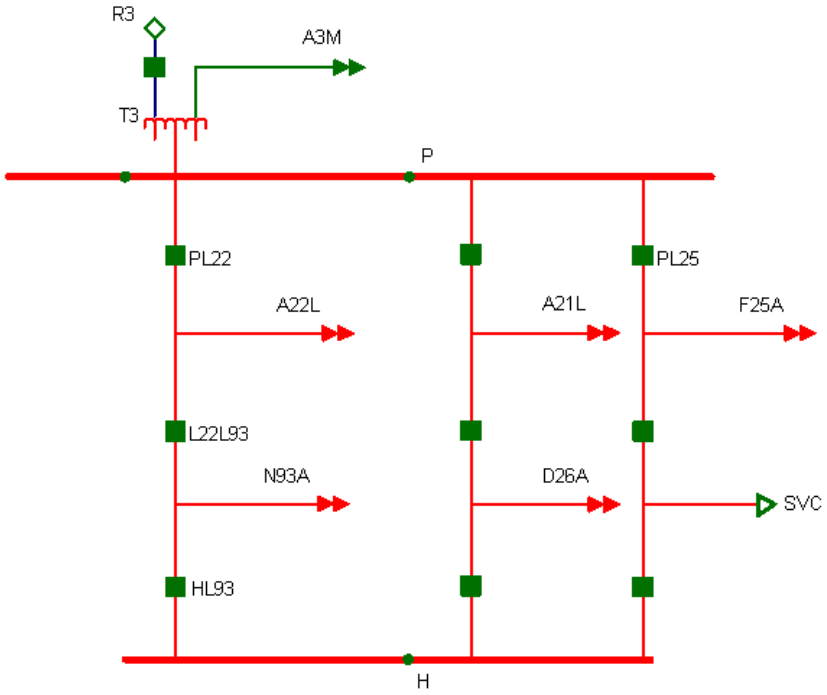


**Figure 4: Proposed configuration at Mackenzie TS**

## 3.3 Load Forecast

The load forecast in Table 10 was provided by the OPA and used in the simulation studies. The minimum loading level was determined based on the type of load:

- Minimum industrial loads (Balmer, Thierry Mine and Musselwhite) were assumed to be 85% of their peak load.
- Minimum non-industrial loads (Ear Falls, Cat Lake, Slate Falls, Crow River and Perrault Falls) were assumed to be 30% of their peak.
- At Red Lake, 8 MW of the peak load was assumed to be retail/commercial and the rest industrial load.

**Table 10: Load Forecast**

| | Minimum Load (MW) | | Peak Load (MW) | |
|---|---|---|---|---|
| **Existing Stations** | **Options 1 or 2** | **Options 3 or 4** | **Options 1 or 2** | **Options 3 or 4** |
| Ear Falls TS | 1.02 | 1.02 | 3.4 | 3.4 |
| Red Lake TS | 52.55 | 52.55 | 67 | 67 |
| Balmer TS | 38.25 | 38.25 | 45 | 45 |
| Cat Lake CTS | 0.3 | 0.3 | 1 | 1 |
| Slate Falls CTS | 0.36 | 0.36 | 1.2 | 1.2 |
| Thierry Mine | 7.65 | 7.65 | 9 | 9 |
| Crow River DS | 1.32 | 1.32 | 4.4 | 4.4 |
| Musselwhite CSS | 34 | 34 | 40 | 40 |
| Perrault Falls TS | 0.18 | 0.18 | 0.6 | 0.6 |
| **New Stations** | | | | |
| North Caribou Lake | 0.338 | 0.338 | 2.192 | 2.192 |
| Muskrat Dam TS | 0.671 | 0.671 | 4.345 | 4.345 |
| Kingfisher Lake TS | 0.465 | 0.188 | 2.785 | 1.126 |
| Wapekeka TS | 1.075 | 1.075 | 6.437 | 6.437 |
| Wunnumin Lake TS | N/A | 0.649 | N/A | 1.659 |
| Nibinamik TS | N/A | 0.383 | N/A | 2.387 |
| Neskantaga TS | 0.552 | 0.552 | 3.865 | 3.865 |
| Webequie TS | 0.354 | N/A | 2.387 | N/A |
| Pikangikum TS | 0.726 | 0.726 | 4.894 | 4.894 |
| Deer Lake TS | 0.279 | 0.279 | 3.033 | 3.033 |
| Sandy Lake TS | 1.07 | 1.07 | 6.929 | 6.929 |
| McFaulds TS | 36 | N/A | 60 | N/A |

## 3.4 Study Scenarios

The initial base cases were developed based on the connection options presented in Section 3.1, the study assumptions in Section 3.2, and the load forecast in Section 3.3 of this report. Different study test cases were developed based on different operations of the 115 kV circuit E1C and the upgrade of the 115 kV circuit E4D. The following table shows the test cases that were prepared for this study.

**Table 11: List of Test Cases**

| Test Case # | Circuit to Pickle Lake | E1C loop | E4D upgrade | E2R upgrade |
|---|---|---|---|---|
| **1** | 230 kV from Ignace Jct. | Open - Radial out of Pickle Lake with Ear Falls load on E1C | Max-Rated (665 A) | New Parallel circuit |
| **2** | 230 kV from Dinorwic Jct. | Open – Radial out of Pickle Lake with Ear Falls load on E1C | Max-Rated (665 A) | New Parallel circuit |
| **3** | 115 kV from Valora Jct. | Open – Radial out of Ear Falls | New Parallel circuit | New Parallel circuit |
| **4** | 115 kV from Dinorwic Jct. | Open – Radial out of Ear Falls | New Parallel circuit | New Parallel circuit |

## 3.5 Relevant Contingencies

A detailed representation of the existing and proposed system in the north of Dryden area, for both the 115 kV and 230 kV configurations, is presented in Appendix A. The contingencies considered for the studies were:

- Any area single element contingency; and
- The simultaneous loss of two 230 kV circuits mounted on a common transmission tower or pole west of Lakehead. The East of Lakehead area was assumed to be addressed by the East-West Tie reinforcement feasibility study.

The following table summarizes the key single and double element contingencies that were assessed for each test case.

**Table 12: List of Contingencies**

| **Single Element Contingencies** |
|---|
| A21L or A22L |
| D26A |
| F25A |
| K23D |
| 1 Manitou Falls unit |
| 1 Shunt reactive device |
| **Double Element Contingencies** |
| A21L & A22L<br>– Isolation on to Manitoba assuming B6M is opened at Moose Lake (cross-tripped) |
| D26A & F25A<br>– Isolation on to Manitoba assuming M2D is cross-tripped |

## 3.6 Study Procedure

For each test case, base cases were developed for both peak and light load conditions. The location and size of the reactive compensation devices for each test case was determined under the following load scenarios to satisfy the criteria listed in section 2.3.

- Peak Load Conditions: Voltage stability analysis was performed to ensure the required margins from the voltage instability point were at least 10% pre-contingency and 5% post-contingency. This test determined the reactive compensation required to ensure sufficient margin from the voltage collapse point.

- Zero Load Conditions. Line energization tests were performed with all existing elements in-service using the following procedure:

    1) Connect a new transmission line with no load.
    2) Supply 25% of the minimum load on this transmission line.
    3) Repeat step 1 for a different transmission line.

    The order in which the transmission lines were energized was varied to determine the largest reactive compensation required. This test determined the reactive compensation to manage high voltages.

Equipment loading and voltage levels were assessed with all elements in-service and following the contingencies presented in Table 12 to determine the feasibility of each test case with the reinforcements determined above. This test determined additional reinforcements required to meet the thermal loading and voltage level criteria.

In addition, the switching of reactive elements was tested under light load conditions to determine the largest acceptable step size to be switched.

**– End of Section**

# 4. 230 kV Test Cases – Findings and Recommendations

## 4.1 Pre-Contingency Voltage Stability Margin – Step 1

Section 4.5.1 of the ORTAC indicates that there must be sufficient margin from the voltage instability point such that the maximum pre-contingency transfer is the lesser of:

- a pre-contingency power transfer that is 10% lower than the voltage instability point of the pre-contingency P-V curve, and
- a pre-contingency transfer that results in a post-contingency power flow that is 5% lower than the voltage instability point of the pre-contingency curve

In addition, Section 7.1 of the ORTAC indicates that with any one element out of service:

- transfers must be within applicable normal condition stability limits. Not more than 150 MW of load may be interrupted by configuration and by planned load *curtailment* or load rejection for local generation outages.

To determine the amount of reactive compensation required to supply the new load north of Dryden with the required stability margin when a transmission element is on an outage, voltage stability analysis was performed at a load level 10% higher than forecast. The most limiting element out of service was determined to be 230 kV circuit A21L.

The results of this test are summarized in Table 13 below.

**Table 13: Pre-Contingency Voltage Stability Reactive Compensation Requirements for the 230 kV Test Cases – Step 1**

| Bus Name | Test Case 1 - Ignace Junction | Test Case 2 – Dinorwic Junction |
|---|---|---|
| | Voltage Stability (+10% Load Pre-Contingency) | Voltage Stability (+10% Load Pre-Contingency) |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | 91 | 94 |
| Dryden 230 kV | 38 | 39 |
| Mackenzie 230 kV | 123 | 141 |
| Mackenzie LV | 0 | 0 |
| Pickle Lake 230 kV | 78 | 76 |
| Kingfisher Jct 115 kV | 0 | 0 |
| Neskantaga 115 kV | 19 | 19 |
| Webequie 115 kV | 17 | 17 |
| McFaulds LV | 48 | 48 |
| Esker LV | 15 (5 Existing) | 15 (5 Existing) |
| Musselwhite LV | 18 (14 Existing) | 18 (14 Existing) |
| Red Lake LV | 20 (26.5 Existing) | 20 (26.5 Existing) |
| Balmer LV | 15 | 16 |
| Deer Lake 115 kV | 0 | 0 |
| Sandy Lake LV | 2 | 2 |
| **Total** | **484** | **505** |

From Table 13, it can be seen that a total reactive compensation of 484 MVar is required for test case 1, and 505 MVar for test case 2. The table lists the total requirement at each station with the value of any existing shunt devices in brackets.

The largest reactive compensation requirement is located at the Mackenzie 230 kV bus. This is expected with A21L out of service, since it leaves only 230 kV circuit A22L and 115 kV circuit B6M supplying the west of Mackenzie load. It should be noted that as the junction point moves further from Mackenzie from Ignace to Dinorwic, the reactive requirement at Mackenzie increases.

The reactive compensation at Ear Falls is required primarily to support the forecasted load growth and Remote Communities in the Red Lake Area.

## 4.2 Line Energization – Step 2

To ensure that bus voltages do not exceed their maximum allowable levels, as specified in the Section 4.2 of ORTAC and the 115 kV Bus Voltages SCO, energization tests were performed to identify the amount of reactive compensation needed to control the voltages below their maximum continuous limits. The study results are provided in Table 14 below.

**Table 14: Line Energization Test Results for the 230 kV Test Cases – Step 2**

| Bus Name | Test Case 1 - Ignace Junction | Test Case 2 – Dinorwic Junction |
|---|---|---|
| | Energization Test | Energization Test |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | -30 | -30 |
| Dryden 230 kV | 0 | 0 |
| Mackenzie 230 kV | 0 | 0 |
| Mackenzie LV | -40 (Existing) | -40 (Existing) |
| Pickle Lake 230 kV | -64 | -64 |
| Kingfisher Jct 115 kV | -12 | -12 |
| Neskantaga 115 kV | 0 | 0 |
| Webequie 115 kV | -6 | -6 |
| McFaulds LV | 0 | 0 |
| Esker LV | 0 | 0 |
| Musselwhite LV | 0 | 0 |
| Red Lake LV | 0 | 0 |
| Balmer LV | 0 | 0 |
| Deer Lake 115 kV | -2 | -2 |
| Sandy Lake LV | 0 | 0 |
| **Total** | **-154** | **-154** |

In both 230 kV test cases, a total reactive compensation requirement of -154 MVar was identified for energization. The results show that reactive compensation is needed at:

- Pickle Lake, Kingfisher and Webequie buses to energize the area north of Dryden.
- Ear Falls and Deer Lake buses to energize the area north of Red Lake.

## 4.3 Device Sizing – Step 3

A switching test was performed for each shunt device identified in Sections 4.1 and 4.2 to determine the maximum step size that can be switched without causing a voltage deviation larger than 4%, as specified in the switching change requirement in Sections 4.3.1 and 4.3.2 of ORTAC. The maximum step size for each location is given in Table 15.

**Table 15: Maximum Switching Step Size for the 230 kV Test Cases**

| Bus Name | Test Case 1 - Ignace Junction | | Test Case 2 – Dinorwic Junction | |
|---|---|---|---|---|
| | Maximum Step Size for Switching | | Maximum Step Size for Switching | |
| | Step Size (MVar) | Base Voltage (kV) | Step Size (MVar) | Base Voltage (kV) |
| Ear Falls 115 kV | 11 | 118.05 | 11 | 118.05 |
| Dryden 230 kV | 30 | 220 | 30 | 220 |
| Mackenzie 230 kV | 36.5 | 220 | 36.5 | 220 |
| Mackenzie LV | 32 | 13.8 | 32 | 13.8 |
| Pickle Lake 230 kV | 8.5 | 220 | 8.5 | 220 |
| Kingfisher Jct 115 kV | 3.5 | 118.05 | 3.5 | 118.05 |
| Neskantaga 115 kV | 4.5 | 118.05 | 4.5 | 118.05 |
| Webequie 115 kV | 3.5 | 118.05 | 3.5 | 118.05 |
| McFaulds LV | 3 | 44. | 3 | 44 |
| Esker LV | 3.5 | 13.8 | 3.5 | 13.8 |
| Musselwhite LV | 3 | 4.16 | 3 | 4.16 |
| Red Lake LV | 7 | 44. | 7 | 44 |
| Balmer LV | 8 | 44 | 8 | 44 |
| Deer Lake 115 kV | 3 | 118.05 | 3 | 118.05 |
| Sandy Lake LV | 1.5 | 27.6 | 1.5 | 27.6 |

Based on the maximum step size and the total reactive compensation required at each location as determined in steps 1 and 2, the number of steps for shunt devices was calculated. These results are listed in Tables 16 and 17 for test cases 1 and 2 respectively.

**Table 16: Reactive Compensation Requirements based on Step Size for the Ignace Junction Test Case – Step 3**

| Bus Name | Capacitor | | | Reactor | | |
|---|---|---|---|---|---|---|
| | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) |
| Ear Falls 115 kV | 9 | 10 | 90 | 3 | -10 | -30 |
| Dryden 230 kV | 2 | 20 | 40 | 0 | 0 | 0 |
| Mackenzie 230 kV | 4 | 31 | 124 | 0 | 0 | 0 |
| Mackenzie LV | 0 | 0 | 0 | 2 | -20 | -40 (Existing) |
| Pickle Lake 230 kV | 10 | 8 | 80 | 8 | -8 | -64 |
| Kingfisher Jct 115 kV | 0 | 0 | 0 | 4 | -3 | -12 |
| Neskantaga 115 kV | 5 | 4 | 20 | 0 | 0 | 0 |
| Webequie 115 kV | 6 | 3 | 18 | 2 | -3 | -6 |
| McFaulds LV | 16 | 3 | 48 | 0 | 0 | 0 |
| Esker LV | 5 | 3 | 15 (5 Existing) | 0 | 0 | 0 |
| Musselwhite LV | 6 | 3 | 18 (14 Existing) | 0 | 0 | 0 |
| Red Lake LV | 3 | 7 | 21 (26.5 Existing) | 0 | 0 | 0 |
| Balmer LV | 2 | 8 | 16 | 0 | 0 | 0 |
| Deer Lake 115 kV | 0 | 0 | 0 | 1 | -2 | -2 |
| Sandy Lake LV | 2 | 1 | 2 | 0 | 0 | 0 |
| **Total** | | | **492** | | | **-154** |

**Table 17: Reactive Compensation Requirements based on Step Size for the Dinorwic Junction Test Case – Step 3**

| Bus Name | Capacitor | | | Reactor | | |
|---|---|---|---|---|---|---|
| | # of Steps | Step Size (Mvar) | Reactive Requirements (MVar) | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) |
| Ear Falls 115 kV | 10 | 9.5 | 95 | 3 | -10 | -30 |
| Dryden 230 kV | 2 | 20 | 40 | 0 | 0 | 0 |
| Mackenzie 230 kV | 4 | 35 | 140 | 0 | 0 | 0 |
| Mackenzie LV | 0 | 0 | 0 | 2 | -20 | -40 (Existing) |
| Pickle Lake 230 kV | 10 | 8 | 80 | 8 | -8 | -64 |
| Kingfisher Jct 115 kV | 0 | 0 | 0 | 4 | -3 | -12 |
| Neskantaga 115 kV | 5 | 4 | 20 | 0 | 0 | 0 |
| Webequie 115 kV | 6 | 3 | 18 | 2 | -3 | -6 |
| McFaulds LV | 16 | 3 | 48 | 0 | 0 | 0 |
| Esker LV | 5 | 3 | 15 (5 Existing) | 0 | 0 | 0 |
| Musselwhite LV | 6 | 3 | 18 (14 Existing) | 0 | 0 | 0 |
| Red Lake LV | 3 | 7 | 21 (26.5 Existing) | 0 | 0 | 0 |
| Balmer LV | 2 | 8 | 16 | 0 | 0 | 0 |
| Deer Lake 115 kV | 0 | 0 | 0 | 1 | -2 | -2 |
| Sandy Lake LV | 2 | 1 | 2 | 0 | 0 | 0 |
| **Total** | | | **513** | | | **-154** |

The shunt devices at Ear Falls, Mackenzie, Pickle Lake and McFaulds require a large number of steps, it is more practical to install SVC instead of switch devices, and they would also provide fast-acting

reactive support to the system and limit the amount of shunt devices at a single location. Therefore, SVCs are strongly recommended for these locations.

The existing size of the SVCs at Esker and Musselwhite will need to be increased to 15 MVar and 18 MVar, respectively. For the remaining locations, auto-switching shunt devices will be required. Further analysis is required to determine the switching speed of the shunt devices as it is beyond the scope of this study.

## 4.4 Post-Contingency Voltage Stability Margin – Step 4

To ensure that there is a sufficient voltage stability margin in response to the loss of each shunt device, a voltage stability test was performed at a load level 5% higher to determine if the capacitive devices require splitting. Similarly, a test was performed to determine if the splitting of reactors is required to ensure that all maximum voltages are respected for the loss of each inductive device.

Based on the simulation results for both test cases, it was found that a minimum of 65 MVar is required at Ear Falls to avoid voltage instability, therefore two SVCs, each with a capability of +65/ -15 MVar, are required.

Similarly, the Pickle Lake SVC will need to be split into two separate SVCs, each with a capability of +40/ -35 MVar. In addition, the switched capacitors at Neskantaga and Webequie will also need to be split into two blocks. The switched reactor at Kingfisher could not be split, therefore an additional step of -3 MVar is required. Tables 18 and 19 summarize the new reactive compensation requirements for test cases 1 and 2, respectively.

**Table 18: Final New Reactive Compensation Requirements for the Ignace Junction Test Case – Step 4**

| Bus Name | 230 kV Test Case 1 - Ignace Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| Ear Falls | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| Dryden | Switched Capacitor | 220 | 1 | 2 | 20 MVar | 40 MVar |
| Mackenzie | SVC * | 220 | 1 | 123 MVar * or 123/ -35 MVar * | | 123 MVar * or 123/ -35 MVar * |
| Pickle Lake | SVC | 220 | 2 | 40/ -35 MVar | | 80/ -70 MVar |
| Kingfisher Jct | Switched Reactor | 118.05 | 5 | 1 | -3 MVar | -15 MVar |
| Neskantaga | Switched Capacitor | 118.05 | 2 | 3 | 4 MVar | 24 MVar |
| Webequie | Switched Capacitor<br>Switched Reactor | 118.05 | 2<br>1 | 3<br>2 | 3 MVar<br>-3 MVar | 18 MVar<br>-6 MVar |
| McFaulds | SVC | 44 | 1 | 48 MVar | | 48 MVar |
| Esker | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| Musselwhite | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| Balmer | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| Deer Lake | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| Sandy Lake | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All shunt devices are assumed to be auto-switching based on controlled bus voltages.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

**Table 19: Final New Reactive Compensation Requirements for the Dinorwic Junction Test Case – Step 4**

| Bus Name | 230 kV Test Case 2 - Dinorwic Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| Ear Falls | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| Dryden | Switched Capcatior | 220 | 1 | 2 | 20 MVar | 40 MVar |
| Mackenzie | SVC * | 220 | 1 | 141 MVar * or<br>141/ -35 MVar * | | 141 MVar * or<br>141/ -35 MVar * |
| Pickle Lake | SVC | 220 | 2 | 40/ -35 MVar | | 80/ -70 MVar |
| Kingfisher Jct | Switched Reactor | 118.05 | 5 | 1 | -3 MVar | -15 MVar |
| Neskantaga | Switched Capcatior | 118.05 | 2 | 3 | 4 MVar | 24 MVar |
| Webequie | Switched Capacitor<br>Switched Reactor | 118.05 | 2<br>1 | 3<br>2 | 3 MVar<br>-3 MVar | 18 MVar<br>-6 MVar |
| McFaulds | SVC | 44 | 1 | 48 MVar | | 48 MVar |
| Esker | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| Musselwhite | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| Balmer | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| Deer Lake | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| Sandy Lake | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All shunt devices are assumed to be auto-switching based on controlled bus voltages.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

## 4.5 Thermal Loading Assessment

Section 4.7.2 of ORTAC requires that elements be loaded within their continuous ratings with all elements in-service, and within their long-term emergency ratings with any one element out of service. Equipment loading was assessed with all elements in-service under peak load conditions and following a relevant contingency as listed in Table 12. The results for the thermal assessment are presented in detail in Appendix B for test cases 1 and 2.

Pre-contingency loadings on all monitored line sections were within their continuous ratings for both test cases 1 and 2.

The loss of one Manitou Falls unit under the assumed conditions resulted in E4D loaded at approximately 105% of its STE ratings. As the LTE and STE ratings for this circuit are identical, line upgrades to achieve a LTE rating of about 700 A or pre-contingency control actions, such as generation re-dispatch if available, could be used to reduce post-contingency flows within acceptable limits. Otherwise, pre-contingency load curtailment may have to be implemented during low water conditions.

Although transformer loading results were not included in this report, there were no thermal limitations on all key transformers monitored in the area.

## 4.6 Voltage Assessment

Sections 4.2 and 4.3 of ORTAC set the maximum and minimum acceptable system voltages under pre-contingency conditions with all elements in-service, as well as the permissible voltage change limits following a contingency. Voltage assessment was performed with all elements in-service under peak and light load conditions following a relevant contingency listed in Table 12. The detailed results for the voltage assessment are presented in Appendix C for test cases 1 and 2.

Voltages were within their acceptable pre-contingency ranges, under peak or light load conditions, for both test cases 1 and 2.

In both test cases, the 115 kV bus voltages at Sapawe DS was above 127 kV for the loss of A21L + A22L and the subsequent opening of B6M at Moose Lake. This overvoltage occurs largely because, following the opening of B6M at Moose Lake, the station is located at the end of a lightly loaded line. The concern can be mitigated by installing a small reactor at the bus or by removing the 115 kV Birch capacitor post-contingency. Alternatively, B6M could be entirely cross-tripped rather than opening it at Moose Lake.

In addition, the 230 kV bus voltages at Mackenzie and Lakehead were above 250 kV for the loss of D26A + F25A and the subsequent cross-trip of M2D. To mitigate this overvoltage concern, it is recommended to either install an additional reactor at Mackenzie or to eliminate the contingency from consideration by separating the circuits from common structures such that the circuits share at most 4 structures.

## 4.7 Intertie Flows

The pre-contingency intertie flows on the Ontario-to-Manitoba and Ontario-to-Minnesota interfaces were assumed to be zero. The loss of A21L + A22L with B6M cross-tripped or D26A + F25A with M2D cross-tripped, results in a system separation, leaving Ontario load connected radially to the Northwest interties circuits (K21W, K22W and F3M). Table 20 shows the resulting intertie flows following the system separation contingencies for test cases 1 and 2. All intertie circuits were well within their thermal capability.

**Table 20: Additional Intertie Flows following a Double-Circuit Contingency**

| Contingency | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|
| Intertie Line | Flow In (MW) | | Flow In (MW) | | Flow In (MW) | |
| | Test Case 1 | Test Case 2 | Test Case 1 | Test Case 2 | Test Case 1 | Test Case 2 |
| F3M | 74 | 78 | 88 | 89 | 78 | 78 |
| K21W | 69 | 66 | 78 | 77 | 77 | 77 |
| K22W | 69 | 66 | 78 | 77 | 77 | 77 |

## 4.8 Transmission Losses

Table 21 summarizes the impact that the new load has on transmission losses. This table lists the total active and reactive power losses on all circuits in the region west of Marathon before the additional load and for test cases 1 and 2. In both 230 kV test cases, the total load added to the system was 190 MW. For test case 1, the active power losses increased by 76.8 MW, from 35 MW to 111.8 MW, while the reactive

power losses increased by 454.9 MVar, from 192 MVar to 646.9 MVar. These losses are slightly higher in test case 2 as the junction point moves further west with supply coming from the east.

**Table 21: Summary of Transmission Losses West of Marathon for the 230 kV Test Cases**

| Case | Active Power Losses | Reactive Power Losses | Total New Load | ΔMW losses/Δload (%) |
|---|---|---|---|---|
| Reference Case - Base Case with no new load | 35 MW | 192 MVar | 0 MW | N/A |
| Test Case 1 - 230 kV Ignace Junction | 111.8 MW | 646.9 MVar | 190 MW | 40% |
| Test Case 2 - 230 kV Dinorwic Junction | 117.2 MW | 676.4 MVar | 190 MW | 43% |

## 4.9 Load Sensitivity Analysis at McFaulds

A sensitivity study, as per OPA request, was conducted for the 230 kV Ignace test case to determine the amount of reactive compensation needed when the load at McFaulds is reduced from 60 MW to 30 MW. This sensitivity analysis focused on voltage stability and line energization, and did not include thermal and voltage assessments. The study results are presented in Tables 22 and 23 below.

**Table 22: Sensitivity – Reactive Compensation Requirements for the Ignace Junction Test Case – Step 1**

| Bus Name | 60 MW McFaulds Load | 30 MW McFaulds Load |
|---|---|---|
| | Voltage Stability (+10% Load Pre-Contingency) | Voltage Stability (+10% Load Pre-Contingency) |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | 91 | 91 |
| Dryden 230 kV | 38 | 0 |
| Mackenzie 230 | 123 | 0 |
| Mackenzie LV | 0 | 0 |
| Pickle Lake 230 | 78 | 35 |
| Kingfisher Jct 115 | 0 | 0 |
| Neskantaga 115 | 19 | 0 |
| Webequie 115 kV | 17 | 0 |
| McFaulds LV | 48 | 20 |
| Esker LV | 15 (5 Existing) | 15 (5 Existing) |
| Musselwhite LV | 18 (14 Existing) | 18 (14 Existing) |
| Red Lake LV | 20 (26.5 Existing) | 20 (26.5 Existing) |
| Balmer LV | 15 | 15 |
| Deer Lake 115 kV | 0 | 0 |
| Sandy Lake LV | 2 | 2 |
| **Total** | **484** | **216** |

**Table 23: Sensitivity – Line Energization Test Results for the Ignace Junction Test Case – Step 2**

| Bus Name | 60 MW McFaulds Load | 30 MW McFaulds Load |
|---|---|---|
| | Energization Test | Energization Test |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | -30 | -30 |
| Dryden 230 kV | 0 | 0 |
| Mackenzie 230 kV | 0 | 0 |
| Mackenzie LV | -40 (Existing) | -40 (Existing) |
| Pickle Lake 230 kV | -64 | -72 |
| Kingfisher Jct 115 | -12 | -15 |
| Neskantaga 115 kV | 0 | 0 |
| Webequie 115 kV | -6 | -6 |
| McFaulds LV | 0 | 0 |
| Esker LV | 0 | 0 |
| Musselwhite LV | 0 | 0 |
| Red Lake LV | 0 | 0 |
| Balmer LV | 0 | 0 |
| Deer Lake 115 kV | -2 | -2 |
| Sandy Lake LV | 0 | 0 |
| **Total** | **-154** | **-165** |

When the load level at McFaulds is 30 MW, the total capacitive requirement is reduced from 484 MVar to 216 MVar, and the total inductive requirement for energization is increased slightly from 154 MVar to 165 MVar.

Reactive support at Mackenzie, Dryden and Neskantaga is no longer required as the load reduction at McFaulds, which is located at the end of a long 115 kV transmission line, greatly reduces the transmission line losses within the area.

Table 24 summarizes the active and reactive power losses as well as the total new load in the area west of Marathon for the two load levels considered at McFaulds. The active power losses decreased from 118.8 MW to 76.3 MW and reactive power losses decreased from 646.9 MVar to 466.6 MVar.

**Table 24: Sensitivity – Summary of Transmission Losses West of Marathon for the Ignace Junction Test Case**

| Case | Active Power Losses | Reactive Power Losses | Total New Load | ΔMW losses/Δload (%) |
|---|---|---|---|---|
| Reference Case - Base Case with no new load | 35 MW | 192 MVar | 0 MW | N/A |
| Test Case 1 – 230 kV Ignace Junction with 60 MW McFaulds Load | 111.8 MW | 646.9 MVar | 190 MW | 40% |
| Sensitivity – 230 kV Ignace Junction with 30 MW McFaulds Load | 76.3MW | 466.6 MVar | 160 MW | 26% |

The reactive compensation requirements for each location, with the maximum step size and the number of steps, are presented in Table 25. SVCs were assumed at Ear Falls, Pickle Lake and McFaulds due to a large number of steps.

Similar to the test case 1 with 60 MW of McFaulds Load, the device size of existing SVCs at Esker and Musselwhite will need to be increased to 15 MVar and 18 MVar, respectively. For the other locations, an auto-switching device will be required. A more detailed analysis is recommended to determine the device type that should be installed at those locations.

**Table 25: Sensitivity – Reactive Compensation Requirements based on Step Size with 30 MW McFaulds Load – Step 3**

| Bus Name | Capacitor | | | Reactor | | |
|---|---|---|---|---|---|---|
| | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) |
| Ear Falls 115 kV | 9 | 10 | 90 | 3 | -10 | -30 |
| Dryden 230 kV | 0 | 0 | 0 | 0 | 0 | 0 |
| Mackenzie 230 kV | 0 | 0 | 0 | 0 | 0 | 0 |
| Mackenzie LV | 0 | 0 | 0 | 2 | -20 | -40 (Existing) |
| Pickle Lake 230 kV | 5 | 7 | 35 | 9 | -8 | -72 |
| Kingfisher Jct 115 kV | 0 | 0 | 0 | 5 | -3 | -15 |
| Neskantaga 115 kV | 0 | 0 | 0 | 0 | 0 | 0 |
| Webequie 115 kV | 0 | 0 | 0 | 2 | -3 | -6 |
| McFaulds LV | 7 | 3 | 21 | 0 | 0 | 0 |
| Esker LV | 5 | 3 | 15 (5 Existing) | 0 | 0 | 0 |
| Musselwhite LV | 6 | 3 | 18 (14 Existing) | 0 | 0 | 0 |
| Red Lake LV | 3 | 7 | 21 (26.5 Existing) | 0 | 0 | 0 |
| Balmer LV | 2 | 8 | 16 | 0 | 0 | 0 |
| Deer Lake 115 kV | 0 | 0 | 0 | 1 | -2 | -2 |
| Sandy Lake LV | 2 | 1 | 2 | 0 | 0 | 0 |
| **Total** | | | **218** | | | **-165** |

In order to determine the need for the splitting of shunt devices, tests were performed to ensure that there is sufficient voltage stability margin for the loss of each capacitive device, and also to ensure that all bus voltages are below the maximum voltages for the loss of a reactor.

It was found that a minimum of 65 MVar is required at Ear Falls to avoid voltage instability. Therefore two SVCs, each with a capability of +65/ -15 MVar, are required. The Pickle Lake SVC will need to be split into two separate SVCs, each with a capability of +18/ -41 MVar. The switched reactor at Kingfisher could not be split, therefore an additional step of -3 MVar is required. Table 26 summarizes the new reactive compensation requirements for the Ignace Junction test case with 30 MW load at McFaulds.

**Table 26: Sensitivity – Final New Reactive Compensation Requirements with 30 MW McFaulds Load – Step 4**

| Bus Name | 230 kV Test Case 1 - Ignace Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| Ear Falls | SVC | 118.05 | 2 | 65/ -15 MVar | | 130/ -30 MVar |
| Pickle Lake | SVC | 220 | 2 | 18/ -41 MVar | | 36/ -82 MVar |
| Kingfisher Jct | Switched Reactor | 118.05 | 6 | 1 | -3 MVar | -18 MVar |
| Webequie | Switched Reactor | 118.05 | 1 | 2 | -3 MVar | -6 MVar |
| McFaulds | SVC | 44 | 1 | 20 MVar | | 20 MVar |
| Esker | SVC | 13.8 | 1 | 10 MVar | | 10 MVar |
| Musselwhite | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| Balmer | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| Deer Lake | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| Sandy Lake | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All shunt devices are assumed to be auto-switching based on controlled bus voltages.

**– End of Section –**

# 5. 115 kV Test Cases - Findings and Recommendations

## 5.1 Pre-Contingency Voltage Stability Margin – Step 1

As previously mentioned in section 4.1, the ORTAC requires a 10% margin from the voltage stability point during normal conditions, which applies with an element out of service pre-contingency.

To determine the amount of reactive compensation required to supply the new load north of Dryden with the required stability margin when a transmission element is on an outage, voltage stability analysis was performed at a load level 10% higher than forecast. The most limiting element out of service was determined to be 230 kV circuit D26A.

The results of this test are summarized in Table 27 below.

**Table 27: Pre-Contingency Voltage Stability Reactive Compensation Requirements for the 115 kV Test Cases – Step 1**

| Bus Name | Test Case 3 - Valora Junction | Test Case 4 – Dinorwic Junction |
|---|---|---|
| | Voltage Stability (+10% Load Pre-Contingency) | Voltage Stability (+10% Load Pre-Contingency) |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | 65 | 65 |
| Dryden 230 kV | 0 | 73 |
| Mackenzie 230 kV | 85 | 100 |
| Mackenzie LV | 0 | 0 |
| Pickle Lake 115 kV | 21 | 39 |
| Kingfisher Jct 115 kV | -9 | -9 |
| Valora Jct 115 kV | 75 | 33 |
| Thierry Mine 115 kV | 0 | 0 |
| Thierry Mine LV | 7 | 7 |
| Esker LV | 17 (5 Existing) | 17 (5 Existing) |
| Musselwhite 115 kV | 0 | 0 |
| Musselwhite LV | 18 (14 Existing) | 18 (14 Existing) |
| Red Lake LV | 19 (26.5 Existing) | 19 (26.5 Existing) |
| Balmer LV | 15 | 15 |
| Deer Lake 115 kV | 0 | 0 |
| Sandy Lake LV | 2 | 2 |
| **Total** | **324/ -9** | **388/ -9** |

The total reactive compensation required for test case 3 is 324 MVar, with 388 MVar required for test case 4. Both cases required a -9 MVar reactor at Kingfisher Junction to ensure that voltages do not exceed their maximum permissible levels. The values in Table 27 represent the total requirement at each station, with the value of any existing shunt devices in brackets.

For test cases 3 and 4, the largest reactive compensation requirement is located at the Mackenzie 230 kV bus since it is the main supply point for new load when transfers are from east to west.

It can be observed that more reactive compensation is required for test case 4 than for test case 3. This is primarily due to the fact that reactive support for the Valora case was directly connected at the junction due to the presence of an existing station, Valora DS. Whereas in the Dinorwic Junction case, it was assumed that since there is no existing station at the junction, reactive support would need to be supplied from neighboring stations, ultimately increasing the requirement.

The reactive compensation at Ear Falls is required to support the forecasted load growth and Remote Communities in the Red Lake Area.

## 5.2 Line Energization – Step 2

To ensure that bus voltages do not exceed their maximum allowable levels, as specified in the Section 4.2 of ORTAC and the 115 kV Bus Voltages SCO, energization tests were performed to identify the amount of reactive compensation needed to control the voltages below their maximum continuous limits. The study results are provided in the following table.

**Table 28: Line Energization Test Results for the 115 kV Test Cases – Step 2**

| Bus Name | Test Case 3 – Valora Junction | Test Case 4 – Dinorwic Junction |
|---|---|---|
| | Energization Test | Energization Test |
| | Compensation Required at Base Voltage (MVar) | Compensation Required at Base Voltage (MVar) |
| Ear Falls 115 kV | -43 | -44 |
| Dryden 230 kV | 0 | 0 |
| Mackenzie 230 kV | 0 | 0 |
| Mackenzie LV | -40 (Existing) | -40 (Existing) |
| Pickle Lake 115 kV | -34 | -34 |
| Kingfisher Jct 115 kV | -18 | -19 |
| Valora Jct 115 kV | 0 | 0 |
| Thierry Mine 115 kV | -8 | -8 |
| Thierry Mine LV | 0 | 0 |
| Esker LV | 0 | 0.0 |
| Musselwhite 115 kV | -6 (-13 Existing) | -6 (-13 Existing) |
| Musselwhite LV | 0 | 0 |
| Red Lake LV | 0 | 0 |
| Balmer LV | 0 | 0 |
| Deer Lake 115 kV | -2 | -2 |
| Sandy Lake LV | 0 | 0 |
| **Total** | **-151** | **-153** |

For both 115 kV test cases, a total reactive compensation of approximately -150 MVar is required for energization. The results show that reactive compensation is required at:

- Pickle Lake and Kingfisher to energize the area north of Dryden.
- Ear Falls and Deer Lake to energize the area north of Red Lake.
- Thierry Mine to energize E1C.

## 5.3 Device Sizing – Step 3

A switching test was performed for each shunt device identified in the Sections 5.1 and 5.2 to determine the maximum step size that can be switched without causing a voltage deviation larger than 4%, as specified in the switching change requirement in sections 4.3.1 and 4.3.2 of ORTAC. The maximum step size of each device is given in Table 29.

**Table 29: Maximum Switching Step Size for the 115 kV Test Cases**

| Bus Name | Test Case 3 - Valora Junction | | Test Case 4 – Dinorwic Junction | |
|---|---|---|---|---|
| | Maximum Step Size for Switching | | Maximum Step Size for Switching | |
| | Step Size (MVar) | Base Voltage (kV) | Step Size (MVar) | Base Voltage (kV) |
| Ear Falls 115 kV | 15 | 118.05 | 15 | 118.05 |
| Dryden 230 kV | 30 | 220 | 30 | 220 |
| Mackenzie 230 kV | 35 | 220 | 35 | 220 |
| Mackenzie LV | 30 | 13.8 | 30 | 13.8 |
| Pickle Lake 115 kV | 3.5 | 118.05 | 3.5 | 118.05 |
| Kingfisher Jct 115 kV | 2 | 118.05 | 2 | 118.05 |
| Valora Jct 115 kV | 8 | 118.05 | 7.5 | 118.05 |
| Thierry Mine 115 kV | 3 | 118.05 | 3 | 118.05 |
| Thierry Mine LV | 3 | 4.16 | 3 | 4.16 |
| Esker LV | 3.5 | 13.8 | 3 | 13.8 |
| Musselwhite 115 kV | 3.5 | 118.05 | 3.5 | 118.05 |
| Musselwhite LV | 4 | 4.16 | 4 | 4.16 |
| Red Lake LV | 8.5 | 44 | 8.5 | 44 |
| Balmer LV | 10 | 44 | 10 | 44 |
| Deer Lake 115 kV | 3.5 | 118.05 | 3.5 | 118.05 |
| Sandy Lake LV | 1.5 | 27.6 | 1.5 | 27.6 |

Based on the maximum step size and the total reactive compensation required at each location as determined in steps 1 and 2, the number of steps for shunt devices was calculated. These results are listed in Table 30 and Table 31 for test cases 3 and 4, respectively.

**Table 30: Reactive Compensation Requirements based on Step Size for the Valora Junction Test Case – Step 3**

| Bus Name | Capacitor | | | Reactor | | |
|---|---|---|---|---|---|---|
| | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) |
| Ear Falls 115 kV | 5 | 13 | 65 | 3 | -15 | -45 |
| Dryden 230 kV | 0 | 0 | 0 | 0 | 0 | 0 |
| Mackenzie 230 kV | 3 | 30 | 90 | 0 | 0 | 0 |
| Mackenzie LV | 0 | 0 | 0 | 2 | -20 | -40 (Existing) |
| Pickle Lake 115 kV | 6 | 3.5 | 21 | 10 | -3.5 | -35 |
| Kingfisher Jct 115 kV | 0 | 0 | 0 | 10 | -2 | -20 |
| Valora Jct 115 kV | 10 | 7.5 | 75 | 0 | 0 | 0 |
| Thierry Mine 115 kV | 0 | 0 | 0 | 3 | -3 | -9 |
| Thierry Mine LV | 3 | 3 | 9 | 0 | 0 | 0 |
| Esker LV | 6 | 3 | 18 (5 Existing) | 0 | 0 | 0 |
| Musselwhite 115 kV | 0 | 0 | 0 | 2 | -3 | -6 (-13 Existing) |
| Musselwhite LV | 5 | 4 | 20 (14 Existing) | 0 | 0 | 0 |
| Red Lake LV | 3 | 7 | 21 (26.5 Existing) | 0 | 0 | 0 |
| Balmer LV | 2 | 8 | 16 | 0 | 0 | 0 |
| Deer Lake 115 kV | 0 | 0 | 0 | 1 | -2 | -2 |
| Sandy Lake LV | 2 | 1 | 2 | 0 | 0 | 0 |
| **Total** | | | **337** | | | **-157** |

**Table 31: Reactive Compensation Requirements based on Step Size for the Dinorwic Junction Test Case – Step 3**

| Bus Name | Capacitor | | | Reactor | | |
|---|---|---|---|---|---|---|
| | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) | # of Steps | Step Size (MVar) | Reactive Requirements (MVar) |
| Ear Falls 115 kV | 5 | 13 | 65 | 3 | -15 | -45 |
| Dryden 230 kV | 3 | 25 | 75 | 0 | 0 | 0 |
| Mackenzie 230 kV | 3 | 33 | 99 | 0 | 0 | 0 |
| Mackenzie LV | 0 | 0 | 0 | 2 | -20 | -40 (Existing) |
| Pickle Lake 115 kV | 12 | 3.5 | 42 | 10 | -3.5 | -35 |
| Kingfisher Jct 115 kV | 0 | 0 | 0 | 10 | -2 | -20 |
| Valora 115 kV | 5 | 7 | 35 | 0 | 0 | 0 |
| Thierry Mine 115 kV | 0 | 0 | 0 | 3 | -3 | -9 |
| Thierry Mine LV | 3 | 3 | 9 | 0 | 0 | 0 |
| Esker LV | 6 | 3 | 18 (5 Existing) | 0 | 0 | 0 |
| Musselwhite 115 kV | 0 | 0 | 0 | 2 | -3 | -6 (-13 Existing) |
| Musselwhite LV | 5 | 4 | 20 (14 Existing) | 0 | 0 | 0 |
| Red Lake LV | 3 | 7 | 21 (26.5 Existing) | 0 | 0 | 0 |
| Balmer LV | 2 | 8 | 16 | 0 | 0 | 0 |
| Deer Lake 115 kV | 0 | 0 | 0 | 1 | -2 | -2 |
| Sandy Lake LV | 2 | 1 | 2 | 0 | 0 | 0 |
| **Total** | | | **402** | | | **-157** |

The shunt devices at Ear Falls, Mackenzie, Pickle Lake and Valora Junction (for test case 3) require a large number of steps, it is more practical to install SVC instead of switch devices, and they would also provide fast-acting reactive support to the system and limit the amount of shunt devices at a single location. Therefore, SVCs are strongly recommended for these locations.

The existing size of the SVCs at Esker and Musselwhite will need to be increased to 17 MVar and 18 MVar, respectively. For the remaining locations, auto-switching shunt devices will be required. Further analysis is required to determine the switching speed of the shunt devices as it is beyond the scope of this study.

## 5.4 Post-Contingency Voltage Stability Margin – Step 4

To ensure that there is a sufficient voltage stability margin in response to the loss of each shunt device, a voltage stability test was performed at a load level 5% higher to determine if the capacitive devices require splitting. Similarly, a test was performed to determine if the splitting of reactors is required to ensure that all maximum voltages are respected for the loss of each inductive device.

Based on the simulation results, it was found that the SVCs at Ear Falls and Pickle Lake for both test cases, and the SVC at Valora Junction for test case 3, need to be split into two separate SVCs. The reactor at Kingfisher could not be split, therefore an additional step of -2 MVar is required. Tables 32 and 33 summarize the new reactive compensation requirements for test cases 3 and 4, respectively.

**Table 32: Final New Reactive Compensation Requirements for the Valora Junction Test Case – Step 4**

| Bus Name | Test Case 3 - Valora Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| Ear Falls | SVC | 118.05 | 2 | 33/ -22 MVar | | 66/ -44 MVar |
| Mackenzie | SVC * | 220 | 1 | 85 MVar * or 85/ -35 MVar * | | 85 MVar * or 85/ -35 MVar * |
| Pickle Lake | SVC | 118.05 | 2 | 11/ -20 MVar | | 22/ -40 MVar |
| Kingfisher Jct | Switched Reactor | 118.05 | 11 | 1 | -2 MVar | -22 MVar |
| Valora Jct | SVC | 118.05 | 2 | 38 MVar | | 76 MVar |
| Thierry Mine | Switched Reactor/ Switched Capacitor | 118.05<br>4.16 | 1<br>1 | 3<br>3 | -3 MVar<br>3 MVar | -9 MVar<br>9 MVar |
| Esker | SVC | 13.8 | 1 | 12 MVar | | 12 MVar |
| Musselwhite | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| Balmer | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| Deer Lake | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| Sandy Lake | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable

**Table 33: Final New Reactive Compensation Requirements for Dinorwic Junction Test Case – Step 4**

| Bus Name | Case 4 – Dinorwic Junction | | | | | |
|---|---|---|---|---|---|---|
| | Recommended Device Type | Base Voltage (kV) | # of Blocks or SVCs | # of Steps per Block or SVC Range | Step Size | Total Compensation |
| Ear Falls | SVC | 118.05 | 2 | 33/ -22 MVar | | 66/ -44 MVar |
| Dryden | Switched Capacitor | 220 | 1 | 3 | 25 MVar | 75 MVar |
| Mackenzie | SVC * | 220 | 1 | 100 MVar * or 100/ -35 MVar * | | 100 MVar * or 100/ -35 MVar * |
| Pickle Lake | SVC | 118.05 | 2 | 20/ -25 MVar | | 40/ -50 MVar |
| Kingfisher Jct | Switched Reactor | 118.05 | 11 | 1 | -2 MVar | -22 MVar |
| Valora Jct | Switched Capacitor | 118.05 | 1 | 5 | 7 MVar | 35 MVar |
| Thierry Mine | Switched Reactor/<br>Switched Capacitor | 118.05<br>4.16 | 1<br>1 | 3<br>3 | -3 MVar<br>3 MVar | -9 MVar<br>9 MVar |
| Esker | SVC | 13.8 | 1 | 12 MVar | | 12 MVar |
| Musselwhite | SVC | 4.16 | 1 | 4 MVar | | 4 MVar |
| Balmer | Switched Capacitor | 44 | 1 | 2 | 8 MVar | 16 MVar |
| Deer Lake | Switched Reactor | 118.05 | 1 | 1 | -2 MVar | -2 MVar |
| Sandy Lake | Switched Capacitor | 27.6 | 1 | 2 | 1 MVar | 2 MVar |

Note: All fixed shunt devices are assumed to be auto-switching based on controlled bus voltages.
* If the existing Mackenzie reactor is kept, an SVC with only positive range will be required. If the reactor is not kept, then an SVC with both a positive and negative range will be required. Further studies are recommended to determine which Mackenzie SVC configuration is more desirable.

## 5.5 Thermal Loading Assessment

Section 4.7.2 of ORTAC requires that elements be loaded within their continuous ratings with all elements in-service, and within their long-term emergency ratings with any one element out of service. Equipment loading was assessed with all elements in-service under peak load conditions and following a relevant contingency as listed in Table 12. The results for the thermal assessment are presented in detail in Appendix D for test cases 3 and 4.

The only pre-contingency thermal limitation was on the line section between Ignace Junction and Ignace DS Junction, for test case 3, with the line loaded at 144% of its continuous rating. Since this line section has a length of 1.1 km, it is recommended to upgrade this line section to achieve continuous rating of 462 A.

Post-contingency thermal limitations were observed for the loss of D26A. Table 34 lists the limiting line sections for this contingency.

**Table 34: Limiting Line Segments for Test Cases 3 and 4 for the Loss of D26A**

| Test Case # | Circuit | Line Section | Circuit Loading (A) | % of LTE Rating |
|---|---|---|---|---|
| 3 | 29M1 | Ignace Juction to Ignace DS Junction | 479 | 119.75 |
| | M2D | Moose Lake to Ignace Juction | 680 | 123.64 |
| 4 | M2D | Moose Lake to Ignace Juction | 590 | 107.27 |
| | M2D | Ignace Junction to Dryden | 557 | 132.62 |

The line section between Ignace Junction and Ignace DS Junction was overloaded by 20% of its LTE rating post-contingency. This line section should at least be upgraded to achieve a LTE rating of 479 A.

The line section between Moose Lake and Ignace Junction on M2D was overloaded by 24% and 7% of its LTE rating for the loss of D26A for test cases 3 and 4, respectively. It is recommended to upgrade this line section to achieve their LTE rating of 680 A for test case 3 and 590 A for test case 4.

The line section between Ignace Junction and Dryden on M2D was overloaded by 33% of its LTE rating. It is recommended to upgrade this section to achieve a LTE rating of 557 A.

Although transformer loading results are not included in this report, there are no thermal limitations on all the key transformers monitored in the area.

## 5.6 Voltage Assessment

Sections 4.2 and 4.3 of ORTAC set the maximum and minimum acceptable system voltages under pre-contingency conditions with all elements in-service, as well as the permissible voltage change limits following a contingency. Voltage assessment was performed with all elements in-service under peak and light load conditions following a relevant contingency listed in Table 12. The detailed results for the voltage assessment are presented in Appendix E for test cases 3 and 4.

Voltages were within their acceptable pre-contingency ranges, under peak or light load conditions, for both test cases 3 and 4.

The 230 kV bus voltages at Mackenzie and Lakehead were above 250 kV for the loss of D26A + F25A and the subsequent cross-trip of M2D. To mitigate this overvoltage concern, it is recommended to either install an additional reactor at Mackenzie or to eliminate the contingency from consideration by separating the circuits from common structures such that the circuits share at most 4 towers.

## 5.7 Intertie Flows

The pre-contingency intertie flows on the Ontario-to-Manitoba and Ontario-to-Minnesota interfaces were assumed to be zero. The loss of A21L + A22L with B6M cross-tripped or D26A + F25A with B6M cross-tripped, results in a system separation, leaving Ontario load connected radially to the Northwest interties circuits (K21W, K22W and F3M). Table 35 shows the resulting intertie flows following the system separation contingencies for cases 3 and 4. All intertie circuits were well within their thermal capability.

**Table 35: Additional Intertie Flows following a Double-Circuit Contingency**

| Contingency | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|
| Intertie Line | Flow In (MW) | | Flow In (MW) | | Flow In (MW) | |
| | Test Case 3 | Test Case 4 | Test Case 3 | Test Case 4 | Test Case 3 | Test Case 4 |
| F3M | 92 | 90 | 76 | 70 | 91 | 90 |
| K21W | 83 | 84 | 66 | 63 | 90 | 90 |
| K22W | 83 | 84 | 66 | 63 | 90 | 90 |

## 5.8 Transmission Losses

Table 36 summarizes the impact that the new load has on transmission losses. This table lists the total active and reactive power losses on all circuits in the region west of Marathon before the additional load and for test cases 3 and 4. In both 115 kV test cases, the total load added to the system is 130 MW. For test case 3, the active power losses increased by 56.6 MW, from 35 MW to 91.6 MW, and the reactive power losses increased by 296.3 MVar, from 192 MVar to 488.3 MVar. The active power losses are slightly higher in test case 3 as the resulting path to Pickle Lake has a higher resistance than in test case 4. However, the reactive power losses are higher in test case 4 as the overall impedance to Pickle Lake is higher than in test case 3.

**Table 36: Summary of Transmission Losses West of Marathon for the 115 kV Test Cases**

| Case | Active Power Losses | Reactive Power Losses | Total New Load | ΔMW losses/Δload (%) |
|---|---|---|---|---|
| Reference Case: Summer 2011 Base Case | 35 MW | 192 MVar | 0 MW | N/A |
| Test Case 3 - 115 kV Valora Junction | 91.6 MW | 488.3 MVar | 130 MW | 44% |
| Test Case 4 - 115 kV Dinorwic Junction | 82.7 MW | 508.7 MVar | 130 MW | 37% |

**– End of Section –**

# Appendix A: Detailed Diagrams

1. 230 kV Ignace Junction:

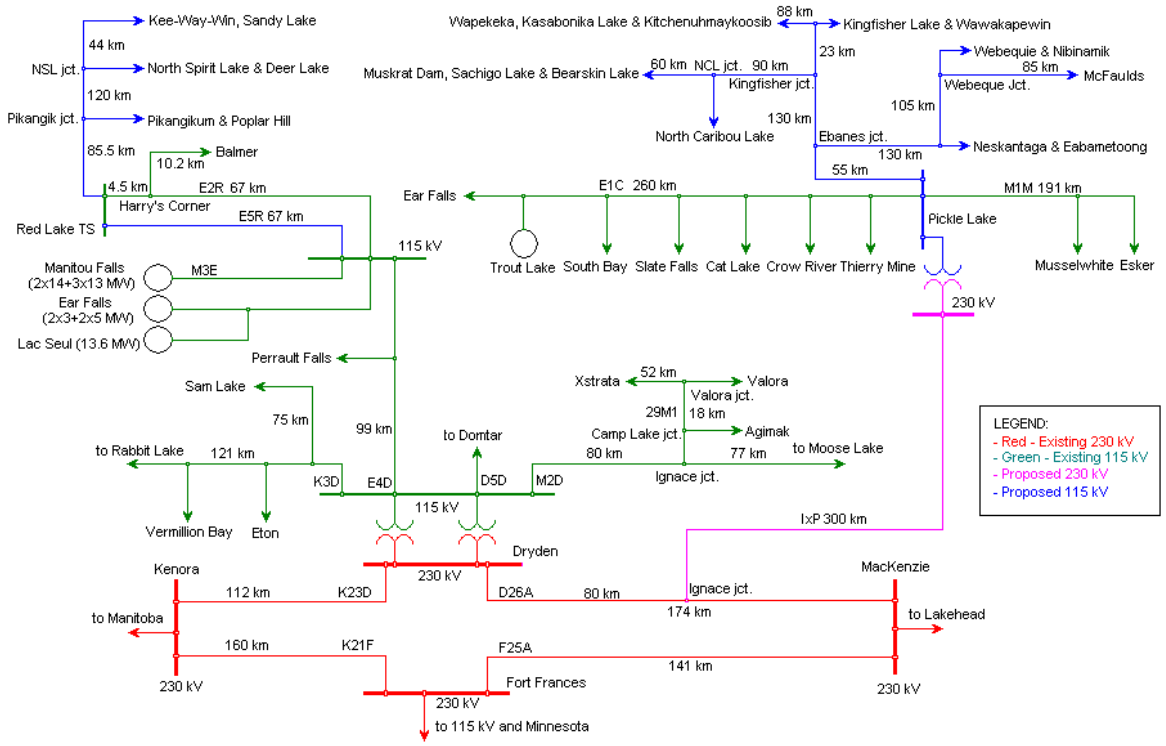


**Figure 5: Detailed Single Line Diagram – 230 kV Ignace Junction**

2. 230 kV Dinorwic Junction:

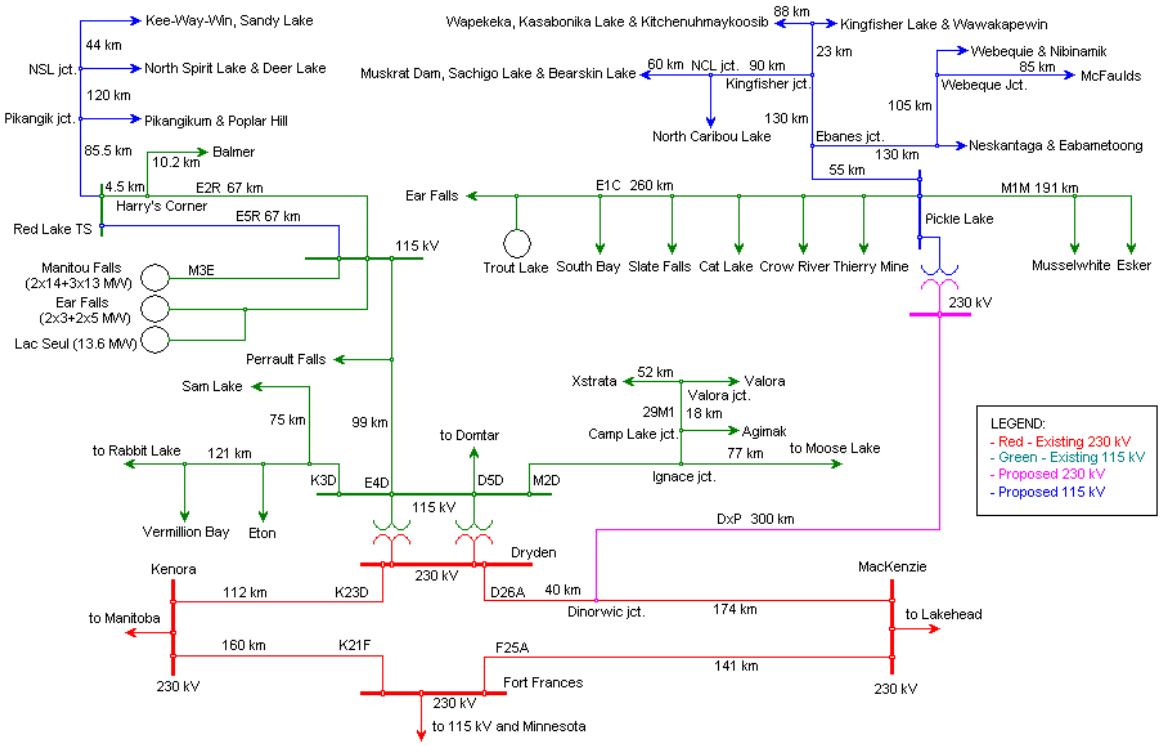


**Figure 6: Detailed Single Line Diagram – 230 kV Dinorwic Junction**

3. 115 kV Valora Junction:

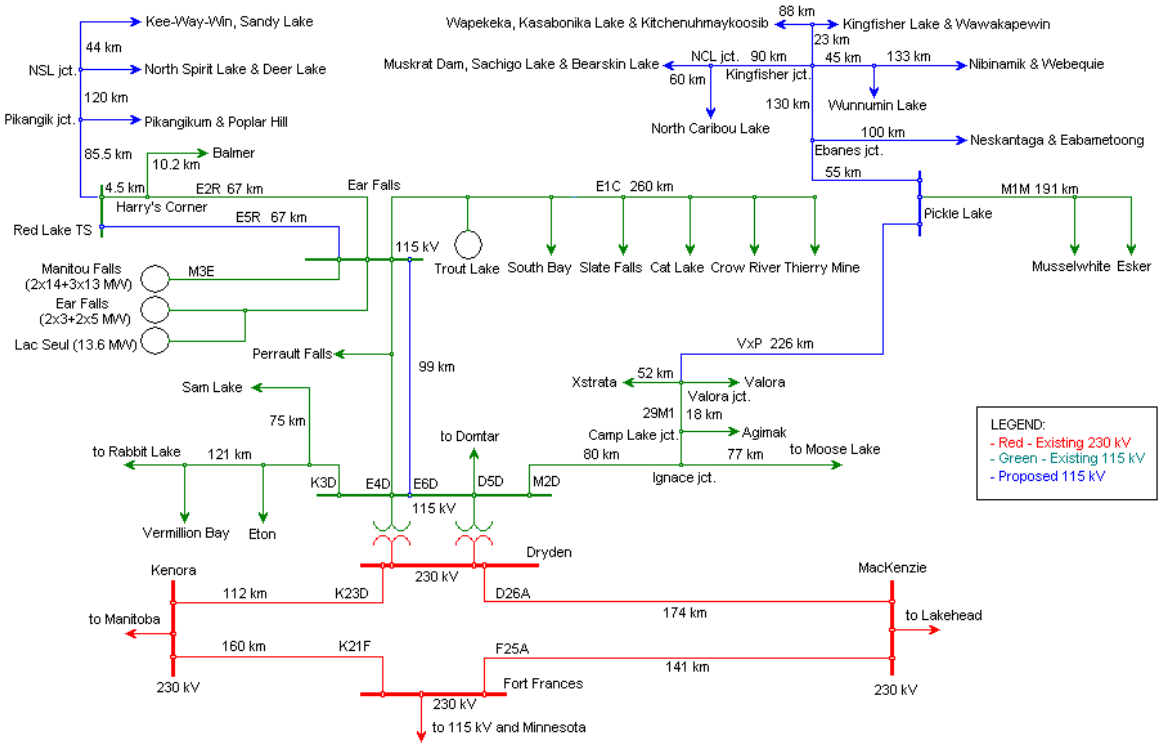


**Figure 7: Detailed Single Line Diagram – 115 kV Valora Junction**

4. 115 kV Dinorwic Junction:

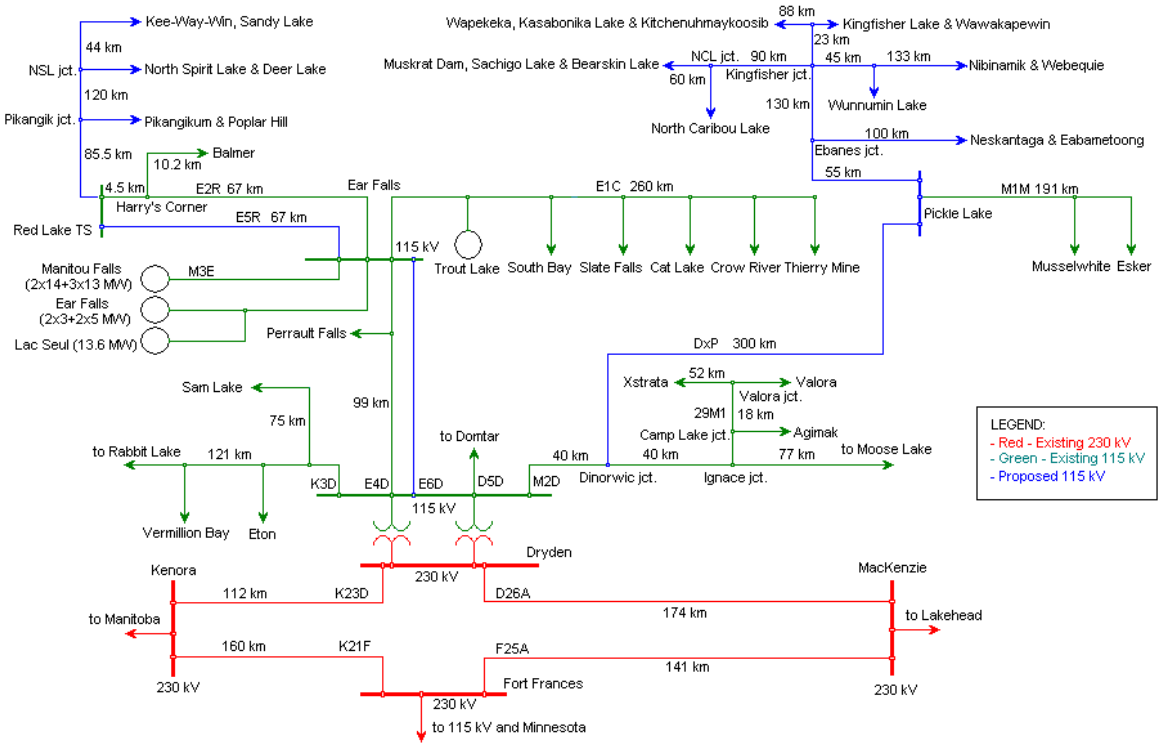


**Figure 8: Detailed Single Line Diagram – 115 kV Dinorwic Junction**

5. West of Thunder Bay System Overview – 230 kV Test Cases:

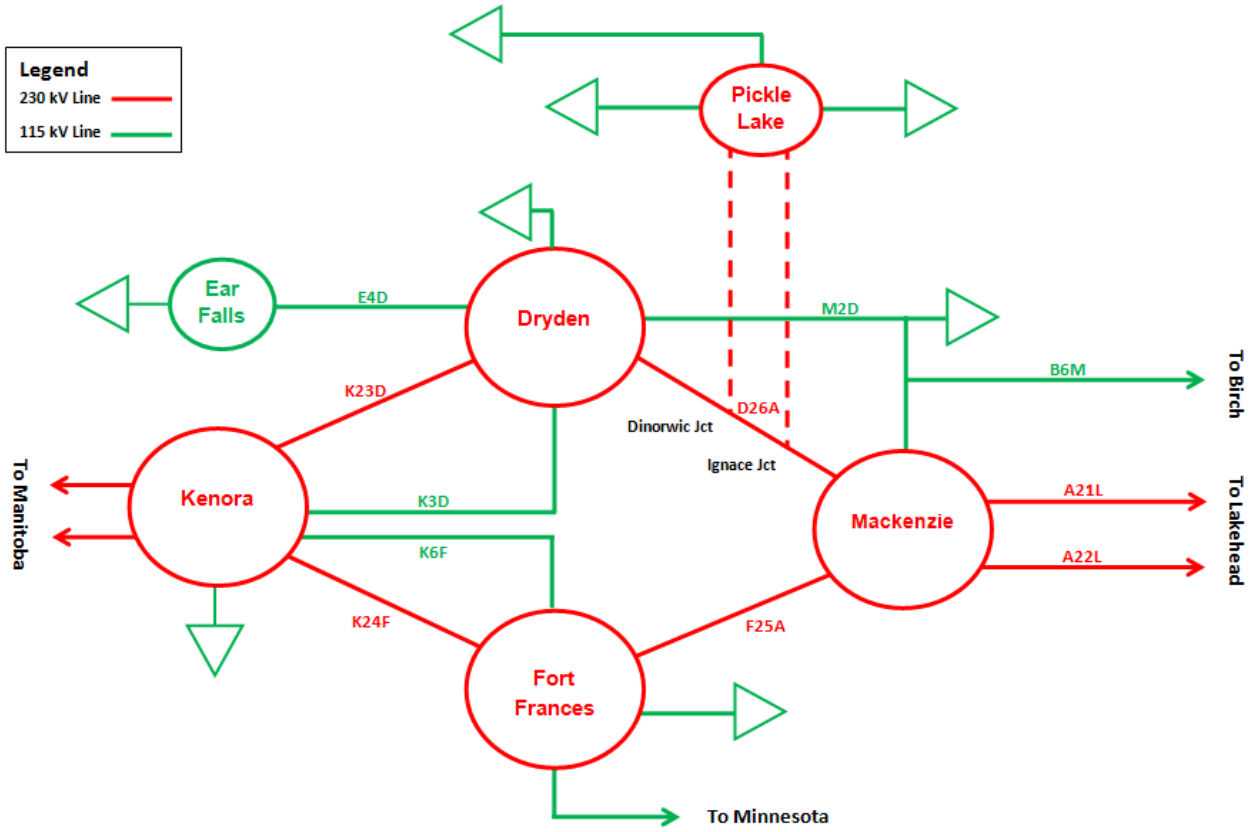


**Figure 9: West of Thunder Bay System – 230 kV Test Cases**

6. West of Thunder Bay System Overview – 115 kV Test Cases:

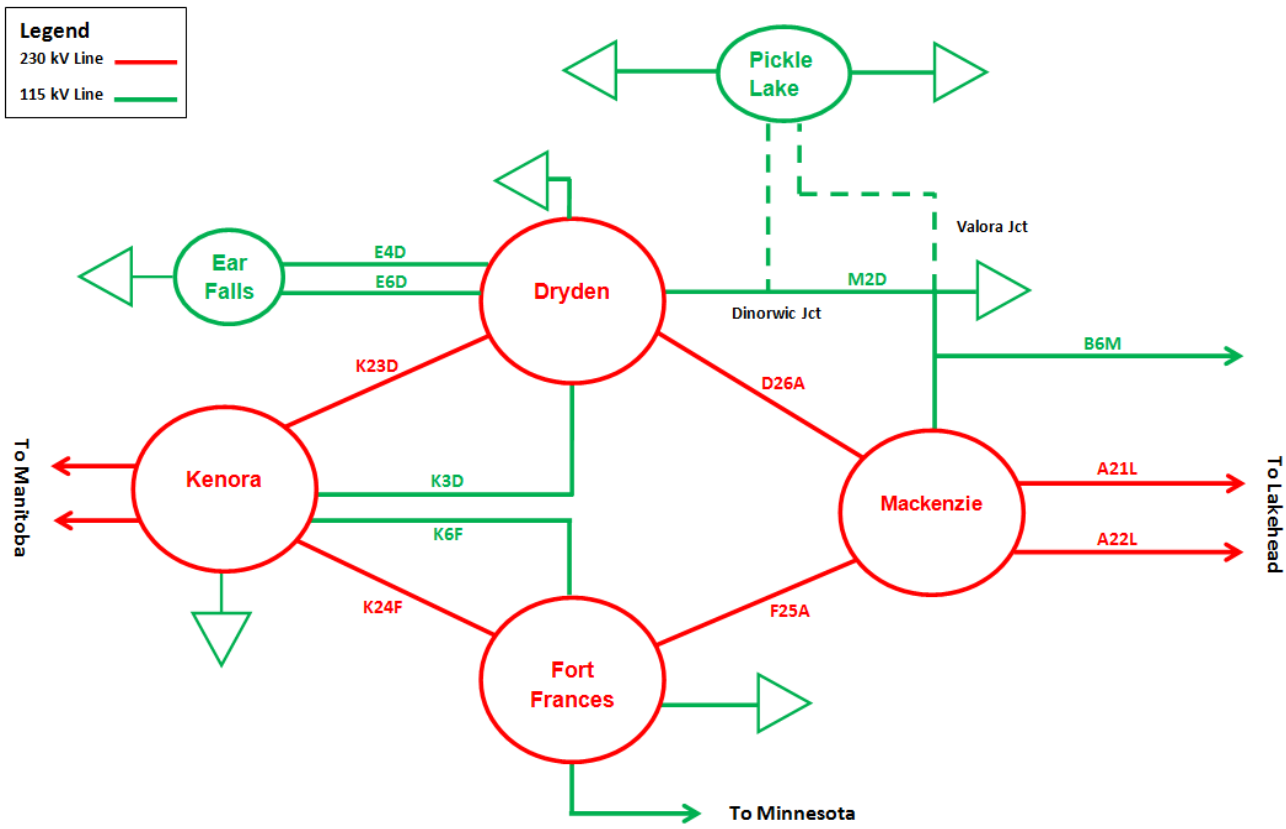


**Figure 10: West of Thunder Bay System – 115 kV Test Cases**

**– End of Section –**

# Appendix B: 230 kV Test Cases – Thermal Assessment Results

**Table 37: Thermal Loading for Test Case 1 – Ignace Junction with All Elements in-service – Single-Circuit Contingency**

| Circuit Name | Length (KM) | CONT Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of A21L | | Loss of D26A | | Loss of F25A | | Loss of K23D | | Loss of 1 Manitou Falls Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | % LTE |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 238 | 54.09 | 385 | 87.50 | 179 | 40.68 | 237 | 53.86 | 244 | 55.45 | 242 | 55.00 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 195 | 45.35 | 341 | 79.30 | 136 | 31.63 | 193 | 44.88 | 201 | 46.74 | 198 | 46.05 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 194 | 41.28 | 340 | 72.34 | 134 | 28.51 | 192 | 40.85 | 200 | 42.55 | 197 | 41.91 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 188 | 40.00 | 334 | 71.06 | 129 | 27.45 | 186 | 39.57 | 194 | 41.28 | 191 | 40.64 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 186 | 40.43 | 331 | 71.96 | 126 | 27.39 | 184 | 40.00 | 192 | 41.74 | 189 | 41.09 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 186 | 43.26 | 331 | 76.98 | 126 | 29.30 | 184 | 42.79 | 192 | 44.65 | 189 | 43.95 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 181 | 29.19 | 323 | 43.65 | 122 | 16.49 | 180 | 24.32 | 187 | 25.27 | 184 | 24.86 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 181 | 29.19 | 323 | 43.65 | 122 | 16.49 | 180 | 24.32 | 187 | 25.27 | 184 | 24.86 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 275 | 50.00 | 279 | 50.73 | 388 | 70.55 | 357 | 64.91 | 293 | 53.27 | 281 | 51.09 |
| M2D IGxDR | 80.4 | 420 | 420 | 420 | 250 | 59.52 | 255 | 60.71 | 366 | 87.14 | 334 | 79.52 | 270 | 64.29 | 257 | 61.19 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 21 | 6.56 | 21 | 5.25 | 20 | 5.00 | 20 | 5.00 | 21 | 5.25 | 21 | 5.25 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 |
| E4D DRxSL | 68.2 | 665 | 665 | 665 | 638 | 95.94 | 638 | 95.94 | 643 | 96.69 | 643 | 96.69 | 642 | 96.54 | 697 | 104.81 |
| E4D SLxEF | 30.2 | 665 | 665 | 665 | 629 | 94.59 | 628 | 94.44 | 633 | 95.19 | 633 | 95.19 | 633 | 95.19 | 688 | 103.46 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 297 | 70.71 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 312 | 74.29 | 312 | 74.29 | 313 | 74.52 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 80 | 17.02 | 90 | 19.15 | 112 | 23.83 | 5 | 1.06 | 145 | 30.85 | 89 | 18.94 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 87 | 18.51 | 96 | 20.43 | 119 | 25.32 | 4 | 0.85 | 152 | 32.34 | 95 | 20.21 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 97 | 20.64 | 106 | 22.55 | 127 | 27.02 | 23 | 4.89 | 160 | 34.04 | 104 | 22.13 |
| A21L | 191.7 | 880 | 880 | 880 | 451 | 51.25 | 0 | 0.00 | 275 | 31.25 | 418 | 47.50 | 459 | 52.16 | 457 | 51.93 |
| A22L | 191.7 | 880 | 880 | 880 | 451 | 51.25 | 795 | 90.34 | 275 | 31.25 | 417 | 47.39 | 459 | 52.16 | 457 | 51.93 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 589 | 66.93 | 550 | 62.50 | 0 | 0.00 | 773 | 87.84 | 641 | 72.84 | 597 | 67.84 |
| D26A IGxDN | 40.4 | 880 | 880 | 880 | 158 | 17.95 | 120 | 13.64 | 0 | 0.00 | 332 | 37.73 | 203 | 23.07 | 165 | 18.75 |
| D26A DNxDR | 40 | 880 | 880 | 880 | 148 | 16.82 | 110 | 12.50 | 0 | 0.00 | 325 | 36.93 | 198 | 22.50 | 156 | 17.73 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 100 | 11.36 | 130 | 14.77 | 178 | 20.23 | 77 | 8.75 | 0 | 0.00 | 111 | 12.61 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 87 | 9.89 | 118 | 13.41 | 175 | 19.89 | 88 | 10.00 | 0 | 0.00 | 100 | 11.36 |
| F25A | 141.6 | 880 | 880 | 880 | 283 | 32.16 | 235 | 26.70 | 448 | 50.91 | 0 | 0.00 | 237 | 26.93 | 281 | 31.93 |

**Table 38: Thermal Loading for Test Case 1 – Ignace Junction with All Elements in-service – Double-Circuit Contingency**

| Circuit Name | Length (KM) | Cont Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 238 | 54.09 | 55 | 12.50 | 55 | 12.50 | 41 | 9.32 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 195 | 45.35 | 38 | 8.84 | 38 | 8.84 | 37 | 8.60 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 194 | 41.28 | 30 | 6.38 | 30 | 6.38 | 41 | 8.72 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 188 | 40.00 | 32 | 6.81 | 32 | 6.81 | 45 | 9.57 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 186 | 40.43 | 19 | 4.13 | 19 | 4.13 | 52 | 11.30 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 186 | 43.26 | 19 | 4.42 | 19 | 4.42 | 52 | 12.09 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 181 | 29.19 | 0 | 0.00 | 0 | 0.00 | 68 | 9.19 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 181 | 29.19 | 0 | 0.00 | 0 | 0.00 | 68 | 9.19 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 275 | 50.00 | 107 | 19.45 | 50 | 9.09 | 0 | 0.00 |
| M2D IGxDR | 80.4 | 420 | 420 | 420 | 250 | 59.52 | 77 | 18.33 | 12 | 2.86 | 0 | 0.00 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 21 | 6.56 | 21 | 5.25 | 21 | 5.25 | 0 | 0.00 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 0 | 0.00 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 15 | 3.00 | 16 | 3.20 | 16 | 3.20 | 0 | 0.00 |
| E4D DRxSL | 68.2 | 665 | 665 | 665 | 638 | 95.94 | 643 | 96.69 | 54 | 8.12 | 641 | 96.39 |
| E4D SLxEF | 30.2 | 665 | 665 | 665 | 629 | 94.59 | 633 | 95.19 | 57 | 8.57 | 632 | 95.04 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 0 | 0.00 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 0 | 0.00 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 80 | 17.02 | 135 | 28.72 | 92 | 19.57 | 177 | 37.66 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 87 | 18.51 | 141 | 30.00 | 98 | 20.85 | 183 | 38.94 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 97 | 20.64 | 148 | 31.49 | 106 | 22.55 | 191 | 40.64 |
| A21L | 191.7 | 880 | 880 | 880 | 451 | 51.25 | 0 | 0.00 | 0 | 0.00 | 53 | 6.02 |
| A22L | 191.7 | 880 | 880 | 880 | 451 | 51.25 | 0 | 0.00 | 0 | 0.00 | 53 | 6.02 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 589 | 66.93 | 81 | 9.20 | 182 | 20.68 | 0 | 0.00 |
| D26A IGxDN | 40.4 | 880 | 880 | 880 | 158 | 17.95 | 62 | 7.05 | 249 | 28.30 | 0 | 0.00 |
| D26A DNxDR | 40 | 880 | 880 | 880 | 148 | 16.82 | 69 | 7.84 | 256 | 29.09 | 0 | 0.00 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 100 | 11.36 | 238 | 27.05 | 259 | 29.43 | 322 | 36.59 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 87 | 9.89 | 226 | 25.68 | 246 | 27.95 | 313 | 35.57 |
| F25A | 141.6 | 880 | 880 | 880 | 283 | 32.16 | 83 | 9.43 | 152 | 17.27 | 0 | 0.00 |

**Table 39: Thermal Loading for Test Case 2 – Dinorwic Junction with All Elements in-service – Single-Circuit Contingency**

| Circuit Name | Length (KM) | CONT Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of A21L | | Loss of D26A | | Loss of F25A | | Loss of K23D | | Loss of 1 Manitou Falls Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | (A) | (A) | (A) |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 245 | 55.68 | 394 | 89.55 | 182 | 41.36 | 243 | 55.23 | 253 | 57.50 | 248 | 56.36 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 203 | 47.21 | 349 | 81.16 | 140 | 32.56 | 200 | 46.51 | 210 | 48.84 | 205 | 47.67 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 201 | 42.77 | 348 | 74.04 | 138 | 29.36 | 199 | 42.34 | 208 | 44.26 | 204 | 43.40 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 196 | 41.70 | 342 | 72.77 | 132 | 28.09 | 193 | 41.06 | 203 | 43.19 | 198 | 42.13 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 193 | 41.96 | 339 | 73.70 | 129 | 28.04 | 191 | 41.52 | 200 | 43.48 | 196 | 42.61 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 193 | 44.88 | 339 | 78.84 | 129 | 30.00 | 191 | 44.42 | 200 | 46.51 | 196 | 45.58 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 187 | 30.16 | 331 | 44.73 | 124 | 16.76 | 186 | 25.14 | 195 | 26.35 | 190 | 25.68 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 187 | 30.16 | 331 | 44.73 | 124 | 16.76 | 186 | 25.14 | 195 | 26.35 | 190 | 25.68 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 301 | 54.73 | 305 | 55.45 | 392 | 71.27 | 396 | 72.00 | 327 | 59.45 | 308 | 56.00 |
| M2D IGxDR | 80.4 | 420 | 420 | 420 | 278 | 66.19 | 281 | 66.90 | 371 | 88.33 | 374 | 89.05 | 304 | 72.38 | 285 | 67.86 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 21 | 6.56 | 21 | 5.25 | 20 | 5.00 | 20 | 5.00 | 20 | 5.00 | 21 | 5.25 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 16 | 3.20 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 | 15 | 3.00 |
| E4D DRxSL | 68.2 | 665 | 665 | 665 | 632 | 95.04 | 641 | 96.39 | 642 | 96.54 | 644 | 96.84 | 646 | 97.14 | 693 | 104.21 |
| E4D SLxEF | 30.2 | 665 | 665 | 665 | 623 | 93.68 | 632 | 95.04 | 632 | 95.04 | 634 | 95.34 | 635 | 95.49 | 683 | 102.71 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 297 | 70.71 | 297 | 70.71 | 297 | 70.71 | 297 | 70.71 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 312 | 74.29 | 312 | 74.29 | 312 | 74.29 | 312 | 74.29 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 312 | 74.29 | 312 | 74.29 | 312 | 74.29 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 97 | 23.10 | 97 | 23.10 | 97 | 23.10 |
| K3D DRxET | 12 | 470 | 470 | 470 | 89 | 18.94 | 98 | 20.85 | 111 | 23.62 | 3 | 0.64 | 174 | 37.02 | 98 | 20.85 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 96 | 20.43 | 105 | 22.34 | 118 | 25.11 | 5 | 1.06 | 181 | 38.51 | 104 | 22.13 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 108 | 22.98 | 113 | 24.04 | 126 | 26.81 | 25 | 5.32 | 188 | 40.00 | 113 | 24.04 |
| A21L | 191.7 | 880 | 880 | 880 | 455 | 51.70 | 0 | 0.00 | 280 | 31.82 | 418 | 47.50 | 466 | 52.95 | 461 | 52.39 |
| A22L | 191.7 | 880 | 880 | 880 | 455 | 51.70 | 803 | 91.25 | 280 | 31.82 | 418 | 47.50 | 466 | 52.95 | 461 | 52.39 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 550 | 62.50 | 512 | 58.18 | 0 | 0.00 | 758 | 86.14 | 619 | 70.34 | 560 | 63.64 |
| D26A IGxDN | 40.4 | 880 | 880 | 880 | 545 | 61.93 | 507 | 57.61 | 0 | 0.00 | 757 | 86.02 | 618 | 70.23 | 556 | 63.18 |
| D26A DNxDR | 40 | 880 | 880 | 880 | 108 | 12.27 | 72 | 8.18 | 0 | 0.00 | 304 | 34.55 | 171 | 19.43 | 117 | 13.30 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 116 | 13.18 | 149 | 16.93 | 176 | 20.00 | 67 | 7.61 | 0 | 0.00 | 130 | 14.77 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 114 | 12.95 | 142 | 16.14 | 173 | 19.66 | 91 | 10.34 | 0 | 0.00 | 127 | 14.43 |
| F25A | 141.6 | 880 | 880 | 880 | 314 | 35.68 | 266 | 30.23 | 455 | 51.70 | 0 | 0.00 | 255 | 28.98 | 312 | 35.45 |

**Table 40: Thermal Loading for Test Case 2 – Dinorwic Junction with All Elements in-service – Double-Circuit Contingency**

| Circuit Name | Length (KM) | Cont Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | (A) |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 245 | 55.68 | 55 | 12.50 | 55 | 12.50 | 9 | 2.05 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 203 | 47.21 | 38 | 8.84 | 38 | 8.84 | 8 | 1.86 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 201 | 42.77 | 30 | 6.38 | 30 | 6.38 | 8 | 1.70 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 196 | 41.70 | 32 | 6.81 | 32 | 6.81 | 9 | 1.91 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 193 | 41.96 | 19 | 4.13 | 19 | 4.13 | 11 | 2.39 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 193 | 44.88 | 19 | 4.42 | 19 | 4.42 | 12 | 2.79 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 187 | 30.16 | 0 | 0.00 | 0 | 0.00 | 8 | 1.08 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 187 | 30.16 | 0 | 0.00 | 0 | 0.00 | 8 | 1.08 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 301 | 54.73 | 105 | 19.09 | 60 | 10.91 | 0 | 0.00 |
| M2D IGxDR | 80.4 | 420 | 420 | 420 | 278 | 66.19 | 76 | 18.10 | 25 | 5.95 | 0 | 0.00 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 21 | 6.56 | 21 | 5.25 | 21 | 5.25 | 0 | 0.00 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 17 | 3.40 | 17 | 3.40 | 17 | 3.40 | 0 | 0.00 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 16 | 3.20 | 16 | 3.20 | 16 | 3.20 | 0 | 0.00 |
| E4D DRxSL | 68.2 | 665 | 665 | 665 | 632 | 95.04 | 643 | 96.69 | 54 | 8.12 | 96 | 14.44 |
| E4D SLxEF | 30.2 | 665 | 665 | 665 | 623 | 93.68 | 633 | 95.19 | 57 | 8.57 | 94 | 14.14 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 0 | 0.00 | 70 | 16.67 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 74 | 17.62 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 74 | 17.62 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 0 | 0.00 | 23 | 5.48 |
| K3D DRxET | 12 | 470 | 470 | 470 | 89 | 18.94 | 134 | 28.51 | 99 | 21.06 | 37 | 7.87 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 96 | 20.43 | 140 | 29.79 | 105 | 22.34 | 39 | 8.30 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 108 | 22.98 | 147 | 31.28 | 112 | 23.83 | 40 | 8.51 |
| A21L | 191.7 | 880 | 880 | 880 | 455 | 51.70 | 0 | 0.00 | 0 | 0.00 | 6 | 0.68 |
| A22L | 191.7 | 880 | 880 | 880 | 455 | 51.70 | 0 | 0.00 | 0 | 0.00 | 6 | 0.68 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 550 | 62.50 | 81 | 9.20 | 145 | 16.48 | 0 | 0.00 |
| D26A IGxDN | 40.4 | 880 | 880 | 880 | 545 | 61.93 | 63 | 7.16 | 135 | 15.34 | 0 | 0.00 |
| D26A DNxDR | 40 | 880 | 880 | 880 | 108 | 12.27 | 70 | 7.95 | 295 | 33.52 | 0 | 0.00 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 116 | 13.18 | 232 | 26.36 | 276 | 31.36 | 36 | 4.09 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 114 | 12.95 | 223 | 25.34 | 267 | 30.34 | 35 | 3.98 |
| F25A | 141.6 | 880 | 880 | 880 | 314 | 35.68 | 77 | 8.75 | 120 | 13.64 | 0 | 0.00 |

# Appendix C: 230 kV Test Cases - Voltage Assessment Results

**Table 41: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Element in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 0 | N/A | 0 | N/A | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 243.5 | 243.8 | 0.12 | 243.8 | 0.12 | 239.9 | -1.48 | 239.6 | -1.60 | 240.4 | -1.27 | 240.4 | -1.27 | 241.2 | -0.94 | 241.4 | -0.86 | 243.1 | -0.16 | 243.1 | -0.16 |
| Dryden 230 kV | 244.4 | 244.5 | 0.04 | 244.7 | 0.12 | 239.8 | -1.88 | 237.7 | -2.74 | 240.7 | -1.51 | 240.1 | -1.76 | 241.8 | -1.06 | 240.4 | -1.64 | 243.6 | -0.33 | 243.6 | -0.33 |
| Fort Frances 230 kV | 244.4 | 244.5 | 0.04 | 244.7 | 0.12 | 239.8 | -1.88 | 237.7 | -2.74 | 240.7 | -1.51 | 240.1 | -1.76 | 241.8 | -1.06 | 240.4 | -1.64 | 243.6 | -0.33 | 243.6 | -0.33 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 246.7 | 243.1 | -1.46 | 242.6 | -1.66 | 246.2 | -0.20 | 246.4 | -0.12 | 247.9 | 0.49 | 247.7 | 0.41 | 246.4 | -0.12 | 246.4 | -0.12 | 246.5 | -0.08 | 246.5 | -0.08 |
| Pickle Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 124.3 | 124.2 | -0.08 | 124.4 | 0.08 | 121.6 | -2.17 | 123.7 | -0.48 | 122.5 | -1.45 | 123.7 | -0.48 | 122.9 | -1.13 | 123.8 | -0.40 | 123.8 | -0.40 | 123.8 | -0.40 |
| Fort Frances 115 kV | 118.5 | 118.6 | 0.08 | 118.6 | 0.08 | 116.9 | -1.35 | 118.4 | -0.08 | 115.5 | -2.53 | 118.3 | -0.17 | 118.2 | -0.25 | 118.2 | -0.25 | 118.4 | -0.08 | 118.4 | -0.08 |
| Mackenzie 115 kV | 120.9 | 119.6 | -1.08 | 120.9 | 0.00 | 120.7 | -0.17 | 121 | 0.08 | 120.8 | -0.08 | 120.9 | 0.00 | 120.7 | -0.17 | 120.8 | -0.08 | 120.8 | -0.08 | 120.8 | -0.08 |
| Moose Lake 115 kV | 121.1 | 119.5 | -1.32 | 120.5 | -0.50 | 120.4 | -0.58 | 120.8 | -0.25 | 120.7 | -0.33 | 120.8 | -0.25 | 120.7 | -0.33 | 120.9 | -0.17 | 121 | -0.08 | 120.9 | -0.17 |
| Birch 115 kV | 124.9 | 122.8 | -1.68 | 122.6 | -1.84 | 123 | -1.52 | 123.1 | -1.44 | 125.4 | 0.40 | 125.3 | 0.32 | 124.7 | -0.16 | 124.7 | -0.16 | 124.8 | -0.08 | 124.7 | -0.16 |
| Valora Jct 115 kV | 123.1 | 122.2 | -0.73 | 122.7 | -0.32 | 120 | -2.52 | 121.3 | -1.46 | 121 | -1.71 | 121.7 | -1.14 | 122 | -0.89 | 122.5 | -0.49 | 122.7 | -0.32 | 122.7 | -0.32 |
| Esker 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 125.6 | 0.00 | 125.6 | 0.00 | 0 | N/A | 0 | N/A | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 0 | N/A | 0 | N/A | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 126.5 | 0.00 | 126.5 | 0.00 | 0 | N/A | 0 | N/A | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 125.7 | 0.00 | 125.7 | 0.00 | 0 | N/A | 0 | N/A | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 127.3 | 0.00 | 127.3 | 0.00 | 0 | N/A | 0 | N/A | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 0 | N/A | 0 | N/A | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.1 | 124 | -0.08 | 124.2 | 0.08 | 121.4 | -2.18 | 123.5 | -0.48 | 122.3 | -1.45 | 123.5 | -0.48 | 122.7 | -1.13 | 123.6 | -0.40 | 123.6 | -0.40 | 123.6 | -0.40 |
| Perrault Falls 115 kV | 123 | 123 | 0.00 | 123 | 0.00 | 122 | -0.81 | 122.8 | -0.16 | 122.3 | -0.57 | 122.8 | -0.16 | 122.5 | -0.41 | 122.8 | -0.16 | 122.4 | -0.49 | 122.4 | -0.49 |
| Sam Lake 115 kV | 122.8 | 122.7 | -0.08 | 122.8 | 0.00 | 120 | -2.28 | 122.2 | -0.49 | 120.9 | -1.55 | 122.2 | -0.49 | 121.3 | -1.22 | 122.2 | -0.49 | 122.3 | -0.41 | 122.3 | -0.41 |

**Table 41: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Single Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 120.8 | 0.08 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.1 | 124.1 | 0.00 | 124.2 | 0.08 | 121.7 | -1.93 | 123.6 | -0.40 | 122.4 | -1.37 | 123.8 | -0.24 | 122.7 | -1.13 | 123.4 | -0.56 | 123.7 | -0.32 | 123.7 | -0.32 |
| Agimak DS 115 kV | 122.7 | 121.8 | -0.73 | 122.4 | -0.24 | 119.7 | -2.44 | 120.9 | -1.47 | 120.7 | -1.63 | 121.4 | -1.06 | 121.6 | -0.90 | 122.1 | -0.49 | 122.3 | -0.33 | 122.3 | -0.33 |
| Mattabi CTS 115 kV | 123.1 | 122.2 | -0.73 | 122.7 | -0.32 | 120 | -2.52 | 121.3 | -1.46 | 121 | -1.71 | 121.7 | -1.14 | 122 | -0.89 | 122.5 | -0.49 | 122.7 | -0.32 | 122.7 | -0.32 |
| Valora DS 115 kV | 123.1 | 122.2 | -0.73 | 122.7 | -0.32 | 120 | -2.52 | 121.3 | -1.46 | 121 | -1.71 | 121.7 | -1.14 | 122 | -0.89 | 122.5 | -0.49 | 122.7 | -0.32 | 122.7 | -0.32 |
| Murillo DS 115 kV | 124 | 121.4 | -2.10 | 121.3 | -2.18 | 122.4 | -1.29 | 122.5 | -1.21 | 124.6 | 0.48 | 124.5 | 0.40 | 123.8 | -0.16 | 123.8 | -0.16 | 123.9 | -0.08 | 123.9 | -0.08 |
| Shabaqua DS 115 kV | 123.1 | 119.6 | -2.84 | 119.6 | -2.84 | 122 | -0.89 | 122.2 | -0.73 | 123.5 | 0.32 | 123.4 | 0.24 | 122.9 | -0.16 | 122.9 | -0.16 | 123 | -0.08 | 123 | -0.08 |
| Sapawe DS 115 kV | 121.4 | 118.9 | -2.06 | 119.7 | -1.40 | 120.8 | -0.49 | 121.1 | -0.25 | 121.1 | -0.25 | 121.2 | -0.16 | 121.1 | -0.25 | 121.2 | -0.16 | 121.3 | -0.08 | 121.3 | -0.08 |
| West Coast 115 kV | 118.3 | 118.4 | 0.08 | 118.5 | 0.17 | 116.7 | -1.35 | 118.2 | -0.08 | 115.3 | -2.54 | 118.2 | -0.08 | 118 | -0.25 | 118.1 | -0.17 | 118.3 | 0.00 | 118.2 | -0.08 |
| Fort Frances MS 115 kV | 118.5 | 118.6 | 0.08 | 118.6 | 0.08 | 116.9 | -1.35 | 118.4 | -0.08 | 115.5 | -2.53 | 118.3 | -0.17 | 118.2 | -0.25 | 118.2 | -0.25 | 118.4 | -0.08 | 118.4 | -0.08 |
| Burleigh DS 115 kV | 118.4 | 118.5 | 0.08 | 118.6 | 0.17 | 116.8 | -1.35 | 118.3 | -0.08 | 115.4 | -2.53 | 118.3 | -0.08 | 118.1 | -0.25 | 118.2 | -0.17 | 118.3 | -0.08 | 118.3 | -0.08 |

**Table 42: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 0 | N/A | 0 | N/A | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 243.5 | 243.4 | -0.04 | 243.5 | 0.00 | 242.8 | -0.29 | 243.1 | -0.16 | 236.8 | -2.75 | 238.5 | -2.05 |
| Dryden 230 kV | 244.4 | 245 | 0.25 | 245 | 0.25 | 245 | 0.25 | 245 | 0.25 | 237.7 | -2.74 | 238.9 | -2.25 |
| Fort Frances 230 kV | 244.4 | 245 | 0.25 | 245 | 0.25 | 245 | 0.25 | 245 | 0.25 | 237.7 | -2.74 | 238.9 | -2.25 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 253.4 | 3.43 | 253.8 | 3.59 |
| Lakehead 230 kV | 246.7 | 249 | 0.93 | 249 | 0.93 | 249 | 0.93 | 249 | 0.93 | 252.8 | 2.47 | 252.7 | 2.43 |
| Pickle Lake 115 kV | 126.1 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 124.3 | 125 | 0.56 | 123.7 | -0.48 | 125 | 0.56 | 123.5 | -0.64 | 121.7 | -2.09 | 123.9 | -0.32 |
| Fort Frances 115 kV | 118.5 | 117 | -1.27 | 119.3 | 0.68 | 116.1 | -2.03 | 118.9 | 0.34 | 112.4 | -5.15 | 118.3 | -0.17 |
| Mackenzie 115 kV | 120.9 | 121.3 | 0.33 | 121.1 | 0.17 | 121 | 0.08 | 120.8 | -0.08 | 124.8 | 3.23 | 121.6 | 0.58 |
| Moose Lake 115 kV | 121.1 | 121.6 | 0.41 | 121.3 | 0.17 | 121.3 | 0.17 | 121.1 | 0.00 | 124.9 | 3.14 | 121.9 | 0.66 |
| Birch 115 kV | 124.9 | 124.8 | -0.08 | 124.8 | -0.08 | 124.8 | -0.08 | 124.8 | -0.08 | 126.4 | 1.20 | 126.1 | 0.96 |
| Valora Jct 115 kV | 123.1 | 124.8 | 1.38 | 123.9 | 0.65 | 124.7 | 1.30 | 123.9 | 0.65 | 123.1 | 0.00 | 123.1 | 0.00 |
| Esker 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 0 | N/A | 0 | N/A | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 0 | N/A | 0 | N/A | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 0 | N/A | 0 | N/A | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 0 | N/A | 0 | N/A | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 0 | N/A | 0 | N/A | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 0 | N/A | 0 | N/A | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.7 | 0.24 | 124.7 | -0.56 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.1 | 124.8 | 0.56 | 123.5 | -0.48 | 124.8 | 0.56 | 123.3 | -0.64 | 121.5 | -2.10 | 123.7 | -0.32 |
| Perrault Falls 115 kV | 123 | 123.3 | 0.24 | 122.8 | -0.16 | 125.6 | 2.11 | 124.5 | 1.22 | 122 | -0.81 | 122.8 | -0.16 |
| Sam Lake 115 kV | 122.8 | 123.5 | 0.57 | 122.1 | -0.57 | 123.5 | 0.57 | 122 | -0.65 | 120.1 | -2.20 | 122.3 | -0.41 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 0 | N/A | 0 | N/A | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 0 | N/A | 0 | N/A | 120.7 | 0.00 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 0 | N/A | 0 | N/A | 120.4 | 0.00 | 120.4 | 0.00 |

**Table 42: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Double Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.1 | 124.5 | 0.32 | 123.6 | -0.40 | 124.5 | 0.32 | 123.6 | -0.40 | 121 | -2.50 | 123.5 | -0.48 |
| Agimak DS 115 kV | 122.7 | 124.4 | 1.39 | 123.6 | 0.73 | 124.4 | 1.39 | 123.5 | 0.65 | 0 | N/A | 0 | N/A |
| Mattabi CTS 115 kV | 123.1 | 124.8 | 1.38 | 123.9 | 0.65 | 124.7 | 1.30 | 123.9 | 0.65 | 0 | N/A | 0 | N/A |
| Valora DS 115 kV | 123.1 | 124.7 | 1.30 | 123.9 | 0.65 | 124.7 | 1.30 | 123.9 | 0.65 | 0 | N/A | 0 | N/A |
| Murillo DS 115 kV | 124 | 124.8 | 0.65 | 124.8 | 0.65 | 124.8 | 0.65 | 124.8 | 0.65 | 126 | 1.61 | 125.5 | 1.21 |
| Shabaqua DS 115 kV | 123.1 | 125.9 | 2.27 | 125.9 | 2.27 | 125.9 | 2.27 | 125.9 | 2.27 | 126.2 | 2.52 | 125 | 1.54 |
| Sapawe DS 115 kV | 121.4 | 127.6 | 5.11 | 127.6 | 5.11 | 127.6 | 5.11 | 127.6 | 5.11 | 125.3 | 3.21 | 122.6 | 0.99 |
| West Coast 115 kV | 118.3 | 116.9 | -1.18 | 119.1 | 0.68 | 116 | -1.94 | 118.8 | 0.42 | 112.2 | -5.16 | 118.1 | -0.17 |
| Fort Frances MS 115 kV | 118.5 | 117 | -1.27 | 119.3 | 0.68 | 116.1 | -2.03 | 118.9 | 0.34 | 112.3 | -5.23 | 118.3 | -0.17 |
| Burleigh DS 115 kV | 118.4 | 117 | -1.18 | 119.2 | 0.68 | 116.1 | -1.94 | 118.9 | 0.42 | 112.3 | -5.15 | 118.2 | -0.17 |

**Table 43: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 243.5 | 243 | -0.21 | 242.9 | -0.25 | 240.9 | -1.07 | 239.9 | -1.48 | 243.5 | 0.00 | 243.5 | 0.00 | 243.5 | 0.00 | 243.5 | 0.00 | 243.5 | 0.00 | 243.5 | 0.00 | 241.2 | -0.94 | 240.1 | -1.40 |
| Dryden 230 kV | 244.4 | 243.3 | -0.45 | 243.2 | -0.49 | 238.8 | -2.29 | 237 | -3.03 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 241.3 | -1.27 | 240 | -1.80 |
| Fort Frances 230 kV | 244.4 | 243.3 | -0.45 | 243.2 | -0.49 | 238.8 | -2.29 | 237 | -3.03 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 241.3 | -1.27 | 240 | -1.80 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 239.5 | -2.24 | 238.1 | -2.82 |
| Lakehead 230 kV | 246.7 | 246.7 | 0.00 | 246.7 | 0.00 | 246.6 | -0.04 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 244.7 | -0.81 | 244.5 | -0.89 |
| Pickle Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 124.3 | 123.5 | -0.64 | 123.4 | -0.72 | 122 | -1.85 | 124.1 | -0.16 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 122.8 | -1.21 | 123.9 | -0.32 |
| Fort Frances 115 kV | 118.5 | 118.4 | -0.08 | 118.4 | -0.08 | 117.9 | -0.51 | 117.9 | -0.51 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 117 | -1.27 | 118 | -0.42 |
| Mackenzie 115 kV | 120.9 | 120.8 | -0.08 | 120.8 | -0.08 | 120.7 | -0.17 | 120.9 | 0.00 | 121 | 0.08 | 121 | 0.08 | 120.9 | 0.00 | 120.9 | 0.00 | 120.9 | 0.00 | 120.9 | 0.00 | 118.6 | -1.90 | 120.9 | 0.00 |
| Moose Lake 115 kV | 121.1 | 120.9 | -0.17 | 120.9 | -0.17 | 120.7 | -0.33 | 121 | -0.08 | 121.1 | 0.00 | 121.1 | 0.00 | 121.1 | 0.00 | 121.1 | 0.00 | 121.1 | 0.00 | 121.1 | 0.00 | 118.9 | -1.82 | 121 | -0.08 |
| Birch 115 kV | 124.9 | 124.8 | -0.08 | 124.8 | -0.08 | 124.8 | -0.08 | 124.8 | -0.08 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 123.8 | -0.88 | 123.9 | -0.80 |
| Valora Jct 115 kV | 123.1 | 122.6 | -0.41 | 122.5 | -0.49 | 121.7 | -1.14 | 122.9 | -0.16 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 121.1 | -1.62 | 122.7 | -0.32 |
| Esker 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 119.4 | -0.50 | 119.3 | -0.58 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 121.6 | -3.03 | 121.4 | -3.19 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.1 | 123.3 | -0.64 | 123.2 | -0.73 | 121.7 | -1.93 | 123.9 | -0.16 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 122.6 | -1.21 | 123.7 | -0.32 |
| Perrault Falls 115 kV | 123 | 120.1 | -2.36 | 119.8 | -2.60 | 122.1 | -0.73 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 122.4 | -0.49 | 122.8 | -0.16 |
| Sam Lake 115 kV | 122.8 | 121.9 | -0.73 | 121.8 | -0.81 | 120.4 | -1.95 | 122.5 | -0.24 | 122.7 | -0.08 | 122.7 | -0.08 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 121.2 | -1.30 | 122.3 | -0.41 |
| Balmer 115 kV | 120 | 116 | -3.33 | 115.6 | -3.67 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 116.5 | -3.32 | 116.1 | -3.65 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 116.8 | -3.23 | 116.4 | -3.56 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.8 | 0.08 |
| Deer Lake 115 kV | 120.4 | 116.8 | -2.99 | 116.3 | -3.41 | 120.4 | 0.00 | 120.5 | 0.08 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |

**Table 43: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls SVC | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 120 | 116.4 | -3.00 | 116 | -3.33 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.1 | 123.5 | -0.48 | 123.4 | -0.56 | 122.1 | -1.61 | 123.9 | -0.16 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 124.1 | 0.00 | 122.7 | -1.13 | 123.8 | -0.24 |
| Agimak DS 115 kV | 122.7 | 122.2 | -0.41 | 122.2 | -0.41 | 121.3 | -1.14 | 122.6 | -0.08 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 120.8 | -1.55 | 122.4 | -0.24 |
| Mattabi CTS 115 kV | 123.1 | 122.6 | -0.41 | 122.5 | -0.49 | 121.7 | -1.14 | 122.9 | -0.16 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 121.1 | -1.62 | 122.7 | -0.32 |
| Valora DS 115 kV | 123.1 | 122.6 | -0.41 | 122.5 | -0.49 | 121.7 | -1.14 | 122.9 | -0.16 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 121.1 | -1.62 | 122.7 | -0.32 |
| Murillo DS 115 kV | 124 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 122.9 | -0.89 | 123.1 | -0.73 |
| Shabaqua DS 115 kV | 123.1 | 123.1 | 0.00 | 123.1 | 0.00 | 123 | -0.08 | 123.1 | 0.00 | 123.2 | 0.08 | 123.2 | 0.08 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 121.8 | -1.06 | 122.4 | -0.57 |
| Sapawe DS 115 kV | 121.4 | 121.3 | -0.08 | 121.3 | -0.08 | 121.1 | -0.25 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 119.4 | -1.65 | 121.2 | -0.16 |
| West Coast 115 kV | 118.3 | 118.2 | -0.08 | 118.2 | -0.08 | 117.8 | -0.42 | 117.7 | -0.51 | 118.3 | 0.00 | 118.3 | 0.00 | 118.3 | 0.00 | 118.3 | 0.00 | 118.3 | 0.00 | 118.3 | 0.00 | 116.8 | -1.27 | 117.9 | -0.34 |
| Fort Frances MS 115 kV | 118.5 | 118.4 | -0.08 | 118.3 | -0.17 | 117.9 | -0.51 | 117.9 | -0.51 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 117 | -1.27 | 118 | -0.42 |
| Burleigh DS 115 kV | 118.4 | 118.3 | -0.08 | 118.3 | -0.08 | 117.9 | -0.42 | 117.8 | -0.51 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 116.9 | -1.27 | 118 | -0.34 |

**Table 44: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 239.8 | 239.8 | 0.00 | 239.8 | 0.00 | 247.7 | 3.29 | 247.4 | 3.17 | 239.8 | 0.00 | 239.8 | 0.00 |
| Kenora 230 kV | 243.5 | 245.3 | 0.74 | 245.3 | 0.74 | 244.2 | 0.29 | 244.2 | 0.29 | 243.5 | 0.00 | 243.5 | 0.00 |
| Dryden 230 kV | 244.9 | 247.5 | 1.06 | 247.5 | 1.06 | 246.2 | 0.53 | 246.1 | 0.49 | 244.9 | 0.00 | 244.9 | 0.00 |
| Fort Frances 230 kV | 244.9 | 247.5 | 1.06 | 247.5 | 1.06 | 246.2 | 0.53 | 246.1 | 0.49 | 244.9 | 0.00 | 244.9 | 0.00 |
| Mackenzie 230 kV | 241.6 | 247 | 2.24 | 247 | 2.24 | 242.6 | 0.41 | 242.5 | 0.37 | 241.6 | 0.00 | 241.6 | 0.00 |
| Lakehead 230 kV | 238.7 | 240 | 0.54 | 240 | 0.54 | 238.7 | 0.00 | 238.7 | 0.00 | 238.7 | 0.00 | 238.7 | 0.00 |
| Pickle Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 124 | 2.99 | 123.9 | 2.91 | 120.4 | 0.00 | 120.4 | 0.00 |
| Dryden 115 kV | 124.1 | 125.4 | 1.05 | 125.4 | 1.05 | 124.7 | 0.48 | 124.7 | 0.48 | 124.1 | 0.00 | 124.1 | 0.00 |
| Fort Frances 115 kV | 119.1 | 120.4 | 1.09 | 120.4 | 1.09 | 119.4 | 0.25 | 119.4 | 0.25 | 119.1 | 0.00 | 119.1 | 0.00 |
| Mackenzie 115 kV | 121.4 | 123.7 | 1.89 | 123.7 | 1.89 | 121.8 | 0.33 | 121.8 | 0.33 | 121.4 | 0.00 | 121.4 | 0.00 |
| Moose Lake 115 kV | 121.7 | 124 | 1.89 | 124 | 1.89 | 122.1 | 0.33 | 122.1 | 0.33 | 121.7 | 0.00 | 121.7 | 0.00 |
| Birch 115 kV | 121.9 | 122.4 | 0.41 | 122.4 | 0.41 | 121.8 | -0.08 | 121.8 | -0.08 | 121.9 | 0.00 | 121.9 | 0.00 |
| Valora Jct 115 kV | 124.3 | 126.2 | 1.53 | 126.2 | 1.53 | 124.8 | 0.40 | 124.8 | 0.40 | 124.3 | 0.00 | 124.3 | 0.00 |
| Esker 115 kV | 118.7 | 118.7 | 0.00 | 118.7 | 0.00 | 120 | 1.10 | 120.1 | 1.18 | 118.7 | 0.00 | 118.7 | 0.00 |
| Musslewhite 115 kV | 118.6 | 118.6 | 0.00 | 118.6 | 0.00 | 120 | 1.18 | 120 | 1.18 | 118.6 | 0.00 | 118.6 | 0.00 |
| King Fisher 115 kV | 125.3 | 125.3 | 0.00 | 125.3 | 0.00 | 126.5 | 0.96 | 126.3 | 0.80 | 125.3 | 0.00 | 125.3 | 0.00 |
| Neskatanga 115 kV | 121 | 121 | 0.00 | 121 | 0.00 | 123 | 1.65 | 122.9 | 1.57 | 121 | 0.00 | 121 | 0.00 |
| Webequie 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 121.4 | 0.83 | 121.3 | 0.75 | 120.4 | 0.00 | 120.4 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 125.7 | 125.7 | 0.00 | 125.7 | 0.00 | 126.9 | 0.95 | 126.7 | 0.80 | 125.7 | 0.00 | 125.7 | 0.00 |
| Wapekeka 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 127.5 | 0.95 | 127.3 | 0.79 | 126.3 | 0.00 | 126.3 | 0.00 |
| North Caribou Lake 115 kV | 127.1 | 127.1 | 0.00 | 127.1 | 0.00 | 128.3 | 0.94 | 128.1 | 0.79 | 127.1 | 0.00 | 127.1 | 0.00 |
| Muskrat Dam 115 kV | 127.4 | 127.4 | 0.00 | 127.4 | 0.00 | 128.6 | 0.94 | 128.4 | 0.78 | 127.4 | 0.00 | 127.4 | 0.00 |
| Crow River 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 124 | 2.99 | 123.9 | 2.91 | 120.4 | 0.00 | 120.4 | 0.00 |
| Thierry Mine 115 kV | 120.3 | 120.3 | 0.00 | 120.3 | 0.00 | 124 | 3.08 | 123.9 | 2.99 | 120.3 | 0.00 | 120.3 | 0.00 |
| Cat Lake 115 kV | 123.1 | 123.1 | 0.00 | 123.1 | 0.00 | 126.9 | 3.09 | 126.8 | 3.01 | 123.1 | 0.00 | 123.1 | 0.00 |
| Slate Falls 115 kV | 124.9 | 124.9 | 0.00 | 124.9 | 0.00 | 128.7 | 3.04 | 128.6 | 2.96 | 124.9 | 0.00 | 124.9 | 0.00 |
| Ear Falls 115 kV | 122.8 | 122.9 | 0.08 | 122.9 | 0.08 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Domtar Dryden 115 kV | 124.1 | 125.4 | 1.05 | 125.4 | 1.05 | 124.7 | 0.48 | 124.7 | 0.48 | 124.1 | 0.00 | 124.1 | 0.00 |
| Perrault Falls 115 kV | 122.4 | 122.9 | 0.41 | 122.9 | 0.41 | 122.6 | 0.16 | 122.6 | 0.16 | 122.4 | 0.00 | 122.4 | 0.00 |
| Sam Lake 115 kV | 123.6 | 124.9 | 1.05 | 124.9 | 1.05 | 124.2 | 0.49 | 124.2 | 0.49 | 123.6 | 0.00 | 123.6 | 0.00 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.6 | 0.08 | 120.6 | 0.08 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 123.8 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 |
| Deer Lake 115 kV | 126 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 |

**Table 44: HV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Vermillion Bay DS 115 kV | 124.2 | 125.3 | 0.89 | 125.3 | 0.89 | 124.7 | 0.40 | 124.7 | 0.40 | 124.2 | 0.00 | 124.2 | 0.00 |
| Agimak DS 115 kV | 123.9 | 125.7 | 1.45 | 125.7 | 1.45 | 124.4 | 0.40 | 124.4 | 0.40 | 123.9 | 0.00 | 123.9 | 0.00 |
| Mattabi CTS 115 kV | 124.4 | 126.2 | 1.45 | 126.2 | 1.45 | 124.9 | 0.40 | 124.9 | 0.40 | 124.4 | 0.00 | 124.4 | 0.00 |
| Valora DS 115 kV | 124.3 | 126.2 | 1.53 | 126.2 | 1.53 | 124.8 | 0.40 | 124.8 | 0.40 | 124.3 | 0.00 | 124.3 | 0.00 |
| Murillo DS 115 kV | 121.8 | 122.4 | 0.49 | 122.4 | 0.49 | 121.7 | -0.08 | 121.7 | -0.08 | 121.8 | 0.00 | 121.8 | 0.00 |
| Shabaqua DS 115 kV | 122.1 | 123.1 | 0.82 | 123.1 | 0.82 | 122.1 | 0.00 | 122.1 | 0.00 | 122.1 | 0.00 | 122.1 | 0.00 |
| Sapawe DS 115 kV | 121.9 | 124 | 1.72 | 124 | 1.72 | 122.3 | 0.33 | 122.3 | 0.33 | 121.9 | 0.00 | 121.9 | 0.00 |
| West Coast 115 kV | 119 | 120.3 | 1.09 | 120.3 | 1.09 | 119.3 | 0.25 | 119.3 | 0.25 | 119 | 0.00 | 119 | 0.00 |
| Fort Frances MS 115 kV | 119.1 | 120.4 | 1.09 | 120.4 | 1.09 | 119.4 | 0.25 | 119.4 | 0.25 | 119.1 | 0.00 | 119.1 | 0.00 |
| Burleigh DS 115 kV | 119 | 120.3 | 1.09 | 120.3 | 1.09 | 119.3 | 0.25 | 119.3 | 0.25 | 119 | 0.00 | 119 | 0.00 |

**Table 45: LV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25 | 24.4 | -2.40 | 24.8 | -0.80 | 24.6 | -1.60 | 24.8 | -0.80 | 25.1 | 0.40 | 25.1 | 0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 |
| Shabaqua DS LV | 13.2 | 12.8 | -3.03 | 12.8 | -3.03 | 13.1 | -0.76 | 13.1 | -0.76 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Sapawe DS LV | 13.7 | 13.4 | -2.19 | 13.5 | -1.46 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 |
| Mattabi DS LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.1 | -2.38 | 4.1 | -2.38 | 4.1 | -2.38 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Agimak DS LV | 26.3 | 26.1 | -0.76 | 26.6 | 1.14 | 25.7 | -2.28 | 26.6 | 1.14 | 25.9 | -1.52 | 26.3 | 0.00 | 26.1 | -0.76 | 26.5 | 0.76 | 26.2 | -0.38 | 26.2 | -0.38 |
| Valora DS LV | 25.6 | 25.4 | -0.78 | 25.5 | -0.39 | 24.9 | -2.73 | 25.2 | -1.56 | 25.1 | -1.95 | 25.3 | -1.17 | 25.3 | -1.17 | 25.4 | -0.78 | 25.5 | -0.39 | 25.5 | -0.39 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 0 | N/A | 0 | N/A | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 22.6 | 0.00 | 22.6 | 0.00 | 0 | N/A | 0 | N/A | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 46 | 0.00 | 46 | 0.00 | 0 | N/A | 0 | N/A | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 25.2 | 0.00 | 25.2 | 0.00 | 0 | N/A | 0 | N/A | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 24 | 0.00 | 24 | 0.00 | 0 | N/A | 0 | N/A | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 0 | N/A | 0 | N/A | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 4.5 | 0.00 | 4.5 | 0.00 | 0 | N/A | 0 | N/A | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 29.4 | 0.00 | 29.4 | 0.00 | 0 | N/A | 0 | N/A | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 0 | N/A | 0 | N/A | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.7 | 0.00 | 13.7 | 0.00 | 13.4 | -2.19 | 13.6 | -0.73 | 13.5 | -1.46 | 13.6 | -0.73 | 13.5 | -1.46 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 |
| Perrault Falls LV | 11.5 | 11.5 | 0.00 | 11.5 | 0.00 | 11.4 | -0.87 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 |
| Sam Lake LV | 26.4 | 26.4 | 0.00 | 26.4 | 0.00 | 25.8 | -2.27 | 26.7 | 1.14 | 26 | -1.52 | 26.5 | 0.38 | 26.1 | -1.14 | 26.5 | 0.38 | 26.3 | -0.38 | 26.3 | -0.38 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.2 | 13.2 | 0.00 | 13.3 | 0.76 | 13 | -1.52 | 13.4 | 1.52 | 13.1 | -0.76 | 13.3 | 0.76 | 13.1 | -0.76 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 |
| Vermillion Bay DS LV | 15.2 | 15.2 | 0.00 | 15.2 | 0.00 | 14.9 | -1.97 | 15.1 | -0.66 | 15 | -1.32 | 15.1 | -0.66 | 15 | -1.32 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 |
| Burleigh DS LV | 13.1 | 13.1 | 0.00 | 13.1 | 0.00 | 12.9 | -1.53 | 13 | -0.76 | 12.7 | -3.05 | 13 | -0.76 | 13 | -0.76 | 13 | -0.76 | 13 | -0.76 | 13 | -0.76 |
| Fort Frances MS1 LV | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 13.9 | -1.42 | 14.1 | 0.00 | 13.7 | -2.84 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.5 | 0.00 | 12.5 | 0.00 | 12.3 | -1.60 | 12.5 | 0.00 | 12.1 | -3.20 | 12.5 | 0.00 | 12.4 | -0.80 | 12.4 | -0.80 | 12.4 | -0.80 | 12.4 | -0.80 |
| Fort Frances L5 | 14.1 | 14.2 | 0.71 | 14.2 | 0.71 | 13.9 | -1.42 | 14.1 | 0.00 | 13.8 | -2.13 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 13.8 | -1.43 | 14 | 0.00 | 13.7 | -2.14 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.8 | 0.00 | 14.9 | 0.68 | 14.6 | -1.35 | 14.8 | 0.00 | 14.5 | -2.03 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.6 | -1.49 | 6.7 | 0.00 | 6.5 | -2.99 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 46: LV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25 | 25.1 | 0.40 | 25.1 | 0.40 | 25.1 | 0.40 | 25.1 | 0.40 | 25.4 | 1.60 | 25.2 | 0.80 |
| Shabaqua DS LV | 13.2 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.4 | 1.52 |
| Sapawe DS LV | 13.7 | 14.4 | 5.11 | 14.4 | 5.11 | 14.4 | 5.11 | 14.4 | 5.11 | 14.2 | 3.65 | 13.9 | 1.46 |
| Mattabi DS LV | 4.2 | 4.3 | 2.38 | 4.2 | 0.00 | 4.3 | 2.38 | 4.2 | 0.00 | 0 | N/A | 0 | N/A |
| Agimak DS LV | 26.3 | 26.7 | 1.52 | 26.5 | 0.76 | 26.7 | 1.52 | 26.5 | 0.76 | 0 | N/A | 0 | N/A |
| Valora DS LV | 25.6 | 25.9 | 1.17 | 25.7 | 0.39 | 25.9 | 1.17 | 25.7 | 0.39 | 0 | N/A | 0 | N/A |
| Esker LV | 13.9 | 0 | N/A | 0 | N/A | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 0 | N/A | 0 | N/A | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 0 | N/A | 0 | N/A | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 0 | N/A | 0 | N/A | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 0 | N/A | 0 | N/A | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 0 | N/A | 0 | N/A | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 0 | N/A | 0 | N/A | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 0 | N/A | 0 | N/A | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 0 | N/A | 0 | N/A | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.8 | 0.73 | 13.6 | -0.73 | 13.8 | 0.73 | 13.6 | -0.73 | 13.4 | -2.19 | 13.6 | -0.73 |
| Perrault Falls LV | 11.5 | 11.6 | 0.87 | 11.5 | 0.00 | 11.8 | 2.61 | 11.7 | 1.74 | 11.4 | -0.87 | 11.5 | 0.00 |
| Sam Lake LV | 26.4 | 26.6 | 0.76 | 26.3 | -0.38 | 26.6 | 0.76 | 26.5 | 0.38 | 25.8 | -2.27 | 26.5 | 0.38 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 0 | N/A | 0 | N/A | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 0 | N/A | 0 | N/A | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.2 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 12.9 | -2.27 | 13.4 | 1.52 |
| Vermillion Bay DS LV | 15.2 | 15.2 | 0.00 | 15.1 | -0.66 | 15.2 | 0.00 | 15.1 | -0.66 | 14.8 | -2.63 | 15.1 | -0.66 |
| Burleigh DS LV | 13.1 | 12.9 | -1.53 | 13.1 | 0.00 | 12.8 | -2.29 | 13.1 | 0.00 | 12.3 | -6.11 | 13 | -0.76 |
| Fort Frances MS1 LV | 14.1 | 13.9 | -1.42 | 14.2 | 0.71 | 13.8 | -2.13 | 14.2 | 0.71 | 13.3 | -5.67 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.3 | -1.60 | 12.5 | 0.00 | 12.2 | -2.40 | 12.6 | 0.80 | 11.8 | -5.60 | 12.5 | 0.00 |
| Fort Frances L5 | 14.1 | 14 | -0.71 | 14.3 | 1.42 | 13.8 | -2.13 | 14.2 | 0.71 | 13.3 | -5.67 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 13.8 | -1.43 | 14.1 | 0.71 | 13.7 | -2.14 | 14.1 | 0.71 | 13.3 | -5.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.7 | -0.68 | 14.9 | 0.68 | 14.5 | -2.03 | 14.9 | 0.68 | 14.1 | -4.73 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.6 | -1.49 | 6.8 | 1.49 | 6.6 | -1.49 | 6.8 | 1.49 | 6.3 | -5.97 | 6.7 | 0.00 |

**Table 47: LV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 24.7 | -1.20 | 24.9 | -0.40 |
| Shabaqua DS LV | 13.2 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13 | -1.52 | 13.1 | -0.76 |
| Sapawe DS LV | 13.7 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.5 | -1.46 | 13.7 | 0.00 |
| Mattabi DS LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.1 | -2.38 | 4.2 | 0.00 |
| Agimak DS LV | 26.3 | 26.2 | -0.38 | 26.2 | -0.38 | 26 | -1.14 | 26.6 | 1.14 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 25.9 | -1.52 | 26.6 | 1.14 |
| Valora DS LV | 25.6 | 25.5 | -0.39 | 25.4 | -0.78 | 25.3 | -1.17 | 25.5 | -0.39 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 | 25.2 | -1.56 | 25.5 | -0.39 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.4 | -0.88 | 22.4 | -0.88 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46.1 | 0.22 | 46.1 | 0.22 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.6 | -0.73 | 13.6 | -0.73 | 13.4 | -2.19 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.5 | -1.46 | 13.6 | -0.73 |
| Perrault Falls LV | 11.5 | 11.2 | -2.61 | 11.2 | -2.61 | 11.4 | -0.87 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 |
| Sam Lake LV | 26.4 | 26.2 | -0.76 | 26.4 | 0.00 | 25.9 | -1.89 | 26.6 | 0.76 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.1 | -1.14 | 26.5 | 0.38 |
| Balmer LV | 44.1 | 42.6 | -3.40 | 43.3 | -1.81 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 45.3 | -3.41 | 46.2 | -1.49 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27 | -3.23 | 27.2 | -2.51 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 26.9 | -3.24 | 27.5 | -1.08 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27 | -1.82 | 27.2 | -1.09 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.2 | 13.2 | 0.00 | 13.3 | 0.76 | 13 | -1.52 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.1 | -0.76 | 13.3 | 0.76 |
| Vermillion Bay DS LV | 15.2 | 15.1 | -0.66 | 15.1 | -0.66 | 14.9 | -1.97 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15 | -1.32 | 15.1 | -0.66 |
| Burleigh DS LV | 13.1 | 13 | -0.76 | 13 | -0.76 | 13 | -0.76 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 12.9 | -1.53 | 13 | -0.76 |
| Fort Frances MS1 LV | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 14 | -0.71 | 14 | -0.71 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 13.9 | -1.42 | 14 | -0.71 |
| Fort Frances MS2 LV | 12.5 | 12.4 | -0.80 | 12.4 | -0.80 | 12.4 | -0.80 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.3 | -1.60 | 12.5 | 0.00 |
| Fort Frances L5 | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 13.9 | -1.42 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 13.9 | -0.71 | 13.9 | -0.71 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 13.8 | -1.43 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.6 | -1.35 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.6 | -1.49 | 6.7 | 0.00 |

**Table 48: LV Voltage Assessment for Test Case 1 – Ignace Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 25 | 0.40 | 25 | 0.40 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Shabaqua DS LV | 13.1 | 13.2 | 0.76 | 13.2 | 0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.8 | 14 | 1.45 | 14 | 1.45 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Mattabi DS LV | 4.3 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 |
| Agimak DS LV | 26.3 | 26.7 | 1.52 | 26.7 | 1.52 | 26.4 | 0.38 | 26.4 | 0.38 | 26.3 | 0.00 | 26.3 | 0.00 |
| Valora DS LV | 25.9 | 26.3 | 1.54 | 26.3 | 1.54 | 26 | 0.39 | 26 | 0.39 | 25.9 | 0.00 | 25.9 | 0.00 |
| Esker LV | 13.7 | 13.7 | 0.00 | 13.7 | 0.00 | 13.8 | 0.73 | 13.9 | 1.46 | 13.7 | 0.00 | 13.7 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Webequie LV | 23.5 | 23.5 | 0.00 | 23.5 | 0.00 | 23.7 | 0.85 | 23.6 | 0.43 | 23.5 | 0.00 | 23.5 | 0.00 |
| McFaulds LV | 45.2 | 45.2 | 0.00 | 45.2 | 0.00 | 44.9 | -0.66 | 45 | -0.44 | 45.2 | 0.00 | 45.2 | 0.00 |
| King Fisher Lake LV | 24.8 | 24.8 | 0.00 | 24.8 | 0.00 | 25 | 0.81 | 25 | 0.81 | 24.8 | 0.00 | 24.8 | 0.00 |
| Wapekeka LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 27.6 | 1.10 | 27.5 | 0.73 | 27.3 | 0.00 | 27.3 | 0.00 |
| North Caribou Lake LV | 24.8 | 24.8 | 0.00 | 24.8 | 0.00 | 25 | 0.81 | 25 | 0.81 | 24.8 | 0.00 | 24.8 | 0.00 |
| Muskrat LV | 27.6 | 27.6 | 0.00 | 27.6 | 0.00 | 27.8 | 0.72 | 27.8 | 0.72 | 27.6 | 0.00 | 27.6 | 0.00 |
| Crow River LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 28.7 | 3.24 | 27.9 | 0.36 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.3 | 4.3 | 0.00 | 4.3 | 0.00 | 4.5 | 4.65 | 4.5 | 4.65 | 4.3 | 0.00 | 4.3 | 0.00 |
| Cat Lake LV | 29.3 | 29.3 | 0.00 | 29.3 | 0.00 | 30.2 | 3.07 | 29.4 | 0.34 | 29.3 | 0.00 | 29.3 | 0.00 |
| Slate Falls LV | 24.4 | 24.4 | 0.00 | 24.4 | 0.00 | 25.1 | 2.87 | 25.1 | 2.87 | 24.4 | 0.00 | 24.4 | 0.00 |
| Ear Falls LV | 45.8 | 45.8 | 0.00 | 45.8 | 0.00 | 47.3 | 3.28 | 47.2 | 3.06 | 45.8 | 0.00 | 45.8 | 0.00 |
| Domtar Dryden LV | 13.9 | 14 | 0.72 | 14 | 0.72 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Perrault Falls LV | 11.6 | 11.6 | 0.00 | 11.6 | 0.00 | 11.6 | 0.00 | 11.6 | 0.00 | 11.6 | 0.00 | 11.6 | 0.00 |
| Sam Lake LV | 26.4 | 26.7 | 1.14 | 26.7 | 1.14 | 26.5 | 0.38 | 26.5 | 0.38 | 26.4 | 0.00 | 26.4 | 0.00 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 47 | 0.21 | 47 | 0.21 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Sandy Lake LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Eton DS LV | 13.2 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 |
| Vermillion Bay DS LV | 15.2 | 15.3 | 0.66 | 15.3 | 0.66 | 15.3 | 0.66 | 15.3 | 0.66 | 15.2 | 0.00 | 15.2 | 0.00 |
| Burleigh DS LV | 13.2 | 13.3 | 0.76 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Fort Frances MS1 LV | 14.2 | 14.4 | 1.41 | 14.4 | 1.41 | 14.3 | 0.70 | 14.3 | 0.70 | 14.2 | 0.00 | 14.2 | 0.00 |
| Fort Frances MS2 LV | 12.6 | 12.7 | 0.79 | 12.7 | 0.79 | 12.6 | 0.00 | 12.5 | -0.79 | 12.6 | 0.00 | 12.6 | 0.00 |
| Fort Frances L5 | 14.4 | 14.6 | 1.39 | 14.6 | 1.39 | 14.5 | 0.69 | 14.5 | 0.69 | 14.4 | 0.00 | 14.4 | 0.00 |
| Fort Frances L4A | 14.1 | 14.3 | 1.42 | 14.3 | 1.42 | 14.2 | 0.71 | 14.2 | 0.71 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4B | 14.9 | 15.1 | 1.34 | 15.1 | 1.34 | 15 | 0.67 | 14.9 | 0.00 | 14.9 | 0.00 | 14.9 | 0.00 |
| Fort Frances AB | 6.9 | 7 | 1.45 | 7 | 1.45 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 |

**Table 49: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 0 | N/A | 0 | N/A | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 244.3 | 244.1 | -0.08 | 244.2 | -0.04 | 241.3 | -1.23 | 239.8 | -1.84 | 240.3 | -1.64 | 239.2 | -2.09 | 242.4 | -0.78 | 242.7 | -0.65 | 243.4 | -0.37 | 243.1 | -0.49 |
| Dryden 230 kV | 242.9 | 243.6 | 0.29 | 243.8 | 0.37 | 241.1 | -0.74 | 238 | -2.02 | 238.8 | -1.69 | 236.8 | -2.51 | 239.2 | -1.52 | 236.6 | -2.59 | 242.6 | -0.12 | 241.7 | -0.49 |
| Fort Frances 230 kV | 242.9 | 243.6 | 0.29 | 243.8 | 0.37 | 241.1 | -0.74 | 238 | -2.02 | 238.8 | -1.69 | 236.8 | -2.51 | 239.2 | -1.52 | 236.6 | -2.59 | 242.6 | -0.12 | 241.7 | -0.49 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 246.6 | 242.8 | -1.54 | 242.3 | -1.74 | 246.1 | -0.20 | 246.3 | -0.12 | 247.8 | 0.49 | 247.6 | 0.41 | 246.1 | -0.20 | 246.1 | -0.20 | 246.3 | -0.12 | 246.3 | -0.12 |
| Pickle Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 125.1 | 123.8 | -1.04 | 123.9 | -0.96 | 122.3 | -2.24 | 123.9 | -0.96 | 121.5 | -2.88 | 123.6 | -1.20 | 121.7 | -2.72 | 123.4 | -1.36 | 123.3 | -1.44 | 124.4 | -0.56 |
| Fort Frances 115 kV | 120.1 | 120.2 | 0.08 | 120.3 | 0.17 | 118.8 | -1.08 | 118.9 | -1.00 | 116.9 | -2.66 | 118.4 | -1.42 | 120 | -0.08 | 120.1 | 0.00 | 119.9 | -0.17 | 119.9 | -0.17 |
| Mackenzie 115 kV | 122.8 | 119.8 | -2.44 | 121.2 | -1.30 | 121.2 | -1.30 | 121.4 | -1.14 | 121 | -1.47 | 121.1 | -1.38 | 120.9 | -1.55 | 121.1 | -1.38 | 121.1 | -1.38 | 121.3 | -1.22 |
| Moose Lake 115 kV | 122.9 | 119.7 | -2.60 | 120.8 | -1.71 | 121.1 | -1.46 | 121.3 | -1.30 | 120.9 | -1.63 | 121 | -1.55 | 121 | -1.55 | 121.2 | -1.38 | 121.3 | -1.30 | 121.5 | -1.14 |
| Birch 115 kV | 124.9 | 122.6 | -1.84 | 122.6 | -1.84 | 122.9 | -1.60 | 123.1 | -1.44 | 125.3 | 0.32 | 125.3 | 0.32 | 124.5 | -0.32 | 124.5 | -0.32 | 124.6 | -0.24 | 124.6 | -0.24 |
| Valora Jct 115 kV | 124.1 | 121.8 | -1.85 | 122.4 | -1.37 | 120.6 | -2.82 | 121.6 | -2.01 | 120.2 | -3.14 | 121.2 | -2.34 | 121.1 | -2.42 | 122.1 | -1.61 | 122.3 | -1.45 | 122.9 | -0.97 |
| Esker 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 125.6 | 0.00 | 125.6 | 0.00 | 0 | N/A | 0 | N/A | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 0 | N/A | 0 | N/A | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 126.5 | 0.00 | 126.5 | 0.00 | 0 | N/A | 0 | N/A | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 125.7 | 0.00 | 125.7 | 0.00 | 0 | N/A | 0 | N/A | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 127.3 | 0.00 | 127.3 | 0.00 | 0 | N/A | 0 | N/A | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 0 | N/A | 0 | N/A | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.9 | 123.6 | -1.04 | 123.7 | -0.96 | 122 | -2.32 | 123.6 | -1.04 | 121.3 | -2.88 | 123.4 | -1.20 | 121.5 | -2.72 | 123.2 | -1.36 | 123.1 | -1.44 | 124.2 | -0.56 |
| Perrault Falls 115 kV | 123.3 | 122.8 | -0.41 | 122.8 | -0.41 | 122.2 | -0.89 | 122.8 | -0.41 | 122 | -1.05 | 122.7 | -0.49 | 122 | -1.05 | 122.7 | -0.49 | 122.2 | -0.89 | 122.6 | -0.57 |
| Sam Lake 115 kV | 123.5 | 122.2 | -1.05 | 122.3 | -0.97 | 120.7 | -2.27 | 122.3 | -0.97 | 119.9 | -2.91 | 122 | -1.21 | 120.1 | -2.75 | 121.8 | -1.38 | 121.7 | -1.46 | 122.8 | -0.57 |

**Table 49: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.5 | 0.08 | 120.4 | 0.00 | 120.5 | 0.08 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.4 | 123.8 | -0.48 | 123.9 | -0.40 | 122.3 | -1.69 | 123.7 | -0.56 | 121.8 | -2.09 | 123.6 | -0.64 | 121.9 | -2.01 | 123.2 | -0.96 | 123.4 | -0.80 | 124.1 | -0.24 |
| Agimak DS 115 kV | 123.8 | 121.5 | -1.86 | 122.1 | -1.37 | 120.3 | -2.83 | 121.2 | -2.10 | 119.8 | -3.23 | 120.9 | -2.34 | 120.8 | -2.42 | 121.8 | -1.62 | 122 | -1.45 | 122.6 | -0.97 |
| Mattabi CTS 115 kV | 124.1 | 121.8 | -1.85 | 122.4 | -1.37 | 120.6 | -2.82 | 121.6 | -2.01 | 120.2 | -3.14 | 121.2 | -2.34 | 121.1 | -2.42 | 122.1 | -1.61 | 122.3 | -1.45 | 122.9 | -0.97 |
| Valora DS 115 kV | 124.1 | 121.8 | -1.85 | 122.4 | -1.37 | 120.6 | -2.82 | 121.6 | -2.01 | 120.2 | -3.14 | 121.2 | -2.34 | 121.1 | -2.42 | 122.1 | -1.61 | 122.3 | -1.45 | 122.9 | -0.97 |
| Murillo DS 115 kV | 124.2 | 121.3 | -2.33 | 121.2 | -2.42 | 122.4 | -1.45 | 122.6 | -1.29 | 124.5 | 0.24 | 124.4 | 0.16 | 123.6 | -0.48 | 123.7 | -0.40 | 123.8 | -0.32 | 123.8 | -0.32 |
| Shabaqua DS 115 kV | 123.6 | 119.4 | -3.40 | 119.5 | -3.32 | 122.2 | -1.13 | 122.4 | -0.97 | 123.4 | -0.16 | 123.4 | -0.16 | 122.7 | -0.73 | 122.8 | -0.65 | 123 | -0.49 | 123 | -0.49 |
| Sapawe DS 115 kV | 123 | 119 | -3.25 | 119.9 | -2.52 | 121.4 | -1.30 | 121.6 | -1.14 | 121.3 | -1.38 | 121.4 | -1.30 | 121.2 | -1.46 | 121.4 | -1.30 | 121.6 | -1.14 | 121.7 | -1.06 |
| West Coast 115 kV | 119.9 | 120 | 0.08 | 120.1 | 0.17 | 118.6 | -1.08 | 118.8 | -0.92 | 116.7 | -2.67 | 118.3 | -1.33 | 119.8 | -0.08 | 119.9 | 0.00 | 119.8 | -0.08 | 119.8 | -0.08 |
| Fort Frances MS 115 kV | 120.1 | 120.2 | 0.08 | 120.3 | 0.17 | 118.7 | -1.17 | 118.9 | -1.00 | 116.9 | -2.66 | 118.4 | -1.42 | 120 | -0.08 | 120 | -0.08 | 119.9 | -0.17 | 119.9 | -0.17 |
| Burleigh DS 115 kV | 120 | 120.1 | 0.08 | 120.2 | 0.17 | 118.7 | -1.08 | 118.9 | -0.92 | 116.8 | -2.67 | 118.4 | -1.33 | 119.9 | -0.08 | 120 | 0.00 | 119.9 | -0.08 | 119.9 | -0.08 |

**Table 50: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 0 | N/A | 0 | N/A | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 244.3 | 244.3 | 0.00 | 244.6 | 0.12 | 243.8 | -0.20 | 244.7 | 0.16 | 238.7 | -2.29 | 239.2 | -2.09 |
| Dryden 230 kV | 242.9 | 245 | 0.86 | 245 | 0.86 | 245 | 0.86 | 245 | 0.86 | 239.4 | -1.44 | 239.5 | -1.40 |
| Fort Frances 230 kV | 242.9 | 245 | 0.86 | 245 | 0.86 | 245 | 0.86 | 245 | 0.86 | 239.4 | -1.44 | 239.5 | -1.40 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 253.9 | 3.63 | 255.7 | 4.37 |
| Lakehead 230 kV | 246.6 | 248.9 | 0.93 | 248.9 | 0.93 | 248.9 | 0.93 | 248.9 | 0.93 | 253 | 2.60 | 253.3 | 2.72 |
| Pickle Lake 115 kV | 126.1 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 125.1 | 125.1 | 0.00 | 123.7 | -1.12 | 125 | -0.08 | 123.6 | -1.20 | 122.5 | -2.08 | 124.2 | -0.72 |
| Fort Frances 115 kV | 120.1 | 118.8 | -1.08 | 120.1 | 0.00 | 118 | -1.75 | 119.8 | -0.25 | 114.3 | -4.83 | 119.2 | -0.75 |
| Mackenzie 115 kV | 122.8 | 121.7 | -0.90 | 121.6 | -0.98 | 121.5 | -1.06 | 121.4 | -1.14 | 125.1 | 1.87 | 121.3 | -1.22 |
| Moose Lake 115 kV | 122.9 | 122.2 | -0.57 | 122 | -0.73 | 122.1 | -0.65 | 121.8 | -0.90 | 125.3 | 1.95 | 121.8 | -0.90 |
| Birch 115 kV | 124.9 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 126.4 | 1.20 | 126.4 | 1.20 |
| Valora Jct 115 kV | 124.1 | 125.1 | 0.81 | 124.3 | 0.16 | 125.1 | 0.81 | 124.2 | 0.08 | 122.7 | -1.13 | 122.7 | -1.13 |
| Esker 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 0 | N/A | 0 | N/A | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 0 | N/A | 0 | N/A | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 0 | N/A | 0 | N/A | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 0 | N/A | 0 | N/A | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 0 | N/A | 0 | N/A | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 0 | N/A | 0 | N/A | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 0 | N/A | 0 | N/A | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 0 | N/A | 0 | N/A | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.7 | 0.24 | 124.7 | -0.56 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.9 | 124.9 | 0.00 | 123.5 | -1.12 | 124.8 | -0.08 | 123.3 | -1.28 | 122.3 | -2.08 | 124 | -0.72 |
| Perrault Falls 115 kV | 123.3 | 123.3 | 0.00 | 122.8 | -0.41 | 125.6 | 1.87 | 124.5 | 0.97 | 122.3 | -0.81 | 122.9 | -0.32 |
| Sam Lake 115 kV | 123.5 | 123.6 | 0.08 | 122.2 | -1.05 | 123.4 | -0.08 | 122 | -1.21 | 120.9 | -2.11 | 122.6 | -0.73 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 0 | N/A | 0 | N/A | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 0 | N/A | 0 | N/A | 120.7 | 0.00 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 0 | N/A | 0 | N/A | 120.4 | 0.00 | 120.4 | 0.00 |

**Table 50: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Double Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.4 | 124.7 | 0.24 | 123.8 | -0.48 | 124.6 | 0.16 | 123.7 | -0.56 | 121.9 | -2.01 | 123.8 | -0.48 |
| Agimak DS 115 kV | 123.8 | 124.8 | 0.81 | 124 | 0.16 | 124.7 | 0.73 | 123.9 | 0.08 | 0 | N/A | 0 | N/A |
| Mattabi CTS 115 kV | 124.1 | 125.1 | 0.81 | 124.3 | 0.16 | 125.1 | 0.81 | 124.2 | 0.08 | 0 | N/A | 0 | N/A |
| Valora DS 115 kV | 124.1 | 125.1 | 0.81 | 124.3 | 0.16 | 125.1 | 0.81 | 124.2 | 0.08 | 0 | N/A | 0 | N/A |
| Murillo DS 115 kV | 124.2 | 124.7 | 0.40 | 124.7 | 0.40 | 124.7 | 0.40 | 124.7 | 0.40 | 126.1 | 1.53 | 125.8 | 1.29 |
| Shabaqua DS 115 kV | 123.6 | 125.8 | 1.78 | 125.8 | 1.78 | 125.8 | 1.78 | 125.8 | 1.78 | 126.3 | 2.18 | 125.2 | 1.29 |
| Sapawe DS 115 kV | 123 | 127.5 | 3.66 | 127.5 | 3.66 | 127.5 | 3.66 | 127.5 | 3.66 | 125.7 | 2.20 | 122.6 | -0.33 |
| West Coast 115 kV | 119.9 | 118.6 | -1.08 | 119.9 | 0.00 | 117.9 | -1.67 | 119.7 | -0.17 | 114.2 | -4.75 | 119.1 | -0.67 |
| Fort Frances MS 115 kV | 120.1 | 118.8 | -1.08 | 120.1 | 0.00 | 118 | -1.75 | 119.8 | -0.25 | 114.3 | -4.83 | 119.2 | -0.75 |
| Burleigh DS 115 kV | 120 | 118.7 | -1.08 | 120 | 0.00 | 118 | -1.67 | 119.8 | -0.17 | 114.3 | -4.75 | 119.2 | -0.67 |

**Table 51: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 244.3 | 243.1 | -0.49 | 243 | -0.53 | 241.3 | -1.23 | 240.3 | -1.64 | 243.7 | -0.25 | 243.7 | -0.25 | 243.7 | -0.25 | 243.7 | -0.25 | 243.7 | -0.25 | 243.7 | -0.25 | 240.7 | -1.47 | 239.8 | -1.84 |
| Dryden 230 kV | 242.9 | 242.1 | -0.33 | 241.6 | -0.54 | 238 | -2.02 | 236.3 | -2.72 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 239.1 | -1.56 | 237.6 | -2.18 |
| Fort Frances 230 kV | 242.9 | 242.1 | -0.33 | 241.6 | -0.54 | 238 | -2.02 | 236.3 | -2.72 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 243.4 | 0.21 | 239.1 | -1.56 | 237.6 | -2.18 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 237.7 | -2.98 | 237 | -3.27 |
| Lakehead 230 kV | 246.6 | 246.5 | -0.04 | 246.5 | -0.04 | 246.4 | -0.08 | 246.5 | -0.04 | 246.5 | -0.04 | 246.5 | -0.04 | 246.5 | -0.04 | 246.5 | -0.04 | 246.5 | -0.04 | 246.5 | -0.04 | 243.8 | -1.14 | 243.9 | -1.09 |
| Pickle Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Dryden 115 kV | 125.1 | 122.8 | -1.84 | 124.1 | -0.80 | 121.5 | -2.88 | 123.7 | -1.12 | 123.8 | -1.04 | 123.8 | -1.04 | 123.8 | -1.04 | 123.8 | -1.04 | 123.8 | -1.04 | 123.8 | -1.04 | 121.7 | -2.72 | 124.1 | -0.80 |
| Fort Frances 115 kV | 120.1 | 119.9 | -0.17 | 119.9 | -0.17 | 119.5 | -0.50 | 119.6 | -0.42 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 118 | -1.75 | 118.2 | -1.58 |
| Mackenzie 115 kV | 122.8 | 121.1 | -1.38 | 121.3 | -1.22 | 121 | -1.47 | 121.2 | -1.30 | 121.2 | -1.30 | 121.2 | -1.30 | 121.2 | -1.30 | 121.2 | -1.30 | 121.2 | -1.30 | 121.2 | -1.30 | 117.9 | -3.99 | 120.7 | -1.71 |
| Moose Lake 115 kV | 122.9 | 121.3 | -1.30 | 121.5 | -1.14 | 121.1 | -1.46 | 121.4 | -1.22 | 121.5 | -1.14 | 121.5 | -1.14 | 121.5 | -1.14 | 121.5 | -1.14 | 121.5 | -1.14 | 121.5 | -1.14 | 118.3 | -3.74 | 120.9 | -1.63 |
| Birch 115 kV | 124.9 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 124.7 | -0.16 | 123.3 | -1.28 | 123.6 | -1.04 |
| Valora Jct 115 kV | 124.1 | 122.1 | -1.61 | 122.9 | -0.97 | 121.4 | -2.18 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 119.9 | -3.38 | 122.5 | -1.29 |
| Esker 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120.1 | 0.08 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Neskatanga 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Webequie 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 119.3 | -0.58 | 119.3 | -0.58 | 120 | 0.00 | 120 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 126.3 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |
| Wapekeka 115 kV | 125.6 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 | 125.6 | 0.00 |
| North Caribou Lake 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Muskrat Dam 115 kV | 126.5 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 | 126.5 | 0.00 |
| Crow River 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Thierry Mine 115 kV | 125.7 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 | 125.7 | 0.00 |
| Cat Lake 115 kV | 127.3 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 | 127.3 | 0.00 |
| Slate Falls 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Ear Falls 115 kV | 125.4 | 120.9 | -3.59 | 122.1 | -2.63 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 124.9 | 122.6 | -1.84 | 123.9 | -0.80 | 121.3 | -2.88 | 123.5 | -1.12 | 123.6 | -1.04 | 123.6 | -1.04 | 123.6 | -1.04 | 123.6 | -1.04 | 123.6 | -1.04 | 123.6 | -1.04 | 121.5 | -2.72 | 123.9 | -0.80 |
| Perrault Falls 115 kV | 123.3 | 119.2 | -3.33 | 120.7 | -2.11 | 121.9 | -1.14 | 122.8 | -0.41 | 122.8 | -0.41 | 122.8 | -0.41 | 122.8 | -0.41 | 122.8 | -0.41 | 122.8 | -0.41 | 122.8 | -0.41 | 122 | -1.05 | 122.9 | -0.32 |
| Sam Lake 115 kV | 123.5 | 121.2 | -1.86 | 122.6 | -0.73 | 119.9 | -2.91 | 122.1 | -1.13 | 122.3 | -0.97 | 122.3 | -0.97 | 122.3 | -0.97 | 122.3 | -0.97 | 122.3 | -0.97 | 122.2 | -1.05 | 120.1 | -2.75 | 122.6 | -0.73 |
| Balmer 115 kV | 120 | 115 | -4.17 | 116.6 | -2.83 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 115.6 | -4.07 | 117.2 | -2.74 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 115.9 | -3.98 | 117.6 | -2.57 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.8 | 0.08 |
| Deer Lake 115 kV | 120.4 | 115.9 | -3.74 | 117.7 | -2.24 | 120.4 | 0.00 | 120.5 | 0.08 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |

**Table 51: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls SVC | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 120 | 115.6 | -3.67 | 117.4 | -2.17 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 124.4 | 123 | -1.13 | 124 | -0.32 | 121.9 | -2.01 | 123.7 | -0.56 | 123.8 | -0.48 | 123.8 | -0.48 | 123.8 | -0.48 | 123.8 | -0.48 | 123.8 | -0.48 | 123.8 | -0.48 | 121.9 | -2.01 | 123.9 | -0.40 |
| Agimak DS 115 kV | 123.8 | 121.8 | -1.62 | 122.6 | -0.97 | 121.1 | -2.18 | 122.3 | -1.21 | 122.4 | -1.13 | 122.4 | -1.13 | 122.4 | -1.13 | 122.4 | -1.13 | 122.4 | -1.13 | 122.4 | -1.13 | 119.6 | -3.39 | 122.1 | -1.37 |
| Mattabi CTS 115 kV | 124.1 | 122.1 | -1.61 | 122.9 | -0.97 | 121.4 | -2.18 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 119.9 | -3.38 | 122.5 | -1.29 |
| Valora DS 115 kV | 124.1 | 122.1 | -1.61 | 122.9 | -0.97 | 121.4 | -2.18 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 122.7 | -1.13 | 119.9 | -3.38 | 122.5 | -1.29 |
| Murillo DS 115 kV | 124.2 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 123.9 | -0.24 | 122.4 | -1.45 | 122.8 | -1.13 |
| Shabaqua DS 115 kV | 123.6 | 123.1 | -0.40 | 123.1 | -0.40 | 123 | -0.49 | 123.1 | -0.40 | 123.1 | -0.40 | 123.1 | -0.40 | 123.1 | -0.40 | 123.1 | -0.40 | 123.1 | -0.40 | 123.1 | -0.40 | 121.1 | -2.02 | 122.1 | -1.21 |
| Sapawe DS 115 kV | 123 | 121.6 | -1.14 | 121.7 | -1.06 | 121.4 | -1.30 | 121.7 | -1.06 | 121.7 | -1.06 | 121.7 | -1.06 | 121.7 | -1.06 | 121.7 | -1.06 | 121.7 | -1.06 | 121.7 | -1.06 | 118.7 | -3.50 | 121 | -1.63 |
| West Coast 115 kV | 119.9 | 119.7 | -0.17 | 119.8 | -0.08 | 119.3 | -0.50 | 119.5 | -0.33 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 117.8 | -1.75 | 118 | -1.58 |
| Fort Frances MS 115 kV | 120.1 | 119.9 | -0.17 | 119.9 | -0.17 | 119.5 | -0.50 | 119.6 | -0.42 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 120 | -0.08 | 118 | -1.75 | 118.2 | -1.58 |
| Burleigh DS 115 kV | 120 | 119.8 | -0.17 | 119.9 | -0.08 | 119.4 | -0.50 | 119.6 | -0.33 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 117.9 | -1.75 | 118.1 | -1.58 |

**Table 52: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Pickle Lake 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Kenora 230 kV | 245.4 | 247.4 | 0.81 | 247.4 | 0.81 | 245.4 | 0.00 | 245.4 | 0.00 | 245.4 | 0.00 | 245.4 | 0.00 |
| Dryden 230 kV | 246.7 | 250 | 1.34 | 250 | 1.34 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 |
| Fort Frances 230 kV | 246.7 | 250 | 1.34 | 250 | 1.34 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 | 246.7 | 0.00 |
| Mackenzie 230 kV | 242.4 | 248.8 | 2.64 | 248.8 | 2.64 | 242.4 | 0.00 | 242.4 | 0.00 | 242.4 | 0.00 | 242.4 | 0.00 |
| Lakehead 230 kV | 238 | 240.4 | 1.01 | 240.4 | 1.01 | 238 | 0.00 | 238 | 0.00 | 238 | 0.00 | 238 | 0.00 |
| Pickle Lake 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Dryden 115 kV | 124.9 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 |
| Fort Frances 115 kV | 120 | 121.2 | 1.00 | 121.2 | 1.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Mackenzie 115 kV | 122 | 121.5 | -0.41 | 121.5 | -0.41 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 |
| Moose Lake 115 kV | 122.4 | 121.9 | -0.41 | 121.9 | -0.41 | 122.4 | 0.00 | 122.4 | 0.00 | 122.4 | 0.00 | 122.4 | 0.00 |
| Birch 115 kV | 122.8 | 122.5 | -0.24 | 122.5 | -0.24 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Valora Jct 115 kV | 125 | 124.8 | -0.16 | 124.8 | -0.16 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 |
| Esker 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Neskatanga 115 kV | 123.9 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 |
| Webequie 115 kV | 121.8 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 |
| McFaulds 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Kingfisher Lake 115 kV | 128.3 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 |
| Wapekeka 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| North Caribou Lake 115 kV | 129.7 | 129.7 | 0.00 | 129.7 | 0.00 | 129.7 | 0.00 | 129.7 | 0.00 | 129.7 | 0.00 | 129.7 | 0.00 |
| Muskrat Dam 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Crow River 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Thierry Mine 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Cat Lake 115 kV | 128.3 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 | 128.3 | 0.00 |
| Slate Falls 115 kV | 130.2 | 130.2 | 0.00 | 130.2 | 0.00 | 130.2 | 0.00 | 130.2 | 0.00 | 130.2 | 0.00 | 130.2 | 0.00 |
| Ear Falls 115 kV | 122.8 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Domtar Dryden 115 kV | 124.9 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 |
| Perrault Falls 115 kV | 122.7 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 |
| Sam Lake 115 kV | 124.4 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 123.8 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 |
| Deer Lake 115 kV | 126 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 |

**Table 52: HV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Condtions (Continued)**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Sandy Lake 115 kV | 126.1 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |
| Vermillion Bay DS 115 kV | 125 | 125.1 | 0.08 | 125.1 | 0.08 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 |
| Agimak DS 115 kV | 124.6 | 124.3 | -0.24 | 124.3 | -0.24 | 124.6 | 0.00 | 124.6 | 0.00 | 124.6 | 0.00 | 124.6 | 0.00 |
| Mattabi CTS 115 kV | 125 | 124.8 | -0.16 | 124.8 | -0.16 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 |
| Valora DS 115 kV | 125 | 124.8 | -0.16 | 124.8 | -0.16 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 | 125 | 0.00 |
| Murillo DS 115 kV | 122.6 | 122.3 | -0.24 | 122.3 | -0.24 | 122.6 | 0.00 | 122.6 | 0.00 | 122.6 | 0.00 | 122.6 | 0.00 |
| Shabaqua DS 115 kV | 122.9 | 122.6 | -0.24 | 122.6 | -0.24 | 122.9 | 0.00 | 122.9 | 0.00 | 122.9 | 0.00 | 122.9 | 0.00 |
| Sapawe DS 115 kV | 122.7 | 122.2 | -0.41 | 122.2 | -0.41 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 | 122.7 | 0.00 |
| West Coast 115 kV | 120 | 121.1 | 0.92 | 121.1 | 0.92 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Fort Frances MS 115 kV | 120 | 121.2 | 1.00 | 121.2 | 1.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Burleigh DS 115 kV | 120 | 121.2 | 1.00 | 121.2 | 1.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |

**Table 53: LV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 24.3 | -2.41 | 24.9 | 0.00 | 24.6 | -1.20 | 24.9 | 0.00 | 25 | 0.40 | 24.8 | -0.40 | 24.8 | -0.40 | 24.8 | -0.40 | 24.9 | 0.00 | 24.9 | 0.00 |
| Shabaqua DS LV | 13.2 | 12.8 | -3.03 | 12.8 | -3.03 | 13.1 | -0.76 | 13.1 | -0.76 | 13.2 | 0.00 | 13.1 | -0.76 | 13.1 | -0.76 | 13.1 | -0.76 | 13.2 | 0.00 | 13.2 | 0.00 |
| Sapawe DS LV | 13.9 | 13.4 | -3.60 | 13.5 | -2.88 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 | 13.7 | -1.44 |
| Mattabi DS LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.1 | -2.38 | 4.2 | 0.00 | 4.1 | -2.38 | 4.1 | -2.38 | 4.1 | -2.38 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Agimak DS LV | 26.2 | 26 | -0.76 | 26.5 | 1.15 | 25.8 | -1.53 | 26.3 | 0.38 | 25.7 | -1.91 | 25.9 | -1.15 | 25.9 | -1.15 | 26.4 | 0.76 | 26.2 | 0.00 | 26.3 | 0.38 |
| Valora DS LV | 25.8 | 25.3 | -1.94 | 25.4 | -1.55 | 25 | -3.10 | 25.2 | -2.33 | 25 | -3.10 | 25.2 | -2.33 | 25.2 | -2.33 | 25.4 | -1.55 | 25.4 | -1.55 | 25.5 | -1.16 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 0 | N/A | 0 | N/A | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 22.6 | 0.00 | 22.6 | 0.00 | 0 | N/A | 0 | N/A | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 46 | 0.00 | 46 | 0.00 | 0 | N/A | 0 | N/A | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 25.2 | 0.00 | 25.2 | 0.00 | 0 | N/A | 0 | N/A | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 24 | 0.00 | 24 | 0.00 | 0 | N/A | 0 | N/A | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 0 | N/A | 0 | N/A | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 4.5 | 0.00 | 4.5 | 0.00 | 0 | N/A | 0 | N/A | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 29.4 | 0.00 | 29.4 | 0.00 | 0 | N/A | 0 | N/A | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 0 | N/A | 0 | N/A | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.8 | 13.6 | -1.45 | 13.6 | -1.45 | 13.5 | -2.17 | 13.6 | -1.45 | 13.4 | -2.90 | 13.4 | -2.90 | 13.4 | -2.90 | 13.6 | -1.45 | 13.6 | -1.45 | 13.7 | -0.72 |
| Perrault Falls LV | 11.6 | 11.5 | -0.86 | 11.5 | -0.86 | 11.5 | -0.86 | 11.5 | -0.86 | 11.4 | -1.72 | 11.4 | -1.72 | 11.4 | -1.72 | 11.5 | -0.86 | 11.4 | -1.72 | 11.5 | -0.86 |
| Sam Lake LV | 26.4 | 26.3 | -0.38 | 26.3 | -0.38 | 26 | -1.52 | 26.5 | 0.38 | 25.8 | -2.27 | 25.8 | -2.27 | 25.8 | -2.27 | 26.6 | 0.76 | 26.2 | -0.76 | 26.6 | 0.76 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Eton DS LV | 13.2 | 13.2 | 0.00 | 13.2 | 0.00 | 13 | -1.52 | 13.3 | 0.76 | 13 | -1.52 | 13 | -1.52 | 13 | -1.52 | 13.3 | 0.76 | 13.1 | -0.76 | 13.4 | 1.52 |
| Vermillion Bay DS LV | 15.2 | 15.1 | -0.66 | 15.2 | 0.00 | 15 | -1.32 | 15.1 | -0.66 | 14.9 | -1.97 | 14.9 | -1.97 | 14.9 | -1.97 | 15.1 | -0.66 | 15.1 | -0.66 | 15.2 | 0.00 |
| Burleigh DS LV | 13.2 | 13.3 | 0.76 | 13.3 | 0.76 | 13.1 | -0.76 | 13.1 | -0.76 | 12.9 | -2.27 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Fort Frances MS1 LV | 14.3 | 14.3 | 0.00 | 14.3 | 0.00 | 14.1 | -1.40 | 14.2 | -0.70 | 13.9 | -2.80 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.5 | 0.00 | 12.5 | 0.00 | 12.3 | -1.60 | 12.5 | 0.00 | 12.1 | -3.20 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 |
| Fort Frances L5 | 14.4 | 14.4 | 0.00 | 14.4 | 0.00 | 14.2 | -1.39 | 14.2 | -1.39 | 13.9 | -3.47 | 14.3 | -0.69 | 14.3 | -0.69 | 14.4 | 0.00 | 14.3 | -0.69 | 14.3 | -0.69 |
| Fort Frances L4A | 14.2 | 14.2 | 0.00 | 14.2 | 0.00 | 14 | -1.41 | 14.1 | -0.70 | 13.8 | -2.82 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 |
| Fort Frances L4B | 15 | 15 | 0.00 | 15.1 | 0.67 | 14.9 | -0.67 | 14.9 | -0.67 | 14.6 | -2.67 | 15 | 0.00 | 15 | 0.00 | 15 | 0.00 | 15 | 0.00 | 15 | 0.00 |
| Fort Frances AB | 6.8 | 6.8 | 0.00 | 6.8 | 0.00 | 6.7 | -1.47 | 6.8 | 0.00 | 6.6 | -2.94 | 6.8 | 0.00 | 6.8 | 0.00 | 6.8 | 0.00 | 6.8 | 0.00 | 6.8 | 0.00 |

**Table 54: LV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 25 | 0.40 | 25 | 0.40 | 25 | 0.40 | 25 | 0.40 | 25.3 | 1.61 | 25.1 | 0.80 |
| Shabaqua DS LV | 13.2 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.5 | 2.27 | 13.4 | 1.52 |
| Sapawe DS LV | 13.9 | 14.4 | 3.60 | 14.4 | 3.60 | 14.4 | 3.60 | 14.4 | 3.60 | 14.2 | 2.16 | 13.9 | 0.00 |
| Mattabi DS LV | 4.2 | 4.3 | 2.38 | 4.3 | 2.38 | 4.3 | 2.38 | 4.3 | 2.38 | 0 | N/A | 0 | N/A |
| Agimak DS LV | 26.2 | 26.8 | 2.29 | 26.6 | 1.53 | 26.7 | 1.91 | 26.6 | 1.53 | 0 | N/A | 0 | N/A |
| Valora DS LV | 25.8 | 26 | 0.78 | 25.8 | 0.00 | 26 | 0.78 | 25.8 | 0.00 | 0 | N/A | 0 | N/A |
| Esker LV | 13.9 | 0 | N/A | 0 | N/A | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 0 | N/A | 0 | N/A | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 0 | N/A | 0 | N/A | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 0 | N/A | 0 | N/A | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 0 | N/A | 0 | N/A | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 0 | N/A | 0 | N/A | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 0 | N/A | 0 | N/A | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 0 | N/A | 0 | N/A | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 0 | N/A | 0 | N/A | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.8 | 13.8 | 0.00 | 13.6 | -1.45 | 13.8 | 0.00 | 13.6 | -1.45 | 13.5 | -2.17 | 13.7 | -0.72 |
| Perrault Falls LV | 11.6 | 11.6 | 0.00 | 11.5 | -0.86 | 11.8 | 1.72 | 11.7 | 0.86 | 11.5 | -0.86 | 11.5 | -0.86 |
| Sam Lake LV | 26.4 | 26.6 | 0.76 | 26.5 | 0.38 | 26.6 | 0.76 | 26.5 | 0.38 | 26 | -1.52 | 26.6 | 0.76 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 0 | N/A | 0 | N/A | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 0 | N/A | 0 | N/A | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 0 | N/A | 0 | N/A | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27.9 | 0.36 | 27.8 | 0.00 |
| Eton DS LV | 13.2 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 13.3 | 0.76 | 13 | -1.52 | 13.3 | 0.76 |
| Vermillion Bay DS LV | 15.2 | 15.3 | 0.66 | 15.1 | -0.66 | 15.2 | 0.00 | 15.1 | -0.66 | 14.9 | -1.97 | 15.1 | -0.66 |
| Burleigh DS LV | 13.2 | 13.1 | -0.76 | 13.2 | 0.00 | 13 | -1.52 | 13.2 | 0.00 | 12.6 | -4.55 | 13.1 | -0.76 |
| Fort Frances MS1 LV | 14.3 | 14.1 | -1.40 | 14.3 | 0.00 | 14 | -2.10 | 14.3 | 0.00 | 13.6 | -4.90 | 14.2 | -0.70 |
| Fort Frances MS2 LV | 12.5 | 12.3 | -1.60 | 12.5 | 0.00 | 12.2 | -2.40 | 12.5 | 0.00 | 11.9 | -4.80 | 12.5 | 0.00 |
| Fort Frances L5 | 14.4 | 14.2 | -1.39 | 14.4 | 0.00 | 14.1 | -2.08 | 14.3 | -0.69 | 13.6 | -5.56 | 14.2 | -1.39 |
| Fort Frances L4A | 14.2 | 14.1 | -0.70 | 14.2 | 0.00 | 14 | -1.41 | 14.2 | 0.00 | 13.5 | -4.93 | 14.1 | -0.70 |
| Fort Frances L4B | 15 | 14.9 | -0.67 | 15 | 0.00 | 14.8 | -1.33 | 15 | 0.00 | 14.3 | -4.67 | 14.9 | -0.67 |
| Fort Frances AB | 6.8 | 6.7 | -1.47 | 6.8 | 0.00 | 6.7 | -1.47 | 6.8 | 0.00 | 6.5 | -4.41 | 6.8 | 0.00 |

**Table 55: LV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Neskatanga Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Webequie Cap | | | | Loss of Mackenzie SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.9 | -0.40 | 24.6 | -1.60 | 25 | 0.00 |
| Shabaqua DS LV | 13.2 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13 | -1.52 | 13.1 | -0.76 |
| Sapawe DS LV | 13.7 | 13.7 | 0.00 | 13.8 | 0.73 | 13.7 | 0.00 | 13.7 | 0.00 | 13.8 | 0.73 | 13.8 | 0.73 | 13.8 | 0.73 | 13.8 | 0.73 | 13.8 | 0.73 | 13.8 | 0.73 | 13.4 | -2.19 | 13.7 | 0.00 |
| Mattabi DS LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.1 | -2.38 | 4.2 | 0.00 |
| Agimak DS LV | 26.3 | 26.1 | -0.76 | 26.6 | 1.14 | 25.9 | -1.52 | 26.6 | 1.14 | 26.2 | -0.38 | 26.2 | -0.38 | 26.2 | -0.38 | 26.2 | -0.38 | 26.2 | -0.38 | 26.2 | -0.38 | 25.6 | -2.66 | 26.5 | 0.76 |
| Valora DS LV | 25.6 | 25.4 | -0.78 | 25.5 | -0.39 | 25.2 | -1.56 | 25.5 | -0.39 | 25.5 | -0.39 | 25.5 | -0.39 | 25.5 | -0.39 | 25.5 | -0.39 | 25.5 | -0.39 | 25.5 | -0.39 | 24.9 | -2.73 | 25.4 | -0.78 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Webequie LV | 22.6 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.6 | 0.00 | 22.4 | -0.88 | 22.4 | -0.88 | 22.6 | 0.00 | 22.6 | 0.00 |
| McFaulds LV | 46 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46 | 0.00 | 46.1 | 0.22 | 46.1 | 0.22 | 46 | 0.00 | 46 | 0.00 |
| King Fisher Lake LV | 25.2 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 | 25.2 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Thierry Mine LV | 4.5 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Ear Falls LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.5 | -1.46 | 13.7 | 0.00 | 13.4 | -2.19 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 | 13.6 | -0.73 | 13.4 | -2.19 | 13.7 | 0.00 |
| Perrault Falls LV | 11.5 | 11.2 | -2.61 | 11.3 | -1.74 | 11.4 | -0.87 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.5 | 0.00 | 11.4 | -0.87 | 11.5 | 0.00 |
| Sam Lake LV | 26.4 | 26.1 | -1.14 | 26.6 | 0.76 | 25.8 | -2.27 | 26.7 | 1.14 | 26.3 | -0.38 | 26.3 | -0.38 | 26.3 | -0.38 | 26.3 | -0.38 | 26.3 | -0.38 | 26.3 | -0.38 | 25.8 | -2.27 | 26.6 | 0.76 |
| Balmer LV | 44.1 | 42.2 | -4.31 | 43.7 | -0.91 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 44.9 | -4.26 | 46.7 | -0.43 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 26.8 | -3.94 | 27.5 | -1.43 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 26.7 | -3.96 | 27.5 | -1.08 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27.2 | -1.09 | 28 | 1.82 | 27.9 | 1.45 | 27.8 | 1.09 | 27.8 | 1.09 | 27.8 | 1.09 | 27.8 | 1.09 | 27.8 | 1.09 | 27.8 | 1.09 | 27.8 | 1.09 | 27.9 | 1.45 | 27.8 | 1.09 |
| Eton DS LV | 13.2 | 13.1 | -0.76 | 13.3 | 0.76 | 13 | -1.52 | 13.4 | 1.52 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13 | -1.52 | 13.3 | 0.76 |
| Vermillion Bay DS LV | 15.2 | 15 | -1.32 | 15.2 | 0.00 | 14.9 | -1.97 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 | 15.1 | -0.66 | 14.9 | -1.97 | 15.2 | 0.00 |
| Burleigh DS LV | 13.1 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13 | -0.76 | 13 | -0.76 |
| Fort Frances MS1 LV | 14.1 | 14.3 | 1.42 | 14.3 | 1.42 | 14.2 | 0.71 | 14.2 | 0.71 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14 | -0.71 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.4 | -0.80 | 12.4 | -0.80 | 12.4 | -0.80 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.2 | -2.40 | 12.4 | -0.80 |
| Fort Frances L5 | 14.1 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14.3 | 1.42 | 14.4 | 2.13 | 14.4 | 2.13 | 14.4 | 2.13 | 14.4 | 2.13 | 14.4 | 2.13 | 14.4 | 2.13 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 14.2 | 1.43 | 14.2 | 1.43 | 14.1 | 0.71 | 14.2 | 1.43 | 14.2 | 1.43 | 14.2 | 1.43 | 14.2 | 1.43 | 14.2 | 1.43 | 14.2 | 1.43 | 14.2 | 1.43 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 15 | 1.35 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.8 | 1.49 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 56: LV Voltage Assessment for Test Case 2 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25.1 | 24.9 | -0.80 | 24.9 | -0.80 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 |
| Shabaqua DS LV | 13.2 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Sapawe DS LV | 13.9 | 13.8 | -0.72 | 13.8 | -0.72 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Mattabi DS LV | 4.3 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 |
| Agimak DS LV | 26.4 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 |
| Valora DS LV | 26 | 26 | 0.00 | 26 | 0.00 | 26 | 0.00 | 26 | 0.00 | 26 | 0.00 | 26 | 0.00 |
| Esker LV | 13.7 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Webequie LV | 23.7 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 |
| McFaulds LV | 44.9 | 44.9 | 0.00 | 44.9 | 0.00 | 44.9 | 0.00 | 44.9 | 0.00 | 44.9 | 0.00 | 44.9 | 0.00 |
| King Fisher Lake LV | 25 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 | 25 | 0.00 |
| Wapekeka LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| North Caribou Lake LV | 25.3 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 |
| Muskrat LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Crow River LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Thierry Mine LV | 4.5 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 | 4.5 | 0.00 |
| Cat Lake LV | 29.4 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 25.4 | 25.4 | 0.00 | 25.4 | 0.00 | 25.4 | 0.00 | 25.4 | 0.00 | 25.4 | 0.00 | 25.4 | 0.00 |
| Ear Falls LV | 47.8 | 47.8 | 0.00 | 47.8 | 0.00 | 47.8 | 0.00 | 47.8 | 0.00 | 47.8 | 0.00 | 47.8 | 0.00 |
| Domtar Dryden LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Perrault Falls LV | 11.7 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 |
| Sam Lake LV | 26.3 | 26.4 | 0.38 | 26.4 | 0.38 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Sandy Lake LV | 27.6 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 |
| Eton DS LV | 13.2 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Vermillion Bay DS LV | 15.3 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 |
| Burleigh DS LV | 13.3 | 13.4 | 0.75 | 13.4 | 0.75 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 |
| Fort Frances MS1 LV | 14.3 | 14.5 | 1.40 | 14.5 | 1.40 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 |
| Fort Frances MS2 LV | 12.6 | 12.6 | 0.00 | 12.6 | 0.00 | 12.6 | 0.00 | 12.6 | 0.00 | 12.6 | 0.00 | 12.6 | 0.00 |
| Fort Frances L5 | 14.5 | 14.7 | 1.38 | 14.7 | 1.38 | 14.5 | 0.00 | 14.5 | 0.00 | 14.5 | 0.00 | 14.5 | 0.00 |
| Fort Frances L4A | 14.3 | 14.4 | 0.70 | 14.4 | 0.70 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 |
| Fort Frances L4B | 15 | 15.2 | 1.33 | 15.2 | 1.33 | 15 | 0.00 | 15 | 0.00 | 15 | 0.00 | 15 | 0.00 |
| Fort Frances AB | 7 | 7 | 0.00 | 7 | 0.00 | 7 | 0.00 | 7 | 0.00 | 7 | 0.00 | 7 | 0.00 |

# Appendix D: 115 kV Test Cases – Thermal Assessment Results

**Table 57: Thermal Loading for Test Case 3 – Valora Junction with All Elements in-service – Single-Circuit Contingency**

| Circuit Name | Length (KM) | CONT Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of A21L | | Loss of D26A | | Loss of F25A | | Loss of K23D | | Loss of 1 Manitou Falls Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | % LTE |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 239 | 54.32 | 356 | 80.91 | 260 | 59.09 | 238 | 54.09 | 243 | 55.23 | 242 | 55.00 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 197 | 45.81 | 313 | 72.79 | 217 | 50.47 | 195 | 45.35 | 201 | 46.74 | 200 | 46.51 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 195 | 41.49 | 311 | 66.17 | 215 | 45.74 | 194 | 41.28 | 199 | 42.34 | 198 | 42.13 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 190 | 40.43 | 305 | 64.89 | 210 | 44.68 | 188 | 40.00 | 193 | 41.06 | 192 | 40.85 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 187 | 40.65 | 302 | 65.65 | 207 | 45.00 | 185 | 40.22 | 191 | 41.52 | 189 | 41.09 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 187 | 43.49 | 302 | 70.23 | 207 | 48.14 | 185 | 43.02 | 190 | 44.19 | 189 | 43.95 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 180 | 29.03 | 294 | 39.73 | 200 | 27.03 | 179 | 24.19 | 184 | 24.86 | 183 | 24.73 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 180 | 29.03 | 294 | 39.73 | 200 | 27.03 | 179 | 24.19 | 184 | 24.86 | 183 | 24.73 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 456 | 82.91 | 456 | 82.91 | 680 | 123.64 | 546 | 99.27 | 471 | 85.64 | 463 | 84.18 |
| M2D IGxDN | 40.4 | 420 | 420 | 420 | 48 | 11.43 | 49 | 11.67 | 199 | 47.38 | 81 | 19.29 | 40 | 9.52 | 45 | 10.71 |
| M2D DNxDR | 40 | 420 | 420 | 420 | 48 | 11.43 | 49 | 11.67 | 199 | 47.38 | 81 | 19.29 | 40 | 9.52 | 45 | 10.71 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 462 | 144.38 | 461 | 115.25 | 479 | 119.75 | 470 | 117.50 | 466 | 116.50 | 463 | 115.75 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 461 | 92.20 | 460 | 92.00 | 478 | 95.60 | 469 | 93.80 | 464 | 92.80 | 462 | 92.40 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 454 | 90.80 | 453 | 90.60 | 472 | 94.40 | 463 | 92.60 | 458 | 91.60 | 455 | 91.00 |
| E4D DRxSL | 68.2 | 470 | 470 | 665 | 364 | 77.45 | 363 | 77.23 | 364 | 77.45 | 368 | 78.30 | 369 | 78.51 | 390 | 82.98 |
| E4D SLxEF | 30.2 | 470 | 470 | 665 | 354 | 75.32 | 353 | 75.11 | 354 | 75.32 | 357 | 75.96 | 359 | 76.38 | 380 | 80.85 |
| E4D#2 DRxEF | 98.4 | 470 | 470 | 470 | 363 | 77.23 | 362 | 77.02 | 362 | 77.02 | 367 | 78.09 | 368 | 78.30 | 389 | 82.77 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 312 | 74.29 | 312 | 74.29 | 313 | 74.52 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 72 | 15.32 | 82 | 17.45 | 158 | 33.62 | 11 | 2.34 | 113 | 24.04 | 80 | 17.02 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 78 | 16.60 | 89 | 18.94 | 164 | 34.89 | 3 | 0.64 | 119 | 25.32 | 86 | 18.30 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 88 | 18.72 | 98 | 20.85 | 172 | 36.60 | 20 | 4.26 | 127 | 27.02 | 96 | 20.43 |
| A21L | 191.7 | 880 | 880 | 880 | 390 | 44.32 | 0 | 0.00 | 364 | 41.36 | 356 | 40.45 | 395 | 44.89 | 394 | 44.77 |
| A22L | 191.7 | 880 | 880 | 880 | 390 | 44.32 | 666 | 75.68 | 364 | 41.36 | 356 | 40.45 | 394 | 44.77 | 394 | 44.77 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 361 | 41.02 | 322 | 36.59 | 0 | 0.00 | 539 | 61.25 | 390 | 44.32 | 367 | 41.70 |
| D26A IGxDR | 80.4 | 880 | 880 | 880 | 353 | 40.11 | 315 | 35.80 | 0 | 0.00 | 534 | 60.68 | 389 | 44.20 | 361 | 41.02 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 58 | 6.59 | 89 | 10.11 | 289 | 32.84 | 111 | 12.61 | 0 | 0.00 | 69 | 7.84 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 62 | 7.05 | 89 | 10.11 | 297 | 33.75 | 131 | 14.89 | 0 | 0.00 | 73 | 8.30 |
| F25A | 141.6 | 880 | 880 | 880 | 282 | 32.05 | 234 | 26.59 | 492 | 55.91 | 0 | 0.00 | 254 | 28.86 | 279 | 31.70 |

**Table 58: Thermal Loading for Test Case 3 – Valora Junction with All Elements in-service – Double-Circuit Contingency**

| Circuit Name | Length (KM) | Cont Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 239 | 54.32 | 56 | 12.73 | 56 | 12.73 | 22 | 5.00 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 197 | 45.81 | 37 | 8.60 | 37 | 8.60 | 31 | 7.21 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 195 | 41.49 | 29 | 6.17 | 29 | 6.17 | 32 | 6.81 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 190 | 40.43 | 31 | 6.60 | 31 | 6.60 | 38 | 8.09 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 187 | 40.65 | 19 | 4.13 | 19 | 4.13 | 41 | 8.91 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 187 | 43.49 | 19 | 4.42 | 19 | 4.42 | 41 | 9.53 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 180 | 29.03 | 0 | 0.00 | 0 | 0.00 | 52 | 7.03 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 180 | 29.03 | 0 | 0.00 | 0 | 0.00 | 52 | 7.03 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 456 | 82.91 | 101 | 18.36 | 225 | 40.91 | 0 | 0.00 |
| M2D IGxDN | 40.4 | 420 | 420 | 420 | 48 | 11.43 | 72 | 17.14 | 235 | 55.95 | 0 | 0.00 |
| M2D DNxDR | 40 | 420 | 420 | 420 | 48 | 11.43 | 72 | 17.14 | 235 | 55.95 | 0 | 0.00 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 462 | 144.38 | 21 | 5.25 | 454 | 113.50 | 0 | 0.00 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 461 | 92.20 | 17 | 3.40 | 453 | 90.60 | 0 | 0.00 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 454 | 90.80 | 16 | 3.20 | 446 | 89.20 | 0 | 0.00 |
| E4D DRxSL | 68.2 | 470 | 470 | 665 | 364 | 77.45 | 364 | 77.45 | 48 | 10.21 | 363 | 77.23 |
| E4D SLxEF | 30.2 | 470 | 470 | 665 | 354 | 75.32 | 354 | 75.32 | 27 | 5.74 | 353 | 75.11 |
| E4D#2 DRxEF | 98.4 | 470 | 470 | 470 | 363 | 77.23 | 363 | 77.23 | 48 | 10.21 | 362 | 77.02 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 0 | 0.00 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 0 | 0.00 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 72 | 15.32 | 133 | 28.30 | 73 | 15.53 | 180 | 38.30 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 78 | 16.60 | 140 | 29.79 | 79 | 16.81 | 186 | 39.57 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 88 | 18.72 | 148 | 31.49 | 87 | 18.51 | 193 | 41.06 |
| A21L | 191.7 | 880 | 880 | 880 | 390 | 44.32 | 0 | 0.00 | 0 | 0.00 | 50 | 5.68 |
| A22L | 191.7 | 880 | 880 | 880 | 390 | 44.32 | 0 | 0.00 | 0 | 0.00 | 50 | 5.68 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 361 | 41.02 | 80 | 9.09 | 60 | 6.82 | 0 | 0.00 |
| D26A IGxDR | 80.4 | 880 | 880 | 880 | 353 | 40.11 | 75 | 8.52 | 25 | 2.84 | 0 | 0.00 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 58 | 6.59 | 272 | 30.91 | 192 | 21.82 | 355 | 40.34 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 62 | 7.05 | 260 | 29.55 | 176 | 20.00 | 355 | 40.34 |
| F25A | 141.6 | 880 | 880 | 880 | 282 | 32.05 | 108 | 12.27 | 92 | 10.45 | 0 | 0.00 |

**Table 59: Thermal Loading for Test Case 4 – Dinorwic Junction with All Elements in-service – Single-Circuit Contingency**

| Circuit Name | Length (KM) | CONT Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of A21L | | Loss of D26A | | Loss of F25A | | Loss of K23D | | Loss of 1 Manitou Falls Unit | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | % LTE | (A) | (A) | (A) | (A) |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 226 | 51.36 | 344 | 78.18 | 248 | 56.36 | 224 | 50.91 | 229 | 52.05 | 228 | 51.82 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 184 | 42.79 | 300 | 69.77 | 205 | 47.67 | 182 | 42.33 | 187 | 43.49 | 186 | 43.26 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 182 | 38.72 | 299 | 63.62 | 204 | 43.40 | 180 | 38.30 | 185 | 39.36 | 185 | 39.36 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 177 | 37.66 | 293 | 62.34 | 198 | 42.13 | 174 | 37.02 | 180 | 38.30 | 179 | 38.09 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 173 | 37.61 | 290 | 63.04 | 195 | 42.39 | 172 | 37.39 | 176 | 38.26 | 176 | 38.26 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 173 | 40.23 | 290 | 67.44 | 195 | 45.35 | 172 | 40.00 | 176 | 40.93 | 176 | 40.93 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 167 | 26.94 | 281 | 37.97 | 189 | 25.54 | 166 | 22.43 | 170 | 22.97 | 169 | 22.84 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 167 | 26.94 | 281 | 37.97 | 189 | 25.54 | 166 | 22.43 | 170 | 22.97 | 169 | 22.84 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 352 | 64.00 | 352 | 64.00 | 590 | 107.27 | 444 | 80.73 | 362 | 65.82 | 359 | 65.27 |
| M2D IGxDN | 40.4 | 420 | 420 | 420 | 331 | 78.81 | 331 | 78.81 | 557 | 132.62 | 419 | 99.76 | 340 | 80.95 | 337 | 80.24 |
| M2D DNxDR | 40 | 420 | 420 | 420 | 173 | 41.19 | 173 | 41.19 | 297 | 70.71 | 200 | 47.62 | 183 | 43.57 | 173 | 41.19 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 29 | 9.06 | 29 | 7.25 | 67 | 16.75 | 42 | 10.50 | 24 | 6.00 | 30 | 7.50 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 25 | 5.00 | 25 | 5.00 | 63 | 12.60 | 38 | 7.60 | 20 | 4.00 | 26 | 5.20 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 24 | 4.80 | 25 | 5.00 | 64 | 12.80 | 39 | 7.80 | 19 | 3.80 | 26 | 5.20 |
| E4D DRxSL | 68.2 | 470 | 470 | 665 | 369 | 78.51 | 369 | 78.51 | 366 | 77.87 | 369 | 78.51 | 362 | 77.02 | 394 | 83.83 |
| E4D SLxEF | 30.2 | 470 | 470 | 665 | 359 | 76.38 | 359 | 76.38 | 356 | 75.74 | 358 | 76.17 | 352 | 74.89 | 383 | 81.49 |
| E4D#2 DRxEF | 98.4 | 470 | 470 | 470 | 368 | 78.30 | 368 | 78.30 | 365 | 77.66 | 368 | 78.30 | 361 | 76.81 | 393 | 83.62 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 298 | 70.95 | 297 | 70.71 | 298 | 70.95 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 312 | 74.29 | 312 | 74.29 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 75 | 15.96 | 86 | 18.30 | 167 | 35.53 | 10 | 2.13 | 112 | 23.83 | 83 | 17.66 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 82 | 17.45 | 92 | 19.57 | 173 | 36.81 | 5 | 1.06 | 119 | 25.32 | 90 | 19.15 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 91 | 19.36 | 100 | 21.28 | 181 | 38.51 | 22 | 4.68 | 128 | 27.23 | 98 | 20.85 |
| A21L | 191.7 | 880 | 880 | 880 | 393 | 44.66 | 0 | 0.00 | 367 | 41.70 | 357 | 40.57 | 397 | 45.11 | 397 | 45.11 |
| A22L | 191.7 | 880 | 880 | 880 | 393 | 44.66 | 670 | 76.14 | 367 | 41.70 | 357 | 40.57 | 397 | 45.11 | 397 | 45.11 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 391 | 44.43 | 352 | 40.00 | 0 | 0.00 | 583 | 66.25 | 420 | 47.73 | 398 | 45.23 |
| D26A IGxDR | 80.4 | 880 | 880 | 880 | 377 | 42.84 | 338 | 38.41 | 0 | 0.00 | 573 | 65.11 | 407 | 46.25 | 384 | 43.64 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 65 | 7.39 | 93 | 10.57 | 306 | 34.77 | 126 | 14.32 | 0 | 0.00 | 75 | 8.52 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 51 | 5.80 | 82 | 9.32 | 297 | 33.75 | 129 | 14.66 | 0 | 0.00 | 62 | 7.05 |
| F25A | 141.6 | 880 | 880 | 880 | 303 | 34.43 | 254 | 28.86 | 535 | 60.80 | 0 | 0.00 | 277 | 31.48 | 300 | 34.09 |

**Table 60: Thermal Loading for Test Case 4 – Dinorwic Junction with All Elements in-service – Double-Circuit Contingency**

| Circuit Name | Length (KM) | Cont Rating | LTE Rating | STE Rating | Pre-Cont | | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | Loss of D26A + F25A and Cross-Trip M2D | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (A) | (A) | (A) | (A) | % Cont | (A) | % LTE | (A) | % LTE | (A) | (A) |
| B6M BIxMU | 14.5 | 440 | 440 | 450 | 226 | 51.36 | 56 | 12.73 | 56 | 12.73 | 18 | 4.09 |
| B6M MUxST | 7.9 | 430 | 430 | 430 | 184 | 42.79 | 37 | 8.60 | 37 | 8.60 | 33 | 7.67 |
| B6M STxSH | 33.5 | 470 | 470 | 470 | 182 | 38.72 | 29 | 6.17 | 29 | 6.17 | 32 | 6.81 |
| B6M SHxIN | 18.5 | 470 | 470 | 470 | 177 | 37.66 | 31 | 6.60 | 31 | 6.60 | 39 | 8.30 |
| B6M INxKA | 32.5 | 460 | 460 | 460 | 173 | 37.61 | 19 | 4.13 | 19 | 4.13 | 40 | 8.70 |
| B6M KAxSA | 58.9 | 430 | 430 | 430 | 173 | 40.23 | 19 | 4.42 | 19 | 4.42 | 40 | 9.30 |
| B6M SAxCA | 22.6 | 620 | 740 | 770 | 167 | 26.94 | 0 | 0.00 | 0 | 0.00 | 49 | 6.62 |
| B6M CAxML | 0.5 | 620 | 740 | 770 | 167 | 26.94 | 0 | 0.00 | 0 | 0.00 | 50 | 6.76 |
| M2D MLxIG | 76.7 | 550 | 550 | 550 | 352 | 64.00 | 99 | 18.00 | 127 | 23.09 | 0 | 0.00 |
| M2D IGxDN | 40.4 | 420 | 420 | 420 | 331 | 78.81 | 73 | 17.38 | 117 | 27.86 | 0 | 0.00 |
| M2D DNxDR | 40 | 420 | 420 | 420 | 173 | 41.19 | 73 | 17.38 | 282 | 67.14 | 0 | 0.00 |
| 29M1 IGxIG | 1.1 | 320 | 400 | 460 | 29 | 9.06 | 21 | 5.25 | 20 | 5.00 | 0 | 0.00 |
| 29M1 IGxCL | 18 | 500 | 500 | 500 | 25 | 5.00 | 17 | 3.40 | 17 | 3.40 | 0 | 0.00 |
| 29M1 CLxVA | 51 | 500 | 500 | 500 | 24 | 4.80 | 16 | 3.20 | 15 | 3.00 | 0 | 0.00 |
| E4D DRxSL | 68.2 | 470 | 470 | 665 | 369 | 78.51 | 368 | 78.30 | 52 | 11.06 | 363 | 77.23 |
| E4D SLxEF | 30.2 | 470 | 470 | 665 | 359 | 76.38 | 358 | 76.17 | 30 | 6.38 | 353 | 75.11 |
| E4D#2 DRxEF | 98.4 | 470 | 470 | 470 | 368 | 78.30 | 367 | 78.09 | 52 | 11.06 | 362 | 77.02 |
| E2R#2 EFxRL | 66.5 | 420 | 420 | 420 | 298 | 70.95 | 298 | 70.95 | 0 | 0.00 | 298 | 70.95 |
| E2R EFxPA | 25.9 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 6 | 1.43 | 313 | 74.52 |
| E2R PAxHC | 36.1 | 420 | 420 | 420 | 313 | 74.52 | 313 | 74.52 | 0 | 0.00 | 313 | 74.52 |
| E2R HCxRL | 4.511 | 420 | 420 | 420 | 96 | 22.86 | 96 | 22.86 | 0 | 0.00 | 96 | 22.86 |
| K3D DRxET | 12 | 470 | 470 | 470 | 75 | 15.96 | 133 | 28.30 | 73 | 15.53 | 178 | 37.87 |
| K3D ETxVB | 27.9 | 470 | 470 | 470 | 82 | 17.45 | 139 | 29.57 | 79 | 16.81 | 185 | 39.36 |
| K3D VBxRL | 81.7 | 470 | 470 | 470 | 91 | 19.36 | 147 | 31.28 | 88 | 18.72 | 193 | 41.06 |
| A21L | 191.7 | 880 | 880 | 880 | 393 | 44.66 | 0 | 0.00 | 0 | 0.00 | 54 | 6.14 |
| A22L | 191.7 | 880 | 880 | 880 | 393 | 44.66 | 0 | 0.00 | 0 | 0.00 | 54 | 6.14 |
| D26A MAxIG | 93.4 | 880 | 880 | 880 | 391 | 44.43 | 86 | 9.77 | 48 | 5.45 | 0 | 0.00 |
| D26A IGxDR | 80.4 | 880 | 880 | 880 | 377 | 42.84 | 69 | 7.84 | 43 | 4.89 | 0 | 0.00 |
| K23D KExVE | 53.2 | 880 | 880 | 880 | 65 | 7.39 | 272 | 30.91 | 179 | 20.34 | 371 | 42.16 |
| K23D VExDR | 58.6 | 880 | 880 | 880 | 51 | 5.80 | 260 | 29.55 | 169 | 19.20 | 355 | 40.34 |
| F25A | 141.6 | 880 | 880 | 880 | 303 | 34.43 | 103 | 11.70 | 79 | 8.98 | 0 | 0.00 |

# Appendix E: 115 kV Test Cases – Voltage Assessment Results

**Table 61: HV Voltage Assessment for Test Case 3 – Valora Junction with All Element in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 242.8 | 243.2 | 0.16 | 243.3 | 0.21 | 236.1 | -2.76 | 235.1 | -3.17 | 239.3 | -1.44 | 238.9 | -1.61 | 241.4 | -0.58 | 241.6 | -0.49 | 242.6 | -0.08 | 242.2 | -0.25 |
| Dryden 230 kV | 242.2 | 242.6 | 0.17 | 242.8 | 0.25 | 233.3 | -3.67 | 227.7 | -5.99 | 238.3 | -1.61 | 236.2 | -2.48 | 239.3 | -1.20 | 235.8 | -2.64 | 241.8 | -0.17 | 240.6 | -0.66 |
| Fort Frances 230 kV | 242.2 | 242.6 | 0.17 | 242.8 | 0.25 | 233.3 | -3.67 | 227.7 | -5.99 | 238.3 | -1.61 | 236.2 | -2.48 | 239.3 | -1.20 | 235.8 | -2.64 | 241.8 | -0.17 | 240.6 | -0.66 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 247.2 | 244.2 | -1.21 | 244.4 | -1.13 | 247.8 | 0.24 | 247.7 | 0.20 | 248.2 | 0.40 | 248.1 | 0.36 | 247 | -0.08 | 247.1 | -0.04 | 247.1 | -0.04 | 247.1 | -0.04 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 123.5 | 0.00 | 123.7 | 0.16 | 118.8 | -3.81 | 123.5 | 0.00 | 121.9 | -1.30 | 123.6 | 0.08 | 122.3 | -0.97 | 123.4 | -0.08 | 123.3 | -0.16 | 124 | 0.40 |
| Fort Frances 115 kV | 118.3 | 118.4 | 0.08 | 118.5 | 0.17 | 115.6 | -2.28 | 118.4 | 0.08 | 115.1 | -2.70 | 117.8 | -0.42 | 118.1 | -0.17 | 118.2 | -0.08 | 118.3 | 0.00 | 118.2 | -0.08 |
| Mackenzie 115 kV | 122.3 | 121.4 | -0.74 | 122.8 | 0.41 | 121.2 | -0.90 | 122.9 | 0.49 | 122.1 | -0.16 | 122.2 | -0.08 | 122.1 | -0.16 | 122.2 | -0.08 | 122.2 | -0.08 | 122.3 | 0.00 |
| Moose Lake 115 kV | 121.7 | 120.6 | -0.90 | 121.8 | 0.08 | 119.8 | -1.56 | 121.4 | -0.25 | 121.2 | -0.41 | 121.4 | -0.25 | 121.5 | -0.16 | 121.6 | -0.08 | 121.6 | -0.08 | 121.7 | 0.00 |
| Birch 115 kV | 123.1 | 121.3 | -1.46 | 121.5 | -1.30 | 123.2 | 0.08 | 123.3 | 0.16 | 123.5 | 0.32 | 123.5 | 0.32 | 122.9 | -0.16 | 123 | -0.08 | 123 | -0.08 | 123 | -0.08 |
| Valora Jct 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Esker 115 kV | 118.6 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Musslewhite 115 kV | 118.5 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| King Fisher 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Neskatanga 115 kV | 123.3 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 |
| Wunnumin 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Wapekeka 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 |
| North Caribou Lake 115 kV | 128.4 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 |
| Muskrat Dam 115 kV | 128.1 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 |
| Crow River 115 kV | 119.8 | 119.9 | 0.08 | 119.9 | 0.08 | 116.7 | -2.59 | 119.9 | 0.08 | 119.7 | -0.08 | 119.9 | 0.08 | 119.9 | 0.08 | 120 | 0.17 | 119.9 | 0.08 | 120 | 0.17 |
| Thierry Mine 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 117 | -2.58 | 120.2 | 0.08 | 120 | -0.08 | 120.2 | 0.08 | 120.1 | 0.00 | 120.2 | 0.08 | 120.1 | 0.00 | 120.3 | 0.17 |
| Cat Lake 115 kV | 121.9 | 121.9 | 0.00 | 121.9 | 0.00 | 118.9 | -2.46 | 122 | 0.08 | 121.8 | -0.08 | 122 | 0.08 | 121.9 | 0.00 | 122 | 0.08 | 121.9 | 0.00 | 122 | 0.08 |
| Slate Falls 115 kV | 123.3 | 123.4 | 0.08 | 123.4 | 0.08 | 120.4 | -2.35 | 123.4 | 0.08 | 123.3 | 0.00 | 123.4 | 0.08 | 123.4 | 0.08 | 123.4 | 0.08 | 123.4 | 0.08 | 123.4 | 0.08 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 122.8 | -2.07 | 125.5 | 0.08 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.5 | 0.08 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 123.3 | 123.3 | 0.00 | 123.5 | 0.16 | 118.6 | -3.81 | 123.3 | 0.00 | 121.7 | -1.30 | 123.4 | 0.08 | 122.1 | -0.97 | 123.2 | -0.08 | 123.1 | -0.16 | 123.8 | 0.41 |
| Perrault Falls 115 kV | 124.3 | 124.3 | 0.00 | 124.3 | 0.00 | 120.9 | -2.74 | 124.3 | 0.00 | 123.7 | -0.48 | 124.3 | 0.00 | 123.9 | -0.32 | 124.3 | 0.00 | 124.1 | -0.16 | 124.4 | 0.08 |
| Sam Lake 115 kV | 121.9 | 122 | 0.08 | 122.1 | 0.16 | 117.1 | -3.94 | 121.9 | 0.00 | 120.3 | -1.31 | 122.1 | 0.16 | 120.7 | -0.98 | 121.9 | 0.00 | 121.7 | -0.16 | 122.5 | 0.49 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 117.2 | -2.33 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |

**Table 61: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Single Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 117.7 | -2.32 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 118.1 | -2.15 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.8 | 0.08 | 120.7 | 0.00 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 118 | -1.99 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 117.7 | -1.92 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Vermillion Bay DS 115 kV | 123.6 | 123.7 | 0.08 | 123.8 | 0.16 | 119 | -3.72 | 123.3 | -0.24 | 122 | -1.29 | 123.7 | 0.08 | 122.5 | -0.89 | 123.4 | -0.16 | 123.4 | -0.16 | 123.9 | 0.24 |
| Agimak DS 115 kV | 119.8 | 119.5 | -0.25 | 119.9 | 0.08 | 116.8 | -2.50 | 118.4 | -1.17 | 118.9 | -0.75 | 119.3 | -0.42 | 119.4 | -0.33 | 119.7 | -0.08 | 119.7 | -0.08 | 119.9 | 0.08 |
| Mattabi CTS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Valora DS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Murillo DS 115 kV | 122.4 | 120.2 | -1.80 | 120.5 | -1.55 | 122.4 | 0.00 | 122.5 | 0.08 | 122.8 | 0.33 | 122.8 | 0.33 | 122.3 | -0.08 | 122.3 | -0.08 | 122.3 | -0.08 | 122.4 | 0.00 |
| Shabaqua DS 115 kV | 122 | 119.1 | -2.38 | 119.6 | -1.97 | 121.4 | -0.49 | 121.9 | -0.08 | 122.3 | 0.25 | 122.3 | 0.25 | 121.9 | -0.08 | 121.9 | -0.08 | 121.9 | -0.08 | 122 | 0.00 |
| Sapawe DS 115 kV | 121.7 | 119.8 | -1.56 | 120.9 | -0.66 | 120 | -1.40 | 121.4 | -0.25 | 121.4 | -0.25 | 121.5 | -0.16 | 121.5 | -0.16 | 121.6 | -0.08 | 121.6 | -0.08 | 121.7 | 0.00 |
| West Coast 115 kV | 118.2 | 118.3 | 0.08 | 118.4 | 0.17 | 115.5 | -2.28 | 118.2 | 0.00 | 115 | -2.71 | 117.7 | -0.42 | 118 | -0.17 | 118.1 | -0.08 | 118.1 | -0.08 | 118.1 | -0.08 |
| Fort Frances MS 115 kV | 118.3 | 118.4 | 0.08 | 118.5 | 0.17 | 115.6 | -2.28 | 118.4 | 0.08 | 115.1 | -2.70 | 117.8 | -0.42 | 118.1 | -0.17 | 118.2 | -0.08 | 118.3 | 0.00 | 118.2 | -0.08 |
| Burleigh DS 115 kV | 118.3 | 118.4 | 0.08 | 118.5 | 0.17 | 115.6 | -2.28 | 118.3 | 0.00 | 115.1 | -2.70 | 117.8 | -0.42 | 118.1 | -0.17 | 118.2 | -0.08 | 118.2 | -0.08 | 118.2 | -0.08 |

**Table 62: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 242.8 | 242.4 | -0.16 | 243 | 0.08 | 244.4 | 0.66 | 245 | 0.91 | 231.7 | -4.57 | 238.7 | -1.69 |
| Dryden 230 kV | 242.2 | 243.9 | 0.70 | 244.3 | 0.87 | 246.6 | 1.82 | 247.7 | 2.27 | 228.3 | -5.74 | 233.9 | -3.43 |
| Fort Frances 230 kV | 242.2 | 243.9 | 0.70 | 244.3 | 0.87 | 246.6 | 1.82 | 247.7 | 2.27 | 228.3 | -5.74 | 233.9 | -3.43 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 251.4 | 2.61 | 252.1 | 2.90 |
| Lakehead 230 kV | 247.2 | 247.4 | 0.08 | 247.5 | 0.12 | 247.4 | 0.08 | 247.5 | 0.12 | 251.3 | 1.66 | 251.3 | 1.66 |
| Pickle Lake 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 124.2 | 0.57 | 124.3 | 0.65 | 125.2 | 1.38 | 124.3 | 0.65 | 116.7 | -5.51 | 124.1 | 0.49 |
| Fort Frances 115 kV | 118.3 | 116.1 | -1.86 | 119.1 | 0.68 | 117.2 | -0.93 | 118.3 | 0.00 | 112.1 | -5.24 | 119.6 | 1.10 |
| Mackenzie 115 kV | 122.3 | 123.1 | 0.65 | 123.1 | 0.65 | 123 | 0.57 | 122.9 | 0.49 | 125.6 | 2.70 | 122.6 | 0.25 |
| Moose Lake 115 kV | 121.7 | 123.3 | 1.31 | 123.4 | 1.40 | 122.8 | 0.90 | 122.7 | 0.82 | 125.6 | 3.20 | 122.7 | 0.82 |
| Birch 115 kV | 123.1 | 121.8 | -1.06 | 121.9 | -0.97 | 121.8 | -1.06 | 121.9 | -0.97 | 123.6 | 0.41 | 123.4 | 0.24 |
| Valora Jct 115 kV | 120 | 125.2 | 4.33 | 125.3 | 4.42 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A |
| Esker 115 kV | 118.6 | 0 | N/A | 0 | N/A | 118.6 | 0.00 | 118.6 | 0.00 | 0 | N/A | 0 | N/A |
| Musslewhite 115 kV | 118.5 | 0 | N/A | 0 | N/A | 118.5 | 0.00 | 118.5 | 0.00 | 0 | N/A | 0 | N/A |
| King Fisher 115 kV | 127.9 | 0 | N/A | 0 | N/A | 127.9 | 0.00 | 127.9 | 0.00 | 0 | N/A | 0 | N/A |
| Neskatanga 115 kV | 123.3 | 0 | N/A | 0 | N/A | 123.3 | 0.00 | 123.3 | 0.00 | 0 | N/A | 0 | N/A |
| Wunnumin 115 kV | 128.9 | 0 | N/A | 0 | N/A | 128.9 | 0.00 | 128.9 | 0.00 | 0 | N/A | 0 | N/A |
| Nibinamik 115 kV | 130 | 0 | N/A | 0 | N/A | 130 | 0.00 | 130 | 0.00 | 0 | N/A | 0 | N/A |
| Kingfisher Lake 115 kV | 127.9 | 0 | N/A | 0 | N/A | 127.9 | 0.00 | 127.9 | 0.00 | 0 | N/A | 0 | N/A |
| Wapekeka 115 kV | 127.2 | 0 | N/A | 0 | N/A | 127.2 | 0.00 | 127.2 | 0.00 | 0 | N/A | 0 | N/A |
| North Caribou Lake 115 kV | 128.4 | 0 | N/A | 0 | N/A | 128.4 | 0.00 | 128.4 | 0.00 | 0 | N/A | 0 | N/A |
| Muskrat Dam 115 kV | 128.1 | 0 | N/A | 0 | N/A | 128.1 | 0.00 | 128.1 | 0.00 | 0 | N/A | 0 | N/A |
| Crow River 115 kV | 119.8 | 119.9 | 0.08 | 119.9 | 0.08 | 120 | 0.17 | 120 | 0.17 | 113.8 | -5.01 | 119.9 | 0.08 |
| Thierry Mine 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 120.2 | 0.08 | 120.2 | 0.08 | 114.1 | -5.00 | 120.1 | 0.00 |
| Cat Lake 115 kV | 121.9 | 121.9 | 0.00 | 121.9 | 0.00 | 122.5 | 0.49 | 122.3 | 0.33 | 116.1 | -4.76 | 121.9 | 0.00 |
| Slate Falls 115 kV | 123.3 | 123.4 | 0.08 | 123.4 | 0.08 | 124.2 | 0.73 | 123.9 | 0.49 | 117.8 | -4.46 | 123.4 | 0.08 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 126.9 | 1.20 | 126.2 | 0.64 | 120.6 | -3.83 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 123.3 | 124 | 0.57 | 124.1 | 0.65 | 125 | 1.38 | 124.1 | 0.65 | 116.5 | -5.52 | 123.9 | 0.49 |
| Perrault Falls 115 kV | 124.3 | 124.5 | 0.16 | 124.6 | 0.24 | 126.5 | 1.77 | 125.8 | 1.21 | 118.7 | -4.51 | 124.5 | 0.16 |
| Sam Lake 115 kV | 121.9 | 122.6 | 0.57 | 122.8 | 0.74 | 123.7 | 1.48 | 122.7 | 0.66 | 114.9 | -5.74 | 122.6 | 0.57 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 114.7 | -4.42 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 0 | N/A | 0 | N/A | 115.2 | -4.40 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 120.7 | 0.00 | 120.7 | 0.00 | 0 | N/A | 0 | N/A | 115.4 | -4.39 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 0 | N/A | 0 | N/A | 115.2 | -4.32 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 114.9 | -4.25 | 120 | 0.00 |

**Table 62: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Double Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 123.6 | 123.9 | 0.24 | 124.2 | 0.49 | 125 | 1.13 | 124.4 | 0.65 | 116.8 | -5.50 | 124.1 | 0.40 |
| Agimak DS 115 kV | 119.8 | 124.9 | 4.26 | 125 | 4.34 | 121 | 1.00 | 120.7 | 0.75 | 0 | N/A | 0 | N/A |
| Mattabi CTS 115 kV | 120 | 125.2 | 4.33 | 125.3 | 4.42 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A |
| Valora DS 115 kV | 120 | 125.2 | 4.33 | 125.3 | 4.42 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A |
| Murillo DS 115 kV | 122.4 | 121.7 | -0.57 | 121.9 | -0.41 | 121.7 | -0.57 | 121.9 | -0.41 | 123.5 | 0.90 | 123.1 | 0.57 |
| Shabaqua DS 115 kV | 122 | 122.8 | 0.66 | 123 | 0.82 | 122.8 | 0.66 | 123 | 0.82 | 124.4 | 1.97 | 123.4 | 1.15 |
| Sapawe DS 115 kV | 121.7 | 124.5 | 2.30 | 124.6 | 2.38 | 124.5 | 2.30 | 124.6 | 2.38 | 125.6 | 3.20 | 123.1 | 1.15 |
| West Coast 115 kV | 118.2 | 116 | -1.86 | 118.9 | 0.59 | 117 | -1.02 | 118.2 | 0.00 | 112 | -5.25 | 119.4 | 1.02 |
| Fort Frances MS 115 kV | 118.3 | 116.1 | -1.86 | 119.1 | 0.68 | 117.2 | -0.93 | 118.3 | 0.00 | 112.1 | -5.24 | 119.6 | 1.10 |
| Burleigh DS 115 kV | 118.3 | 116.1 | -1.86 | 119 | 0.59 | 117.1 | -1.01 | 118.3 | 0.00 | 112.1 | -5.24 | 119.5 | 1.01 |

**Table 63: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of 1 Pickle Lake SVC | | | | Loss of Mackenzie SVC | | | | Loss of 1 Valora SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 242.8 | 241.1 | -0.70 | 241.1 | -0.70 | 242.8 | 0.00 | 242.8 | 0.00 | 242.1 | -0.29 | 241.5 | -0.54 | 242.8 | 0.00 | 242.8 | 0.00 |
| Dryden 230 kV | 242.2 | 238.9 | -1.36 | 237.8 | -1.82 | 242.2 | 0.00 | 242.2 | 0.00 | 241.2 | -0.41 | 239.9 | -0.95 | 242.2 | 0.00 | 242.2 | 0.00 |
| Fort Frances 230 kV | 242.2 | 238.9 | -1.36 | 237.8 | -1.82 | 242.2 | 0.00 | 242.2 | 0.00 | 241.2 | -0.41 | 239.9 | -0.95 | 242.2 | 0.00 | 242.2 | 0.00 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 243.1 | -0.78 | 242.3 | -1.10 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 247.2 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 246.5 | -0.28 | 246.4 | -0.32 | 247.2 | 0.00 | 247.2 | 0.00 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 121 | -2.02 | 123.5 | 0.00 | 123.5 | 0.00 | 123.5 | 0.00 | 123 | -0.40 | 123.8 | 0.24 | 123.5 | 0.00 | 123.5 | 0.00 |
| Fort Frances 115 kV | 118.3 | 117.9 | -0.34 | 118.2 | -0.08 | 118.3 | 0.00 | 118.3 | 0.00 | 117.8 | -0.42 | 117.8 | -0.42 | 118.3 | 0.00 | 118.3 | 0.00 |
| Mackenzie 115 kV | 122.3 | 122.1 | -0.16 | 122.3 | 0.00 | 122.3 | 0.00 | 122.3 | 0.00 | 121.5 | -0.65 | 122.6 | 0.25 | 122.3 | 0.00 | 122.3 | 0.00 |
| Moose Lake 115 kV | 121.7 | 121.4 | -0.25 | 121.7 | 0.00 | 121.7 | 0.00 | 121.7 | 0.00 | 121 | -0.58 | 122 | 0.25 | 121.7 | 0.00 | 121.7 | 0.00 |
| Birch 115 kV | 123.1 | 123 | -0.08 | 123.1 | 0.00 | 123.1 | 0.00 | 123.1 | 0.00 | 122.7 | -0.32 | 122.8 | -0.24 | 123.1 | 0.00 | 123.1 | 0.00 |
| Valora Jct 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Esker 115 kV | 118.6 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Musslewhite 115 kV | 118.5 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| King Fisher 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Neskatanga 115 kV | 123.3 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 |
| Wunnumin 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Wapekeka 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 |
| North Caribou Lake 115 kV | 128.4 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 |
| Muskrat Dam 115 kV | 128.1 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 |
| Crow River 115 kV | 119.8 | 111 | -7.35 | 114.3 | -4.59 | 119.8 | 0.00 | 119.8 | 0.00 | 119.7 | -0.08 | 119.9 | 0.08 | 119.8 | 0.00 | 119.8 | 0.00 |
| Thierry Mine 115 kV | 120.1 | 111.3 | -7.33 | 114.5 | -4.66 | 120.1 | 0.00 | 120.1 | 0.00 | 120 | -0.08 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 |
| Cat Lake 115 kV | 121.9 | 113.4 | -6.97 | 116.5 | -4.43 | 121.9 | 0.00 | 121.9 | 0.00 | 121.8 | -0.08 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 |
| Slate Falls 115 kV | 123.3 | 115.2 | -6.57 | 118.2 | -4.14 | 123.3 | 0.00 | 123.3 | 0.00 | 123.2 | -0.08 | 123.4 | 0.08 | 123.3 | 0.00 | 123.3 | 0.00 |
| Ear Falls 115 kV | 125.4 | 118.4 | -5.58 | 121 | -3.51 | 125.4 | 0.00 | 125.4 | 0.00 | 125.3 | -0.08 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 123.3 | 120.7 | -2.11 | 123.2 | -0.08 | 123.3 | 0.00 | 123.3 | 0.00 | 122.8 | -0.41 | 123.6 | 0.24 | 123.3 | 0.00 | 123.3 | 0.00 |
| Perrault Falls 115 kV | 124.3 | 118.6 | -4.59 | 121.2 | -2.49 | 124.3 | 0.00 | 124.3 | 0.00 | 124.1 | -0.16 | 124.4 | 0.08 | 124.3 | 0.00 | 124.3 | 0.00 |
| Sam Lake 115 kV | 121.9 | 119.3 | -2.13 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.5 | -0.33 | 122.2 | 0.25 | 121.9 | 0.00 | 121.9 | 0.00 |
| Balmer 115 kV | 120 | 112.1 | -6.58 | 115.1 | -4.08 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 112.7 | -6.47 | 115.7 | -3.98 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.7 | 112.7 | -6.63 | 115.8 | -4.06 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 | 120.7 | 0.00 |
| Deer Lake 115 kV | 120.4 | 112.3 | -6.73 | 115.7 | -3.90 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 112 | -6.67 | 115.3 | -3.92 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |

**Table 63: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of 1 Pickle Lake SVC | | | | Loss of Mackenzie SVC | | | | Loss of 1 Valora SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 123.6 | 121.6 | -1.62 | 123.4 | -0.16 | 123.6 | 0.00 | 123.6 | 0.00 | 123.2 | -0.32 | 123.7 | 0.08 | 123.6 | 0.00 | 123.6 | 0.00 |
| Agimak DS 115 kV | 119.8 | 119.1 | -0.58 | 119.8 | 0.00 | 119.8 | 0.00 | 119.8 | 0.00 | 119.5 | -0.25 | 120 | 0.17 | 119.8 | 0.00 | 119.8 | 0.00 |
| Mattabi CTS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Valora DS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Murillo DS 115 kV | 122.4 | 122.4 | 0.00 | 122.4 | 0.00 | 122.4 | 0.00 | 122.4 | 0.00 | 122 | -0.33 | 122.2 | -0.16 | 122.4 | 0.00 | 122.4 | 0.00 |
| Shabaqua DS 115 kV | 122 | 121.9 | -0.08 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 121.6 | -0.33 | 121.9 | -0.08 | 122 | 0.00 | 122 | 0.00 |
| Sapawe DS 115 kV | 121.7 | 121.5 | -0.16 | 121.7 | 0.00 | 121.7 | 0.00 | 121.7 | 0.00 | 121.1 | -0.49 | 121.9 | 0.16 | 121.7 | 0.00 | 121.7 | 0.00 |
| West Coast 115 kV | 118.2 | 117.8 | -0.34 | 118 | -0.17 | 118.2 | 0.00 | 118.2 | 0.00 | 117.7 | -0.42 | 117.6 | -0.51 | 118.2 | 0.00 | 118.2 | 0.00 |
| Fort Frances MS 115 kV | 118.3 | 117.9 | -0.34 | 118.2 | -0.08 | 118.3 | 0.00 | 118.3 | 0.00 | 117.8 | -0.42 | 117.7 | -0.51 | 118.3 | 0.00 | 118.3 | 0.00 |
| Burleigh DS 115 kV | 118.3 | 117.9 | -0.34 | 118.1 | -0.17 | 118.3 | 0.00 | 118.3 | 0.00 | 117.8 | -0.42 | 117.7 | -0.51 | 118.3 | 0.00 | 118.3 | 0.00 |

**Table 64: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 241.9 | 244.5 | 1.07 | 245 | 1.28 | 242 | 0.04 | 242 | 0.04 | 241.9 | 0.00 | 241.9 | 0.00 |
| Dryden 230 kV | 242 | 246.1 | 1.69 | 247.6 | 2.31 | 242.1 | 0.04 | 242.1 | 0.04 | 242 | 0.00 | 242 | 0.00 |
| Fort Frances 230 kV | 242 | 246.1 | 1.69 | 247.6 | 2.31 | 242.1 | 0.04 | 242.1 | 0.04 | 242 | 0.00 | 242 | 0.00 |
| Mackenzie 230 kV | 238.3 | 244.9 | 2.77 | 245.9 | 3.19 | 238.3 | 0.00 | 238.3 | 0.00 | 238.3 | 0.00 | 238.3 | 0.00 |
| Lakehead 230 kV | 236.4 | 238.7 | 0.97 | 238.8 | 1.02 | 236.5 | 0.04 | 236.5 | 0.04 | 236.4 | 0.00 | 236.4 | 0.00 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120.6 | 0.50 | 120.6 | 0.50 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 124.9 | 126.9 | 1.60 | 124.5 | -0.32 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 |
| Fort Frances 115 kV | 118.6 | 120.3 | 1.43 | 120.5 | 1.60 | 118.6 | 0.00 | 118.7 | 0.08 | 118.6 | 0.00 | 118.6 | 0.00 |
| Mackenzie 115 kV | 123.2 | 126.3 | 2.52 | 123.4 | 0.16 | 123.3 | 0.08 | 123.3 | 0.08 | 123.2 | 0.00 | 123.2 | 0.00 |
| Moose Lake 115 kV | 123.2 | 126.1 | 2.35 | 123.4 | 0.16 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 |
| Birch 115 kV | 121.9 | 123.1 | 0.98 | 123 | 0.90 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 |
| Valora Jct 115 kV | 120.5 | 122.6 | 1.74 | 120.5 | 0.00 | 120.8 | 0.25 | 120.8 | 0.25 | 120.5 | 0.00 | 120.5 | 0.00 |
| Esker 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 126.9 | 0.08 | 126.9 | 0.08 | 126.8 | 0.00 | 126.8 | 0.00 |
| Neskatanga 115 kV | 124.4 | 124.4 | 0.00 | 124.4 | 0.00 | 124.8 | 0.32 | 124.8 | 0.32 | 124.4 | 0.00 | 124.4 | 0.00 |
| Wunnumin 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 128.3 | 0.08 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.3 | 0.08 | 127.3 | 0.08 | 127.2 | 0.00 | 127.2 | 0.00 |
| Wapekeka 115 kV | 127.8 | 127.8 | 0.00 | 127.8 | 0.00 | 127.9 | 0.08 | 127.9 | 0.08 | 127.8 | 0.00 | 127.8 | 0.00 |
| North Caribou Lake 115 kV | 128.6 | 128.6 | 0.00 | 128.6 | 0.00 | 128.7 | 0.08 | 128.7 | 0.08 | 128.6 | 0.00 | 128.6 | 0.00 |
| Muskrat Dam 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 129 | 0.08 | 129 | 0.08 | 128.9 | 0.00 | 128.9 | 0.00 |
| Crow River 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Thierry Mine 115 kV | 119.9 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 |
| Cat Lake 115 kV | 121.8 | 122.3 | 0.41 | 121.7 | -0.08 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 |
| Slate Falls 115 kV | 122.9 | 123.7 | 0.65 | 122.7 | -0.16 | 122.9 | 0.00 | 122.9 | 0.00 | 122.9 | 0.00 | 122.9 | 0.00 |
| Ear Falls 115 kV | 123 | 124.6 | 1.30 | 122.8 | -0.16 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 |
| Domtar Dryden 115 kV | 124.9 | 126.8 | 1.52 | 124.5 | -0.32 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 | 124.9 | 0.00 |
| Perrault Falls 115 kV | 123.5 | 125.3 | 1.46 | 123.2 | -0.24 | 123.5 | 0.00 | 123.5 | 0.00 | 123.5 | 0.00 | 123.5 | 0.00 |
| Sam Lake 115 kV | 124.3 | 126.4 | 1.69 | 124 | -0.24 | 124.4 | 0.08 | 124.4 | 0.08 | 124.3 | 0.00 | 124.3 | 0.00 |
| Balmer 115 kV | 120.2 | 122 | 1.50 | 120 | -0.17 | 120.2 | 0.00 | 120.2 | 0.00 | 120.2 | 0.00 | 120.2 | 0.00 |
| Red Lake 115 kV | 120.7 | 122.5 | 1.49 | 120.5 | -0.17 | 120.8 | 0.08 | 120.8 | 0.08 | 120.7 | 0.00 | 120.7 | 0.00 |
| Pikangikum 115 kV | 124 | 125.8 | 1.45 | 123.7 | -0.24 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 | 124 | 0.00 |
| Deer Lake 115 kV | 126.2 | 128.1 | 1.51 | 126 | -0.16 | 126.2 | 0.00 | 126.2 | 0.00 | 126.2 | 0.00 | 126.2 | 0.00 |
| Sandy Lake 115 kV | 126.3 | 128.2 | 1.50 | 126.1 | -0.16 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 | 126.3 | 0.00 |

**Table 64: HV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 125.1 | 126.8 | 1.36 | 125.1 | 0.00 | 125.1 | 0.00 | 125.1 | 0.00 | 125.1 | 0.00 | 125.1 | 0.00 |
| Agimak DS 115 kV | 122.3 | 124.6 | 1.88 | 122.2 | -0.08 | 122.4 | 0.08 | 122.4 | 0.08 | 122.3 | 0.00 | 122.3 | 0.00 |
| Mattabi CTS 115 kV | 120.6 | 122.6 | 1.66 | 120.5 | -0.08 | 120.8 | 0.17 | 120.8 | 0.17 | 120.6 | 0.00 | 120.6 | 0.00 |
| Valora DS 115 kV | 120.5 | 122.6 | 1.74 | 120.5 | 0.00 | 120.8 | 0.25 | 120.8 | 0.25 | 120.5 | 0.00 | 120.5 | 0.00 |
| Murillo DS 115 kV | 121.8 | 123.2 | 1.15 | 122.9 | 0.90 | 121.9 | 0.08 | 121.9 | 0.08 | 121.8 | 0.00 | 121.8 | 0.00 |
| Shabaqua DS 115 kV | 122.4 | 124.2 | 1.47 | 123.3 | 0.74 | 122.5 | 0.08 | 122.5 | 0.08 | 122.4 | 0.00 | 122.4 | 0.00 |
| Sapawe DS 115 kV | 123.2 | 126 | 2.27 | 123.5 | 0.24 | 123.3 | 0.08 | 123.3 | 0.08 | 123.2 | 0.00 | 123.2 | 0.00 |
| West Coast 115 kV | 118.5 | 120.2 | 1.43 | 120.5 | 1.69 | 118.6 | 0.08 | 118.6 | 0.08 | 118.5 | 0.00 | 118.5 | 0.00 |
| Fort Frances MS 115 kV | 118.6 | 120.3 | 1.43 | 120.5 | 1.60 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Burleigh DS 115 kV | 118.6 | 120.3 | 1.43 | 120.5 | 1.60 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |

**Table 65: LV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.8 | 24.3 | -2.02 | 24.8 | 0.00 | 24.8 | 0.00 | 25 | 0.81 | 24.9 | 0.40 | 24.9 | 0.40 | 24.8 | 0.00 | 24.9 | 0.40 | 24.8 | 0.00 | 24.9 | 0.40 |
| Shabaqua DS LV | 13.1 | 12.7 | -3.05 | 12.8 | -2.29 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.8 | 13.5 | -2.17 | 13.7 | -0.72 | 13.6 | -1.45 | 13.7 | -0.72 | 13.7 | -0.72 | 13.7 | -0.72 | 13.7 | -0.72 | 13.7 | -0.72 | 13.8 | 0.00 | 13.8 | 0.00 |
| Mattabi DS LV | 4.1 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 |
| Agimak DS LV | 26.4 | 26.3 | -0.38 | 26.4 | 0.00 | 25.7 | -2.65 | 26.4 | 0.00 | 26.2 | -0.76 | 26.2 | -0.76 | 26.3 | -0.38 | 26.3 | -0.38 | 26.4 | 0.00 | 26.4 | 0.00 |
| Valora DS LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Esker LV | 13.8 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Nibinamik LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| King Fisher Lake LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24.4 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.3 | -1.80 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4.4 | 0.00 | 4.4 | 0.00 | 4.3 | -2.27 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 29.2 | 0.00 | 29.2 | 0.00 | 28.7 | -1.71 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.3 | 0.34 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.7 | 23.7 | 0.00 | 23.7 | 0.00 | 23.3 | -1.69 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.8 | 0.42 | 23.7 | 0.00 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 45.3 | 0.00 | 45.3 | 0.00 | 44.7 | -1.32 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.7 | 0.00 | 13.7 | 0.00 | 13.2 | -3.65 | 13.7 | 0.00 | 13.5 | -1.46 | 13.6 | -0.73 | 13.5 | -1.46 | 13.6 | -0.73 | 13.7 | 0.00 | 13.7 | 0.00 |
| Perrault Falls LV | 11.7 | 11.7 | 0.00 | 11.7 | 0.00 | 11.4 | -2.56 | 11.7 | 0.00 | 11.6 | -0.85 | 11.7 | 0.00 | 11.6 | -0.85 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 |
| Sam Lake LV | 26.4 | 26.4 | 0.00 | 26.5 | 0.38 | 25.4 | -3.79 | 26.6 | 0.76 | 26 | -1.52 | 26.5 | 0.38 | 26.1 | -1.14 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 43.4 | -1.59 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 46.2 | -1.49 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 27.5 | -1.43 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.5 | -1.08 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.2 | 13.2 | 0.00 | 13.3 | 0.76 | 12.7 | -3.79 | 13.3 | 0.76 | 13.1 | -0.76 | 13.3 | 0.76 | 13.1 | -0.76 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 |
| Vermillion Bay DS LV | 15.2 | 15.2 | 0.00 | 15.2 | 0.00 | 14.6 | -3.95 | 15.2 | 0.00 | 15 | -1.32 | 15.1 | -0.66 | 15 | -1.32 | 15.1 | -0.66 | 15.2 | 0.00 | 15.2 | 0.00 |
| Burleigh DS LV | 13 | 13 | 0.00 | 13.1 | 0.77 | 12.7 | -2.31 | 13.1 | 0.77 | 12.6 | -3.08 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 |
| Fort Frances MS1 LV | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 13.7 | -2.84 | 14.1 | 0.00 | 13.7 | -2.84 | 14 | -0.71 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.4 | 12.4 | 0.00 | 12.5 | 0.81 | 12.1 | -2.42 | 12.5 | 0.81 | 12.1 | -2.42 | 12.5 | 0.81 | 12.4 | 0.00 | 12.4 | 0.00 | 12.4 | 0.00 | 12.4 | 0.00 |
| Fort Frances L5 | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 13.8 | -2.13 | 14.2 | 0.71 | 13.7 | -2.84 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 13.7 | -2.14 | 14 | 0.00 | 13.6 | -2.86 | 13.9 | -0.71 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.8 | 0.00 | 14.8 | 0.00 | 14.5 | -2.03 | 14.8 | 0.00 | 14.4 | -2.70 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.5 | -2.99 | 6.7 | 0.00 | 6.5 | -2.99 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 66: LV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.8 | 24.6 | -0.81 | 24.8 | 0.00 | 24.6 | -0.81 | 24.8 | 0.00 | 25 | 0.81 | 24.9 | 0.40 |
| Shabaqua DS LV | 13.1 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.2 | 0.76 | 13.3 | 1.53 | 13.2 | 0.76 |
| Sapawe DS LV | 13.8 | 14.1 | 2.17 | 14.1 | 2.17 | 14.1 | 2.17 | 14.1 | 2.17 | 14.2 | 2.90 | 13.9 | 0.72 |
| Mattabi DS LV | 4.1 | 4.3 | 4.88 | 4.3 | 4.88 | 4.1 | 0.00 | 4.1 | 0.00 | 0 | N/A | 0 | N/A |
| Agimak DS LV | 26.4 | 27.6 | 4.55 | 26.8 | 1.52 | 26.7 | 1.14 | 26.5 | 0.38 | 0 | N/A | 0 | N/A |
| Valora DS LV | 24.9 | 26.1 | 4.82 | 26 | 4.42 | 24.9 | 0.00 | 24.9 | 0.00 | 0 | N/A | 0 | N/A |
| Esker LV | 13.8 | 0 | N/A | 0 | N/A | 13.8 | 0.00 | 13.8 | 0.00 | 0 | N/A | 0 | N/A |
| Musselwhite LV | 4.2 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 0 | N/A | 0 | N/A |
| Neskatanga LV | 27.7 | 0 | N/A | 0 | N/A | 27.7 | 0.00 | 27.7 | 0.00 | 0 | N/A | 0 | N/A |
| Wunnumin LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A |
| Nibinamik LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A |
| King Fisher Lake LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A |
| Wapekeka LV | 27.8 | 0 | N/A | 0 | N/A | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A |
| North Caribou Lake LV | 24.4 | 0 | N/A | 0 | N/A | 24.4 | 0.00 | 24.4 | 0.00 | 0 | N/A | 0 | N/A |
| Muskrat LV | 28 | 0 | N/A | 0 | N/A | 28 | 0.00 | 28 | 0.00 | 0 | N/A | 0 | N/A |
| Crow River LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 26.8 | -3.60 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.2 | -4.55 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 29.2 | 0.00 | 29.2 | 0.00 | 29.4 | 0.68 | 29.3 | 0.34 | 28.2 | -3.42 | 29.4 | 0.68 |
| Slate Falls LV | 23.7 | 23.7 | 0.00 | 23.7 | 0.00 | 24 | 1.27 | 23.8 | 0.42 | 23 | -2.95 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 45.3 | 0.00 | 45.3 | 0.00 | 46.1 | 1.77 | 45.6 | 0.66 | 44.1 | -2.65 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.8 | 0.73 | 13.7 | 0.00 | 13.9 | 1.46 | 13.7 | 0.00 | 13 | -5.11 | 13.7 | 0.00 |
| Perrault Falls LV | 11.7 | 11.7 | 0.00 | 11.7 | 0.00 | 12 | 2.56 | 11.8 | 0.85 | 11.2 | -4.27 | 11.7 | 0.00 |
| Sam Lake LV | 26.4 | 26.6 | 0.76 | 26.4 | 0.00 | 26.9 | 1.89 | 26.4 | 0.00 | 25 | -5.30 | 26.7 | 1.14 |
| Balmer LV | 44.1 | 44.1 | 0.00 | 44.1 | 0.00 | 0 | N/A | 0 | N/A | 42.7 | -3.17 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 46.9 | 0.00 | 46.9 | 0.00 | 0 | N/A | 0 | N/A | 45.4 | -3.20 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 27.9 | 0.00 | 27.9 | 0.00 | 0 | N/A | 0 | N/A | 27.1 | -2.87 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 0 | N/A | 0 | N/A | 27 | -2.88 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27 | -1.82 | 27.8 | 1.09 |
| Eton DS LV | 13.2 | 13.3 | 0.76 | 13.2 | 0.00 | 13.4 | 1.52 | 13.3 | 0.76 | 12.6 | -4.55 | 13.4 | 1.52 |
| Vermillion Bay DS LV | 15.2 | 15.2 | 0.00 | 15.2 | 0.00 | 15.4 | 1.32 | 15.2 | 0.00 | 14.4 | -5.26 | 15.2 | 0.00 |
| Burleigh DS LV | 13 | 12.8 | -1.54 | 13.1 | 0.77 | 12.9 | -0.77 | 13 | 0.00 | 12.3 | -5.38 | 13.2 | 1.54 |
| Fort Frances MS1 LV | 14.1 | 13.8 | -2.13 | 14.1 | 0.00 | 13.9 | -1.42 | 14.1 | 0.00 | 13.3 | -5.67 | 14.2 | 0.71 |
| Fort Frances MS2 LV | 12.4 | 12.2 | -1.61 | 12.6 | 1.61 | 12.3 | -0.81 | 12.5 | 0.81 | 11.8 | -4.84 | 12.5 | 0.81 |
| Fort Frances L5 | 14.1 | 13.8 | -2.13 | 14.2 | 0.71 | 14 | -0.71 | 14.1 | 0.00 | 13.3 | -5.67 | 14.3 | 1.42 |
| Fort Frances L4A | 14 | 13.7 | -2.14 | 14 | 0.00 | 13.9 | -0.71 | 14 | 0.00 | 13.3 | -5.00 | 14.1 | 0.71 |
| Fort Frances L4B | 14.8 | 14.5 | -2.03 | 14.9 | 0.68 | 14.7 | -0.68 | 14.8 | 0.00 | 14.1 | -4.73 | 14.9 | 0.68 |
| Fort Frances AB | 6.7 | 6.6 | -1.49 | 6.7 | 0.00 | 6.6 | -1.49 | 6.7 | 0.00 | 6.3 | -5.97 | 6.8 | 1.49 |

**Table 67: LV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of 1 Pickle Lake SVC | | | | Loss of Mackenzie SVC | | | | Loss of 1 Valora SVC | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.8 | 24.8 | 0.00 | 24.9 | 0.40 | 24.8 | 0.00 | 24.8 | 0.00 | 24.7 | -0.40 | 24.9 | 0.40 | 24.8 | 0.00 | 24.8 | 0.00 |
| Shabaqua DS LV | 13.1 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13 | -0.76 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.8 | 13.7 | -0.72 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.7 | -0.72 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Mattabi DS LV | 4.1 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 |
| Agimak DS LV | 26.4 | 26.2 | -0.38 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.3 | 0.00 | 26.4 | 0.38 | 26.3 | 0.00 | 26.3 | 0.00 |
| Valora DS LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Esker LV | 13.8 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Nibinamik LV | 24.7 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 |
| King Fisher Lake LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Wapekeka LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| North Caribou Lake LV | 24.4 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 |
| Muskrat LV | 28 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 | 28 | 0.00 |
| Crow River LV | 27.8 | 25.7 | -7.55 | 27.5 | -1.08 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4 | -9.09 | 4.2 | -4.55 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 27.1 | -7.19 | 29.1 | -0.34 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.7 | 22.1 | -6.75 | 22.7 | -4.22 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 42.8 | -5.52 | 43.7 | -3.53 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.7 | 13.3 | -2.21 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.5 | -0.74 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 |
| Perrault Falls LV | 11.7 | 11.1 | -5.13 | 11.4 | -2.56 | 11.7 | 0.00 | 11.7 | 0.00 | 11.6 | -0.85 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 |
| Sam Lake LV | 26.4 | 25.9 | -1.89 | 26.6 | 0.76 | 26.4 | 0.00 | 26.4 | 0.00 | 26.3 | -0.38 | 26.5 | 0.38 | 26.4 | 0.00 | 26.4 | 0.00 |
| Balmer LV | 44.1 | 41.2 | -6.58 | 44 | -0.23 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 | 44.1 | 0.00 |
| Red Lake LV | 46.9 | 43.8 | -6.61 | 46.6 | -0.64 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 | 46.9 | 0.00 |
| Pikangikum LV | 27.9 | 26 | -6.81 | 27.7 | -0.72 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 | 27.9 | 0.00 |
| Deer Lake LV | 27.8 | 25.9 | -6.83 | 27.7 | -0.36 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Sandy Lake LV | 27.5 | 25.9 | -5.82 | 27.7 | 0.73 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.2 | 13 | -2.26 | 13.4 | 0.75 | 13.3 | 0.00 | 13.3 | 0.00 | 13.2 | -0.75 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 |
| Vermillion Bay DS LV | 15.2 | 14.9 | -1.32 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 |
| Burleigh DS LV | 13 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 | 13 | 0.00 |
| Fort Frances MS1 LV | 14.1 | 14 | -0.71 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14 | -0.71 | 14 | -0.71 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.4 | 12.4 | 0.00 | 12.5 | 0.81 | 12.4 | 0.00 | 12.4 | 0.00 | 12.4 | 0.00 | 12.5 | 0.81 | 12.4 | 0.00 | 12.4 | 0.00 |
| Fort Frances L5 | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 13.9 | -0.71 | 13.9 | -0.71 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.7 | -0.68 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 68: LV Voltage Assessment for Test Case 3 – Valora Junction with All Elements in-service) – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 25.1 | 25.4 | 1.20 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 |
| Shabaqua DS LV | 13.2 | 13.4 | 1.52 | 13.3 | 0.76 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 | 13.2 | 0.00 |
| Sapawe DS LV | 13.9 | 14.2 | 2.16 | 14 | 0.72 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Mattabi DS LV | 4.1 | 4.2 | 2.44 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 |
| Agimak DS LV | 26.6 | 27.1 | 1.88 | 26.2 | -1.50 | 26.6 | 0.00 | 26.6 | 0.00 | 26.6 | 0.00 | 26.6 | 0.00 |
| Valora DS LV | 25.1 | 25.5 | 1.59 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Nibinamik LV | 25.3 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 |
| King Fisher Lake LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Wapekeka LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| North Caribou Lake LV | 25.1 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 |
| Muskrat LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.6 | 0.36 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Crow River LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Thierry Mine LV | 4.3 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 |
| Cat Lake LV | 29.4 | 29.5 | 0.34 | 29.3 | -0.34 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 | 29.4 | 0.00 |
| Slate Falls LV | 24 | 24.1 | 0.42 | 23.9 | -0.42 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 | 24 | 0.00 |
| Ear Falls LV | 44.7 | 45.3 | 1.34 | 44.6 | -0.22 | 44.7 | 0.00 | 44.7 | 0.00 | 44.7 | 0.00 | 44.7 | 0.00 |
| Domtar Dryden LV | 13.9 | 14.2 | 2.16 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Perrault Falls LV | 11.8 | 11.9 | 0.85 | 11.7 | -0.85 | 11.8 | 0.00 | 11.8 | 0.00 | 11.8 | 0.00 | 11.8 | 0.00 |
| Sam Lake LV | 26.5 | 27 | 1.89 | 26.3 | -0.75 | 26.6 | 0.38 | 26.6 | 0.38 | 26.5 | 0.00 | 26.5 | 0.00 |
| Balmer LV | 43.3 | 43.9 | 1.39 | 43.2 | -0.23 | 43.3 | 0.00 | 43.3 | 0.00 | 43.3 | 0.00 | 43.3 | 0.00 |
| Red Lake LV | 46.4 | 47.1 | 1.51 | 46.4 | 0.00 | 46.5 | 0.22 | 46.5 | 0.22 | 46.4 | 0.00 | 46.4 | 0.00 |
| Pikangikum LV | 27.5 | 28 | 1.82 | 27.5 | 0.00 | 27.6 | 0.36 | 27.6 | 0.36 | 27.5 | 0.00 | 27.5 | 0.00 |
| Deer Lake LV | 27.4 | 27.8 | 1.46 | 27.3 | -0.36 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 |
| Sandy Lake LV | 27.7 | 28.1 | 1.44 | 27.2 | -1.81 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Eton DS LV | 13.4 | 13.6 | 1.49 | 13.3 | -0.75 | 13.4 | 0.00 | 13.4 | 0.00 | 13.4 | 0.00 | 13.4 | 0.00 |
| Vermillion Bay DS LV | 15.3 | 15.5 | 1.31 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 | 15.3 | 0.00 |
| Burleigh DS LV | 13.1 | 13.3 | 1.53 | 13.4 | 2.29 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Fort Frances MS1 LV | 14.2 | 14.4 | 1.41 | 14.4 | 1.41 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.7 | 1.60 | 12.6 | 0.80 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 |
| Fort Frances L5 | 14.4 | 14.6 | 1.39 | 14.6 | 1.39 | 14.4 | 0.00 | 14.4 | 0.00 | 14.4 | 0.00 | 14.4 | 0.00 |
| Fort Frances L4A | 14.1 | 14.3 | 1.42 | 14.3 | 1.42 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4B | 14.9 | 15.1 | 1.34 | 15.1 | 1.34 | 14.9 | 0.00 | 14.9 | 0.00 | 14.9 | 0.00 | 14.9 | 0.00 |
| Fort Frances AB | 6.9 | 7 | 1.45 | 7 | 1.45 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 |

**Table 69: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 244.4 | 244.6 | 0.08 | 244.7 | 0.12 | 239.3 | -2.09 | 238.6 | -2.37 | 242.6 | -0.74 | 240.9 | -1.43 | 242.3 | -0.86 | 241.7 | -1.10 | 244.4 | 0.00 | 244.4 | 0.00 |
| Dryden 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 239 | -2.45 | 238.5 | -2.65 | 243.8 | -0.49 | 242.1 | -1.18 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Fort Frances 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 239 | -2.45 | 238.5 | -2.65 | 243.8 | -0.49 | 242.1 | -1.18 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 247.2 | 244.2 | -1.21 | 244.4 | -1.13 | 248 | 0.32 | 247.7 | 0.20 | 248.3 | 0.44 | 248.1 | 0.36 | 247 | -0.08 | 247 | -0.08 | 247 | -0.08 | 247 | -0.08 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 123.4 | -0.08 | 123.4 | -0.08 | 124.1 | 0.49 | 123.8 | 0.24 | 122.8 | -0.57 | 123.5 | 0.00 | 123.3 | -0.16 | 124.6 | 0.89 | 123.4 | -0.08 | 123.4 | -0.08 |
| Fort Frances 115 kV | 118.6 | 118.7 | 0.08 | 118.7 | 0.08 | 117.7 | -0.76 | 117.3 | -1.10 | 116.2 | -2.02 | 118.3 | -0.25 | 118.2 | -0.34 | 118.3 | -0.25 | 118.6 | 0.00 | 118.6 | 0.00 |
| Mackenzie 115 kV | 122.3 | 121.3 | -0.82 | 122.7 | 0.33 | 123.1 | 0.65 | 123 | 0.57 | 122.2 | -0.08 | 122.2 | -0.08 | 122.2 | -0.08 | 122.3 | 0.00 | 122.2 | -0.08 | 122.2 | -0.08 |
| Moose Lake 115 kV | 121.8 | 120.7 | -0.90 | 121.8 | 0.00 | 121.8 | 0.00 | 121.6 | -0.16 | 121.6 | -0.16 | 121.6 | -0.16 | 121.8 | 0.00 | 121.9 | 0.08 | 121.8 | 0.00 | 121.8 | 0.00 |
| Birch 115 kV | 123 | 121.3 | -1.38 | 121.5 | -1.22 | 123.4 | 0.33 | 123.3 | 0.24 | 123.6 | 0.49 | 123.5 | 0.41 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 |
| Valora Jct 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Esker 115 kV | 118.6 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Musslewhite 115 kV | 118.5 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| King Fisher 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Neskatanga 115 kV | 123.3 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 |
| Wunnumin 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Wapekeka 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 |
| North Caribou Lake 115 kV | 128.4 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 |
| Muskrat Dam 115 kV | 128.1 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 |
| Crow River 115 kV | 119.9 | 119.9 | 0.00 | 119.9 | 0.00 | 120 | 0.08 | 119.8 | -0.08 | 119.7 | -0.17 | 120 | 0.08 | 119.9 | 0.00 | 120 | 0.08 | 119.9 | 0.00 | 119.9 | 0.00 |
| Thierry Mine 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 120.3 | 0.17 | 120 | -0.08 | 120 | -0.08 | 120.3 | 0.17 | 120.1 | 0.00 | 120.3 | 0.17 | 120.1 | 0.00 | 120.1 | 0.00 |
| Cat Lake 115 kV | 122 | 122 | 0.00 | 122 | 0.00 | 122.1 | 0.08 | 121.9 | -0.08 | 121.8 | -0.16 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 |
| Slate Falls 115 kV | 123.4 | 123.4 | 0.00 | 123.4 | 0.00 | 123.5 | 0.08 | 123.3 | -0.08 | 123.2 | -0.16 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 123.3 | 123.2 | -0.08 | 123.2 | -0.08 | 123.9 | 0.49 | 123.6 | 0.24 | 122.6 | -0.57 | 123.3 | 0.00 | 123.1 | -0.16 | 124.4 | 0.89 | 123.2 | -0.08 | 123.2 | -0.08 |
| Perrault Falls 115 kV | 124.3 | 124.3 | 0.00 | 124.3 | 0.00 | 124.5 | 0.16 | 124.3 | 0.00 | 124 | -0.24 | 124.3 | 0.00 | 124.2 | -0.08 | 124.7 | 0.32 | 124.2 | -0.08 | 124.2 | -0.08 |
| Sam Lake 115 kV | 121.9 | 121.8 | -0.08 | 121.9 | 0.00 | 122.5 | 0.49 | 122.2 | 0.25 | 121.3 | -0.49 | 122 | 0.08 | 121.7 | -0.16 | 123.1 | 0.98 | 121.8 | -0.08 | 121.8 | -0.08 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.8 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.7 | -0.08 | 120.7 | -0.08 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |

**Table 69: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 123.4 | 123.4 | 0.00 | 123.4 | 0.00 | 123.7 | 0.24 | 123.4 | 0.00 | 122.7 | -0.57 | 123.5 | 0.08 | 123 | -0.32 | 124.3 | 0.73 | 123.4 | 0.00 | 123.4 | 0.00 |
| Agimak DS 115 kV | 119.3 | 119 | -0.25 | 119.2 | -0.08 | 117.8 | -1.26 | 117.6 | -1.42 | 118.5 | -0.67 | 118.7 | -0.50 | 119.1 | -0.17 | 119.5 | 0.17 | 119.2 | -0.08 | 119.2 | -0.08 |
| Mattabi CTS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Valora DS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Murillo DS 115 kV | 122.5 | 120.3 | -1.80 | 120.6 | -1.55 | 122.7 | 0.16 | 122.6 | 0.08 | 123 | 0.41 | 122.9 | 0.33 | 122.4 | -0.08 | 122.4 | -0.08 | 122.4 | -0.08 | 122.4 | -0.08 |
| Shabaqua DS 115 kV | 122.2 | 119.3 | -2.37 | 119.8 | -1.96 | 122.3 | 0.08 | 122.1 | -0.08 | 122.5 | 0.25 | 122.4 | 0.16 | 122.1 | -0.08 | 122.1 | -0.08 | 122.1 | -0.08 | 122.1 | -0.08 |
| Sapawe DS 115 kV | 121.9 | 120 | -1.56 | 121 | -0.74 | 121.9 | 0.00 | 121.6 | -0.25 | 121.7 | -0.16 | 121.7 | -0.16 | 121.8 | -0.08 | 121.9 | 0.00 | 121.8 | -0.08 | 121.8 | -0.08 |
| West Coast 115 kV | 118.4 | 118.5 | 0.08 | 118.6 | 0.17 | 117.6 | -0.68 | 117.2 | -1.01 | 116.1 | -1.94 | 118.1 | -0.25 | 118.1 | -0.25 | 118.1 | -0.25 | 118.4 | 0.00 | 118.4 | 0.00 |
| Fort Frances MS 115 kV | 118.6 | 118.7 | 0.08 | 118.7 | 0.08 | 117.7 | -0.76 | 117.3 | -1.10 | 116.2 | -2.02 | 118.3 | -0.25 | 118.2 | -0.34 | 118.3 | -0.25 | 118.6 | 0.00 | 118.6 | 0.00 |
| Burleigh DS 115 kV | 118.5 | 118.6 | 0.08 | 118.7 | 0.17 | 117.7 | -0.68 | 117.3 | -1.01 | 116.2 | -1.94 | 118.2 | -0.25 | 118.2 | -0.25 | 118.2 | -0.25 | 118.5 | 0.00 | 118.5 | 0.00 |

**Table 70: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 244.4 | 243.4 | -0.41 | 244 | -0.16 | 244.4 | 0.00 | 244.5 | 0.04 | 240.2 | -1.72 | 239.9 | -1.84 |
| Dryden 230 kV | 245 | 245 | 0.00 | 245.6 | 0.24 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Fort Frances 230 kV | 245 | 245 | 0.00 | 245.6 | 0.24 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 251.7 | 2.73 | 253 | 3.27 |
| Lakehead 230 kV | 247.2 | 247.3 | 0.04 | 247.4 | 0.08 | 247.3 | 0.04 | 247.4 | 0.08 | 251.3 | 1.66 | 251.5 | 1.74 |
| Pickle Lake 115 kV | 120 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 124.5 | 0.81 | 123.6 | 0.08 | 123.6 | 0.08 | 123.6 | 0.08 | 124.2 | 0.57 | 124.4 | 0.73 |
| Fort Frances 115 kV | 118.6 | 116.3 | -1.94 | 119.2 | 0.51 | 117.3 | -1.10 | 119.4 | 0.67 | 112.9 | -4.81 | 119.4 | 0.67 |
| Mackenzie 115 kV | 122.3 | 123.4 | 0.90 | 123.3 | 0.82 | 122.7 | 0.33 | 122.7 | 0.33 | 125.8 | 2.86 | 123.3 | 0.82 |
| Moose Lake 115 kV | 121.8 | 123.8 | 1.64 | 123.6 | 1.48 | 122.6 | 0.66 | 122.6 | 0.66 | 125.9 | 3.37 | 123.5 | 1.40 |
| Birch 115 kV | 123 | 121.7 | -1.06 | 121.8 | -0.98 | 121.7 | -1.06 | 121.8 | -0.98 | 123.6 | 0.49 | 123.6 | 0.49 |
| Valora Jct 115 kV | 120 | 125.6 | 4.67 | 125.1 | 4.25 | 121.1 | 0.92 | 121.2 | 1.00 | 0 | N/A | 0 | N/A |
| Esker 115 kV | 118.6 | 0 | N/A | 0 | N/A | 118.6 | 0.00 | 118.6 | 0.00 | 0 | N/A | 0 | N/A |
| Musslewhite 115 kV | 118.5 | 0 | N/A | 0 | N/A | 118.5 | 0.00 | 118.5 | 0.00 | 0 | N/A | 0 | N/A |
| King Fisher 115 kV | 127.9 | 0 | N/A | 0 | N/A | 127.9 | 0.00 | 127.9 | 0.00 | 0 | N/A | 0 | N/A |
| Neskatanga 115 kV | 123.3 | 0 | N/A | 0 | N/A | 123.3 | 0.00 | 123.3 | 0.00 | 0 | N/A | 0 | N/A |
| Wunnumin 115 kV | 128.9 | 0 | N/A | 0 | N/A | 128.9 | 0.00 | 128.9 | 0.00 | 0 | N/A | 0 | N/A |
| Nibinamik 115 kV | 130 | 0 | N/A | 0 | N/A | 130 | 0.00 | 130 | 0.00 | 0 | N/A | 0 | N/A |
| Kingfisher Lake 115 kV | 127.9 | 0 | N/A | 0 | N/A | 127.9 | 0.00 | 127.9 | 0.00 | 0 | N/A | 0 | N/A |
| Wapekeka 115 kV | 127.2 | 0 | N/A | 0 | N/A | 127.2 | 0.00 | 127.2 | 0.00 | 0 | N/A | 0 | N/A |
| North Caribou Lake 115 kV | 128.4 | 0 | N/A | 0 | N/A | 128.4 | 0.00 | 128.4 | 0.00 | 0 | N/A | 0 | N/A |
| Muskrat Dam 115 kV | 128.1 | 0 | N/A | 0 | N/A | 128.1 | 0.00 | 128.1 | 0.00 | 0 | N/A | 0 | N/A |
| Crow River 115 kV | 119.9 | 119.9 | 0.00 | 119.9 | 0.00 | 120 | 0.08 | 120 | 0.08 | 119.9 | 0.00 | 119.9 | 0.00 |
| Thierry Mine 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 120.2 | 0.08 | 120.2 | 0.08 | 120.1 | 0.00 | 120.1 | 0.00 |
| Cat Lake 115 kV | 122 | 122 | 0.00 | 122 | 0.00 | 122.2 | 0.16 | 122.2 | 0.16 | 121.9 | -0.08 | 122 | 0.00 |
| Slate Falls 115 kV | 123.4 | 123.4 | 0.00 | 123.4 | 0.00 | 123.7 | 0.24 | 123.7 | 0.24 | 123.4 | 0.00 | 123.4 | 0.00 |
| Ear Falls 115 kV | 125.4 | 125.4 | 0.00 | 125.4 | 0.00 | 125.7 | 0.24 | 125.7 | 0.24 | 125.4 | 0.00 | 125.4 | 0.00 |
| Domtar Dryden 115 kV | 123.3 | 124.3 | 0.81 | 123.4 | 0.08 | 123.4 | 0.08 | 123.4 | 0.08 | 124 | 0.57 | 124.2 | 0.73 |
| Perrault Falls 115 kV | 124.3 | 124.6 | 0.24 | 124.3 | 0.00 | 125.3 | 0.80 | 125.4 | 0.88 | 124.5 | 0.16 | 124.6 | 0.24 |
| Sam Lake 115 kV | 121.9 | 123 | 0.90 | 122 | 0.08 | 122 | 0.08 | 122.1 | 0.16 | 122.7 | 0.66 | 122.9 | 0.82 |
| Balmer 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 120.5 | 0.00 | 120.5 | 0.00 | 0 | N/A | 0 | N/A | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.8 | 120.8 | 0.00 | 120.8 | 0.00 | 0 | N/A | 0 | N/A | 120.7 | -0.08 | 120.8 | 0.00 |
| Deer Lake 115 kV | 120.4 | 120.4 | 0.00 | 120.4 | 0.00 | 0 | N/A | 0 | N/A | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 0 | N/A | 0 | N/A | 120 | 0.00 | 120 | 0.00 |

**Table 70: HV Voltage Assessment for Test Case 4 – Valora Junction with All Elements in-service – Double Circuit Contingency (Continued)**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 123.4 | 123.9 | 0.41 | 123.4 | 0.00 | 123.5 | 0.08 | 123.6 | 0.16 | 123 | -0.32 | 123.8 | 0.32 |
| Agimak DS 115 kV | 119.3 | 125.3 | 5.03 | 124.7 | 4.53 | 120.8 | 1.26 | 120.8 | 1.26 | 0 | N/A | 0 | N/A |
| Mattabi CTS 115 kV | 120 | 125.7 | 4.75 | 125.1 | 4.25 | 121.1 | 0.92 | 121.2 | 1.00 | 0 | N/A | 0 | N/A |
| Valora DS 115 kV | 120 | 125.6 | 4.67 | 125.1 | 4.25 | 121.1 | 0.92 | 121.2 | 1.00 | 0 | N/A | 0 | N/A |
| Murillo DS 115 kV | 122.5 | 121.7 | -0.65 | 121.8 | -0.57 | 121.7 | -0.65 | 121.8 | -0.57 | 123.5 | 0.82 | 123.3 | 0.65 |
| Shabaqua DS 115 kV | 122.2 | 122.8 | 0.49 | 122.9 | 0.57 | 122.8 | 0.49 | 122.9 | 0.57 | 124.5 | 1.88 | 123.8 | 1.31 |
| Sapawe DS 115 kV | 121.9 | 124.4 | 2.05 | 124.6 | 2.21 | 124.4 | 2.05 | 124.6 | 2.21 | 125.9 | 3.28 | 123.8 | 1.56 |
| West Coast 115 kV | 118.4 | 116.2 | -1.86 | 119.1 | 0.59 | 117.2 | -1.01 | 119.3 | 0.76 | 112.7 | -4.81 | 119.2 | 0.68 |
| Fort Frances MS 115 kV | 118.6 | 116.3 | -1.94 | 119.2 | 0.51 | 117.3 | -1.10 | 119.4 | 0.67 | 112.8 | -4.89 | 119.4 | 0.67 |
| Burleigh DS 115 kV | 118.5 | 116.2 | -1.94 | 119.2 | 0.59 | 117.3 | -1.01 | 119.4 | 0.76 | 112.8 | -4.81 | 119.3 | 0.68 |

**Table 71: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of Mackenzie SVC | | | | Loss of Valora Cap | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 244.4 | 244.2 | -0.08 | 244.2 | -0.08 | 241.4 | -1.23 | 240.5 | -1.60 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 | 244.4 | 0.00 |
| Dryden 230 kV | 245 | 245 | 0.00 | 244.6 | -0.16 | 238.8 | -2.53 | 235.8 | -3.76 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Fort Frances 230 kV | 245 | 245 | 0.00 | 244.6 | -0.16 | 238.8 | -2.53 | 235.8 | -3.76 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Mackenzie 230 kV | 245 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Lakehead 230 kV | 247.2 | 247.2 | 0.00 | 247.2 | 0.00 | 247.1 | -0.04 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 | 247.2 | 0.00 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 123.5 | 122.5 | -0.81 | 123.7 | 0.16 | 121 | -2.02 | 123.9 | 0.32 | 123.5 | 0.00 | 123.5 | 0.00 | 123.5 | 0.00 | 123.5 | 0.00 | 123.4 | -0.08 | 123.4 | -0.08 |
| Fort Frances 115 kV | 118.6 | 118.5 | -0.08 | 118.5 | -0.08 | 117.9 | -0.59 | 118 | -0.51 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Mackenzie 115 kV | 122.3 | 122.2 | -0.08 | 122.3 | 0.00 | 122.1 | -0.16 | 122.3 | 0.00 | 122.3 | 0.00 | 122.3 | 0.00 | 122.3 | 0.00 | 122.3 | 0.00 | 122.2 | -0.08 | 122.2 | -0.08 |
| Moose Lake 115 kV | 121.8 | 121.8 | 0.00 | 121.9 | 0.08 | 121.6 | -0.16 | 121.9 | 0.08 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.7 | -0.08 | 121.7 | -0.08 |
| Birch 115 kV | 123 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123.1 | 0.08 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 | 123 | 0.00 |
| Valora Jct 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 118.9 | -0.92 | 119 | -0.83 |
| Esker 115 kV | 118.6 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Musslewhite 115 kV | 118.5 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| King Fisher 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Neskatanga 115 kV | 123.3 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 |
| Wunnumin 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.9 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 | 127.9 | 0.00 |
| Wapekeka 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 |
| North Caribou Lake 115 kV | 128.4 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 | 128.4 | 0.00 |
| Muskrat Dam 115 kV | 128.1 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 | 128.1 | 0.00 |
| Crow River 115 kV | 119.9 | 113.1 | -5.67 | 114.1 | -4.84 | 119.2 | -0.58 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 |
| Thierry Mine 115 kV | 120.1 | 113.3 | -5.66 | 114.4 | -4.75 | 119.5 | -0.50 | 120.2 | 0.08 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 |
| Cat Lake 115 kV | 122 | 115.3 | -5.49 | 116.4 | -4.59 | 121.3 | -0.57 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 122 | 0.00 | 121.9 | -0.08 | 121.9 | -0.08 |
| Slate Falls 115 kV | 123.4 | 117 | -5.19 | 118.1 | -4.29 | 122.8 | -0.49 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 |
| Ear Falls 115 kV | 125.4 | 120.2 | -4.15 | 121.3 | -3.27 | 124.9 | -0.40 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 125.4 | 0.00 | 45.3 | -63.88 | 45.3 | -63.88 |
| Domtar Dryden 115 kV | 123.3 | 122.3 | -0.81 | 123.5 | 0.16 | 120.8 | -2.03 | 123.7 | 0.32 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.3 | 0.00 | 123.2 | -0.08 | 123.2 | -0.08 |
| Perrault Falls 115 kV | 124.3 | 120.2 | -3.30 | 121.2 | -2.49 | 123.1 | -0.97 | 124.4 | 0.08 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 | 124.3 | 0.00 |
| Sam Lake 115 kV | 121.9 | 120.9 | -0.82 | 122.2 | 0.25 | 119.4 | -2.05 | 122.3 | 0.33 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.8 | -0.08 |
| Balmer 115 kV | 120 | 113.9 | -5.08 | 115 | -4.17 | 119.5 | -0.42 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 114.5 | -4.98 | 115.5 | -4.15 | 120 | -0.41 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 120.8 | 114.6 | -5.13 | 115.7 | -4.22 | 120.4 | -0.33 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.8 | 0.00 | 120.7 | -0.08 | 120.7 | -0.08 |
| Deer Lake 115 kV | 120.4 | 114.3 | -5.07 | 115.5 | -4.07 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 | 120.4 | 0.00 |
| Sandy Lake 115 kV | 120 | 114 | -5.00 | 115.2 | -4.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |

**Table 71: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions (Continued)**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls | | | | Loss of Dryden Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of Mackenzie SVC | | | | Loss of Valora Cap | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 123.4 | 122.7 | -0.57 | 123.6 | 0.16 | 121.3 | -1.70 | 124 | 0.49 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 | 123.4 | 0.00 |
| Agimak DS 115 kV | 119.3 | 119 | -0.25 | 119.3 | 0.00 | 118.6 | -0.59 | 119.4 | 0.08 | 119.3 | 0.00 | 119.3 | 0.00 | 119.3 | 0.00 | 119.3 | 0.00 | 118.7 | -0.50 | 118.7 | -0.50 |
| Mattabi CTS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 118.9 | -0.92 | 119 | -0.83 |
| Valora DS 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 118.9 | -0.92 | 119 | -0.83 |
| Murillo DS 115 kV | 122.5 | 122.4 | -0.08 | 122.5 | 0.00 | 122.4 | -0.08 | 122.5 | 0.00 | 122.5 | 0.00 | 122.5 | 0.00 | 122.5 | 0.00 | 122.5 | 0.00 | 122.4 | -0.08 | 122.4 | -0.08 |
| Shabaqua DS 115 kV | 122.2 | 122.2 | 0.00 | 122.2 | 0.00 | 122.1 | -0.08 | 122.2 | 0.00 | 122.2 | 0.00 | 122.2 | 0.00 | 122.2 | 0.00 | 122.2 | 0.00 | 122.2 | 0.00 | 122.2 | 0.00 |
| Sapawe DS 115 kV | 121.9 | 121.8 | -0.08 | 121.9 | 0.00 | 121.7 | -0.16 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.9 | 0.00 | 121.8 | -0.08 | 121.8 | -0.08 |
| West Coast 115 kV | 118.4 | 118.4 | 0.00 | 118.4 | 0.00 | 117.7 | -0.59 | 117.9 | -0.42 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 |
| Fort Frances MS 115 kV | 118.6 | 118.5 | -0.08 | 118.5 | -0.08 | 117.9 | -0.59 | 118 | -0.51 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 | 118.6 | 0.00 |
| Burleigh DS 115 kV | 118.5 | 118.5 | 0.00 | 118.5 | 0.00 | 117.8 | -0.59 | 118 | -0.42 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |

**Table 72: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Kenora 230 kV | 244.8 | 246.9 | 0.86 | 247.2 | 0.98 | 244.8 | 0.00 | 244.8 | 0.00 | 244.8 | 0.00 | 244.8 | 0.00 |
| Dryden 230 kV | 245 | 248.1 | 1.27 | 248.9 | 1.59 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Fort Frances 230 kV | 245 | 248.1 | 1.27 | 248.9 | 1.59 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 | 245 | 0.00 |
| Mackenzie 230 kV | 242.7 | 248.7 | 2.47 | 249.3 | 2.72 | 242.7 | 0.00 | 242.7 | 0.00 | 242.7 | 0.00 | 242.7 | 0.00 |
| Lakehead 230 kV | 238.3 | 240.3 | 0.84 | 240.4 | 0.88 | 238.3 | 0.00 | 238.3 | 0.00 | 238.3 | 0.00 | 238.3 | 0.00 |
| Pickle Lake 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Dryden 115 kV | 124.4 | 125.9 | 1.21 | 124.8 | 0.32 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 |
| Fort Frances 115 kV | 118.5 | 119.9 | 1.18 | 120.1 | 1.35 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| Mackenzie 115 kV | 120.9 | 123.4 | 2.07 | 122.1 | 0.99 | 120.9 | 0.00 | 120.9 | 0.00 | 120.9 | 0.00 | 120.9 | 0.00 |
| Moose Lake 115 kV | 121.4 | 123.6 | 1.81 | 122.5 | 0.91 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 | 121.4 | 0.00 |
| Birch 115 kV | 121.3 | 122.4 | 0.91 | 122.4 | 0.91 | 121.3 | 0.00 | 121.3 | 0.00 | 121.3 | 0.00 | 121.3 | 0.00 |
| Valora Jct 115 kV | 123.2 | 125.1 | 1.54 | 124 | 0.65 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 |
| Esker 115 kV | 120.1 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 | 120.1 | 0.00 |
| Musslewhite 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| King Fisher 115 kV | 126.8 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 | 126.8 | 0.00 |
| Neskatanga 115 kV | 124.4 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 |
| Wunnumin 115 kV | 128.2 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 | 128.2 | 0.00 |
| Nibinamik 115 kV | 130 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 | 130 | 0.00 |
| Kingfisher Lake 115 kV | 127.2 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 | 127.2 | 0.00 |
| Wapekeka 115 kV | 127.8 | 127.8 | 0.00 | 127.8 | 0.00 | 127.8 | 0.00 | 127.8 | 0.00 | 127.8 | 0.00 | 127.8 | 0.00 |
| North Caribou Lake 115 kV | 128.6 | 128.6 | 0.00 | 128.6 | 0.00 | 128.6 | 0.00 | 128.6 | 0.00 | 128.6 | 0.00 | 128.6 | 0.00 |
| Muskrat Dam 115 kV | 128.9 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 | 128.9 | 0.00 |
| Crow River 115 kV | 120 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Thierry Mine 115 kV | 119.9 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 | 119.9 | 0.00 |
| Cat Lake 115 kV | 121.8 | 122.1 | 0.25 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 | 121.8 | 0.00 |
| Slate Falls 115 kV | 122.8 | 123.3 | 0.41 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Ear Falls 115 kV | 122.8 | 123.8 | 0.81 | 122.9 | 0.08 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Domtar Dryden 115 kV | 124.4 | 125.9 | 1.21 | 124.7 | 0.24 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 |
| Perrault Falls 115 kV | 123.2 | 124.4 | 0.97 | 123.4 | 0.16 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 |
| Sam Lake 115 kV | 123.9 | 125.4 | 1.21 | 124.2 | 0.24 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 | 123.9 | 0.00 |
| Balmer 115 kV | 120 | 121.1 | 0.92 | 120.1 | 0.08 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 | 120 | 0.00 |
| Red Lake 115 kV | 120.5 | 121.6 | 0.91 | 120.6 | 0.08 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 | 120.5 | 0.00 |
| Pikangikum 115 kV | 123.8 | 124.9 | 0.89 | 123.9 | 0.08 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 | 123.8 | 0.00 |
| Deer Lake 115 kV | 126 | 127.2 | 0.95 | 126.1 | 0.08 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 | 126 | 0.00 |
| Sandy Lake 115 kV | 126.1 | 127.3 | 0.95 | 126.2 | 0.08 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 | 126.1 | 0.00 |

**Table 72: HV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Condtions (Continued)**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Vermillion Bay DS 115 kV | 124.4 | 125.7 | 1.05 | 124.9 | 0.40 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 | 124.4 | 0.00 |
| Agimak DS 115 kV | 122.8 | 124.7 | 1.55 | 123.5 | 0.57 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 | 122.8 | 0.00 |
| Mattabi CTS 115 kV | 123.2 | 125.1 | 1.54 | 124 | 0.65 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 |
| Valora DS 115 kV | 123.2 | 125.1 | 1.54 | 124 | 0.65 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 | 123.2 | 0.00 |
| Murillo DS 115 kV | 121.2 | 122.3 | 0.91 | 122.2 | 0.83 | 121.2 | 0.00 | 121.2 | 0.00 | 121.2 | 0.00 | 121.2 | 0.00 |
| Shabaqua DS 115 kV | 121.5 | 123 | 1.23 | 122.6 | 0.91 | 121.5 | 0.00 | 121.5 | 0.00 | 121.5 | 0.00 | 121.5 | 0.00 |
| Sapawe DS 115 kV | 121.6 | 123.7 | 1.73 | 122.7 | 0.90 | 121.6 | 0.00 | 121.6 | 0.00 | 121.6 | 0.00 | 121.6 | 0.00 |
| West Coast 115 kV | 118.4 | 119.8 | 1.18 | 120 | 1.35 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 |
| Fort Frances MS 115 kV | 118.5 | 119.9 | 1.18 | 120.1 | 1.35 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 | 118.5 | 0.00 |
| Burleigh DS 115 kV | 118.4 | 119.9 | 1.27 | 120 | 1.35 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 | 118.4 | 0.00 |

**Table 73: LV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Single Circuit Contingency**

| Bus Name | Pre-Cont | Loss of A21L | | | | Loss of D26A | | | | Loss of F25A | | | | Loss of K23D | | | | Loss of 1 Manitou Falls Unit | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 24.4 | -2.01 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 25 | 0.40 | 25 | 0.40 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Shabaqua DS LV | 13.1 | 12.8 | -2.29 | 12.8 | -2.29 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.8 | 13.6 | -1.45 | 13.7 | -0.72 | 13.8 | 0.00 | 13.7 | -0.72 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Mattabi DS LV | 4.1 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 |
| Agimak DS LV | 26.2 | 26.1 | -0.38 | 26.2 | 0.00 | 26.5 | 1.15 | 26.5 | 1.15 | 26.1 | -0.38 | 26.4 | 0.76 | 26.2 | 0.00 | 26.3 | 0.38 | 26.2 | 0.00 | 26.2 | 0.00 |
| Valora DS LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Nibinamik LV | 24.6 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 |
| King Fisher Lake LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Wapekeka LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| North Caribou Lake LV | 24.4 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 |
| Muskrat LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| Crow River LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 29.2 | 0.00 | 29.2 | 0.00 | 29.3 | 0.34 | 29.2 | 0.00 | 29.2 | 0.00 | 29.3 | 0.34 | 29.2 | 0.00 | 29.5 | 1.03 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.7 | 23.7 | 0.00 | 23.7 | 0.00 | 23.8 | 0.42 | 23.7 | 0.00 | 23.7 | 0.00 | 23.8 | 0.42 | 23.7 | 0.00 | 23.8 | 0.42 | 23.7 | 0.00 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 45.3 | 0.00 | 45.3 | 0.00 | 45.4 | 0.22 | 45.3 | 0.00 | 45.3 | 0.00 | 45.4 | 0.22 | 45.3 | 0.00 | 45.4 | 0.22 | 45.3 | 0.00 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.6 | 13.6 | 0.00 | 13.6 | 0.00 | 13.7 | 0.74 | 13.6 | 0.00 | 13.5 | -0.74 | 13.6 | 0.00 | 13.6 | 0.00 | 13.7 | 0.74 | 13.6 | 0.00 | 13.6 | 0.00 |
| Perrault Falls LV | 11.7 | 11.6 | -0.85 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.6 | -0.85 | 11.7 | 0.00 | 11.6 | -0.85 | 11.7 | 0.00 | 11.6 | -0.85 | 11.6 | -0.85 |
| Sam Lake LV | 26.4 | 26.4 | 0.00 | 26.4 | 0.00 | 26.6 | 0.76 | 26.5 | 0.38 | 26.3 | -0.38 | 26.4 | 0.00 | 26.4 | 0.00 | 26.7 | 1.14 | 26.4 | 0.00 | 26.4 | 0.00 |
| Balmer LV | 43.2 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 |
| Red Lake LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Pikangikum LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.2 | -0.37 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| Deer Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.3 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.2 | -0.75 | 13.3 | 0.00 | 13.2 | -0.75 | 13.4 | 0.75 | 13.3 | 0.00 | 13.3 | 0.00 |
| Vermillion Bay DS LV | 15.1 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15 | -0.66 | 15.1 | 0.00 | 15 | -0.66 | 15.2 | 0.66 | 15.1 | 0.00 | 15.1 | 0.00 |
| Burleigh DS LV | 13.1 | 13.1 | 0.00 | 13.1 | 0.00 | 13 | -0.76 | 12.9 | -1.53 | 12.8 | -2.29 | 13.1 | 0.00 | 13 | -0.76 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 |
| Fort Frances MS1 LV | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 14 | -0.71 | 14 | -0.71 | 13.8 | -2.13 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.2 | -2.40 | 12.5 | 0.00 | 12.4 | -0.80 | 12.4 | -0.80 | 12.5 | 0.00 | 12.5 | 0.00 |
| Fort Frances L5 | 14.2 | 14.2 | 0.00 | 14.2 | 0.00 | 14.1 | -0.70 | 14 | -1.41 | 13.8 | -2.82 | 14.1 | -0.70 | 14.1 | -0.70 | 14.1 | -0.70 | 14.2 | 0.00 | 14.2 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 13.9 | -0.71 | 13.9 | -0.71 | 13.7 | -2.14 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.9 | 0.68 | 14.9 | 0.68 | 14.7 | -0.68 | 14.7 | -0.68 | 14.6 | -1.35 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.6 | -1.49 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 74: LV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Double Circuit Contingency**

| Bus Name | Pre-Cont | Loss of AxLs and Cross-Trip B6M + Pickle Lake Line | | | | Loss of AxLs and Cross-Trip B6M + E2R Lines | | | | Loss of D26A + F25A and Cross-Trip M2D | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 24.7 | -0.80 | 24.9 | 0.00 | 24.7 | -0.80 | 24.9 | 0.00 | 25.1 | 0.80 | 25.1 | 0.80 |
| Shabaqua DS LV | 13.1 | 13.1 | 0.00 | 13.2 | 0.76 | 13.1 | 0.00 | 13.2 | 0.76 | 13.3 | 1.53 | 13.3 | 1.53 |
| Sapawe DS LV | 13.8 | 14.1 | 2.17 | 14.1 | 2.17 | 14.1 | 2.17 | 14.1 | 2.17 | 14.2 | 2.90 | 14 | 1.45 |
| Mattabi DS LV | 4.1 | 4.3 | 4.88 | 4.3 | 4.88 | 4.1 | 0.00 | 4.1 | 0.00 | 0 | N/A | 0 | N/A |
| Agimak DS LV | 26.2 | 27.5 | 4.96 | 26.7 | 1.91 | 26.6 | 1.53 | 26.6 | 1.53 | 0 | N/A | 0 | N/A |
| Valora DS LV | 24.9 | 26.1 | 4.82 | 26 | 4.42 | 25.2 | 1.20 | 25.2 | 1.20 | 0 | N/A | 0 | N/A |
| Esker LV | 13.9 | 0 | N/A | 0 | N/A | 13.9 | 0.00 | 13.9 | 0.00 | 0 | N/A | 0 | N/A |
| Musselwhite LV | 4.2 | 0 | N/A | 0 | N/A | 4.2 | 0.00 | 4.2 | 0.00 | 0 | N/A | 0 | N/A |
| Neskatanga LV | 27.7 | 0 | N/A | 0 | N/A | 27.7 | 0.00 | 27.7 | 0.00 | 0 | N/A | 0 | N/A |
| Wunnumin LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A |
| Nibinamik LV | 24.6 | 0 | N/A | 0 | N/A | 24.6 | 0.00 | 24.6 | 0.00 | 0 | N/A | 0 | N/A |
| King Fisher Lake LV | 24.7 | 0 | N/A | 0 | N/A | 24.7 | 0.00 | 24.7 | 0.00 | 0 | N/A | 0 | N/A |
| Wapekeka LV | 27.5 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 | 0 | N/A | 0 | N/A |
| North Caribou Lake LV | 24.4 | 0 | N/A | 0 | N/A | 24.4 | 0.00 | 24.4 | 0.00 | 0 | N/A | 0 | N/A |
| Muskrat LV | 27.3 | 0 | N/A | 0 | N/A | 27.3 | 0.00 | 27.3 | 0.00 | 0 | N/A | 0 | N/A |
| Crow River LV | 27.8 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 29.2 | 0.00 | 29.2 | 0.00 | 29.3 | 0.34 | 29.3 | 0.34 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.7 | 23.7 | 0.00 | 23.7 | 0.00 | 23.8 | 0.42 | 23.8 | 0.42 | 23.7 | 0.00 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 45.3 | 0.00 | 45.3 | 0.00 | 45.5 | 0.44 | 45.5 | 0.44 | 45.3 | 0.00 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.6 | 13.7 | 0.74 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.7 | 0.74 | 13.7 | 0.74 |
| Perrault Falls LV | 11.7 | 11.7 | 0.00 | 11.7 | 0.00 | 11.8 | 0.85 | 11.8 | 0.85 | 11.7 | 0.00 | 11.7 | 0.00 |
| Sam Lake LV | 26.4 | 26.7 | 1.14 | 26.5 | 0.38 | 26.5 | 0.38 | 26.5 | 0.38 | 26.6 | 0.76 | 26.7 | 1.14 |
| Balmer LV | 43.2 | 43.2 | 0.00 | 43.2 | 0.00 | 0 | N/A | 0 | N/A | 43.2 | 0.00 | 43.2 | 0.00 |
| Red Lake LV | 46.3 | 46.3 | 0.00 | 46.3 | 0.00 | 0 | N/A | 0 | N/A | 46.3 | 0.00 | 46.3 | 0.00 |
| Pikangikum LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 0 | N/A | 0 | N/A | 27.3 | 0.00 | 27.3 | 0.00 |
| Deer Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 0 | N/A | 0 | N/A | 27.5 | 0.00 | 27.5 | 0.00 |
| Sandy Lake LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.3 | 13.4 | 0.75 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 |
| Vermillion Bay DS LV | 15.1 | 15.2 | 0.66 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15 | -0.66 | 15.1 | 0.00 |
| Burleigh DS LV | 13.1 | 12.8 | -2.29 | 13.1 | 0.00 | 12.9 | -1.53 | 13.2 | 0.76 | 12.4 | -5.34 | 13.2 | 0.76 |
| Fort Frances MS1 LV | 14.1 | 13.8 | -2.13 | 14.2 | 0.71 | 14 | -0.71 | 14.2 | 0.71 | 13.4 | -4.96 | 14.2 | 0.71 |
| Fort Frances MS2 LV | 12.5 | 12.2 | -2.40 | 12.5 | 0.00 | 12.3 | -1.60 | 12.6 | 0.80 | 11.8 | -5.60 | 12.5 | 0.00 |
| Fort Frances L5 | 14.2 | 13.9 | -2.11 | 14.2 | 0.00 | 14 | -1.41 | 14.3 | 0.70 | 13.4 | -5.63 | 14.3 | 0.70 |
| Fort Frances L4A | 14 | 13.8 | -1.43 | 14.1 | 0.71 | 13.9 | -0.71 | 14.1 | 0.71 | 13.3 | -5.00 | 14.1 | 0.71 |
| Fort Frances L4B | 14.8 | 14.6 | -1.35 | 14.9 | 0.68 | 14.7 | -0.68 | 15 | 1.35 | 14.1 | -4.73 | 14.9 | 0.68 |
| Fort Frances AB | 6.7 | 6.6 | -1.49 | 6.8 | 1.49 | 6.7 | 0.00 | 6.8 | 1.49 | 6.4 | -4.48 | 6.8 | 1.49 |

**Table 75: LV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Peak Load Conditions**

| Bus Name | Pre-Cont | Loss of 1 Ear Falls SVC | | | | Loss of Dryden Cap | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Mackenzie SVC | | | | Loss of Valora Cap | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Shabaqua DS LV | 13.1 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.8 | 13.8 | 0.00 | 13.8 | 0.00 | 13.7 | -0.72 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Mattabi DS LV | 4.1 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 | 4.1 | 0.00 |
| Agimak DS LV | 26.2 | 26.2 | 0.00 | 26.2 | 0.00 | 26.1 | -0.38 | 26.6 | 1.53 | 26.2 | 0.00 | 26.2 | 0.00 | 26.2 | 0.00 | 26.2 | 0.00 | 26.1 | -0.38 | 26.4 | 0.76 |
| Valora DS LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.7 | -0.80 | 24.7 | -0.80 |
| Esker LV | 13.9 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Nibinamik LV | 24.6 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 | 24.6 | 0.00 |
| King Fisher Lake LV | 24.7 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 | 24.7 | 0.00 |
| Wapekeka LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| North Caribou Lake LV | 24.4 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 | 24.4 | 0.00 |
| Muskrat LV | 27.3 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| Crow River LV | 27.8 | 26.2 | -5.76 | 27.4 | -1.44 | 27.7 | -0.36 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 | 27.8 | 0.00 |
| Thierry Mine LV | 4.4 | 4.1 | -6.82 | 4.2 | -4.55 | 4.3 | -2.27 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 | 4.4 | 0.00 |
| Cat Lake LV | 29.2 | 27.6 | -5.48 | 29 | -0.68 | 29.1 | -0.34 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.7 | 22.5 | -5.06 | 22.7 | -4.22 | 23.6 | -0.42 | 23.8 | 0.42 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 | 23.7 | 0.00 |
| Ear Falls LV | 45.3 | 43.3 | -4.42 | 43.7 | -3.53 | 45.2 | -0.22 | 45.4 | 0.22 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 | 45.3 | 0.00 |
| Domtar Dryden LV | 13.6 | 13.5 | -0.74 | 13.6 | 0.00 | 13.3 | -2.21 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 | 13.6 | 0.00 |
| Perrault Falls LV | 11.7 | 11.2 | -4.27 | 11.4 | -2.56 | 11.5 | -1.71 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.6 | -0.85 | 11.6 | -0.85 |
| Sam Lake LV | 26.4 | 26.2 | -0.76 | 26.5 | 0.38 | 25.9 | -1.89 | 26.7 | 1.14 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 |
| Balmer LV | 43.2 | 41 | -5.09 | 43.5 | 0.69 | 43 | -0.46 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 |
| Red Lake LV | 46.3 | 44 | -4.97 | 46 | -0.65 | 46.1 | -0.43 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 | 46.3 | 0.00 |
| Pikangikum LV | 27.3 | 25.8 | -5.49 | 27.4 | 0.37 | 27.2 | -0.37 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| Deer Lake LV | 27.5 | 26 | -5.45 | 27.3 | -0.73 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Sandy Lake LV | 27.5 | 26.4 | -4.00 | 27.3 | -0.73 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Eton DS LV | 13.3 | 13.2 | -0.75 | 13.4 | 0.75 | 13 | -2.26 | 13.4 | 0.75 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 |
| Vermillion Bay DS LV | 15.1 | 15 | -0.66 | 15.1 | 0.00 | 14.8 | -1.99 | 15.2 | 0.66 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 | 15.1 | 0.00 |
| Burleigh DS LV | 13.1 | 13.1 | 0.00 | 13.1 | 0.00 | 13 | -0.76 | 13 | -0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Fort Frances MS1 LV | 14.1 | 14.1 | 0.00 | 14.1 | 0.00 | 14 | -0.71 | 14 | -0.71 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.5 | 0.00 | 12.5 | 0.00 | 12.4 | -0.80 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 |
| Fort Frances L5 | 14.2 | 14.2 | 0.00 | 14.2 | 0.00 | 14.1 | -0.70 | 14.1 | -0.70 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 | 14.2 | 0.00 |
| Fort Frances L4A | 14 | 14 | 0.00 | 14 | 0.00 | 13.9 | -0.71 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 | 14 | 0.00 |
| Fort Frances L4B | 14.8 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.7 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 | 6.7 | 0.00 |

**Table 76: LV Voltage Assessment for Test Case 4 – Dinorwic Junction with All Elements in-service – Loss of Reactive Devices under Light Load Conditions**

| Bus Name | Pre-Cont | Loss of Mackenzie Reactor | | | | Loss of 1 Pickle Lake SVC | | | | Loss of 1 Kingfisher Reactor | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | | Pre-ULTC | | Post-ULTC | |
| | Volt (kV) | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% | Volt (kV) | $V_{ch}$% |
| Murillo DS LV | 24.9 | 25.2 | 1.20 | 25.2 | 1.20 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Shabaqua DS LV | 13.1 | 13.2 | 0.76 | 13.2 | 0.76 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Sapawe DS LV | 13.7 | 14 | 2.19 | 13.9 | 1.46 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 | 13.7 | 0.00 |
| Mattabi DS LV | 4.2 | 4.3 | 2.38 | 4.3 | 2.38 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Agimak DS LV | 26.4 | 26.8 | 1.52 | 26.5 | 0.38 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 | 26.4 | 0.00 |
| Valora DS LV | 25.6 | 26 | 1.56 | 25.8 | 0.78 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 | 25.6 | 0.00 |
| Esker LV | 13.8 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 | 13.8 | 0.00 |
| Musselwhite LV | 4.2 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 | 4.2 | 0.00 |
| Neskatanga LV | 27.7 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 | 27.7 | 0.00 |
| Wunnumin LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Nibinamik LV | 25.3 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 | 25.3 | 0.00 |
| King Fisher Lake LV | 24.9 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 | 24.9 | 0.00 |
| Wapekeka LV | 27.6 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 |
| North Caribou Lake LV | 25.1 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 | 25.1 | 0.00 |
| Muskrat LV | 27.5 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Crow River LV | 27.4 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 | 27.4 | 0.00 |
| Thierry Mine LV | 4.3 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 | 4.3 | 0.00 |
| Cat Lake LV | 29.2 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 | 29.2 | 0.00 |
| Slate Falls LV | 23.9 | 24 | 0.42 | 23.9 | 0.00 | 23.9 | 0.00 | 23.9 | 0.00 | 23.9 | 0.00 | 23.9 | 0.00 |
| Ear Falls LV | 44.6 | 45 | 0.90 | 44.6 | 0.00 | 44.6 | 0.00 | 44.6 | 0.00 | 44.6 | 0.00 | 44.6 | 0.00 |
| Domtar Dryden LV | 13.9 | 14 | 0.72 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 | 13.9 | 0.00 |
| Perrault Falls LV | 11.7 | 11.9 | 1.71 | 11.8 | 0.85 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 | 11.7 | 0.00 |
| Sam Lake LV | 26.5 | 26.8 | 1.13 | 26.3 | -0.75 | 26.5 | 0.00 | 26.5 | 0.00 | 26.5 | 0.00 | 26.5 | 0.00 |
| Balmer LV | 43.2 | 43.6 | 0.93 | 43.3 | 0.23 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 | 43.2 | 0.00 |
| Red Lake LV | 46.4 | 46.8 | 0.86 | 46.4 | 0.00 | 46.4 | 0.00 | 46.4 | 0.00 | 46.4 | 0.00 | 46.4 | 0.00 |
| Pikangikum LV | 27.5 | 27.8 | 1.09 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 | 27.5 | 0.00 |
| Deer Lake LV | 27.3 | 27.6 | 1.10 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 | 27.3 | 0.00 |
| Sandy Lake LV | 27.6 | 27.9 | 1.09 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 | 27.6 | 0.00 |
| Eton DS LV | 13.3 | 13.5 | 1.50 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 | 13.3 | 0.00 |
| Vermillion Bay DS LV | 15.2 | 15.4 | 1.32 | 15.3 | 0.66 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 | 15.2 | 0.00 |
| Burleigh DS LV | 13.1 | 13.3 | 1.53 | 13.3 | 1.53 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 | 13.1 | 0.00 |
| Fort Frances MS1 LV | 14.1 | 14.3 | 1.42 | 14.3 | 1.42 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances MS2 LV | 12.5 | 12.7 | 1.60 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 | 12.5 | 0.00 |
| Fort Frances L5 | 14.3 | 14.5 | 1.40 | 14.5 | 1.40 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 | 14.3 | 0.00 |
| Fort Frances L4A | 14.1 | 14.2 | 0.71 | 14.3 | 1.42 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 | 14.1 | 0.00 |
| Fort Frances L4B | 14.8 | 15 | 1.35 | 15 | 1.35 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 | 14.8 | 0.00 |
| Fort Frances AB | 6.9 | 7 | 1.45 | 7 | 1.45 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 | 6.9 | 0.00 |

# References

| Document Name | Document ID |
|---|---|
| Ontario Resource and Transmission Assessment Criteria | IESO_REQ_0041 |
| An Assessment of the Westward Transfer Capability of Various Options for Reinforcing the East-West Tie | IESO_REQ_0748 |

**– End of Document –**