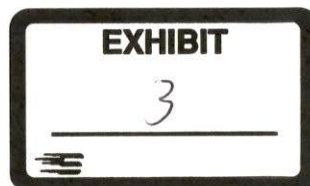


BASIN ELECTRIC POWER COOPERATIVE

Tioga-Williston-Charlie Creek 230kV Line and Tioga 230/115kV Transformer #2 Analysis

**Prepared by:
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September 2008**

31 **PU-07-671** Filed: 11/12/2009 Pages: 47
Exhibit 3 from Oct. 27, 2009 Hearing



1.0 Executive Summary

This project consists of a new 230kV line between Tioga and Williston Substations and a rebuild of the existing Western Area Power Administration 115kV line between Williston and Charlie Creek Substations to 230kV. The Tioga-Williston 230kV line will be approximately 50 miles long. Williston Substation will be upgraded to include a 230/115kV transformer. Also, a second 230/115kV transformer will be added at Tioga Substation. The Williston-Charlie Creek 230kV line will be approximately 75 miles long. The Watford City Substation will be converted to a 230/115/69kV Substation. A 345/230kV transformer will be added at Charlie Creek Substation. The geographic location is provided in Figure #1.

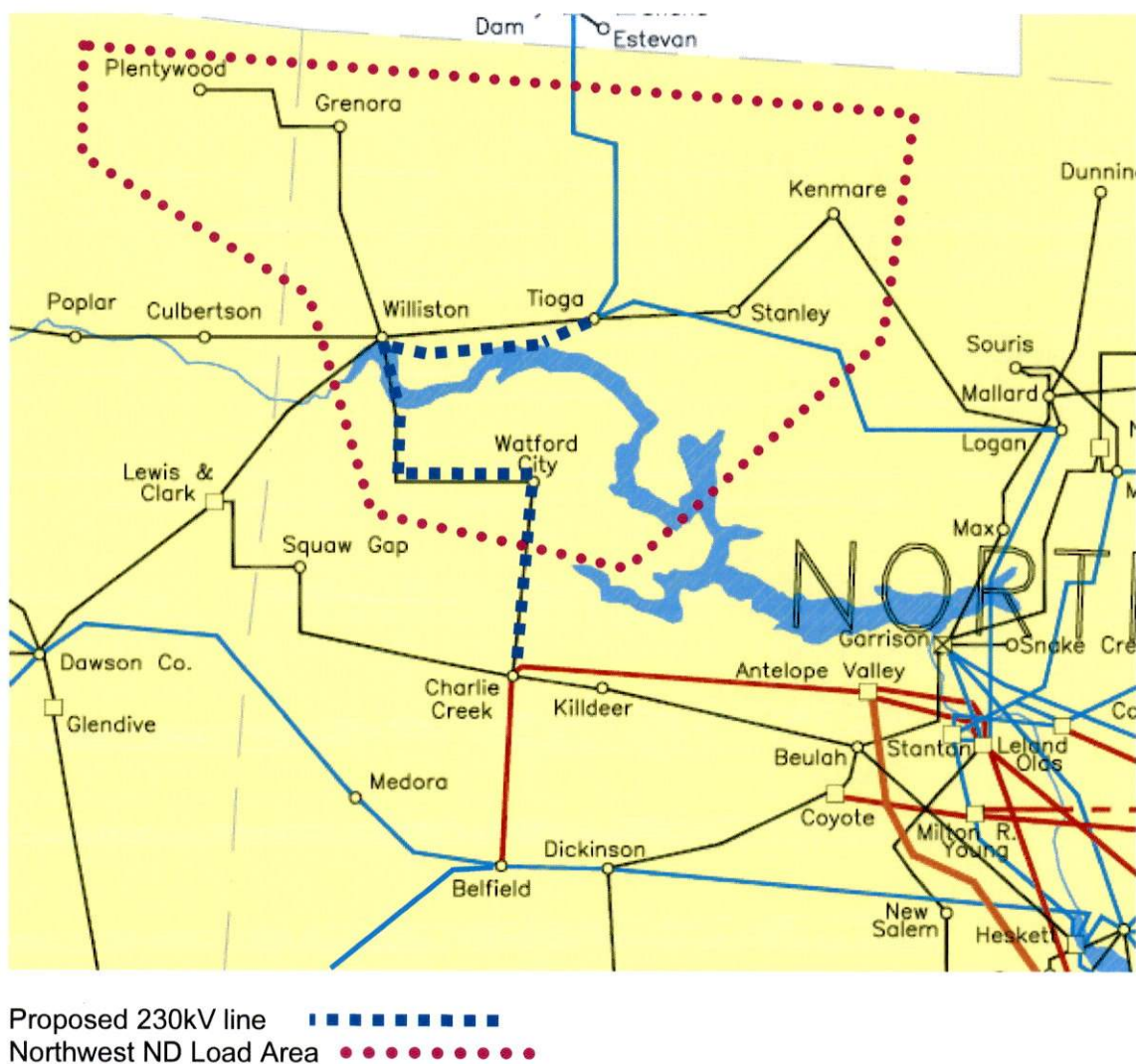


Figure #1 – Geographic Location

**Northwest North Dakota Load Forecast
2007 Forecast**

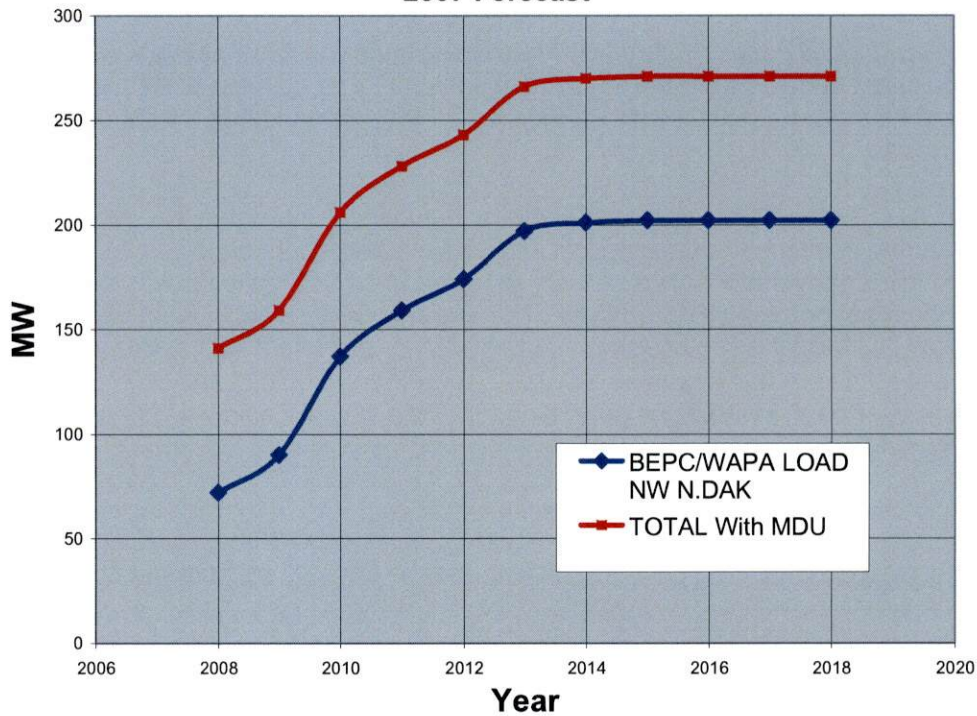


Table #1 – Northwest North Dakota Load Forecast

2.0 Introduction

The purpose of this study is to analyze the impact of the latest load forecast for the northwest North Dakota area. This area is defined as the area bounded by the pink dotted line in Figure #1. Electrical network load related to oil and gas extraction and delivery is growing at a fast rate. The 2007 load forecast for this area is provided in Table #1.

This study is the second phase in a larger effort to analyze the impact of the 2007 Basin Electric load forecast. The first phase was the analysis of the southwestern North Dakota area that showed a need for the Belfield-Rhame 230kV line.

3.0 Base Cases

3.1 Steady State

The steady state base cases are the 2011 heavy summer and 2011 heavy winter from the 2006 series. The latest updates from the MAPP website and other updates are added. The new capacitor banks are added at Dawson 115kV (2 x 20MVAR) and Little Missouri 115kV (2 x 20MVAR) buses.

The Miles City DC steady state powerflow model behavior complicates the steady state analysis. During solution iterations it blocks its power transfer during low voltage conditions. In block mode the steady state voltage usually recovers and the results appear to meet criteria. This only happens for east-west transfers. Therefore, in Miles City DC east-west transfer cases the Miles City DC model is replaced with a load with an equivalent MW and MVAR. For 200MW east-west operation the tie consumes 90MVAR, therefore a 200MW and 90MVAR load will be used. Shunt filter bank modeling is not changed. Miles City will also be tested operating in the west-east direction at 200MW.

RCDC Tie is scheduled 130MW east to west in all cases.

Saskatchewan schedules are tested 165MW north to south and 165MW south to north on the B10T path.

Area generation is set at the following levels;

| Generation | 2011 Heavy Summer MW | 2011 Heavy Winter MW |
|---------------------|----------------------|----------------------|
| Miles City CT | 0 | 0 |
| Ft Peck Hydro | 60 | 60 |
| Lewis & Clark | 44 | 44 |
| Glendive CT | 0 | 0 |
| Diamond Willow Wind | 0 | 0 |

Table #2

Several cases are constructed to include the parameters listed in this section. The following table describes each case.

| Case Naming Convention | | | | |
|------------------------|-------------|-------------------|-----------------|-----------------------------------|
| Case Name | Year/Season | B10T | MCDC | Tioga-Williston-Charlie Creek 230 |
| 1 | 2011 Summer | 165MW south-north | 200MW east-west | |
| 2 | 2011 Summer | 165MW north-south | 200MW east-west | |
| 3 | 2011 Summer | 165MW south-north | 150MW west-east | |
| 4 | 2011 Summer | 165MW north-south | 150MW west-east | |
| 5 | 2011 Summer | 165MW south-north | 200MW east-west | In Service |
| 6 | 2011 Summer | 165MW north-south | 200MW east-west | In Service |
| 7 | 2011 Summer | 165MW south-north | 150MW west-east | In Service |
| 8 | 2011 Summer | 165MW north-south | 150MW west-east | In Service |
| 9 | 2011 Winter | 165MW south-north | 200MW east-west | |
| 10 | 2011 Winter | 165MW north-south | 200MW east-west | |
| 11 | 2011 Winter | 165MW south-north | 150MW west-east | |
| 12 | 2011 Winter | 165MW north-south | 150MW west-east | |
| 13 | 2011 Winter | 165MW south-north | 200MW east-west | In Service |
| 14 | 2011 Winter | 165MW north-south | 200MW east-west | In Service |
| 15 | 2011 Winter | 165MW south-north | 150MW west-east | In Service |
| 16 | 2011 Winter | 165MW north-south | 150MW west-east | In Service |

Table #3

The Miles City DC tie limit is 200MW east-west and 150MW west-east.

3.2 Stability Case

The stability case is based on the 2006 NMORWG package 2008 summer off peak URGE case. NDEX is set to 2080MW. Additions required to support the 2080MW limit are added including the 60MVAR capacitors at Groton and the 75MVAR capacitors at Watertown. The "setexport" routine is run to establish the benchmark case with NDEX at 2080 and MHEX at 2180MW.

The Tioga-Williston-Charlie Creek 230kV line is added to the benchmark case to create the study case. The Setexport routine is run to re-establish NDEX at 2080MW.

4.0 Proposed Alternative

The WAPA Williston-Charlie Creek 115kV line is in poor physical condition and was scheduled for rebuilding several years ago, prior to the identification of this project. Subsequently, as part of this project, the rebuilding will be accelerated. The replacement transmission line will be built for 230kV operation.

The Tioga 230/115kV transformer overload is an existing limit to Saskatchewan imports. The normal import capability is 165MW. The increased 115kV network load has increased loading on the Tioga 230/115kV transformer to the extent the 165MW Saskatchewan import can no longer be accommodated. Also the loss of the Tioga 230/115kV transformer causes low

voltage on the 115kV system. Therefore a parallel transformer will provide additional thermal capacity to mitigate the existing overload and provide a back up for loss of the existing transformer to mitigate the low voltage issue.

The proposed Tioga-Williston 230kV line will complete the 230kV loop from Tioga to Charlie Creek. Without this facility the existing Williston-Tioga 115kV line is subject to overload.

5.0 Criteria

Voltage Criteria:

Normal Voltage Levels: The normal voltage range is a minimum of 0.95 PU and a maximum of 1.05 PU.

Emergency Voltage Limits: For periods less than 30 minutes, the emergency voltage range is a minimum of 0.90 PU and a maximum of 1.10 PU.

Loading Criteria:

Normal Loading Levels: The limit is 100% of normal ratings for transformers, conductors and line/substation related equipment.

Emergency Loading Limits: Not all facilities have an emergency limit. Continuous ratings (Rate A) will be monitored in the analysis. Facilities that are flagged as overloads will be checked for the presence of an emergency limit. If such a limit exists it will be noted in the results.

6.0 Methodology

The forced outage list includes all branches in western North Dakota plus the Tioga 230/115kV Transformer Trip with loss of the Tioga-Logan 230kV line and also the Leland Olds 345/230kV double outage. For the MCDC-Dawson 230kV outage the MCDC tie is auto-ramped to 60MW east-west and for the Dawson-Medora-Belfield 230kV outage the MCDC tie is auto-ramped to 100MW east-west. All of the buses and branches in the WAPA control area and adjacent control areas in central North Dakota are monitored.

Voltage stability in northwestern North Dakota will also be tested. The most critical voltage stability scenario is with MCDC east-west and B10T south-north. Referring to Table #3, cases #1 and #5 represent the critical scenario. PV curves will be created for each of these cases.

Fault duty at Tioga 230kV and 115kV, Williston 115kV, and Charlie Creek 115kV and 345kV buses will be calculated before and after the addition of the Tioga-Williston-Charlie Creek 230kV line.

A check on stability performance will be performed. A summer off peak, high transfer case (NDEX=2080), URGE case from the 2006 package will be used as a benchmark.

7.0 Steady State Contingency Results

Detailed Results are provided in Appendix A. The following is a summary of the results. The limiting condition for each case is listed.

7.1 2011 Summer Peak

| CASE 1 | |
|--|---------------------------|
| B10T = 165 South - North MCDC = 200 East - West | |
| Outage | Violation |
| System Intact | Stanley 115 Volts = 0.948 |
| Tioga 230/115 | Not Solved |
| AVS-C.Creek 345 | Not Solved |
| Logan-Tioga 230 with Tioga 230/115 Cross Trip | Not Solved |
| Tioga-Stanley 115 | Stanley 115 Volts = 0.843 |

| CASE 2 | |
|--|----------------------------------|
| B10T = 165 North - South MCDC = 200 East - West | |
| Outage | Violation |
| Tioga 230/115 | Tioga 115 Volts = 0.749 + others |
| Logan-Tioga 230 with Tioga 230/115 CrossTrip | Tioga 115 Volts = 0.728 + others |
| Tioga-Stanley 115 | Stanley 115 Volts = 0.895 |

| CASE 3 | |
|--|--|
| B10T = 165 South - North MCDC = 150 West - East | |
| Outage | Violation |
| Tioga 230/115 | Tioga 115 Volts = 0.698 + others |
| Logan-Tioga 230 with Tioga 230/115 CrossTrip | Tioga 115 Volts = 0.636 + others Logan-Kenmare 115 = 107.2% of 100MVA |
| Tioga-Stanley 115 | Stanley 115 Volts = 0.854 |

| CASE 4 | |
|--|----------------------------------|
| B10T = 165 North - South MCDC = 150 West - East | |
| Outage | Violation |
| Tioga 230/115 | Tioga 115 Volts = 0.749 + others |
| Logan-Tioga 230 with Tioga 230/115 CrossTrip | Tioga 115 Volts = 0.725 + others |
| Tioga-Stanley 115 | Stanley 115 Volts = 0.895 |

CASE 5 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer

B10T = 165 South - North

MCDC = 200 East - West

| | |
|---------------|--|
| No Violations | |
|---------------|--|

CASE 6 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer

B10T = 165 North - South

MCDC = 200 East - West

| | |
|---------------|--|
| No Violations | |
|---------------|--|

CASE 7 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer

B10T = 165 South - North

MCDC = 150 West - East

| | |
|---------------|--|
| No Violations | |
|---------------|--|

CASE 8 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer

B10T = 165 North - South

MCDC = 150 West - East

| | |
|---------------|--|
| No Violations | |
|---------------|--|

7.2 2011 Winter Peak

| | |
|---|------------|
| CASE 9 B10T = 165 South - North MCDC = 200 East - West | |
| Outage | Violation |
| System Intact | Not Solved |
| | |

| | |
|--|--------------------------------|
| CASE 10 B10T = 165 North - South MCDC = 200 East - West | |
| Outage | Violation |
| System Intact | Tioga 230/115 @ 160% of 100MVA |
| AVS-CCR345, Tioga-BDV230, Tioga230/115 | Not Solved |
| Tioga-Stanley 115 | Stanley 115 volts = 0.830 pu |

| | |
|--|------------|
| CASE 11 B10T = 165 South - North MCDC = 150 West - East | |
| Outage | Violation |
| System Intact | Not Solved |
| | |

| | |
|--|--------------------------------|
| CASE 12 B10T = 165 North - South MCDC = 150 West - East | |
| Outage | Violation |
| System Intact | Tioga 230/115 @ 160% of 100MVA |
| Tioga230/115 | Numerous 115kV low voltage |
| Tioga-Tiogajct 115 | Tiogajct 115 volts = 0.862 pu |
| Tioga-BDV230 | Numerous 115kV low voltage |
| Tioga-Stanley 115 | Stanley 115 volts = 0.823 pu |
| Tioga-Logan with Tioga 230/115 cross trip | Numerous 115kV low voltage |

| | |
|---|--|
| CASE 13 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer B10T = 165 South - North MCDC = 200 East - West | |
| | |
| No Violations | |

| | |
|---|--|
| CASE 14 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer B10T = 165 North - South MCDC = 200 East - West | |
| | |
| No Violations | |

| | |
|---|--|
| CASE 15 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer | |
| B10T = 165 South - North | |
| MCDC = 150 West - East | |
| | |
| No Violations | |

| | |
|---|--|
| CASE 16 – Add Tioga-Williston-Charlie Creek 230 and 2nd Tioga 230/115kV Transformer | |
| B10T = 165 North - South | |
| MCDC = 150 West - East | |
| | |
| No Violations | |

In the summer and winter peak base cases there are numerous criteria violations, including unsolved cases. The worst outages are the AVS-Charlie Creek 345kV line, the Tioga 230/115kV Transformer, Tioga-Boundary Dam 230kV Line, or the Tioga-Logan 230kV line. These violations occur during each combination of MCDC and Saskatchewan powerflow.

Addition of the Tioga-Williston- Charlie Creek 230kV line completes a 230kV loop between Tioga and the North Dakota coal field 345kV transmission system and thereby provides enough transmission system redundancy to maintain load serving capacity during contingencies.

8.0 Voltage Stability Results

PV curves are provided in Appendix B.

In the base case the AVS-Charlie Creek 345kV outage does not solve. Therefore the base case has inadequate voltage stability performance. Addition of the Tioga-Williston-Charlie Creek 230kV line allows the AVS-Charlie Creek 345kV outage to solve with loads at the 2011 summer peak level (220MW). However, the Dickinson 115kV voltage is barely above criteria and there is not adequate capacity to support projected load growth beyond 2012. Addition of 40MVARs of capacitance improves the voltage stability performance and increases the area load serving capability to 300MW. This allows the load growth to be accommodated through the end of the projected load forecast time period of 2020.

9.0 Stability Results

The following Table #4 shows that the addition of the Tioga-Williston-Charlie Creek 230kV line does not change any of the transient voltages for the regional faults. Three critical buses that have been noted with low voltages in the past are compared.

| | Groton 345 kV (PU) Transient Voltage Minimum | | | Wahpeton 115 kV (PU) Transient Voltage Minimum | | | Watertown 345 kV (PU) Transient Voltage Minimum | | |
|------------------------------|---|------|-------|---|------|------|--|------|------|
| | Disturbance | | | Disturbance | | | Disturbance | | |
| | ag1 | ei2 | nmz | ag1 | Ei2 | nmz | ag1 | ei2 | nmz |
| Base Case | 0.85 | 0.83 | 0.85 | 0.96 | 0.88 | 0.89 | 0.93 | 0.88 | 0.90 |
| Befield-Rhame 230kV Added | 0.86 | 0.83 | 0.86 | 0.96 | 0.88 | 0.89 | 0.94 | 0.88 | 0.90 |
| Delta Impact | +0.01 | 0.00 | +0.01 | 0.00 | 0.00 | 0.00 | +0.01 | 0.00 | 0.00 |

Table #4 - Transient Voltages at Critical Buses in MAPP Region

The results indicate a slightly positive impact. The transient low voltage increased by 0.01 p.u. or remained the same for each disturbance.

10.0 Fault Duty

The addition of the Tioga-Williston-Charlie Creek 230kV line will increase fault current in the area. The following table provides the three phase fault duties at Tioga, Williston, Watford City, and Charlie Creek.

| Three Phase Fault Duty - MVA | | |
|------------------------------|-------------------------------|------------------------------------|
| Bus | Pre – Tioga-Charlie Creek 230 | Tioga-Charlie Creek 230 In Service |
| Tioga 230kV | 1316 | 1750 |
| Tioga 115kV | 879 | 1189 |
| Williston 115kV | 724 | 1053 |
| Watford City 115kV | 590 | 651 |
| Charlie Creek 115kV | 1897 | 1929 |
| Charlie Creek 345kV | 2716 | 2975 |

Table #5

11.0 – Conclusion

The existing system is not able to accommodate the 2011 forecasted load in the Northwestern North Dakota area. Addition of the Tioga-Williston- Charlie Creek 230kV line completes a 230kV loop between Tioga and the North Dakota coal field 345kV transmission system and thereby provides enough transmission system redundancy to maintain load serving capacity during contingencies.

12.0 – Listing of Appendices

- Appendix A – Powerflow Results
- Appendix B – PV Results
- Appendix C – Stability Results Table

Appendix A

CASE #1

2011 Summer Peak

Saskatchewan 165MW South-North, MCDC 200MW East-West

CELL NAME = 1A1A2,B10T=-161,LOAD=253 NC, NC, DC-EW, B10T=165SN, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|--|--|--|
| OUTAGES: | | |
| 4_1A1A2*NOT SOLVED* OUTAGE: BELFELDT 345 -BELFELD4 230 | ****DID NOT SOLVE**** | |
| 11_1A1A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 114.5 % OF 100.0 MVA RATING |
| 12_1A1A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 119.1 % OF 100.0 MVA RATING |
| 15_1A1A2 OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | WATFORD7 115 WILISTN7 115 RICHLND7 115 GRENORA7 115 PLNTYWD7 115 KOCH 7 115 INDNHLS7 115 SQUAWGP7 115 BTHOLD 7 115 CLBR7SN7 115 KENMARE7 115 LEWIS 7 115 STANLEY7 115 TIOGA4 7 115 TIOGA7 7 115 LOGAN 7 115-BTHOLD 7 115 BTHOLD 7 115-KENMARE7 115 | 0.854 VOLTAGE LOWER THAN 0.9 0.786 VOLTAGE LOWER THAN 0.9 0.885 VOLTAGE LOWER THAN 0.9 0.768 VOLTAGE LOWER THAN 0.9 0.766 VOLTAGE LOWER THAN 0.9 0.881 VOLTAGE LOWER THAN 0.9 0.798 VOLTAGE LOWER THAN 0.9 0.887 VOLTAGE LOWER THAN 0.9 0.791 VOLTAGE LOWER THAN 0.9 0.837 VOLTAGE LOWER THAN 0.9 0.681 VOLTAGE LOWER THAN 0.9 0.895 VOLTAGE LOWER THAN 0.9 0.622 VOLTAGE LOWER THAN 0.9 0.622 VOLTAGE LOWER THAN 0.9 0.626 VOLTAGE LOWER THAN 0.9 115.7 % OF 100.0 MVA RATING 115.4 % OF 100.0 MVA RATING |
| 18_1A1A2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 123.2 % OF 250.0 MVA RATING 123.2 % OF 250.0 MVA RATING |

20_1A1A2 OUTAGE: CHAR.CK7 115 -CHARCKTY 345 BELFELDT 345-BELFELD3 345 117.0 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 117.0 % OF 319.0 MVA RATING
 Rate C = 122%

40_1A1A2*NOT SOLVED* OUTAGE: DAWSONC4 230 -MI CTYE4 230 ****DID NOT SOLVE****
 Outage initiates MCDC ramp which enables solution

47_1A1A2 OUTAGE: DICKNSN4 230 -BELFELD4 230 BELFELDT 345-BELFELD3 345 115.1 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 115.1 % OF 319.0 MVA RATING
 Rate C = 122%

48_1A1A2 OUTAGE: DICKNSN4 230 -HESKETT4 230 BELFELDT 345-BELFELD3 345 121.7 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 121.7 % OF 319.0 MVA RATING
 Rate C = 122%
 COYOTE 7 115-DICKSWH7 115 100.1 % OF 101.41 MVA RATING
 Coyote overload initiates unit runback

49_1A1A2*NOT SOLVED* OUTAGE: BELFELD3 345 -CHAR.CK3 345 ****DID NOT SOLVE****

50_1A1A2*NOT SOLVED* OUTAGE: BELFELD4 230 -RHAME 4 230 ****DID NOT SOLVE****

61_1A1A2 OUTAGE: BISON 4 230 -MAURINE4 230 BELFELDT 345-BELFELD3 345 102.1 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 102.1 % OF 319.0 MVA RATING
 Rate C = 122%

62_1A1A2 OUTAGE: BISON 4 230 -HETINGR4 230 BELFELDT 345-BELFELD3 345 101.0 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 101.0 % OF 319.0 MVA RATING
 Rate C = 122%

66_1A1A2 OUTAGE: CENTER 4 230 -HESKETT4 230 BELFELDT 345-BELFELD3 345 103.8 % OF 319.0 MVA RATING
 BELFELDT 345-BELFELD4 230 103.8 % OF 319.0 MVA RATING
 Rate C = 122%

67_1A1A2 OUTAGE: CENTER 3 345 -COYOTE 3 345 COYOTE 3 345-COYOTE 7 115 240.4 % OF 168.0 MVA RATING
 DKSN-ND7 115-DICKSWH7 115 131.4 % OF 101.41 MVA RATING
 BEULAH 7 115-COYOTE 7 115 254.0 % OF 101.4 MVA RATING
 COYOTE 7 115-DICKSWH7 115 137.8 % OF 101.41 MVA RATING
 Coyote overload initiates unit runback

71_1A1A2*NOT SOLVED* OUTAGE: ANTELOP3 345 -CHAR.CK3 345 ****DID NOT SOLVE****

72_1A1A2 OUTAGE: TIOGA4 4 230 -LOGAN 4 230 ETHOLD 7 115 0.887 VOLTAGE LOWER THAN 0.9
 KENMARE7 115 0.853 VOLTAGE LOWER THAN 0.9

| | | |
|--|------------------------------|------------------------------|
| | STANLEY7 115 | 0.860 VOLTAGE LOWER THAN 0.9 |
| | LOGAN 7 115-BTHOLD 7 115 | 127.2 % OF 100.0 MVA RATING |
| | BTHOLD 7 115-KENMARE7 115 | 126.4 % OF 100.0 MVA RATING |
| | KENMARE7 115-STANLEY7 115 | 105.2 % OF 101.67 MVA RATING |
| 77_1A1A2 OUTAGE: LELANDO4 230 -LOGAN 4 230 | MALLARD7 115-MAX 7 115 | 111.7 % OF 120.0 MVA RATING |
| | Line Thermal Rating = 199MVA | |
| | MALLARD7 115-LOGAN 7 115 | 126.9 % OF 159.0 MVA RATING |
| | Line Thermal Rating = 218MVA | |
| | GARRISN7 115-MAX 7 115 | 117.2 % OF 120.0 MVA RATING |
| | Line Thermal Rating = 199MVA | |
| 79_1A1A2*NOT SOLVED* OUTAGE: LTLMISS4 230 -RHAME 4 230 | ***DID NOT SOLVE*** | |
| 82_1A1A2 OUTAGE: BOWMAN 4 230 -HETINGR4 230 | BELFELDT 345-BELFELD3 345 | 101.6 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 101.6 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| 95_1A1A2 OUTAGE: TIOGA4 7 115 -STANLEY7 115 | KENMARE7 115 | 0.880 VOLTAGE LOWER THAN 0.9 |
| | STANLEY7 115 | 0.847 VOLTAGE LOWER THAN 0.9 |
| 100_1A1A2 OUTAGE: DICKSWH7 115 -COYOTE 7 115 | BELFELDT 345-BELFELD3 345 | 105.0 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 105.0 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| 104_1A1A2*NOT SOLVED*OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS | ***DID NOT SOLVE*** | |
| 105_1A1A2 OUTAGE: CHAR.CK7 115 -WATFORD7 115 | BELFELDT 345-BELFELD3 345 | 105.1 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 105.1 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| 106_1A1A2 OUTAGE: CHAR.CK7 115 -R.RIDER7 115 | BELFELDT 345-BELFELD3 345 | 104.8 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 104.8 % OF 319.0 MVA RATING |
| | Rate C = 122% | |

CASE #2

2011 Summer Peak

Saskatchewan 165MW North-South, MCDC 200MW East-West

CELL NAME = 1A1B2,B10T=164,LOAD=235 NC, NC, DC-EW, B10T=165NS, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|--|
| OUTAGES: | | |
| 4_1A1B2 OUTAGE: BELFELDT 345 -BELFELD4 230 | DKSN-ND7 115-DICKSWH7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 118.5 % OF 101.41 MVA RATING 124.9 % OF 101.41 MVA RATING |
| 11_1A1B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 112.4 % OF 100.0 MVA RATING |
| 12_1A1B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 116.8 % OF 100.0 MVA RATING |
| 15_1A1B2 OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | WATTFORD7 115 WILISTN7 115 RICHLND7 115 GRENORA7 115 PLNTYWD7 115 KOCH 7 115 INDNHLS7 115 SQUAWGP7 115 BTHOLD 7 115 CLBR7SN7 115 KENMARE7 115 LEWIS 7 115 STANLEY7 115 TIOGA4 7 115 TIOGA7 7 115 BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% LOGAN 7 115-BTHOLD 7 115 BTHOLD 7 115-KENMARE7 115 Line Thermal Rating = 144MVA KENMARE7 115-STANLEY7 115 | 0.859 VOLTAGE LOWER THAN 0.9 0.793 VOLTAGE LOWER THAN 0.9 0.889 VOLTAGE LOWER THAN 0.9 0.775 VOLTAGE LOWER THAN 0.9 0.773 VOLTAGE LOWER THAN 0.9 0.885 VOLTAGE LOWER THAN 0.9 0.804 VOLTAGE LOWER THAN 0.9 0.890 VOLTAGE LOWER THAN 0.9 0.796 VOLTAGE LOWER THAN 0.9 0.842 VOLTAGE LOWER THAN 0.9 0.676 VOLTAGE LOWER THAN 0.9 0.899 VOLTAGE LOWER THAN 0.9 0.616 VOLTAGE LOWER THAN 0.9 0.620 VOLTAGE LOWER THAN 0.9 0.625 VOLTAGE LOWER THAN 0.9 100.9 % OF 319.0 MVA RATING 100.9 % OF 319.0 MVA RATING 126.2 % OF 100.0 MVA RATING 126.0 % OF 100.0 MVA RATING 101.2 % OF 101.67 MVA RATING |

| | | | |
|---|---|------------|-------------------|
| 18_1A1B2 OUTAGE: LELANDO4 230 -LELND2TY 345 | LELANDO3 345-LELND1TY 345 | 102.8 % OF | 250.0 MVA RATING |
| | LELANDO4 230-LELND1TY 345 | 102.8 % OF | 250.0 MVA RATING |
| | Overload of L.Olds transformers initiates tripping scheme | | |
| 20_1A1B2 OUTAGE: CHAR.CK7 115 -CHARCKTY 345 | BELFELDT 345-BELFELD3 345 | 111.4 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 111.4 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |
| 33_1A1B2 OUTAGE: STANTON4 230 -LELANDO4 230 | BELFELDT 345-BELFELD3 345 | 100.5 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 100.5 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |
| 37_1A1B2 OUTAGE: JAMESTN3 345 -CENTER 3 345 | COYOTE 3 345-COYOTE 7 115 | 103.9 % OF | 168.0 MVA RATING |
| | Coyote overload initiates unit runback | | |
| 40_1A1B2*NOT SOLVED* OUTAGE: DAWSONC4 230 -MI CTYE4 230 | ****DID NOT SOLVE***** | | |
| | Outage initiates MCDC ramp which enables solution | | |
| 47_1A1B2 OUTAGE: DICKNSN4 230 -BELFELD4 230 | BELFELDT 345-BELFELD3 345 | 111.1 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 111.1 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |
| 48_1A1B2 OUTAGE: DICKNSN4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 | 118.6 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 118.6 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |
| 49_1A1B2 OUTAGE: BELFELD3 345 -CHAR.CK3 345 | DKSN-ND7 115-DICKSWH7 115 | 118.6 % OF | 101.41 MVA RATING |
| | COYOTE 7 115-DICKSWH7 115 | 125.0 % OF | 101.41 MVA RATING |
| | Coyote overload initiates unit runback | | |
| 66_1A1B2 OUTAGE: CENTER 4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 | 104.9 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 104.9 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |
| 67_1A1B2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | COYOTE 3 345-COYOTE 7 115 | 240.2 % OF | 168.0 MVA RATING |
| | DKSN-ND7 115-DICKSWH7 115 | 131.3 % OF | 101.41 MVA RATING |
| | BEULAH 7 115-COYOTE 7 115 | 253.4 % OF | 101.4 MVA RATING |
| | BEULAH 7 115-HESKETT7 115 | 105.1 % OF | 88.0 MVA RATING |
| | COYOTE 7 115-DICKSWH7 115 | 137.7 % OF | 101.41 MVA RATING |
| | Coyote overload initiates unit runback | | |
| 70_1A1B2 OUTAGE: ANTELOP3 345 -BRDLAND3 345 | BELFELDT 345-BELFELD3 345 | 100.1 % OF | 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 100.1 % OF | 319.0 MVA RATING |
| | Rate C = 122% | | |

71_1A1B2*NOT SOLVED* OUTAGE: ANTELOP3 345 -CHAR.CK3 345 *****DID NOT SOLVE*****

79_1A1B2*NOT SOLVED* OUTAGE: LTLMISS4 230 -RHAME 4 230 *****DID NOT SOLVE*****

95_1A1B2 OUTAGE: TIOGA4 7 115 -STANLEY7 115 **STANLEY7 115 0.896 VOLTAGE LOWER THAN 0.9**

100_1A1B2 OUTAGE: DICKSWH7 115 -COYOTE 7 115
BELFELDT 345-BELFELD3 345 105.1 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 105.1 % OF 319.0 MVA RATING
Rate C = 122%

104 1A1B2OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS **WATFORD7 115 0.853 VOLTAGE LOWER THAN 0.9**

WILISTN7 115 0.785 VOLTAGE LOWER THAN 0.9
RICHLND7 115 0.884 VOLTAGE LOWER THAN 0.9
GRENORA7 115 0.766 VOLTAGE LOWER THAN 0.9
PLNTYWD7 115 0.764 VOLTAGE LOWER THAN 0.9
KOCH 7 115 0.880 VOLTAGE LOWER THAN 0.9
BICNTNL7 115 0.900 VOLTAGE LOWER THAN 0.9
INDNHLS7 115 0.797 VOLTAGE LOWER THAN 0.9
SQUAWGP7 115 0.886 VOLTAGE LOWER THAN 0.9
BTHOLD 7 115 0.786 VOLTAGE LOWER THAN 0.9
CLBR7SN7 115 0.836 VOLTAGE LOWER THAN 0.9
KENMARE7 115 0.668 VOLTAGE LOWER THAN 0.9
LEWIS 7 115 0.895 VOLTAGE LOWER THAN 0.9
STANLEY7 115 0.609 VOLTAGE LOWER THAN 0.9
TIOGA4 7 115 0.612 VOLTAGE LOWER THAN 0.9
TIOGA7 7 115 0.617 VOLTAGE LOWER THAN 0.9

BELFELDT 345-BELFELD3 345 100.3 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 100.3 % OF 319.0 MVA RATING
Rate C = 122%
LOGAN 7 115-BTHOLD 7 115 122.9 % OF 100.0 MVA RATING
BTHOLD 7 115-KENMARE7 115 122.6 % OF 100.0 MVA RATING
Line Thermal Rating = 144MVA

105_1A1B2 OUTAGE: CHAR.CK7 115 -WATFORD7 115
BELFELDT 345-BELFELD3 345 102.1 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 102.1 % OF 319.0 MVA RATING
Rate C = 122%

TIOGA4 7 115-TIOGA7 7 115 100.4 % OF 120.0 MVA RATING

106_1A1B2 OUTAGE: CHAR.CK7 115 -R.RIDER7 115
BELFELDT 345-BELFELD3 345 103.2 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 103.2 % OF 319.0 MVA RATING
Rate C = 122%

CASE #3

2011 Summer Peak

Saskatchewan 165MW South-North, MCDC 200MW West-East

CELL NAME = 1A2A2,B10T=-159,LOAD=248 NC, NC, DC-WE, B10T=165SN, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|--|
| OUTAGES: | | |
| 11_1A2A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 107.5 % OF 100.0 MVA RATING |
| 12_1A2A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 111.8 % OF 100.0 MVA RATING |
| 15_1A2A2 OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | KENMARE7 115 STANLEY7 115 TIOGA4 7 115 TIOGA7 7 115 | 0.846 VOLTAGE LOWER THAN 0.9 0.809 VOLTAGE LOWER THAN 0.9 0.808 VOLTAGE LOWER THAN 0.9 0.811 VOLTAGE LOWER THAN 0.9 |
| 18_1A2A2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 139.1 % OF 250.0 MVA RATING 139.1 % OF 250.0 MVA RATING |
| 67_1A2A2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | COYOTE 3 345-COYOTE 7 115 DKSN-ND7 115-DICKSWH7 115 BEULAH 7 115-COYOTE 7 115 BEULAH 7 115-HESKETT7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 238.7 % OF 168.0 MVA RATING 100.1 % OF 101.41 MVA RATING 280.4 % OF 101.4 MVA RATING 113.1 % OF 88.0 MVA RATING 106.3 % OF 101.41 MVA RATING |
| 72_1A2A2 OUTAGE: TIOGA4 4 230 -LOGAN 4 230 | KENMARE7 115 STANLEY7 115 LOGAN 7 115-BTHOLD 7 115 BTHOLD 7 115-KENMARE7 115 Line Thermal Rating = 144MVA | 0.888 VOLTAGE LOWER THAN 0.9 0.887 VOLTAGE LOWER THAN 0.9 108.9 % OF 100.0 MVA RATING 108.1 % OF 100.0 MVA RATING |
| 77_1A2A2 OUTAGE: LELAND04 230 -LOGAN 4 230 | MALLARD7 115-MAX 7 115 Line Thermal Rating = 199MVA MALLARD7 115-LOGAN 7 115 Line Thermal Rating = 218MVA GARRISN7 115-MAX 7 115 | 108.1 % OF 120.0 MVA RATING 105.9 % OF 159.0 MVA RATING 113.6 % OF 120.0 MVA RATING |

Line Thermal Rating = 199MVA

95 1A2A2 OUTAGE: TIOGA4 7 115 -STANLEY7 115

| | | | |
|--------------|-------|--------------------|-----|
| KENMARE7 115 | 0.892 | VOLTAGE LOWER THAN | 0.9 |
| STANLEY7 115 | 0.860 | VOLTAGE LOWER THAN | 0.9 |

104 1A2A2OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS

| | | | |
|--------------|-------|---------------------|-----|
| TIOGA4 4 230 | 1.139 | VOLTAGE HIGHER THAN | 1.1 |
| GRENORA7 115 | 0.896 | VOLTAGE LOWER THAN | 0.9 |
| PENNYWD7 115 | 0.897 | VOLTAGE LOWER THAN | 0.9 |
| BTHOLD 7 115 | 0.896 | VOLTAGE LOWER THAN | 0.9 |
| KENMARE7 115 | 0.832 | VOLTAGE LOWER THAN | 0.9 |
| STANLEY7 115 | 0.792 | VOLTAGE LOWER THAN | 0.9 |
| TIOGA4 7 115 | 0.793 | VOLTAGE LOWER THAN | 0.9 |
| TIOGA7 7 115 | 0.796 | VOLTAGE LOWER THAN | 0.9 |

CASE #4

2011 Summer Peak

Saskatchewan 165MW North-South, MCDC 200MW West-East

CELL NAME = 1A2B2,B10T=163,LOAD=230 NC, NC, DC-WE, B10T=165NS, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|--|---|
| OUTAGES: | | |
| 11_1A2B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 105.7 % OF 100.0 MVA RATING |
| 12_1A2B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 109.9 % OF 100.0 MVA RATING |
| 15_1A2B2 OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | KENMARE7 115 STANLEY7 115 TIOGA4 7 115 TIOGA7 7 115 | 0.853 VOLTAGE LOWER THAN 0.9 0.817 VOLTAGE LOWER THAN 0.9 0.820 VOLTAGE LOWER THAN 0.9 0.823 VOLTAGE LOWER THAN 0.9 |
| 18_1A2B2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 119.6 % OF 250.0 MVA RATING 119.6 % OF 250.0 MVA RATING |
| 67_1A2B2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | SQBUTTE4 230-CENTER 3 345 COYOTE 3 345-COYOTE 7 115 DKSN-ND7 115-DICKSWH7 115 BEULAH 7 115-COYOTE 7 115 BEULAH 7 115-HESKETT7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 100.5 % OF 336.0 MVA RATING 238.8 % OF 168.0 MVA RATING 100.5 % OF 101.41 MVA RATING 280.1 % OF 101.4 MVA RATING 120.1 % OF 88.0 MVA RATING 106.7 % OF 101.41 MVA RATING |
| 95_1A2B2 OUTAGE: TIOGA4 7 115 -STANLEY7 115 | STANLEY7 115 | 0.896 VOLTAGE LOWER THAN 0.9 |
| 104_1A2B2OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS | KENMARE7 115 STANLEY7 115 TIOGA4 7 115 TIOGA7 7 115 | 0.847 VOLTAGE LOWER THAN 0.9 0.811 VOLTAGE LOWER THAN 0.9 0.813 VOLTAGE LOWER THAN 0.9 0.816 VOLTAGE LOWER THAN 0.9 |

CASE #5

2011 Summer Peak

Tioga-Williston-Charlie Creek 230kV In Service Saskatchewan 165MW South-North, MCDC 200MW East-West

CELL NAME = 1B1A2,B10T=-160,LOAD=240 NC, T-W-CCR230, DC-EW, B10T=165SN, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|--|---|
| OUTAGES: | | |
| 4_1B1A2 OUTAGE: BELFELDT 345 -BELFELD4 230 | DKSN-ND7 115-DICKSWH7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 116.1 % OF 101.41 MVA RATING 122.6 % OF 101.41 MVA RATING |
| 11_1B1A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 114.6 % OF 100.0 MVA RATING |
| 12_1B1A2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 119.2 % OF 100.0 MVA RATING |
| 18_1B1A2 OUTAGE: LELANDO4 230 -LELND2TY 345 | LELANDO3 345-LELND1TY 345 LELANDO4 230-LELND1TY 345 Rate C = 120% | 107.3 % OF 250.0 MVA RATING 107.3 % OF 250.0 MVA RATING |
| 21_1B1A2 OUTAGE: CHAR.CK3 345 -CHAR.CK4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% | 102.2 % OF 319.0 MVA RATING 102.2 % OF 319.0 MVA RATING |
| 40_1B1A2*NOT SOLVED* OUTAGE: DAWSONC4 230 -MI CTYE4 230 | ****DID NOT SOLVE**** Outage initiates MCDC ramp which enables solution | |
| 47_1B1A2 OUTAGE: DICKNSN4 230 -BELFELD4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% ANTELOP3 345-CHAR.CK3 345 Line Thermal Rating = 1135MVA | 106.9 % OF 319.0 MVA RATING 106.9 % OF 319.0 MVA RATING 101.7 % OF 538.0 MVA RATING |
| 48_1B1A2 OUTAGE: DICKNSN4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% ANTELOP3 345-CHAR.CK3 345 Line Thermal Rating = 1135MVA COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 112.3 % OF 319.0 MVA RATING 112.3 % OF 319.0 MVA RATING 105.0 % OF 538.0 MVA RATING 101.1 % OF 101.41 MVA RATING |

49_1B1A2 OUTAGE: BELFELD3 345 -CHAR.CK3 345 DKSND7 115-DICKSWH7 115 116.3 % OF 101.41 MVA RATING
COYOTE 7 115-DICKSWH7 115 122.7 % OF 101.41 MVA RATING
Coyote overload initiates unit runback

67_1B1A2 OUTAGE: CENTER 3 345 -COYOTE 3 345 COYOTE 3 345-COYOTE 7 115 240.4 % OF 168.0 MVA RATING
DKSND7 115-DICKSWH7 115 133.3 % OF 101.41 MVA RATING
BEULAH 7 115-COYOTE 7 115 252.0 % OF 101.4 MVA RATING
COYOTE 7 115-DICKSWH7 115 139.7 % OF 101.41 MVA RATING
Coyote overload initiates unit runback

71_1B1A2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345 COYOTE 3 345-COYOTE 7 115 108.5 % OF 168.0 MVA RATING
DICKNSN4 230-BELFELD4 230 101.6 % OF 319.0 MVA RATING
DKSND7 115-DICKSWH7 115 115.8 % OF 101.41 MVA RATING
HALIDAY7 115-BEULAH 7 115 100.1 % OF 120.0 MVA RATING
COYOTE 7 115-DICKSWH7 115 122.3 % OF 101.41 MVA RATING
Coyote overload initiates unit runback

72_1B1A2 OUTAGE: TIOGA4 4 230 -LOGAN 4 230 ANTELOP3 345-CHAR.CK3 345 104.2 % OF 538.0 MVA RATING
Line Thermal Rating = 1135MVA

77_1B1A2 OUTAGE: LELAND04 230 -LOGAN 4 230 ANTELOP3 345-CHAR.CK3 345 102.0 % OF 538.0 MVA RATING
Line Thermal Rating = 1135MVA

79_1B1A2*NOT SOLVED* OUTAGE: LTLMISS4 230 -RHAME 4 230 *****DID NOT SOLVE*****
Fix by Shifting Local Load From Little Missouri To Rhame

85_1B1A2 OUTAGE: CHAR.CK4 230 -WATFORD4 230 BELFELDT 345-BELFELD3 345 102.3 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 102.3 % OF 319.0 MVA RATING
Rate C = 122%

86_1B1A2 OUTAGE: WATFORD4 230 -INDNHLS4 230 BELFELDT 345-BELFELD3 345 100.9 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 100.9 % OF 319.0 MVA RATING
Rate C = 122%

87_1B1A2 OUTAGE: INDNHLS4 230 -WILISTN4 230 BELFELDT 345-BELFELD3 345 100.5 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 100.5 % OF 319.0 MVA RATING
Rate C = 122%

104_1B1A2OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS ANTELOP3 345-CHAR.CK3 345 104.2 % OF 538.0 MVA RATING
Line Thermal Rating = 1135MVA

CASE #6

2011 Summer Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW North-South, MCDC 200MW East-West

CELL NAME = 1B1B2,B10T=163,LOAD=229 NC, T-W-CCR230, DC-EW, B10T=165NS, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|--|---|--|
| OUTAGES: | | |
| 4_1B1B2 OUTAGE: BELFELDT 345 -BELFELD4 230 | DKSN-ND7 115-DICKSWH7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 113.0 % OF 101.41 MVA RATING 119.4 % OF 101.41 MVA RATING |
| 11_1B1B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 111.6 % OF 100.0 MVA RATING |
| 12_1B1B2 OUTAGE: BISMARCK4 230 -BISMARCK7 115 | BISMARCK4 230-BISMARCK7 115 Rate C = 125MVA | 116.0 % OF 100.0 MVA RATING |
| 18_1B1B2 OUTAGE: LELANDO4 230 -LELND2TY 345 | LELANDO3 345-LELND1TY 345 LELANDO4 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 107.1 % OF 250.0 MVA RATING 107.1 % OF 250.0 MVA RATING |
| 37_1B1B2 OUTAGE: JAMESTN3 345 -CENTER 3 345 | COYOTE 3 345-COYOTE 7 115 Coyote overload initiates unit runback | 102.1 % OF 168.0 MVA RATING |
| 40_1B1B2*NOT SOLVED* OUTAGE: DAWSONC4 230 -MICTYE4 230 | ****DID NOT SOLVE**** Outage initiates MCDC ramp which enables solution | |
| 47_1B1B2 OUTAGE: DICKNSN4 230 -BELFELD4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% | 106.6 % OF 319.0 MVA RATING 106.6 % OF 319.0 MVA RATING |
| 48_1B1B2 OUTAGE: DICKNSN4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% | 113.9 % OF 319.0 MVA RATING 113.9 % OF 319.0 MVA RATING |
| 49_1B1B2 OUTAGE: BELFELD3 345 -CHAR.CK3 345 | DKSN-ND7 115-DICKSWH7 115 COYOTE 7 115-DICKSWH7 115 | 113.2 % OF 101.41 MVA RATING 119.6 % OF 101.41 MVA RATING |

Coyote overload initiates unit runback

66_1B1B2 OUTAGE: CENTER 4 230 -HESKETT4 230

BELFELDT 345-BELFELD3 345 102.3 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 102.3 % OF 319.0 MVA RATING
Rate C = 122%

67_1B1B2 OUTAGE: CENTER 3 345 -COYOTE 3 345

COYOTE 3 345-COYOTE 7 115 239.9 % OF 168.0 MVA RATING
DKSN-ND7 115-DICKSWH7 115 130.1 % OF 101.41 MVA RATING
BEULAH 7 115-COYOTE 7 115 254.0 % OF 101.4 MVA RATING
BEULAH 7 115-HESKETT7 115 106.7 % OF 88.0 MVA RATING
COYOTE 7 115-DICKSWH7 115 136.5 % OF 101.41 MVA RATING
Coyote overload initiates unit runback

71_1B1B2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345

COYOTE 7 115-DICKSWH7 115 104.5 % OF 101.41 MVA RATING
Coyote overload initiates unit runback

100_1B1B2 OUTAGE: DICKSWH7 115 -COYOTE 7 115

BELFELDT 345-BELFELD3 345 102.3 % OF 319.0 MVA RATING
BELFELDT 345-BELFELD4 230 102.3 % OF 319.0 MVA RATING
Rate C = 122%

CASE #7

2011 Summer Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW South-North, MCDC 200MW West-East

CELL NAME = 1B2A2,B10T=-162,LOAD=237 NC, T-W-CCR230, DC-WE, B10T=165SN, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|--|
| OUTAGES: | | |
| 11_1B2A2 OUTAGE: BISMAR4 230 -BISMAR7 115 | BISMAR4 230-BISMAR7 115 Rate C = 125MVA | 107.9 % OF 100.0 MVA RATING |
| 12_1B2A2 OUTAGE: BISMAR4 230 -BISMAR7 115 | BISMAR4 230-BISMAR7 115 Rate C = 125MVA | 112.2 % OF 100.0 MVA RATING |
| 18_1B2A2 OUTAGE: LELAND4 230 -LELND2TY 345 | LELAND3 345-LELND1TY 345 LELAND4 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 119.9 % OF 250.0 MVA RATING 119.9 % OF 250.0 MVA RATING |
| 67_1B2A2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | COYOTE 3 345-COYOTE 7 115 DKSN-ND7 115-DICKSWH7 115 BEULAH 7 115-COYOTE 7 115 BEULAH 7 115-HESKETT7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 238.9 % OF 168.0 MVA RATING 103.1 % OF 101.41 MVA RATING 277.6 % OF 101.4 MVA RATING 113.4 % OF 88.0 MVA RATING 109.4 % OF 101.41 MVA RATING |

CASE #8

2011 Summer Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW North-South, MCDC 200MW West-East

CELL NAME = 1B2B2,B10T=163,LOAD=226 NC, T-W-CCR230, DC-WE, B10T=165NS, JUL11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|--|---|
| OUTAGES: | | |
| 11_1B2B2 OUTAGE: BISMAR4 230 -BISMAR7 115 | BISMAR4 230-BISMAR7 115 Rate C = 125MVA | 105.4 % OF 100.0 MVA RATING |
| 12_1B2B2 OUTAGE: BISMAR4 230 -BISMAR7 115 | BISMAR4 230-BISMAR7 115 Rate C = 125MVA | 109.5 % OF 100.0 MVA RATING |
| 18_1B2B2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 120.7 % OF 250.0 MVA RATING 120.7 % OF 250.0 MVA RATING |
| 67_1B2B2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | SQBUTTE4 230-CENTER 3 345 COYOTE 3 345-COYOTE 7 115 DKSN-ND7 115-DICKSWH7 115 BEULAH 7 115-COYOTE 7 115 BEULAH 7 115-HESKETT7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 100.6 % OF 336.0 MVA RATING 238.8 % OF 168.0 MVA RATING 100.1 % OF 101.41 MVA RATING 280.3 % OF 101.4 MVA RATING 121.1 % OF 88.0 MVA RATING 106.4 % OF 101.41 MVA RATING |

CASE #9

2011 Winter Peak

Saskatchewan 165MW South-North, MCDC 200MW East-West

CELL NAME = 1A1A2*NOT SOLVED*,B10T=-17 NC, NC, DC-EW, B10T=165SN, JAN11

STATUS

VIOLATED ELEMENT

PU

=====

=====

=====

SYSTEM INTACT

DID NOT SOLVE

CASE #10

2011 Winter Peak

Saskatchewan 165MW North-South, MCDC 200MW East-West

CELL NAME = 1A1B2,B10T=165 NC, NC, DC-EW, B10T=165NS, JAN11

| STATUS | VIOLATED ELEMENT | PU |
|---|---|--|
| ===== | ===== | ===== |
| SYSTEM INTACT | TIOGA4 4 230-TIOGA4 7 115 | 160.2 % OF 100.0 MVA RATING |
| OUTAGES: | | |
| 15_1A1B2*NOT SOLVED* OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | ***DID NOT SOLVE*** | |
| 16_1A1B2 OUTAGE: TIOGA4 7 115 -TIOGA7 7 115 | GRENORA7 115 PLNTYWD7 115 INDNHLS7 115 TIOGA7 7 115 | 0.895 VOLTAGE LOWER THAN 0.9 0.899 VOLTAGE LOWER THAN 0.9 0.899 VOLTAGE LOWER THAN 0.9 0.803 VOLTAGE LOWER THAN 0.9 |
| 18_1A1B2 OUTAGE: LELANDO4 230 -LELND2TY 345 | LELANDO3 345-LELND1TY 345 LELANDO4 230-LELND1TY 345 | 170.1 % OF 250.0 MVA RATING 170.1 % OF 250.0 MVA RATING |
| | Overload of L.Olds transformers initiates tripping scheme | |
| 20_1A1B2 OUTAGE: CHAR.CK7 115 -CHARCKTY 345 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 | 107.9 % OF 319.0 MVA RATING 107.9 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| | TIOGA4 7 115-TIOGA7 7 115 | 107.4 % OF 108.9 MVA RATING |
| 37_1A1B2 OUTAGE: JAMESTN3 345 -CENTER 3 345 | COYOTE 3 345-COYOTE 7 115 | 101.9 % OF 168.0 MVA RATING |
| | Coyote overload initiates unit runback | |
| 40_1A1B2 OUTAGE: DAWSONC4 230 -MI CTYE4 230 | DAWSONCT 230 FALLON T 115 MICTYE1T 230 MI CTYE857.0 BELFELDT 345 BISON 869.0 CIRCLE 7 115 DAWSONC4 230 DAWSONC7 115 FALLON 7 115 MI CTYE4 230 | 0.851 VOLTAGE LOWER THAN 0.9 0.688 VOLTAGE LOWER THAN 0.9 0.505 VOLTAGE LOWER THAN 0.9 0.496 VOLTAGE LOWER THAN 0.9 0.888 VOLTAGE LOWER THAN 0.9 0.831 VOLTAGE LOWER THAN 0.9 0.881 VOLTAGE LOWER THAN 0.9 0.872 VOLTAGE LOWER THAN 0.9 0.853 VOLTAGE LOWER THAN 0.9 0.709 VOLTAGE LOWER THAN 0.9 0.490 VOLTAGE LOWER THAN 0.9 |

| | |
|---------------------------|------------------------------|
| MI CTYE7 115 | 0.505 VOLTAGE LOWER THAN 0.9 |
| MEDORA 4 230 | 0.888 VOLTAGE LOWER THAN 0.9 |
| DKSN-ND7 115 | 0.886 VOLTAGE LOWER THAN 0.9 |
| BELFELD4 230 | 0.894 VOLTAGE LOWER THAN 0.9 |
| BISON 4 230 | 0.844 VOLTAGE LOWER THAN 0.9 |
| MAURINE4 230 | 0.888 VOLTAGE LOWER THAN 0.9 |
| LTLMISS7 115 | 0.681 VOLTAGE LOWER THAN 0.9 |
| LTLMISS4 230 | 0.680 VOLTAGE LOWER THAN 0.9 |
| BAKER 4 230 | 0.653 VOLTAGE LOWER THAN 0.9 |
| BAKER 7 115 | 0.710 VOLTAGE LOWER THAN 0.9 |
| BOWMAN 4 230 | 0.755 VOLTAGE LOWER THAN 0.9 |
| DICKSWH7 115 | 0.899 VOLTAGE LOWER THAN 0.9 |
| DICKNTH7 115 | 0.899 VOLTAGE LOWER THAN 0.9 |
| GLENDCT7 115 | 0.831 VOLTAGE LOWER THAN 0.9 |
| HETINGR4 230 | 0.806 VOLTAGE LOWER THAN 0.9 |
| HETINGR7 115 | 0.858 VOLTAGE LOWER THAN 0.9 |
| GASCOYN7 115 | 0.859 VOLTAGE LOWER THAN 0.9 |
| N ENGLN7 115 | 0.872 VOLTAGE LOWER THAN 0.9 |
| RHAME 7 115 | 0.707 VOLTAGE LOWER THAN 0.9 |
| RHAME 4 230 | 0.730 VOLTAGE LOWER THAN 0.9 |
| DAWSONC7 115-FALLON 7 115 | 138.5 % OF 80.0 MVA RATING |
| FALLON 7 115-MI CTYE7 115 | 137.3 % OF 80.0 MVA RATING |
| MI CTYE4 230-BAKER 4 230 | 123.7 % OF 200.0 MVA RATING |
| LTLMISS4 230-RHAME 4 230 | 123.7 % OF 240.0 MVA RATING |

Outage initiates MCDC ramp which clears violations

| | | |
|---|--|-----------------------------|
| 42_1A1B2 OUTAGE: DAWSONC4 230 -MEDORA 4 230 | LTLMISS4 230-RHAME 4 230 | 109.2 % OF 240.0 MVA RATING |
| | Minimum Line Thermal Rating = 322MVA | |
| 45_1A1B2 OUTAGE: MEDORA 4 230 -BELFELD4 230 | LTLMISS4 230-RHAME 4 230 | 114.2 % OF 240.0 MVA RATING |
| | Line Thermal Rating = 1135MVA | |
| | TIOGA4 7 115-TIOGA7 7 115 | 101.0 % OF 108.9 MVA RATING |
| | Rate A line rating = 120MVA after 2008 reconductor | |
| 47_1A1B2 OUTAGE: DICKNSN4 230 -BELFELD4 230 | BELFELDT 345-BELFELD3 345 | 100.2 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 100.2 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| 48_1A1B2 OUTAGE: DICKNSN4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 | 107.3 % OF 319.0 MVA RATING |
| | BELFELDT 345-BELFELD4 230 | 107.3 % OF 319.0 MVA RATING |
| | Rate C = 122% | |
| 50_1A1B2 OUTAGE: BELFELD4 230 -RHAME 4 230 | MEDORA 4 230-BELFELD4 230 | 101.4 % OF 239.0 MVA RATING |
| | Minimum Line Thermal Rating = 322MVA | |

CASE #11

2011 Winter Peak

Saskatchewan 165MW South-North, MCDC 200MW West-East

CELL NAME = 1A2A2*NOT SOLVED*,B10T=-13 NC, NC, DC-WE, B10T=165SN, JAN11

| STATUS | VIOLATED ELEMENT | PU |
|--------|------------------|-------|
| ===== | ===== | ===== |

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|---------------|---------------------|--|
| SYSTEM INTACT | ***DID NOT SOLVE*** | |
|---------------|---------------------|--|

CASE #12

2011 Winter Peak

Saskatchewan 165MW North-South, MCDC 200MW West-East

CELL NAME = 1A2B2,B10T=164 NC, NC, DC-WE, B10T=165NS, JAN11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|------------------------------|
| SYSTEM INTACT | TIOGA4 4 230-TIOGA4 7 115 | 159.8 % OF 100.0 MVA RATING |
| OUTAGES: | | |
| 15 1A2B2 OUTAGE: TIOGA4 4 230 -TIOGA4 7 115 | WATFORD7 115 | 0.855 VOLTAGE LOWER THAN 0.9 |
| | WILISTN7 115 | 0.730 VOLTAGE LOWER THAN 0.9 |
| | RICHLND7 115 | 0.873 VOLTAGE LOWER THAN 0.9 |
| | GRENORA7 115 | 0.701 VOLTAGE LOWER THAN 0.9 |
| | PLNTYWD7 115 | 0.700 VOLTAGE LOWER THAN 0.9 |
| | KOCH 7 115 | 0.883 VOLTAGE LOWER THAN 0.9 |
| | INDNHLS7 115 | 0.761 VOLTAGE LOWER THAN 0.9 |
| | SQUAWGP7 115 | 0.897 VOLTAGE LOWER THAN 0.9 |
| | BTHOLD 7 115 | 0.717 VOLTAGE LOWER THAN 0.9 |
| | CLBRTSN7 115 | 0.789 VOLTAGE LOWER THAN 0.9 |
| | KENMARE7 115 | 0.563 VOLTAGE LOWER THAN 0.9 |
| | LEWIS 7 115 | 0.884 VOLTAGE LOWER THAN 0.9 |
| | POPLAR 7 115 | 0.876 VOLTAGE LOWER THAN 0.9 |
| | STANLEY7 115 | 0.478 VOLTAGE LOWER THAN 0.9 |
| | TIOGA4 7 115 | 0.460 VOLTAGE LOWER THAN 0.9 |
| | TIOGA7 7 115 | 0.464 VOLTAGE LOWER THAN 0.9 |
| | WILISTN7 115-RICHLND7 115 | 113.9 % OF 80.0 MVA RATING |
| | WILISTN7 115-TIOGA7 7 115 | 169.0 % OF 79.67 MVA RATING |
| | RICHLND7 115-LEWIS 7 115 | 110.1 % OF 79.67 MVA RATING |
| | LOGAN 7 115-BTHOLD 7 115 | 158.9 % OF 80.0 MVA RATING |
| | BTHOLD 7 115-KENMARE7 115 | 158.4 % OF 80.0 MVA RATING |
| | KENMARE7 115-STANLEY7 115 | 120.8 % OF 79.7 MVA RATING |
| 16_1A2B2 OUTAGE: TIOGA4 7 115 -TIOGA7 7 115 | TIOGA7 7 115 | 0.862 VOLTAGE LOWER THAN 0.9 |
| 17_1A2B2 OUTAGE: LELAND04 230 -LELND1TY 345 | LELAND03 345-LELND2TY 345 | 107.8 % OF 500.0 MVA RATING |
| | LELAND04 230-LELND2TY 345 | 105.1 % OF 500.0 MVA RATING |
| | Overload of L.Olds transformers initiates tripping scheme | |
| 18_1A2B2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 | 189.5 % OF 250.0 MVA RATING |

| | | | | | |
|------------------|-----------------------------|---|--------------------------|------------------|--|
| | | LELANDO4 230-LELND1TY 345 | 189.5 % OF | 250.0 MVA RATING | |
| | | Overload of L.Olds transformers initiates tripping scheme | | | |
| 19_1A2B2 OUTAGE: | LOGAN 7 115 -LOGAN TY 230 | STANTON4 230-LELANDO4 230 | 100.3 % OF | 478.0 MVA RATING | |
| | | Rate C = 110% | | | |
| 30_1A2B2 OUTAGE: | COAL TP4 230 -MCHENRY4 230 | GARRISN7 115-VOLTAIR7 115 | 103.9 % OF | 109.0 MVA RATING | |
| | | Minimum Thermal Rating = 128MVA | | | |
| 52_1A2B2 OUTAGE: | BISMARCK4 230 -WASHBRN4 230 | STANTON4 230-LELANDO4 230 | 102.2 % OF | 478.0 MVA RATING | |
| | | Rate C = 110% | | | |
| 60_1A2B2 OUTAGE: | WASHBRN4 230 -LELANDO4 230 | STANTON4 230-LELANDO4 230 | 103.7 % OF | 478.0 MVA RATING | |
| | | Rate C = 110% | | | |
| 67_1A2B2 OUTAGE: | CENTER 3 345 -COYOTE 3 345 | SQBUTTE4 230-CENTER 3 345 | 103.5 % OF | 352.0 MVA RATING | |
| | | COYOTE 3 345-COYOTE 7 115 | 238.0 % OF | 168.0 MVA RATING | |
| | | STANTON4 230-LELANDO4 230 | 114.9 % OF | 478.0 MVA RATING | |
| | | BEULAH 7 115-COYOTE 7 115 | 243.6 % OF | 119.5 MVA RATING | |
| | | Coyote overload initiates unit runback | | | |
| 71_1A2B2 OUTAGE: | ANTELOP3 345 -CHAR.CK3 345 | STANTON4 230-LELANDO4 230 | 105.1 % OF | 478.0 MVA RATING | |
| | | Rate C = 110% | | | |
| 75_1A2B2 OUTAGE: | TIOGA4 4 230 -BDV 4 230 | WATFORD7 115 | 0.855 VOLTAGE LOWER THAN | 0.9 | |
| | | WILISTN7 115 | 0.729 VOLTAGE LOWER THAN | 0.9 | |
| | | RICHLND7 115 | 0.872 VOLTAGE LOWER THAN | 0.9 | |
| | | TIOGA4 4 230 | 0.459 VOLTAGE LOWER THAN | 0.9 | |
| | | GREMORA7 115 | 0.701 VOLTAGE LOWER THAN | 0.9 | |
| | | PLNTYWD7 115 | 0.700 VOLTAGE LOWER THAN | 0.9 | |
| | | KOCH 7 115 | 0.883 VOLTAGE LOWER THAN | 0.9 | |
| | | INDNHLS7 115 | 0.761 VOLTAGE LOWER THAN | 0.9 | |
| | | SQUAWGP7 115 | 0.897 VOLTAGE LOWER THAN | 0.9 | |
| | | BTHOLD 7 115 | 0.717 VOLTAGE LOWER THAN | 0.9 | |
| | | CLBRTSN7 115 | 0.789 VOLTAGE LOWER THAN | 0.9 | |
| | | KENMARE7 115 | 0.563 VOLTAGE LOWER THAN | 0.9 | |
| | | LEWIS 7 115 | 0.884 VOLTAGE LOWER THAN | 0.9 | |
| | | POPLAR 7 115 | 0.876 VOLTAGE LOWER THAN | 0.9 | |
| | | STANLEY7 115 | 0.478 VOLTAGE LOWER THAN | 0.9 | |
| | | TIOGA4 7 115 | 0.459 VOLTAGE LOWER THAN | 0.9 | |
| | | TIOGA7 7 115 | 0.464 VOLTAGE LOWER THAN | 0.9 | |
| | | WILISTN7 115-RICHLND7 115 | 113.9 % OF | 80.0 MVA RATING | |
| | | WILISTN7 115-TIOGA7 7 115 | 169.1 % OF | 79.67 MVA RATING | |
| | | RICHLND7 115-LEWIS 7 115 | 110.1 % OF | 79.67 MVA RATING | |
| | | LOGAN 7 115-BTHOLD 7 115 | 158.9 % OF | 80.0 MVA RATING | |

BTHOLD 7 115-KENMARE7 115 158.4 % OF 80.0 MVA RATING
 KENMARE7 115-STANLEY7 115 120.8 % OF 79.7 MVA RATING

95_1A2B2 OUTAGE: TIOGA4 7 115 -STANLEY7 115

KENMARE7 115 0.858 VOLTAGE LOWER THAN 0.9
 STANLEY7 115 0.823 VOLTAGE LOWER THAN 0.9

104_1A2B2OUTAGE:TIOGA-LOGAN230 & TIOGA TRANS

WATFORD7 115 0.855 VOLTAGE LOWER THAN 0.9
 WILISTN7 115 0.730 VOLTAGE LOWER THAN 0.9
 RICHLND7 115 0.873 VOLTAGE LOWER THAN 0.9
 GRENORA7 115 0.701 VOLTAGE LOWER THAN 0.9
 PLNTYWD7 115 0.700 VOLTAGE LOWER THAN 0.9
 KOCH 7 115 0.883 VOLTAGE LOWER THAN 0.9
 INDNHLS7 115 0.761 VOLTAGE LOWER THAN 0.9
 SQUAWGP7 115 0.897 VOLTAGE LOWER THAN 0.9
 BTHOLD 7 115 0.717 VOLTAGE LOWER THAN 0.9
 CLBRTSN7 115 0.789 VOLTAGE LOWER THAN 0.9
 KENMARE7 115 0.563 VOLTAGE LOWER THAN 0.9
 LEWIS 7 115 0.884 VOLTAGE LOWER THAN 0.9
 POPLAR 7 115 0.876 VOLTAGE LOWER THAN 0.9
 STANLEY7 115 0.478 VOLTAGE LOWER THAN 0.9
 TIOGA4 7 115 0.460 VOLTAGE LOWER THAN 0.9
 TIOGA7 7 115 0.464 VOLTAGE LOWER THAN 0.9
 WILISTN7 115-RICHLND7 115 113.9 % OF 80.0 MVA RATING
 WILISTN7 115-TIOGA7 7 115 169.0 % OF 79.67 MVA RATING
 RICHLND7 115-LEWIS 7 115 110.1 % OF 79.67 MVA RATING
 LOGAN 7 115-BTHOLD 7 115 158.9 % OF 80.0 MVA RATING
 BTHOLD 7 115-KENMARE7 115 158.4 % OF 80.0 MVA RATING
 KENMARE7 115-STANLEY7 115 120.8 % OF 79.7 MVA RATING

CASE #13

2011 Winter Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW South-North, MCDC 200MW East-West

CELL NAME = 1B1A2,B10T=-161 NC, T-W-CCR230, DC-EW, B10T=165SN, JAN11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|--|
| OUTAGES: | | |
| 18_1B1A2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 168.7 % OF 250.0 MVA RATING 168.7 % OF 250.0 MVA RATING |
| 21_1B1A2 OUTAGE: CHAR.CK3 345 -CHAR.CK4 230 | LELAND04 230-LOGAN 4 230 Line Thermal Rating = 445MVA LOGAN 4 230-NETIOGA4 230 | 100.5 % OF 319.0 MVA RATING 110.1 % OF 240.0 MVA RATING |
| 33_1B1A2 OUTAGE: STANTON4 230 -LELAND04 230 | ANTELOP3 345-CHAR.CK3 345 Line Thermal Rating = 1135MVA | 101.4 % OF 538.0 MVA RATING |
| 40_1B1A2 OUTAGE: DAWSONC4 230 -MI CTYE4 230 | DAWSONCT 230 FALLON T 115 MICTYE1T 230 MI CTYE857.0 BELFELDT 345 BISON 869.0 CIRCLE 7 115 DAWSONC4 230 DAWSONC7 115 FALLON 7 115 MI CTYE4 230 MI CTYE7 115 MEDORA 4 230 DKSN-ND7 115 BELFELD4 230 BISON 4 230 MAURINE4 230 LTLMISS7 115 LTLMISS4 230 BAKER 4 230 | 0.861 VOLTAGE LOWER THAN 0.9 0.696 VOLTAGE LOWER THAN 0.9 0.510 VOLTAGE LOWER THAN 0.9 0.501 VOLTAGE LOWER THAN 0.9 0.888 VOLTAGE LOWER THAN 0.9 0.822 VOLTAGE LOWER THAN 0.9 0.895 VOLTAGE LOWER THAN 0.9 0.880 VOLTAGE LOWER THAN 0.9 0.862 VOLTAGE LOWER THAN 0.9 0.717 VOLTAGE LOWER THAN 0.9 0.493 VOLTAGE LOWER THAN 0.9 0.510 VOLTAGE LOWER THAN 0.9 0.889 VOLTAGE LOWER THAN 0.9 0.883 VOLTAGE LOWER THAN 0.9 0.894 VOLTAGE LOWER THAN 0.9 0.835 VOLTAGE LOWER THAN 0.9 0.878 VOLTAGE LOWER THAN 0.9 0.681 VOLTAGE LOWER THAN 0.9 0.680 VOLTAGE LOWER THAN 0.9 0.654 VOLTAGE LOWER THAN 0.9 |

| | | | | | |
|----------|----------------|-------|-------|-----------------------|-----|
| BAKER | 7 | 115 | 0.714 | VOLTAGE LOWER THAN | 0.9 |
| BOWMAN | 4 | 230 | 0.752 | VOLTAGE LOWER THAN | 0.9 |
| DICKSWH7 | 115 | | 0.896 | VOLTAGE LOWER THAN | 0.9 |
| DICKNTH7 | 115 | | 0.896 | VOLTAGE LOWER THAN | 0.9 |
| GLENDCT7 | 115 | | 0.839 | VOLTAGE LOWER THAN | 0.9 |
| HETINGR4 | 230 | | 0.800 | VOLTAGE LOWER THAN | 0.9 |
| HETINGR7 | 115 | | 0.853 | VOLTAGE LOWER THAN | 0.9 |
| GASCOYN7 | 115 | | 0.854 | VOLTAGE LOWER THAN | 0.9 |
| N ENGLN7 | 115 | | 0.869 | VOLTAGE LOWER THAN | 0.9 |
| RHAME | 7 | 115 | 0.706 | VOLTAGE LOWER THAN | 0.9 |
| RHAME | 4 | 230 | 0.729 | VOLTAGE LOWER THAN | 0.9 |
| DAWSONC7 | 115-FALLON | 7 115 | 138.7 | % OF 80.0 MVA RATING | |
| FALLON | 7 115-MI CTYE7 | 115 | 137.6 | % OF 80.0 MVA RATING | |
| MI CTYE4 | 230-BAKER | 4 230 | 123.5 | % OF 200.0 MVA RATING | |
| LTLMISS4 | 230-RHAME | 4 230 | 123.8 | % OF 240.0 MVA RATING | |

Outage initiates MCDC ramp which clears violations

| | | | | | | | | | |
|------------------|----------|-----------------|-------|----------|----------------|-------|-------|-------------------------------|---------|
| 42_1B1A2 OUTAGE: | DAWSONC4 | 230 -MEDORA | 4 230 | LTLMISS4 | 230-RHAME | 4 230 | 108.0 | % OF 240.0 MVA RATING | |
| | | | | | | | | Minimum Line Thermal Rating = | 322MVA |
| 45_1B1A2 OUTAGE: | MEDORA | 4 230 -BELFELD4 | 230 | LTLMISS4 | 230-RHAME | 4 230 | 113.3 | % OF 240.0 MVA RATING | |
| | | | | | | | | Minimum Line Thermal Rating = | 322MVA |
| 47_1B1A2 OUTAGE: | DICKNSN4 | 230 -BELFELD4 | 230 | ANTELOP3 | 345-CHAR.CK3 | 345 | 103.4 | % OF 538.0 MVA RATING | |
| | | | | | | | | Line Thermal Rating = | 1135MVA |
| 48_1B1A2 OUTAGE: | DICKNSN4 | 230 -HESKETT4 | 230 | BELFELDT | 345-BELFELD3 | 345 | 100.6 | % OF 319.0 MVA RATING | |
| | | | | BELFELDT | 345-BELFELD4 | 230 | 100.6 | % OF 319.0 MVA RATING | |
| | | | | | | | | Rate C = | 122% |
| | | | | ANTELOP3 | 345-CHAR.CK3 | 345 | 106.5 | % OF 538.0 MVA RATING | |
| | | | | | | | | Line Thermal Rating = | 1135MVA |
| 50_1B1A2 OUTAGE: | BELFELD4 | 230 -RHAME | 4 230 | MEDORA | 4 230-BELFELD4 | 230 | 100.3 | % OF 239.0 MVA RATING | |
| | | | | | | | | Minimum Line Thermal Rating = | 322MVA |
| 61_1B1A2 OUTAGE: | BISON | 4 230 -MAURINE4 | 230 | ANTELOP3 | 345-CHAR.CK3 | 345 | 102.1 | % OF 538.0 MVA RATING | |
| | | | | | | | | Line Thermal Rating = | 1135MVA |
| 62_1B1A2 OUTAGE: | BISON | 4 230 -HETINGR4 | 230 | ANTELOP3 | 345-CHAR.CK3 | 345 | 101.1 | % OF 538.0 MVA RATING | |
| | | | | | | | | Line Thermal Rating = | 1135MVA |
| 67_1B1A2 OUTAGE: | CENTER | 3 345 -COYOTE | 3 345 | COYOTE | 3 345-COYOTE | 7 115 | 239.3 | % OF 168.0 MVA RATING | |
| | | | | DKSN-ND7 | 115-DICKSWH7 | 115 | 106.3 | % OF 119.51 MVA RATING | |
| | | | | BEULAH | 7 115-COYOTE | 7 115 | 218.1 | % OF 119.5 MVA RATING | |
| | | | | COYOTE | 7 115-DICKSWH7 | 115 | 112.1 | % OF 119.51 MVA RATING | |

Coyote overload initiates unit runback

| | | | |
|--|-------------------------------|------------|------------------|
| 71_1B1A2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345 | LELANDO3 345-LELND1TY 345 | 122.2 % OF | 250.0 MVA RATING |
| | LELANDO3 345-LELND2TY 345 | 119.0 % OF | 500.0 MVA RATING |
| | LELANDO4 230-LELND1TY 345 | 122.2 % OF | 250.0 MVA RATING |
| | LELANDO4 230-LELND2TY 345 | 116.0 % OF | 500.0 MVA RATING |
| | COYOTE 3 345-COYOTE 7 115 | 106.5 % OF | 168.0 MVA RATING |
| | DICKNSN4 230-BELFELD4 230 | 101.2 % OF | 319.0 MVA RATING |
| | HALIDAY7 115-BEULAH 7 115 | 102.3 % OF | 120.0 MVA RATING |
| | LELANDO4 230-LOGAN 4 230 | 108.6 % OF | 319.0 MVA RATING |
| | Line Thermal Rating = 445MVA | | |
| | LOGAN 4 230-NETIOGA4 230 | 118.3 % OF | 240.0 MVA RATING |
| 77_1B1A2 OUTAGE: LELANDO4 230 -LOGAN 4 230 | MALLARD7 115-MAX 7 115 | 108.2 % OF | 120.0 MVA RATING |
| | GARRISN7 115-MAX 7 115 | 115.6 % OF | 120.0 MVA RATING |
| | ANTELOP3 345-CHAR.CK3 345 | 105.9 % OF | 538.0 MVA RATING |
| | Line Thermal Rating = 1135MVA | | |
| 79_1B1A2*NOT SOLVED* OUTAGE: LTLMISS4 230 -RHAME 4 230 | ****DID NOT SOLVE**** | | |
| 85_1B1A2 OUTAGE: CHAR.CK4 230 -WATFORD4 230 | LELANDO4 230-LOGAN 4 230 | 100.3 % OF | 319.0 MVA RATING |
| | Line Thermal Rating = 445MVA | | |
| | LOGAN 4 230-NETIOGA4 230 | 112.0 % OF | 240.0 MVA RATING |
| | Line Thermal Rating = 445MVA | | |
| 86_1B1A2 OUTAGE: WATFORD4 230 -INDNHLS4 230 | LOGAN 4 230-NETIOGA4 230 | 108.5 % OF | 240.0 MVA RATING |
| | Line Thermal Rating = 445MVA | | |
| 87_1B1A2 OUTAGE: INDNHLS4 230 -WILISTN4 230 | LOGAN 4 230-NETIOGA4 230 | 107.7 % OF | 240.0 MVA RATING |
| | Line Thermal Rating = 445MVA | | |

CASE #14

2011 Winter Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW North-South, MCDC 200MW East-West

CELL NAME = 1B1B2,B10T=162 NC, T-W-CCR230, DC-EW, B10T=165NS, JAN11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|--|---|
| OUTAGES: | | |
| 10_1B1B2 OUTAGE: WILISTN7 115 -WILISTN4 230 | TIOGA4 4 230-TIOGA4 7 115 New Tioga 230/115 Transformer Rate A = 150MVA TIOGA4 7 115-TIOGA7 7 115 Line is being reconductored | 104.0 % OF 100.0 MVA RATING 115.3 % OF 108.9 MVA RATING |
| 18_1B1B2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 172.1 % OF 250.0 MVA RATING 172.1 % OF 250.0 MVA RATING |
| 26_1B1B2 OUTAGE: NETIOGA4 230 -NETIOGA7 115 | TIOGA4 4 230-TIOGA4 7 115 New Tioga 230/115 Transformer Rate A = 150MVA | 134.9 % OF 100.0 MVA RATING |
| 45_1B1B2 OUTAGE: MEDORA 4 230 -BELFELD4 230 | LTLMISS4 230-RHAME 4 230 Minimum Line Thermal Rating = 322MVA | 101.6 % OF 240.0 MVA RATING |
| 48_1B1B2 OUTAGE: DICKNSN4 230 -HESKETT4 230 | BELFELDT 345-BELFELD3 345 BELFELDT 345-BELFELD4 230 Rate C = 122% | 101.3 % OF 319.0 MVA RATING 101.3 % OF 319.0 MVA RATING |
| 67_1B1B2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | COYOTE 3 345-COYOTE 7 115 DKSN-ND7 115-DICKSWH7 115 BEULAH 7 115-COYOTE 7 115 COYOTE 7 115-DICKSWH7 115 Coyote overload initiates unit runback | 238.7 % OF 168.0 MVA RATING 103.0 % OF 119.51 MVA RATING 220.3 % OF 119.5 MVA RATING 108.8 % OF 119.51 MVA RATING |
| 71_1B1B2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345 | LELAND03 345-LELND1TY 345 LELAND03 345-LELND2TY 345 LELAND04 230-LELND1TY 345 LELAND04 230-LELND2TY 345 STANTON4 230-LELAND04 230 Overload of L.Olds transformers initiates tripping scheme | 113.2 % OF 250.0 MVA RATING 110.2 % OF 500.0 MVA RATING 113.2 % OF 250.0 MVA RATING 107.5 % OF 500.0 MVA RATING 104.3 % OF 478.0 MVA RATING |

79_1B1B2*NOT SOLVED* OUTAGE: LTLMISS4 230 -RHAME 4 230 ****DID NOT SOLVE*****

Fix by Shifting Local Load From Little Missouri To Rhame

CASE #15

2011 Winter Peak

Tioga-Williston-Charlie Creek 230kV In Service

Saskatchewan 165MW South-North, MCDC 200MW West-East

CELL NAME = 1B2A2,B10T=-162 NC, T-W-CCR230, DC-WE, B10T=165SN, JAN11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|---|--|
| OUTAGES: | | |
| 17_1B2A2 OUTAGE: LELANDO4 230 -LELND1TY 345 | LELANDO3 345-LELND2TY 345 LELANDO4 230-LELND2TY 345 Overload of L.Olds transformers initiates tripping scheme | 104.0 % OF 500.0 MVA RATING 101.4 % OF 500.0 MVA RATING |
| 18_1B2A2 OUTAGE: LELANDO4 230 -LELND2TY 345 | LELANDO3 345-LELND1TY 345 LELANDO4 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 181.4 % OF 250.0 MVA RATING 181.4 % OF 250.0 MVA RATING |
| 21_1B2A2 OUTAGE: CHAR.CK3 345 -CHAR.CK4 230 | WILISTN7 115-RICHLND7 115 Minimum Thermal Rating = 116MVA | 117.2 % OF 80.0 MVA RATING |
| 67_1B2A2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | COYOTE 3 345-COYOTE 7 115 BEULAH 7 115-COYOTE 7 115 Coyote overload initiates unit runback | 238.1 % OF 168.0 MVA RATING 240.4 % OF 119.5 MVA RATING |
| 71_1B2A2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345 | LELANDO3 345-LELND1TY 345 LELANDO3 345-LELND2TY 345 LELANDO4 230-LELND1TY 345 LELANDO4 230-LELND2TY 345 Overload of L.Olds transformers initiates tripping scheme | 107.3 % OF 250.0 MVA RATING 104.5 % OF 500.0 MVA RATING 107.3 % OF 250.0 MVA RATING 101.9 % OF 500.0 MVA RATING |
| 77_1B2A2 OUTAGE: LELANDO4 230 -LOGAN 4 230 | MALLARD7 115-MAX 7 115 GARRISN7 115-MAX 7 115 Minimum Thermal Rating = 199MVA | 102.4 % OF 120.0 MVA RATING 109.8 % OF 120.0 MVA RATING |
| 85_1B2A2 OUTAGE: CHAR.CK4 230 -WATFORD4 230 | WILISTN7 115-RICHLND7 115 Minimum Thermal Rating = 116MVA | 116.6 % OF 80.0 MVA RATING |
| 86_1B2A2 OUTAGE: WATFORD4 230 -INDNHLS4 230 | WILISTN7 115-RICHLND7 115 Minimum Thermal Rating = 116MVA | 112.0 % OF 80.0 MVA RATING |

87_1B2A2 OUTAGE: INDNHLS4 230 -WILISTN4 230

WILISTN7 115-RICHLND7 115 110.9 % OF 80.0 MVA RATING
Minimum Thermal Rating = 116MVA

CASE #16

2011 Winter Peak

Tioga-Williston-Charlie Creek 230kV In Service

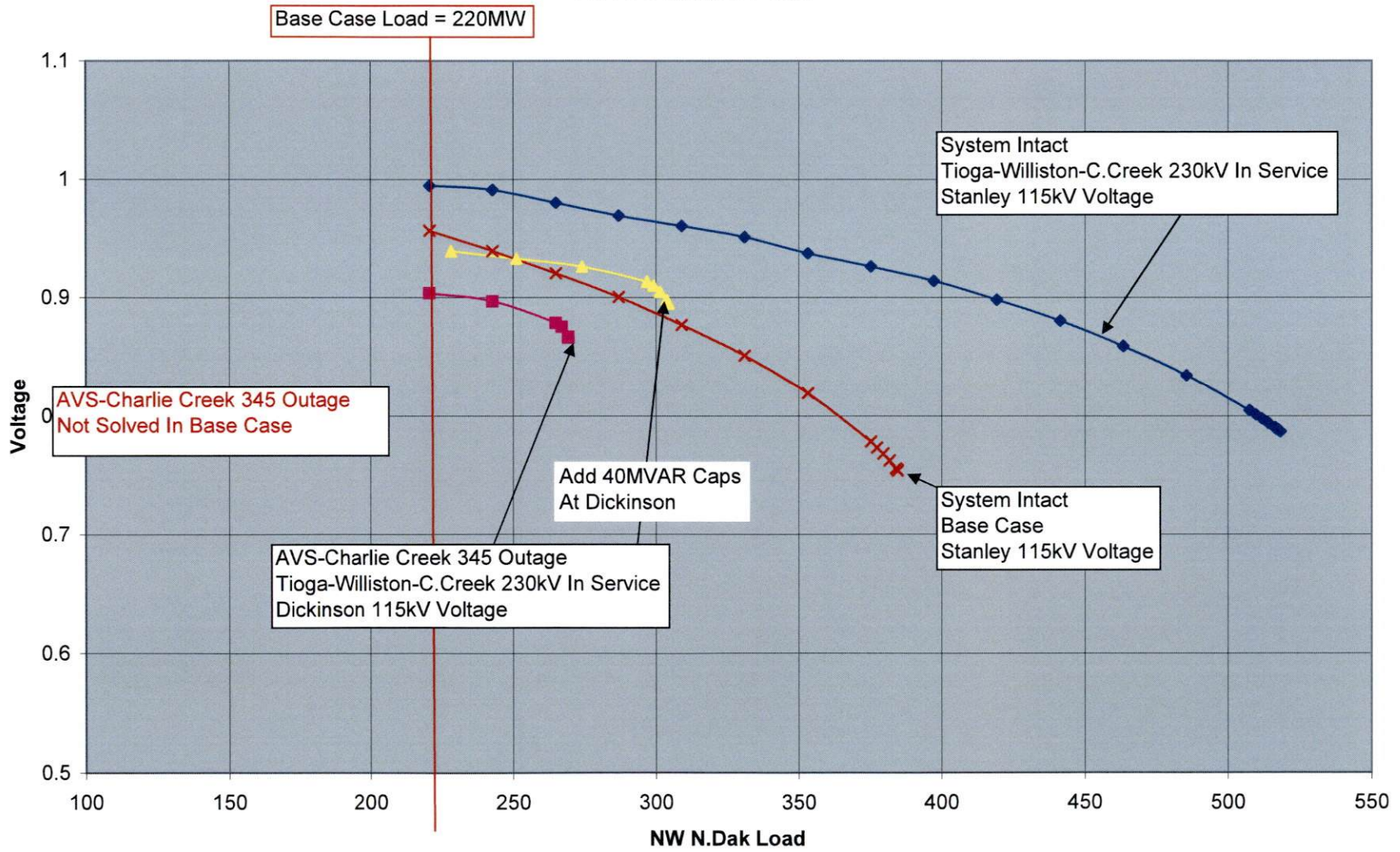
Saskatchewan 165MW North-South, MCDC 200MW West-East

CELL NAME = 1B2B2,B10T=163 NC, T-W-CCR230, DC-WE, B10T=165NS, JAN11

| STATUS ===== | VIOLATED ELEMENT ===== | PU ===== |
|---|--|--|
| OUTAGES: | | |
| 17_1B2B2 OUTAGE: LELAND04 230 -LELND1TY 345 | LELAND03 345-LELND2TY 345 LELAND04 230-LELND2TY 345 Overload of L.Olds transformers initiates tripping scheme | 105.7 % OF 500.0 MVA RATING 103.1 % OF 500.0 MVA RATING |
| 18_1B2B2 OUTAGE: LELAND04 230 -LELND2TY 345 | LELAND03 345-LELND1TY 345 LELAND04 230-LELND1TY 345 Overload of L.Olds transformers initiates tripping scheme | 184.5 % OF 250.0 MVA RATING 184.5 % OF 250.0 MVA RATING |
| 26_1B2B2 OUTAGE: NETIOGA4 230 -NETIOGA7 115 | TIOGA4 4 230-TIOGA4 7 115 New Tioga 230/115 Transformer Rate A = 150MVA | 127.8 % OF 100.0 MVA RATING |
| 52_1B2B2 OUTAGE: BISMAR4 230 -WASHBRN4 230 | STANTON4 230-LELAND04 230 Rate C = 110% | 101.5 % OF 478.0 MVA RATING |
| 60_1B2B2 OUTAGE: WASHBRN4 230 -LELAND04 230 | STANTON4 230-LELAND04 230 Rate C = 110% | 103.0 % OF 478.0 MVA RATING |
| 67_1B2B2 OUTAGE: CENTER 3 345 -COYOTE 3 345 | SQBUTTE4 230-CENTER 3 345 COYOTE 3 345-COYOTE 7 115 STANTON4 230-LELAND04 230 BEULAH 7 115-COYOTE 7 115 Coyote overload initiates unit runback | 103.5 % OF 352.0 MVA RATING 238.0 % OF 168.0 MVA RATING 114.6 % OF 478.0 MVA RATING 243.2 % OF 119.5 MVA RATING |
| 71_1B2B2 OUTAGE: ANTELOP3 345 -CHAR.CK3 345 | STANTON4 230-LELAND04 230 Rate C = 110% | 102.7 % OF 478.0 MVA RATING |
| 74_1B2B2 OUTAGE: TIOGA4 4 230 -NETIOGA4 230 | TIOGA4 4 230-TIOGA4 7 115 New Tioga 230/115 Transformer Rate A = 150MVA | 118.0 % OF 100.0 MVA RATING |

Appendix B

NW N.Dak PV Curves 2011 Summer Peak



Appendix C

Transient Stability Results Table

| Case No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|------------------------|-----------------------|-----------------------|-------------------------|-------------------------|
| Case Name | w00-so08aa-ag1 | w01-so08aa-ag1 | w00-so08aa-ag3 | w01-so08aa-ag3 | w00-so08aa-ei2 | w01-so08aa-ei2 | w00-so08aa-fds | w01-so08aa-fds | w00-so08aa-nmz | w01-so08aa-nmz |
| Disturbance | ag1 | ag1 | ag3 | ag3 | ei2 | ei2 | fds | fds | nmz | nmz |
| Prior Outage | None | None | None | None | None | None | None | None | None | None |
| Date/Time | SEP 17 2008 10:25 | SEP 17 2008 10:35 | SEP 17 2008 10:27 | SEP 17 2008 10:37 | SEP 17 2008 10:29 | SEP 17 2008 10:39 | SEP 17 2008 10:31 | SEP 17 2008 10:41 | SEP 17 2008 10:33 | SEP 17 2008 10:43 |
| Comments | | | | | | | | | | |
| Steady State Flows | | | | | | | | | | |
| NDEX / EAST BIAS | 2080 / 279 | 2081 / 279 | 2080 / 279 | 2081 / 279 | 2080 / 279 | 2081 / 279 | 2080 / 279 | 2081 / 279 | 2080 / 279 | 2081 / 279 |
| MH-EX / L20D | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 | 2173 / 263 |
| ECL-ARP / PRI-BYN | 565 / 741 | 566 / 742 | 565 / 741 | 566 / 742 | 565 / 741 | 566 / 742 | 565 / 741 | 566 / 742 | 565 / 741 | 566 / 742 |
| MWEX / AHD-SLK | 1522 / 642 | 1524 / 642 | 1522 / 642 | 1524 / 642 | 1522 / 642 | 1524 / 642 | 1522 / 642 | 1524 / 642 | 1522 / 642 | 1524 / 642 |
| D602F / F01C | 1739 / 1472 | 1738 / 1471 | 1739 / 1472 | 1738 / 1471 | 1739 / 1472 | 1738 / 1471 | 1739 / 1472 | 1738 / 1471 | 1739 / 1472 | 1738 / 1471 |
| B10T / MH-SPC | 166 / 62 | 166 / 63 | 166 / 62 | 166 / 63 | 166 / 62 | 166 / 63 | 166 / 62 | 166 / 63 | 166 / 62 | 166 / 63 |
| OH E-W / OH-MH | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 | 189 / -196 |
| R50M / OH-MP | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 | 150 / 150 |
| G82R | 20 | 21 | 20 | 21 | 20 | 21 | 20 | 21 | 20 | 21 |
| Dorsey bipole / CU bipole | 3246 / 1104 | 3247 / 1104 | 3246 / 1104 | 3247 / 1104 | 3246 / 1104 | 3247 / 1104 | 3246 / 1104 | 3247 / 1104 | 3246 / 1104 | 3247 / 1104 |
| Dorsey Reserve / Wtrn SVC | 293 / 5 | 294 / 5 | 293 / 5 | 294 / 5 | 293 / 5 | 294 / 5 | 293 / 5 | 294 / 5 | 293 / 5 | 294 / 5 |
| Forbes SVC / MSC | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 | 24 / 600 |
| RCDC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Steady State Vltgs | | | | | | | | | | |
| Dorsey 500/Dorsey 230 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 | 1.004 / 1.045 |
| Roseau 500/Forbes 500 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 | 1.028 / 1.009 |
| Chisago 500/EauClaire 345 | 1.011 / 1.004 | 1.011 / 1.003 | 1.011 / 1.004 | 1.011 / 1.003 | 1.011 / 1.004 | 1.011 / 1.003 | 1.011 / 1.004 | 1.011 / 1.003 | 1.011 / 1.004 | 1.011 / 1.003 |
| Int Falls 115/Badoura 115 | 1.014 / 1.032 | 1.017 / 1.032 | 1.014 / 1.032 | 1.017 / 1.032 | 1.014 / 1.032 | 1.017 / 1.032 | 1.014 / 1.032 | 1.017 / 1.032 | 1.014 / 1.032 | 1.017 / 1.032 |
| Drayton 230/Grton 345 | 1.026 / 1.010 | 1.025 / 1.010 | 1.026 / 1.010 | 1.025 / 1.010 | 1.026 / 1.010 | 1.025 / 1.010 | 1.026 / 1.010 | 1.025 / 1.010 | 1.026 / 1.010 | 1.025 / 1.010 |
| SS OS Relay Margins | | | | | | | | | | |
| D602F at Forbes/Dorsey | 233% / 363% | 234% / 364% | 233% / 363% | 234% / 364% | 233% / 363% | 234% / 364% | 233% / 363% | 234% / 364% | 233% / 363% | 234% / 364% |
| 32R at Rugby/L20D at Drayton | 999% / 767% | 999% / 766% | 999% / 767% | 999% / 766% | 999% / 767% | 999% / 766% | 999% / 767% | 999% / 766% | 999% / 767% | 999% / 766% |
| R50M/F3M | 857% / 318% | 858% / 321% | 857% / 318% | 858% / 321% | 857% / 318% | 858% / 321% | 857% / 318% | 858% / 321% | 857% / 318% | 858% / 321% |
| B10T | 334% | 340% | 334% | 340% | 334% | 340% | 334% | 340% | 334% | 340% |
| Min/MaxTransientVltg | | | | | | | | | | |
| Arrowhd 230 | 0.97 1.03 | 0.97 1.02 | 0.97 1.03 | 0.97 1.03 | 0.95 1.04 | 0.95 1.04 | 0.95 1.04 | 0.95 1.04 | 0.93 1.06 | 0.93 1.06 |
| Boise 115 | 0.99 1.03 | 0.99 1.03 | 0.99 1.03 | 0.99 1.03 | 0.97 1.03 | 0.97 1.03 | 1.00 1.03 | 1.00 1.03 | 0.92 1.03 | 0.92 1.03 |
| Dorsey 230 | 1.02 1.06 | 1.02 1.06 | 1.02 1.06 | 1.02 1.06 | 1.02 1.06 | 1.02 1.06 | 1.03 1.07 | 1.03 1.07 | 1.04 1.16 | 1.04 1.16 |
| Forbes 230 | 0.99 1.03 | 0.99 1.03 | 0.99 1.03 | 0.99 1.03 | 0.96 1.03 | 0.96 1.03 | 0.99 1.03 | 0.99 1.03 | 0.99 1.04 | 0.99 1.04 |
| Riverton 230 | 0.98 1.05 | 0.98 1.05 | 0.98 1.06 | 0.98 1.06 | 0.91 1.06 | 0.91 1.06 | 0.95 1.06 | 0.95 1.06 | 0.92 1.06 | 0.92 1.06 |
| Coal Creek 230 | 0.96 1.12 | 0.96 1.12 | 0.96 1.12 | 0.96 1.12 | 1.01 1.13 | 1.01 1.13 | 0.95 1.14 | 0.95 1.14 | 0.95 1.10 | 0.95 1.10 |
| Jamestown 345 | 0.88 1.05 | 0.88 1.05 | 0.87 1.05 | 0.87 1.05 | 0.81 1.06 | 0.81 1.06 | 0.78 1.07 | 0.78 1.06 | 0.83 1.05 | 0.83 1.05 |
| Drayton 230 | 0.99 1.09 | 0.99 1.09 | 0.99 1.09 | 0.99 1.09 | 0.95 1.09 | 0.95 1.09 | 1.00 1.11 | 1.00 1.11 | 0.98 1.09 | 0.98 1.09 |
| Grton 345 | 0.85 1.05 | 0.86 1.04 | 0.85 1.05 | 0.85 1.05 | 0.83 1.11 | 0.83 1.11 | 0.88 1.07 | 0.88 1.07 | 0.85 1.07 | 0.85 1.07 |
| Minong 161 | 0.99 1.05 | 0.99 1.03 | 0.99 1.05 | 0.99 1.05 | 1.00 1.06 | 1.00 1.06 | 0.98 1.05 | 0.98 1.05 | 0.98 1.09 | 0.98 1.09 |
| Wahpeton 115 | 0.96 1.10 | 0.96 1.10 | 0.95 1.10 | 0.95 1.10 | 0.88 1.11 | 0.88 1.11 | 0.92 1.11 | 0.92 1.10 | 0.89 1.11 | 0.89 1.10 |
| Watertown 345 | 0.93 1.05 | 0.94 1.05 | 0.94 1.05 | 0.94 1.05 | 0.88 1.10 | 0.88 1.10 | 0.93 1.07 | 0.93 1.06 | 0.90 1.07 | 0.90 1.07 |
| Dynamic Voltage Warnings | | | | | | | | | | |
| | none | none | none | none | none | none | none | none | none | none |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Worst Case Angle Damping | | | | | | | | | | |
| Dorsey SUVP / UdHold | | | | | | | / 0.175 | / 0.166 | / 0.133 | / 0.133 |
| Forbes DC Red (DCAR) | 394% | 392% | 390% | 387% | 507% | 507% | 389% | 394% | 507% | 507% |
| K22W (max +dP @ t. d-ang) | 10.6@ (2.51666, 1.7) | 9.0@ (2.49999, 2.5) | 12.2@ (2.48332, 1.8) | 12.1@ (2.45832, 1.8) | 63.6@ (1.87500, -27.5) | 63.8@ (1.87500, -27.7) | 16.7@ (2.58332, -1.6) | 16.2@ (2.56665, -1.6) | 123.6@ (2.22499, -53.7) | 122.4@ (2.24166, -53.8) |
| K22W (max -dP @ t. d-ang) | 22.5@ (0.80000, 5.8) | 22.6@ (0.79166, 5.8) | 22.6@ (0.75000, 6.4) | 22.9@ (0.73333, 6.3) | 8.2@ (0.60000, 1.1) | 8.4@ (0.60000, 1.2) | 16.4@ (0.60833, 2.2) | 16.9@ (0.60833, 2.2) | 84.6@ (0.23333, 6.8) | 84.5@ (0.23333, 6.7) |
| K22W (max d-ang @ t. dP) | 8.2@ (1.06666, -10.6) | 8.4@ (1.06666, -10.5) | 8.6@ (1.00833, -11.8) | 8.7@ (1.00000, -11.9) | -31.4@ (2.23333, 58.5) | -31.6@ (2.24999, 60.7) | 5.8@ (1.04166, -10.5) | 5.9@ (1.03333, -10.8) | -53.8@ (2.24999, 122.4) | -53.9@ (2.24166, 121.3) |
| OS Rel Trip / Marg | | | | | | | | | | |
| MH - OH | | | | | | | | | | |
| D602F at Forbes/Dorsey | 172% / 263% | 175% / 268% | 170% / 259% | 171% / 261% | 131% / 197% | 131% / 196% | 189% / 292% | 190% / 294% | 18333 sec / 0.18333 sec | 18333 sec / 0.18333 sec |
| 32R at Rugby/L20D at Drayton | 999% / 582% | 999% / 583% | 999% / 569% | 999% / 570% | 999% / 473% | 999% / 489% | 999% / 584% | 999% / 593% | 999% / 526% | 999% / 531% |
| R50M / F3M | 679% / 259% | 690% / 266% | 672% / 258% | 677% / 261% | 605% / 209% | 605% / 213% | 692% / 269% | 694% / 271% | 368% / 136% | 366% / 137% |
| B10T | 178% | 163% | 165% | 149% | 80% | 70% | 157% | 146% | 110% | 100% |
| FSCAPS (SS/Unav/Final) | | | | | | | | | | |
| Balta 230 | (0 0 0) | (0 0 0) | (0 1 0) | (0 1 0) | (0 0 0) | (0 0 0) | (0 1 0) | (0 1 0) | (0 0 0) | (0 0 0) |
| Eau Cl 345 / Park Lk 115 | (3 3 3)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 2)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 3)/(0 0 0) | (3 3 1)/(0 0 0) | (3 3 1)/(0 0 0) |
| Prairie 115 / Ramsey 230 | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) | (1 1 1)/(0 1 0) |
| Roseau 230 / Running 230 | (0 0 0)/(1 1 1) | (0 0 0)/(1 1 1) | (0 0 0)/(1 1 1) | (0 0 0)/(1 1 1) | (0 1 0)/(1 1 1) | (0 1 0)/(1 1 1) | (0 0 0)/(1 1 1) | (0 0 0)/(1 1 1) | (0 2 0)/(1 1 1) | (0 2 0)/(1 1 1) |
| Shew 115 / Split Rock 115 | (1 5 2)/(1 1 1) | (1 5 2)/(1 1 1) | (1 5 2)/(1 1 1) | (1 5 2)/(1 1 1) | (1 5 0)/(1 1 1) | (1 5 0)/(1 1 1) | (1 5 1)/(1 1 1) | (1 5 1)/(1 1 1) | (1 5 1)/(1 1 1) | (1 5 1)/(1 1 1) |
| Damping Performance | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

| Case | w00-so08aa-ag1 | w01-so08aa-ag1 | w00-so08aa-ag3 | w01-so08aa-ag3 | w00-so08aa-ei2 | w01-so08aa-ei2 | w00-so08aa-fds | w01-so08aa-fds | w00-so08aa-nmz | w01-so08aa-nmz |
|--------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Disturbance | ag1 | ag1 | ag3 | ag3 | ei2 | ei2 | fds | fds | nmz | nmz |
| System Response | OK | OK | OK | OK | OK | OK | OK | OK | OK | OK |
| 70% or 120% Violations | | | | | | | | | | |
| ORWG Criteria Violations | | | | | | | | | | |
| Line Tripping | | | | | | | | | (5T)(6T) | (5T)(6T) |