

## **Report R7-06**

# ***G519*** ***System Impact Study***

Prepared for

**Midwest ISO**

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## Legal Notice

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# Executive Summary

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This report presents the results of a system impact study performed to evaluate the interconnection of a 600 MW combined cycle power plant at the Blackberry 230 kV substation. This project, G519, is number 38491-01 in the MISO Generation Interconnection Queue and has a queue date of 05/19/05. The project is expected to be on-line by April, 2009. The evaluation involved an assessment of system performance based on steady state analysis, contingency analysis, constrained interface analysis, short circuit analysis and stability analysis. This study was performed under the Out of Queue Order Letter Agreement as allowed in the MISO OATT Attachment X. This project is subject to review and restudy at a later date when the studies of pending higher-queued requests are completed.

In the MISO process of generator interconnection, an Energy Resource (ER) request has to mitigate short circuit impacts, stability impacts and any injection overloads identified in the steady state N-1 analysis. Although the customer requested Network Resource (NR) interconnection service for G519, it was treated as ER for the purpose of this study. The purpose of this study is to evaluate the ability of G519 to interconnect to the grid; any results related to delivery of power from G519 are provided for informational purposes only. Additional deliverability analysis will be performed by MISO to evaluate if G519 can be certified as NR.

G519 caused one transmission line to overload for system intact conditions. The Grand Rapids-Hill City-Riverton 115 kV circuit overloads in the summer peak case. This is not an injection limit and opening this line to simulate the existing operating guide adequately addressed this issue.

The N-1 contingency analysis found that G519 causes the Blackberry-Riverton 230 kV circuit to overload. Because this facility is a direct outlet from the G519 POI, this is an injection overload and must be mitigated. A new 73-mile 230 kV circuit from Boswell to Riverton is proposed to mitigate the identified injection overload. This new line was found to mitigate the identified G519 injection overload without causing any new issues.

Under high off peak transfer conditions G519 aggravates voltage problems at 230 kV, 161 kV and 115 kV buses around Arrowhead and Stone Lake. N-2 contingency analysis results with the Boswell-Riverton 230 kV line do not indicate any threat for cascading outages.

The constrained interface analysis found that G519 has a distribution factor greater than the applicable 5% (PTDF flowgates) or 3% (OTDF flowgates) threshold on the following flowgates:

- FORCHS - 26% (with reinforcements)
- MWSI - 14% (with reinforcements)
- PR\_ISL\_BYRON - 9% (with reinforcements)

The conclusion of the stability analysis is that all design standards are maintained as long as loading of Forbes-Chisago is within limits and flow on Arrowhead-Weston is limited to not more than 750 MW.

The conclusion of the short circuit analysis is that the interconnection of G519 at the Blackberry 230 kV substation causes four breakers at the Nashwauk 115 kV bus to become

overdutied. These four 115 kV circuit breakers need to be replaced due to the addition of G519.

Study results with the Grand Rapids-Hill City-Riverton 115 kV circuit open indicate that after addition of the new 230 kV line from Boswell to Riverton the primary need for the 115 kV circuit is to serve Hill City load. Two assumptions incorporated in the cost estimate are that the 230 kV line route will use the 115 kV line right-of-way and that a new 230 kV substation will be constructed at Hill City. Maintaining the 115 kV circuit needs to be evaluated as part of the long term planning process.

The following network upgrades described in Table 1 are required to connect G519 as an Energy Resource:

- Add new 230 kV line from Boswell to Riverton
- New 230 kV bus position for Boswell-Riverton line at Boswell
- New 230 kV bus position for Boswell-Riverton line at Riverton
- New 230 kV substation at Hill City
- Replace 4 115 kV circuit breakers at Nashwauk

Costs shown in Table 1 are good faith estimates and will be further developed and refined in the Facility Study. Additional deliverability analysis will be performed by MISO to evaluate if G519 can be certified as NR.

**Table 1: Cost Estimate for Network Upgrades**

Location	Facilities	Good Faith Cost Estimate <sup>1</sup>
Boswell-Riverton	Add new Boswell-Riverton 230 kV line	\$45 million <sup>2</sup>
Boswell 230 kV Substation	Add new 230 kV bus position for new Boswell-Riverton 230 kV line.	\$1.9 million <sup>3</sup>
Riverton 230 kV Substation	Add new 230 kV bus position for new Boswell-Riverton 230 kV line.	\$1.7 million <sup>4</sup>
Hill City 230 kV Substation	Add new 230 kV substation at Hill City	\$3.5 million <sup>5</sup>
Nashwauk 115 kV Substation	Replace 4 115 kV circuit breakers	\$720,000

Notes

- 1: Cost estimate provided by MP
- 2: Estimate for new 230 kV line form Boswell to Riverton incorporates a new route from Boswell, south to Hill City. The route from Hill City to Riverton would use 11 Line right-of-way. Assumptions are: single circuit, wood H-frame construction, 954 ACSR (54/7) conductor, one 3/8 steel shield wire, and one 528 (24 fiber) OPGW. Cost includes permitting, engineering, right-of-way, clearing, removals, material, inspection, construction, and restoration. This route would be approximately 73 miles in length.
- 3: Estimate (+/- 40%) for terminating a line in the Boswell 230 kV substation.
- 4: Estimate (+/- 40%) for terminating a line in the Riverton 230 kV substation.
- 5: Estimate (+/- 40%) for constructing a new 230 kV Substation at Hill City (land, 2-230 kV line breakers, 230/12.5 kV 20 MVA Transformer, Control Building, Line Panels, etc.)



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## Introduction

This report presents the results of a system impact study performed to evaluate interconnection of 600 MW of generation in Itasca County, MN. This project, G519, is number 38491-01 in the MISO Generation Interconnection Queue and has a queue date of 05/19/05. The project is expected to be on-line by April, 2009.

This study will document the effects that the proposed project has on the local and regional transmission grid. The objective is to identify potential transmission constraints and provide corrective actions, when necessary. Voltage profiles and line loading will be reviewed to ensure that the transmission grid will function within acceptable criteria for both steady-state and stability considerations and that the project will not degrade the reliability of the transmission system. This study was performed under the Out of Queue Order Letter Agreement as allowed in the MISO OATT Attachment X. This project is subject to review and restudy at a later date when the studies of pending higher-queued requests are completed.

This report presents the outcome of steady-state, short circuit and transient stability analysis. The purpose of the steady-state portion of the study is to identify thermal upgrades required to connect the plant to the transmission system and to provide the customer with an indication of possible thermal or voltage problems when delivering power from the plant. Short circuit analysis is done to determine the impact of the project on the short circuit current capability of the circuit breakers at the interconnection point and at the other nearby stations affected by the project. Stability analysis is performed to evaluate transient stability of the proposed generator and the impact of the Project on the stability of the regional transmission system.

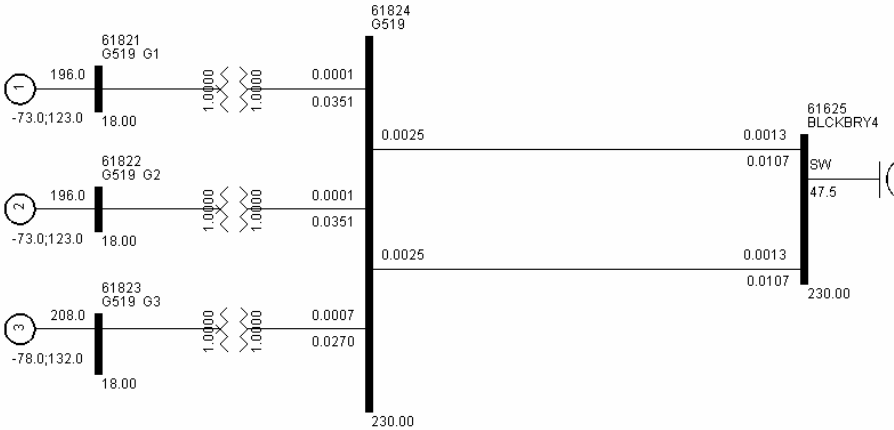
This report was performed under the direction of the MISO by Siemens PTI and an Ad Hoc Study Group consisting of ATC LLC, Great River Energy, Manitoba Hydro, Minnesota Power, Otter Tail Power and Xcel Energy.

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Section  
**2**

# G519 Project

The G519 project will interconnect to the MISO system at the Blackberry 230 kV substation as shown in Figure 2-1.



**Figure 2-1: G519 Conceptual One-Line Diagram**

The data used to model the G519 project was provided by the project developer. The G519 project is a two-on-one combined cycle plant with a net output of 600 MW. There are two 255 MVA CTG (0.9 power factor) and one 333 MVA STG (0.9 power factor). Although PSS were not modeled for this study, all three machines will have power system stabilizers. Dynamic simulation model parameters are shown in Appendix A.

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## Steady-State Analysis

Steady-state analysis is performed to identify thermal upgrades required to connect the plant to the transmission system and to provide the customer with an indication of possible thermal or voltage problems when delivering power from the plant.

### 3.1 Study Procedure

#### 3.1.1 Computer Programs

Analysis was performed using PSS/E version 29.5 and MUST version 8.

#### 3.1.2 Methodology

Benchmark cases were developed from the MAPP 2004 series models representing 2009 summer peak conditions and off-peak high transfer conditions without the G519 project. G519 study cases were then developed by adding the G519 project to the benchmark cases.

FCITC analysis was performed using MUST to show how much incremental capacity is available for the proposed generator under single contingency conditions. Nonlinear (AC) contingency analysis was performed to show the limiting constraint, associated contingency and overloading before and after connecting the new generator. The impact of the project on MAPP constrained interfaces was also determined.

#### 3.1.3 Case Development

The power flow case selected for the steady-state analysis is from the MAPP 2004 series. The 2009 Summer Peak case (f-09supk) was the starting point used for the various steady-state analyses for this system impact study; this case was provided by Minnesota Power. Before the power case was modified to incorporate the G519 project, the summer peak case was updated as described in Section 3.1.4. The base cases were solved with the following PSS/E solution options, using PSS/E version 29.5:

- Tap adjustment: Enable stepping
- Area interchange control: Tie lines only
- Phase shifter adjustment: Enabled
- DC tap adjustment: Enabled
- Switched shunt adjustment: Enabled

### 3.1.4 2009 Summer Peak Case

The MAPP summer peak case was adjusted based upon comments provided by the study team. The study team included representatives from Minnesota Power, Xcel Energy, American Transmission Company, Otter Tail Power, Great River Energy, and Manitoba Hydro.

These transmission system changes reflect numerous system changes that have been initiated by the various transmission owners and that are planned to be in service prior to the operation of G519. This included the new Arrowhead – Stone Lake 345-kV line and new 345-kV substations at Arrowhead, Werner West, Stone Lake, Gardner Park, Central Wisconsin, and Nobles. Other changes to the summer base case power flow model include the increased rating of the Wilmar – Granite Falls 115-kV circuit and of the second circuit between Prairie Island and Red Rock to match circuit #1.

The higher queued projects listed in Table 3-1 have been included in the base power flow case used for the evaluation of G519.

**Table 3-1: Projects Added to Power Flow Cases**

Project	Queue Number	Size	Location
G144, Weston	37187-02	550 MW	Marathon, WI
G237, High Bridge	37642-01	313 MW	Ramsey, MN
G238, Riverside	37642-02	125 MW	Hennepin, MN
G261, Wilmarth	37540-02	698 MW	Blue Earth, MN
G330, Adams	37722-01	17 MW	Mower, MN
G370, Anson	37911-02	170 MW	Minnehaha, SD
G392, Big Stone II	38020-01	600 MW	Grant, SD
G424, Minntac	38096-01	100 MW	St. Louis, MN
G502, Center	38425-01	50 MW	Oliver, ND
G509, Laskin	38429-01	75 MW	St. Louis, MN

The summer peak base case “M01-f-09supk” includes all these adjustments.

The 2009 Summer Peak case was then modified to incorporate the G519 project. The project was modeled with three generators, two combustion turbines and one steam turbine, with a total summer net output of 600 MW. The generators will be connected through a double circuit 230-kV line from the project to Blackberry Substation. Figure 2-1 shows the general layout of the proposed project facilities and summarizes the new plant data for the generators, step-up transformers, and the 230-kV lines to Blackberry.

The G519 project was dispatched uniformly to generation within the MISO-MAPP footprint in the 2009 Summer Peak case.

### 3.1.5 Disturbance Criteria

The Study Group provided a variety of contingencies for the steady-state analysis. These contingencies included single transmission branches in the North\_MAPP and ATC areas rated at 115 kV and above. Multiple-element contingencies such as multiple circuit towers and multiple terminal lines have been included in the analysis as well as contingencies that have operating procedures. The contingency specifications associated with the 500-kV facilities between Dorsey and Chisago were adjusted to reflect the operating procedures and the level of flows over the various facilities for the base case power flow.

A number of complex contingencies to be studied reflect single contingencies that have operating procedures or switching schemes that take other circuit elements out of service. Since those single contingencies will be studied through the complex contingency list, they have been excluded from the list of single contingencies to be studied. These are primarily associated with the 500-kV facilities between Dorsey and Chisago. The various single branches associated with the 28L contingency have also been removed from the contingency list; only the 6-element 28L contingency is included in the final analysis.

The only branches in the study area that were excluded from the monitoring process for thermal loading were the generator step-up transformers.

### 3.1.6 Performance Criteria

Relevant MAPP, MISO and Minnesota Power planning criteria were used to analyze the load flow study results. Transmission system branches and buses were monitored for branch loading and bus voltage violations in the following areas, included in the subsystem definition file as MAPP\_HV:

- Xcel Energy (NSP) – Area 600
- Minnesota Power – Area 608
- Southern Minnesota Municipal Power Agency – Area 613
- Great River Energy – Area 618
- Otter Tail Power – Area 626
- Western Area Power Administration – Area 652
- Manitoba Hydro – Area 667
- Dairyland Power Cooperative – Area 680

Additionally, facilities for the following control areas have been monitored for ATC:

- Alliant Energy – Wisconsin Power & Light – Area 364
- Wisconsin Electric – Area 365
- Wisconsin Public Service – Area 366
- Madison Gas & Electric – Area 367
- Upper Peninsula Power – Area 368

For all areas except GRE, all branches at 115 kV and above were monitored for thermal loading and voltage violations. In GRE's control area, facilities operating at 69 kV and above were monitored. Under contingency analysis, branches were monitored for loading greater than 100 percent of the Rating C rating, except for ATC areas where the criteria is 95% of rating B.

Bus voltages were monitored for system intact and contingency conditions. Buses in the Minnesota Power area were monitored for voltages outside the range of 0.95 pu for the lower limit and 1.05 pu for the upper limit. Buses in the Xcel Energy area were monitored for voltage outside the range of 0.92 pu for the lower limit and 1.10 pu for the upper limit. For all other monitored buses, the voltage criteria limits that were used were 0.90 and 1.10 pu.

Branches were also flagged for all pre-existing conditions made worse with a power transfer distribution factor (PTDF) greater than 3 percent.

## 3.2 Contingency Analysis

### 3.2.1 Summer Peak

The addition of G519 causes the Riverton-Hill City-Grand Rapids 115-kV line to overload in the base case as shown in Table 3-2. This is not an injection limit (a limit with a distribution factor greater than 20% or a direct outlet from the generator POI). The line was opened for preliminary contingency analysis, in both the case without and with G519, to simulate an existing operating guide.

**Table 3-2: System Intact Riverton-Hill City-Grand Rapids 115 kV Line Loading, Without Reinforcements**

Branch	Rating	Without G519	With G519	DF
61653 RIVERTN7 115-62448 HILLCTY7 115	53 MVA	95.1%	131.6%	3.2%
61740 GR RPDS7 115-62448 HILLCTY7 115	53 MVA	100.0%	136.4 %	3.2%

The results of the contingency analysis are summarized in Appendix B. The interconnection of G519 at Blackberry results in the overload of the Blackberry-Riverton 230-kV circuit under two contingencies. Because the facility is a direct outlet from the G519 POI, this is an injection limit that must be mitigated. The Stone Lake-Washco 161-kV circuit is a known issue and there are plans to upgrade this line.

The proposed solution to the Blackberry-Riverton overload is the construction of a new 73-mile bundled 795 mcm 600-MVA 230-kV circuit from Boswell to Riverton. Two options were considered, one includes the new Boswell-Riverton 230 kV line keeping the existing 53 MVA Riverton-Hill City-Grand Rapids 115-kV circuit (Option 1) and a second that includes both the new Boswell-Riverton 230 and rebuilding of the existing 115 kV line to achieve a rating of 200 MVA (Option 2).

Reinforcement option 1 does not resolve the system intact overload of the Riverton-Hill City-Grand Rapids line as shown in Table 3-3 so the 115 kV circuit was opened to simulate the existing operating guide. With the 115 kV circuit open, reinforcement option 1 mitigates G519 impacts on Blackberry-Riverton as shown in the table "Comparison of Branch Violations - With Reinforcement Option 1" in Appendix B. Reinforcement option 2 mitigates the system intact overload of the Riverton-Hill City-Grand Rapids 115 kV line and post-contingency impacts on both Blackberry-Riverton and Stone Lake-Washco. Neither reinforcement option causes any new thermal issues.



**Table 3-3: System Intact Riverton-Hill City-Grand Rapids 115 kV Line Loading**

Branch	Rating	Without G519	With G519 Option 1	DF
61740 GR RPDS7 115-62448 HILLCTY7 115	53 MVA	100.0%	104.2%	0.4%
61653 RIVERTN7 115-62448 HILLCTY7 115	53 MVA	95.1%	99.3%	0.4%

There were no voltage violations that were made worse due to the addition of G519 with its 230-kV connection to Blackberry.

The results of the N-2 contingency analysis, without reinforcements and with reinforcement option 2, are summarized in the tables labeled “Comparison of N-2 Branch Violations” in Appendix B. The results with reinforcement option 2 do not indicate any threat for cascading outages.

### 3.2.2 Light Load High Transfer

The analysis for G519 was performed for the case without reinforcements for the Blackberry interconnection. Thus the overloads noted in the results in Appendix C for Forbes – Blackberry 230 kV circuit would be alleviated by the proposed reinforcements. While the HVDC reduction scheme as outlined for the steady state operation does not specifically address the loss of the Drayton – Leteler 230 kV circuit, there is provision in the stability analysis process for the loss of this circuit. Since this circuit along with the Chisago transformers are impacted by high transfers compared to summer peak conditions and would have remedial actions in the form of DC reductions, the constraints shown for N-1 contingencies are not valid for high transfer cases.

There are two multiple-circuit outages around AS King that result in the depressed voltages shown in Appendix C during the period of high transfers due to limited reactive support. The NSP 1 and NSP 2 contingencies open three branches at AS King and two additional at Eau Claire. The low voltages shown in the attached table are on the 230-kV system at Arrowhead and Stone Lake, with corresponding low voltages on the 161 kV and 115-kV system in the area. The addition of G519 does result in lower voltages under these two contingencies, although there are violations without G519. The ATC\_ARPG2 and “050 2” contingencies are two other multiple-element contingencies in that same general area that lead to low voltages at Arrowhead and Stone Lake. The loss of either of the Arrowhead transformer branches also reduces the reactive power support in the same area.

## 3.3 Transfer Analysis

In order to establish the capability of the existing transmission system to accommodate some or all of the new generation from G519, a FCITC analysis was performed. This effort started with the base case without the G519 project (N00b-f-09supk) and used the 230-kV bus at Blackberry Substation as the delivery or injection point. The contingencies that were studied in the contingency analysis have also been used in this analysis. For this analysis, only elements showing an outage transfer distribution factor (OTDF) greater than 3 percent have been considered.

Without reinforcements, the Riverton-Blackberry 230-kV circuit restricts delivery to 364 MW, under the defined contingency, “015 2”. While the Stone Lake-Washco 161-kV circuit limits delivery of power from G519 to 267 MW, this is a known issue and there are plans to increase the rating of this line.

In order to confirm that the proposed reinforcements between Boswell and Riverton would alleviate the identified limitation, the transfer analysis was rerun with reinforcement option 2. With reinforcement option 2 the Blackberry-Riverton constraint is removed and no additional limitations are shown to the 600-MW capacity associated with G519, as shown in Appendix D in the table “FCITC Single Study – G519 With Reinforcements”. Reinforcement option 1 (with the Riverton-Hill City-Grand Rapids operating guide simulated) yields similar results.

### 3.4 Constrained Interface Analysis

Using the interface definitions file provided by MP, the impact of the addition of G519 on the flows across those interfaces was measured in terms of the transfer distribution factor (TDF) for either all facilities in service or with a critical contingency associated with the interface.

The data file for lines comprising the interfaces was modified for MHEX-N and MHEX-S to match the representation in the power flow models. In the power flow case, the Riel bus is between these two points. For MHEX-S, the branch for the interface analysis was changed to the Roseau – Riel branch, while MHEX-N used the Dorsey – Riel branch.

The NDEX definition was modified to reflect the planned conversion of the Canby-Granite Falls circuit from 115 kV to 230 kV as part of the higher queued Big Stone II generator interconnection project (G392).

The results of the interface analysis are summarized in the following table. Except for the Forbes-Chisago interface where the TDF value is 26.3% (in case with reinforcement option 2), the addition of G519 only has a moderate impact across two other interfaces, the MWSI at 13.5% and the PR\_ISL\_BYRON at 9.2%. G519 has less impact on the other system constrained interfaces.

**Table 3-4: Constrained Interface Analysis, Distribution Factors, Transfer of 600 MW**

Flowgate	Without G519 (MW)	Without Reinforcements		With Reinforcement Option 2	
		With G519 (MW)	DF (%)	With G519 (MW)	DF (%)
COOPER_S	251.2	261.1	1.7%	269.5	3.1%
EAUARP__XCEL	109.5	130.4	3.5%	135.5	4.3%
FORCHS_PTFD	1153.0	1388.4	39.4%	1310.7	26.3%
FTCAL_S	229.6	247.3	2.9%	243.2	3.9%
GGG	1380.0	1383.8	0.6%	1385.5	0.9%
GRIS_LNC	323.6	333.8	1.7%	337.7	4.4%
LEECONELS	171.3	183.2	2.0%	180.3	1.5%
MHEX_N+	-1760.9	-1758.7	0.4%	-1762.3	-0.2%

Flowgate	Without G519 (MW)	Without Reinforcements		With Reinforcement Option 2	
		With G519 (MW)	DF (%)	With G519 (MW)	DF (%)
MHEX_S+	1808.4	1805.6	-0.5%	1809.5	0.2%
MH_SPC_E+	-61.4	-61.5	0.0%	-56.1	0.9%
MH_SPC_W+	63.0	63.1	0.0%	57.8	-0.9%
MNTZUMA_W	48.4	59.1	1.8%	53.3	0.8%
MWSI	194.2	266.7	12.1%	275.2	13.5%
NDDC	-42.3	-77.5	-5.9%	-77.5	-5.9%
NDEX	1106.5	1032.4	-12.3%	1033.6	-12.1%
PR_ISL_BYRON	84.6	136.3	8.6%	139.7	9.2%
QUADCITY_W	545.6	557.7	2.0%	551.8	1.0%
WNE_WKS	302.6	306.7	0.7%	309.0	1.1%
Y2DC	17.5	8.2	-1.5%	8.2	-1.5%
ALBGARQUAST	33.5	33.6	0.0%	34.3	0.1%
ARNVINARNHAZ	146.9	139.5	-1.2%	138.1	-1.5%
BYCHEBYCHE	1145.0	1145.2	0.0%	1146.7	0.3%
DAVCALQUARCK	115.0	110.6	-0.7%	110.2	-0.8%
HLSXFMTIFARN	111.2	101.1	-1.7%	100.2	-1.8%
LACWGRLACSTI	1003.7	998.5	-0.9%	995.9	-1.3%
LEEBYREJNEL	-23.0	-32.2	-1.5%	-27.9	-0.8%
LKFFOXLKGWLM	57.0	49.2	-1.3%	49.9	-1.3%
LORTRKWEMPAD	84.4	76.3	-1.3%	76.7	-1.3%
POWREAMTZBON	45.6	47.9	0.4%	45.9	0.0%
S1226TEKAMAH	48.1	41.4	-1.1%	39.2	-1.5%
SALXFMQUADAV	226.1	220.5	-0.9%	219.7	-1.1%
SALXFMWEMPAD	204.4	198.2	-1.0%	196.7	-1.1%
SPETRILAKRAU	-22.8	-36.1	-2.2%	-36.8	-2.3%
SPHWMCSUMEMC	-6.6	-7.1	-0.1%	-7.3	-0.1%

### 3.5 Loss Analysis

The loss analysis determined the difference in losses for Xcel's, Minnesota Power's, and GRE's systems for the addition of G519 generation. The G519 project was studied with a net output of 600 MW. The impact on losses was examined for the G519 capacity to displace generation within MISO.

A summary of the loss analysis is provided in Table 3-5 through Table 3-7. Losses for the 230-kV circuits between the G519 generating facility and Blackberry Substation as well as the transformers at the G519 end of the 230-kV line are not included in Area 608 losses but are documented in Table 3-8. Prior to the addition of the various reinforcements in the Boswell to Riverton region, the addition of G519 would increase losses for the three areas evaluated by about 39.2 MW. With the addition of the new Boswell – Riverton 23-kV circuit coupled with the reconductoring of the Boswell – Grand Rapids – Hill City – Riverton 115-kV circuits, system losses will increase 21.8 MW during the 2009 summer peak load as a result of the addition of G519.

**Table 3-5: Loss Analysis Results Without System Reinforcements**

Case	Area 600 - Xcel	Area 608 – MP	Area 618 – GRE	Total
2009 Summer Peak without G519	311.3 MW	97.0 MW	98.3 MW	506.6 MW
	3188.9 MVAR	1149.1 MVAR	1858.1 MVAR	6196.2 MVAR
2009 Summer Peak with G519	319.9 MW	126.0 MW	99.9 MW	545.8 MW
	3255.0 MVAR	1337.4 MVAR	1848.2 MVAR	6440.6 MVAR
Difference (MW)	8.6 MW	29.0 MW	1.6 MW	39.2 MW

**Table 3-6: Loss Analysis Results With Reinforcement Option 1**

Case	Area 600 - Xcel	Area 608 – MP	Area 618 – GRE	Total
2009 Summer Peak without G519	311.3 MW	97.0 MW	98.3 MW	506.6 MW
	3188.9 MVAR	1149.1 MVAR	1858.1 MVAR	6196.2 MVAR
2009 Summer Peak with G519	319.8 MW	112.9 MW	98.4 MW	531.1 MW
	3243.4 MVAR	1275.3 MVAR	1844.2 MVAR	6362.9 MVAR
Difference (MW)	8.5 MW	15.9 MW	0.1 MW	24.5 MW

**Table 3-7: Loss Analysis Results With Reinforcement Option 2**

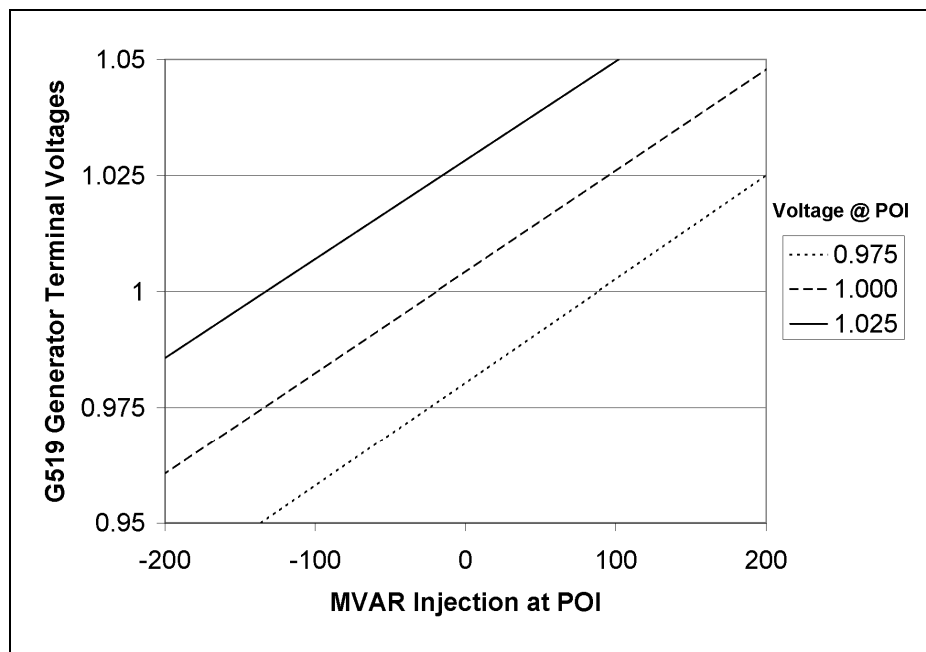
Case	Area 600 - Xcel	Area 608 – MP	Area 618 – GRE	Total
2009 Summer Peak without G519	311.3 MW	97.0 MW	98.3 MW	506.6 MW
	3188.9 MVAR	1149.1 MVAR	1858.1 MVAR	6196.2 MVAR
2009 Summer Peak with G519	320.2 MW	110.2 MW	98.0 MW	528.4 MW
	3239.9MVAR	1234.5 MVAR	1843.4MVAR	6317.8 MVAR
Difference (MW)	8.9 MW	13.2 MW	-0.3 MW	21.8 MW

Table 3-8 documents losses for G519 facilities including the step-up transformers and direct connect 230 kV lines between G519 and Blackberry. The power factor at the Blackberry 230 kV POI in the summer peak case is 1.0.

**Table 3-8: Losses in G519 Facilities**

Case	From Generation	From Charging	Injection at POI	Losses
2009 SUPK Case	600.0 MW	0 MW	596.6 MW	3.4 MW
	82.9 MVAR	0.5 MVAR	7.6 MVAR	75.8 MVAR

Figure 3-1 shows MVAR injection at the Blackberry 230 kV POI for various voltages at G519 generator terminals and at the POI. The G519 step-up transformers were at the nominal tap (1.0) for these calculations. With G519 generating 600 MW a power factor of 0.95 at the POI corresponds to approximately 200 MVAR. As shown in Figure 3-1, G519 can maintain a power factor within the range of 0.95 leading to 0.95 lagging at the POI depending on the voltage at the POI and the setting of the taps on the step-up transformers.

**Figure 3-1: MVAR Injection at Blackberry POI**

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Section

**4**

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# Short Circuit Analysis

**Short-Circuit Study**  
**Generation Project Queue: G519**  
**Queue: # 38491-01**

**By: Carol Gerou**  
**Date: January 5, 2006**



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## **1.0 Executive Summary**

The purpose of this report was to determine the impact of the generation interconnection known as G519 on the short-circuit currents at and surrounding the point of interconnection, respectively.

To determine impact, a model of the current transmission network was used which included higher queued generation interconnections. The most up to date information known about the Arrowhead-Weston line project was incorporated into the model. Faults (both three phase and single-line-to-ground) were applied to the point of interconnection and other buses. Fault currents were compared to the interrupting capability of the associated breakers.

The breaker capability analysis concluded that there were several overdutied breakers during the base case conditions without the G519 generation. At the Blackberry 115 kV bus, these overdutied breakers included: "62L", "63L", "20L", and "20WB1".

With the interconnection of G519 at the Blackberry 230 kV substation, it was found that several breakers connected to the Nashwauk 115 kV bus were overdutied. The following breakers should be replaced: "53L", "62L", "115W", and "14L". The estimated preliminary replacement cost for four 115 kV circuit breakers is \$720,000.

## **2.0 Introduction**

The purpose of this report was to determine the impact of the Midwest Independent System Operator (MISO) generation interconnection known as G519 (queue # 38491-01) on the short-circuit currents produced on the local grid.

## **3.0 Base Case Development**

### **3.1 Benchmark**

The study model was developed from the Minnesota Power short circuit base case (*Joe.olr*) dated October 27, 2005 using the ASPEN One-liner short circuit program. This model was then updated to include higher queued generation projects. This model was also modified to include the Arrowhead-Weston 345 kV line project.

### **3.2 Assumptions Made**

#### **3.2.1 Wind Farms**

Two wind farm generating facilities were modeled according to information supplied by the developer and are described below.

The G424 generation project consisted of seventy doubly-fed induction generators (DFIG) with each connection having a power converter interfacing the

rotor to the network. The net output of this project was 100 MW. The point of interconnection (POI) for G424 is the Minntac 115 kV bus.

The G509 generation project consisted of forty-five Vestas induction generators with each connection having an inverter interfacing the rotor to the network. The net output of this project was 75 MW. The point of interconnection for G509 is Minnesota Power's 34 line adjacent to the Hoyt Lakes 115 kV bus.

Since control logic and protection strategy dictate the response of a wind generator (with use of a converter) and commonly used short-circuit programs, including ASPEN, don't model all the nuances associated with wind generator control and protection, the wind generators were modeled as synchronous generators.

### **3.2.2 Overhead Transmission Lines**

For some of the data provided, the zero sequence impedance data was lacking for the overhead transmission lines; accordingly, the zero sequence impedance data was assumed to be 3.25 times the positive sequence impedance data.<sup>1</sup>

### **3.2.3 Transmission Transformers**

If not all information was known about a transformer then the following was assumed: (1) If the positive sequence impedance data was provided but the zero sequence impedance data was not provided then the zero sequence impedance data was assumed to be equal to the positive sequence impedance data.<sup>2</sup> (2) If the phase relationship is not known then the high voltage side should lead the low voltage side by 30° with wye-delta or delta-wye transformer banks.<sup>3</sup> (3) If a winding configuration is unknown, the transformer is assumed to be an autotransformer with a wye-to-wye grounded winding configuration.

### **3.2.4 Circuit Breakers**

If a circuit breaker's interrupting capability could not be determined, it was assumed that its interrupting capability was dependent upon the breaker class and its vintage. In most cases, its vintage, manufacturer, and application may have been unknown. Its vintage helped to define which standard applied to that breaker.

Also, circuit breakers made in accordance with ANSI C37.6-1961 need to have their interrupting capability converted to the present day standard of C37.04-1999. If the old interrupting capability is provided on a nameplate, this value is then derated for age, how this breaker was maintained, and reclosing history. For example, the circuit breaker labeled "62L" at the 115 kV Blackberry

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<sup>1</sup> Applied Protective Relaying: B7235. Westinghouse. Copyright 1982. Page 2-15.

<sup>2</sup> Applied Protective Relaying: B7235. Westinghouse. Copyright 1982. Page 2-13.

<sup>3</sup> Protective Relaying. J. Lewis Blackburn. Copyright 1987. Page 59

substation has a nameplate interrupting capability of 5000 MVA; however, the calculated interrupting capability is 16.3 kA.

### **3.3 G519**

The Blackberry 230 kV substation was the POI for G519. Directly off the POI, two transmission lines proceeded to the actual G519 facility. Three generators fed power from this facility. There were two combined turbine generators each rated at 225 MVA with a terminal voltage of 16.5 kV; and finally, one steam turbine rated at 333 MVA with a terminal voltage of 18 kV. The net output of this facility was 600 MW.

Both the G424 generation project and the G509 generation project were included in this fault study. Originally, the Weston generation unit four was thought to be modeled but upon closer study it was found that the fault current at the Stone Lake substation with and without the entire (all units) Weston generation in-service only varied by 100 amperes. This fault current contribution was thought to be negligible. All other generation projects mentioned in the feasibility study were thought to be negligible since they were connected remotely to the POI.

### **4.0 Results**

Three phase and single-line-to-ground faults were calculated at the POI and other nearby buses. The resulting short circuit currents were recorded at these buses with and without the generation interconnection. This data has been placed in the Appendix and in the Section 6.0 which is labeled "Table". A summarized version of this data is in Table 4.1. Table 6.1 also includes a listing of the affected circuit breakers and their interrupting capabilities.

The criterion for determining if a circuit breaker needed to be upgraded was solely based on the circuit breaker's interrupting capability. If this capability was less than the maximum fault current seen by this breaker then this breaker was considered to be overdutied. The maximum worst case fault current seen by the breaker was assumed to be a local bus fault. In Table 4.1, proposed circuit breaker up-grades were listed.

Table 4.1 illustrates the short-circuit currents with and without the G519 generation project.

**Table 4.1  
Fault Current Levels (POI At The Blackberry 230 kV Bus)**

Bus Name	G519		Pre-G519		Change		Proposed Circuit Breaker Up-grades
	3 PH A	SLG A	3 PH A	SLG A	3 PH %	SLG %	
Blackberry 230 kV	20722	20458	14925	13463	38.84	51.95	n/a
Blackberry 115 kV	24307	22368	20985	17940	15.83	24.68	62L,63L,20L,20WB1
Boswell 230 kV	18017	19998	15677	17842	14.93	12.08	n/a
Nashwauk 115 kV	15549	9799	14643	9385	6.19	4.41	53L,62L,115W,14L
Forbes 230 kV	18199	18687	17265	17972	5.41	3.98	n/a
Grand Rapids Bus 1 115 kV	11319	8068	10914	7792	3.71	3.54	n/a
Grand Rapids Bus 2 115 kV	11241	8031	10845	7760	3.66	3.50	n/a
National Taconite 115 kV	14602	9004	13946	8775	4.70	2.61	n/a
Hibbing 115 kV	13546	10677	13099	10465	3.41	2.03	n/a
Arrowhead 230 kV	9313	10280	9015	10029	3.30	2.51	n/a
Blandin 115 kV	9052	5708	8855	5609	2.23	1.75	n/a
Boswell 115 kV	11427	10757	11170	10585	2.30	1.62	n/a
Riverton 230 kV	7632	7679	7491	7571	1.88	1.42	n/a
Hilltop 115 kV	12190	13265	11990	13105	1.67	1.22	n/a

**Notes**

1. The formula for calculating the change variable which has the column headings of "3 PH %" and "SLG %" is below:

$$\text{Change (\%)} = ((\text{G519} - \text{Pre-G519}) / (\text{Pre-G519})) * 100$$

2. "3 PH" represents a three phase fault.
3. "SLG" represents a single-line-to-ground fault.(The fault was taken on the A phase.)
4. All proposed circuit breaker upgrades should be replaced with a circuit breaker having at a minimum 40 kA interrupting capability.

Table 4.1 was sorted on the Change variable for a single-line-to-ground fault. This sort was such that it was in descending order from maximum to minimum.

All proposed circuit breaker upgrades should be replaced with a circuit breaker having at a minimum 40 kA interrupting capability. The present preliminary cost to replace a 115 kV circuit breaker was assumed to be \$180,000.

Of the breakers found to be overdutied, only those breakers at the Nashwauk 115 kV substation should be upgraded as a consequence of G519 generation project. The other breakers were found to be overdutied in the base case condition (without G519) and are, therefore, considered to be pre-existing conditions. The preliminary cost to upgrade only those circuit breakers at the Nashwauk 115 kV substation is \$720,000.

## 5.0 Conclusions

The breaker capability analysis concluded that there were several overdutied breakers during the base case conditions without the G519 generation. At the Blackberry 115 kV bus, these overdutied breakers included: "62L", "63L", "20L", and "20WB1".

With the interconnection of G519 at the Blackberry 230 kV substation, it was found that several breakers connected to the Nashwauk 115 kV bus were overdutied. The following breakers should be replaced: "53L", "62L", "115W", and "14L". The estimated preliminary replacement cost for four 115 kV circuit breakers is \$720,000.

## 6.0 Table

**Table 6.1  
G519 - POI At 230 kV Blackberry Substation  
Known Circuit Breakers**

Bus Name		Circuit Breaker #	Interrupting Capability (3 cycle duration)		Actual Interrupting Capability (3 cycle duration)	Max. Outfeed				
			kA	MVA	kA	G519		Pre-G519		
						3 PH A	SLG A	3 PH A	SLG A	
Blackberry	230kV	Max. Bus Fault				20722	20458	14925	13463	
		1.05* (Max. Bus Fault)				21758	21481	15672	14136	
		93L	40		40.0					
		83-93LW	40		40.0					
		83L	40		40.0					
		98L		15935	26.0					
		98-FUT 1LW		15935	26.0					
		92L	40		40.0					
		92-95LW	40		40.0					
		95L		15935	26.0					
		115kV	Max. Bus Fault				24307	22368	20985	17940
			1.05* (Max. Bus Fault)				25522	23486	22034	18837
			1T	40		40.0				
		62L		5000	16.3					
		2T	40		40.0					
		9L	40		40.0					
		63L		5000	16.3					
		20L		5000	16.3					
		20WB1(GRE)		5000	16.3					
Boswell	230kV	Max. Bus Fault				18017	19998	15677	17842	
		1.05* (Max. Bus Fault)				18918	20998	16461	18734	
		83L	40		40.0					
		1-83LW Future	40		40.0					
		95L	40		40.0					
		3H-95LW	40		40.0					
Forbes	230kV	Max. Bus Fault				18199	18687	17265	17972	
		1.05* (Max. Bus Fault)				19109	19621	18129	18871	
		93L	40		40.0					
		Fut. 1 93LW	40		40.0					
Riverton	230kV	Max. Bus Fault				7632	7679	7491	7571	
		1.05* (Max. Bus Fault)				8014	8063	7865	7950	
		91-92LW	40		40.0					
		89L	40		40.0					
Arrowhead	230kV	Max. Bus Fault				9313	10280	9015	10029	
		1.05* (Max. Bus Fault)				9779	10794	9466	10530	
		98-99LW	31.5		31.5					
		98L	31.5		31.5					

**Table 6.1  
G519 - POI At 230 kV Blackberry Substation  
Known Circuit Breakers**

Bus Name		Circuit Breaker #	Interrupting Capability (3 cycle duration)		Actual Interrupting Capability (3 cycle duration)	Max. Outfeed			
			kA	MVA	kA	G519		Pre-G519	
						3 PH A	SLG A	3 PH A	SLG A
Hilltop	115kV	Max. Bus Fault				12190	13265	11990	13105
		1.05* (Max. Bus Fault)				12800	13928	12590	13760
		1T	40		40.0				
Nashwauk	115kV	Max. Bus Fault				15549	9799	14643	9385
		1.05* (Max. Bus Fault)				16327	10289	15375	9854
		10K	40		40.0				
		53L		5000	16.3				
		62L		5000	16.3				
		115W		5000	16.3				
		14L		5000	16.3				
		63L	40		40.0				
Grand Rapids Bus 1	115kV	Max. Bus Fault				11319	8068	10914	7792
		1.05* (Max. Bus Fault)				11885	8471	11460	8181
		20L		5000	16.3				
Grand Rapids Bus 2	115kV	Max. Bus Fault				11241	8031	10845	7760
		1.05* (Max. Bus Fault)				11803	8433	11387	8147
		11L	40		40.0				
		29L		5000	16.3				
Blandin	115kV	Max. Bus Fault				9052	5708	8855	5609
		1.05* (Max. Bus Fault)				9504	5993	9297	5890
		20L	20		20.0				
		61L	40		40.0				
		27L	40		40.0				
		1H	40		40.0				
		2H	40		40.0				
National Taconite	115kV	Max. Bus Fault				14602	9004	13946	8775
		1.05* (Max. Bus Fault)				15333	9454	14644	9213
		1H	40		40.0				
		2H	40		40.0				
		3H	40		40.0				
		R06	40		40.0				
		53L	40		40.0				
		14L	40		40.0				
		78L	40		40.0				



**Table 6.1  
G519 - POI At 230 kV Blackberry Substation  
Known Circuit Breakers**

Bus Name		Circuit Breaker #	Interrupting Capability (3 cycle duration)		Actual Interrupting Capability (3 cycle duration)		Max. Outfeed			
			kA	MVA	kA	G519		Pre-G519		
						3 PH A	SLG A	3 PH A	SLG A	
<b>Hibbing</b>	<b>115kV</b>	<b>Max. Bus Fault</b>				<b>13546</b>	<b>10677</b>	<b>13099</b>	<b>10465</b>	
		<b>1.05* (Max. Bus Fault)</b>				<b>14223</b>	<b>11211</b>	<b>13754</b>	<b>10988</b>	
		14L	20		20.0					
		44L	20		20.0					
		25L	20		20.0					
<b>Boswell</b>	<b>115kV</b>	<b>Max. Bus Fault</b>				<b>11427</b>	<b>10757</b>	<b>11170</b>	<b>10585</b>	
		<b>1.05* (Max. Bus Fault)</b>				<b>11998</b>	<b>11295</b>	<b>11728</b>	<b>11114</b>	
		16SH		5000	16.3					
		28L		5000	16.3					
		29L	20		20.0					
		27L	20		20.0					
		28-29MW		5000	16.3					
17-18SH	20		20.0							

**Notes**

1. Angle ignored.
2. Used Russ Mattson's scaling factors to compare breakers made in 1971.
3. The maximum bus fault current is multiplied by 1.05 to account software nuances.
4. In the column labeled "Actual Interrupting Capability", an orange highlighted cell represents those breakers proposed for replacement.

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## Stability Analysis

Stability analysis is performed to evaluate transient stability of the Project and the impact of the Project on the stability of the regional transmission system.

### 5.1 Study Procedure

#### 5.1.1 Computer Programs

Analysis was performed using PSS/E, revision 29.5 and the NMORWG UIP PC package.

#### 5.1.2 Methodology

A benchmark case was developed representing 2009 summer off-peak conditions without the G519 project. A G519 study case was developed by adding the G519 project to the benchmark case. Regional disturbances from the UIP disturbance library were simulated on the G519 study case to assess the regional transmission system. Disturbances local to the interconnection point were simulated to evaluate the transient stability of the project. If a simulation with the Project violates MAPP System Design Standards the simulation was repeated on the benchmark case without the Project to assess the impact of the Project on the violation.

#### 5.1.3 Case Development

##### 5.1.3.1 Benchmark Case without Project

The 2009 summer off-peak case (70%) and associated dynamics data from the NMORWG UIP PC package (MAPP 2004 model series) were used for stability analysis. Adjustments were made to the case to correct modeling inaccuracies or reflect system additions that have been initiated and are planned to be in service prior to G519. Adjustments are summarized below and described in more detail in Appendix E:

- Changes provided by MAPP to updated standard series model
- Changes related to Arrowhead-Weston
- Addition of higher queued generation projects listed in Table 5-1
- Changes associated with NDEX increase to 2080 MW

**Table 5-1: Projects Added to Power Flow Cases**

Project	Queue Number	Size	Location
G162, Fenton	37228-01	200 MW	Murray, MN
G164, Lakefield	37229-01	200 MW	Martin, MN
G173	37305-01	300 MW	Rice, MN
G176, Yankee	37319-01	100 MW	Lincoln, MN
G186, Emery	37337-01	600 MW	Cerro Gordo, IA
G255, Yankee	37517-01	100 MW	Brookings, SD
G261, Wilmarth	37540-02	698 MW	Blue Earth, MN
G263, Lakefield	37551-02	105 MW	Martin, MN
G287, Nobles	37642-03	200 MW	Nobles, MN
G298, Triboji	37061-02	100 MW	Dickinson, IA
G349, White	37774-01	200 MW	Brookings, SD
G358, Winnebago	37894-01	36 MW	Faribault, MN
G380, Rugby	37946-02	150 MW	Pierce, ND
G386, Lakefield	37967-01	100 MW	Martin, MN
G392, Big Stone II	38020-01	600 MW	Grant, SD
G424, Minntac	38096-01	100 MW	St. Louis, MN
GI108, White	37110-01	200 MW	Brookings, SD
GI303, White	37690-01	200 MW	Brookings, SD
GI316, Groton	37837-03	120 MW	Brown, SD
G502, Center	38425-01	50 MW	Oliver, ND
G509, Laskin	38429-01	75 MW	St. Louis, MN
Council Bluffs 4	37067-02	800 MW	Pottawattamie, IA
Nebraska City 2		700 MW	Otoe, NE

Export levels for the case without the project, case B51, are shown in Table 5-2. NDEX is modeled at the existing 2080 MW limit plus a 370 MW increment for Big Stone II. MWSI was loaded to its existing 1480 MW limit with Arrowhead-Weston open and then Arrowhead-Weston was returned to service in the final case.

**Table 5-2: Interface Transfer Levels**

Case	NDEX	MHEX	MWSI	F601C	A-W
B51-s709aa.Ezp0444	2452	2177	1221	1560 MW	726 MW
G51-s709aa.Ezp0444	2463	2179	1243	1763 MW	771 MW

Three prior-outage system conditions were modeled for the case with and without the project. The prior outages correspond to:

- Eau Claire – Arpin 345 kV line
- Gardner Park – Rocky Run 345 kV
- Gardner Park – C. Wisconsin 345 kV

No changes were made to interface transfer levels for the Gardner Park outages. For the Eau Claire-Arpin outage, flow on MWSI was reduced to 609 MW with Arrowhead-Gardner Park out of service and then Arrowhead-Gardner Park was returned to service in the final case making sure that the Stinton PST returned to a flow of 90 - 130 MW (towards Wisconsin).

Export levels for the previous outages conditions are shown on Table 5-3.

**Table 5-3: Interface Transfer Levels – Prior Outage Conditions**

Case	Prior Outage	NDEX	MHEX	MWSI	ELC-ARP
B51-ea09aa.Eyp0444	Eau Claire –Arpin 345 kV	2464	2177	484	0
G51-ea09aa.Eyp0444	Eau Claire –Arpin 345 kV	2478	2175	495	0
B51-gr09aa.Eyp0444	Gardner Park – R. Run 345 kV	2453	2176	1297	646
G51-gr09aa.Eyp0444	Gardner Park – R. Run 345	2463	2179	1320	647
B51-gw09aa.Eyp0444	Gardner Park – C. Wisconsin 345	2453	2170	1233	566
G51-gw09aa.Eyp0444	Gardner Park – C. Wisconsin 345	2463	2179	1251	561

### 5.1.3.2 G519 Case

The G519 project was modeled as described in Section 2. The project was dispatched at 600 MW to generation in the Xcel Energy control area as shown in Table 5-4.

**Table 5-4: G519 600 MW Dispatch**

Bus Name	Bus Number	Generator ID	Benchmark Case	G519 Case	Change (MW)
BFT 85G13.8	60043	5	20	0	-20
BLL C75G13.8	60056	P5	200	155	-75
BLL C76G13.8	60057	P6	200	155	-75
BUFFRIDG34.5	60708	9	205	150	-55
CHANRMB934.5	60715	9	200	150	-50
FRENCH G69.0	60974	2	14	0	-14
FRENCH G69.0	60974	1	14	0	-14
G261-CT115.0	8006	1	192.1	167.5	-24.6
G261-CT215.0	8007	1	192.1	167.5	-24.6

Bus Name	Bus Number	Generator ID	Benchmark Case	G519 Case	Change (MW)
G261-ST 19.5	8001	1	326	275	-51
HBR C71G18.0	60051	P1	150	100	-50
REDWING869.0	60823	1	21.3	0	-21.3
RICEGEN 13.8	5999	1	185.3	85.3	-100
STP CO1G13.8	60042	1	25	0	-25

After adding and dispatching the G519 project to create the study case G51, the interfaces were reloaded to the levels shown in Table 5-2 and Table 5-3.

The G519 project was modeled with reinforcement option 1, which includes the new Boswell-Riverton 230-kV circuit and utilizes the existing Riverton-Hill City-Grand Rapids 115 kV circuit. The 115 kV circuit does not overload and was left closed. Since the only significant different between reinforcement options 1 and 2 is the rating of the Riverton-Hill City-Grand Rapids 115 kV circuit, reinforcement option 1 with the 115 kV line closed is essentially the same as reinforcement option 2 and the conclusions of the stability analysis results apply to both reinforcement options.

#### 5.1.4 Disturbance Criteria

The stability simulations performed as part of this study considered the regional and local contingencies listed in Table 4.3.

**Table 5-5: Regional and Local Disturbances**

Benchmark Case Without G519	G519 Case	Description
ag1	ag1	SLG fault with breaker failure at Leland Olds on Ft. Thompson 345 kV line
ag3	ag3	3PH fault at Leland Olds on the Ft. Thompson 345 kV line
ei2	ei2	CU DC permanent bipole fault with tripping of both Coal Creek units
evl	evl	SLG fault with breaker failure (14) at Square Butte 230 kV
fd3	fd3	3PH fault at Square Butte 230 kV on the Stanton line 230 kV line
mad	mad	3PH fault at Dorsey 500 kV on the Forbes 500 kV line
mqs	mqs	SLG fault at Sherco on #3 with breaker failure.
mss	mss	SLG fault on Sherco-Coon Crk 345 kV with breaker failure.
msz	msz	3PH fault on Sherco-Coon Crk 345 kV
mts	mts	SLG fault with breaker failure at Monticello
mtz	mtz	3PH fault at Monticello on the Parker Lake line

<b>Benchmark Case Without G519</b>	<b>G519 Case</b>	<b>Description</b>
nad	nad	3PH fault at Forbes 500 kV on the Dorsey 500 kV line
nbz	nbz	3PH fault at Chisago County 500 kV on the Forbes 500 kV line trip F601C and cross trip D602
nmz	nmz	3PH fault at Chisago County 500 kV on the Forbes 500 kV line trip F601C and cross trip D602 – No tripping of Forbes SVS
oas	oas	SLG fault with breaker failure at Dorsey 500 kV on Forbes 500 kV line (Roseaun2)
pas	pac	SLG fault with breaker failure at Forbes 500 kV on Dorsey 500 kV line (Roseaun2)
pcs	pcs	SLG fault with breaker failure at King on Eau Claire 345 kV line
pct	pct	No fault trip King-Eau Claire - Arpin 345 kV line
pys	pys	14 cycle SLG fault at Prairie Island on line to Byron 345 kV
pyt	pyt	No Fault – trip of Prairie Island - Byron 345 kV line
qa3	qa3	3PH fault at Blackberry 230 kV on the Riverton line
gas	qac	SLG fault with breaker failure at Blackberry 230 kV on Riverton 230 kV line
qb3	qb3	3PH fault at Blackberry 230 kV on the Hilltop 230 kV line
qbs	qbc	SLG fault with breaker failure at Blackberry 230 kV on Arrowhead ckt 1
qc3	qc3	3PH fault at Blackberry 230 kV on the Forbes 230 kV line
qcs	qcc	SLG fault with breaker failure at Blackberry 230 kV on Forbes 230 kV line
rx3	rx3	3PH fault at Boswell 230 kV on the Blackberry 230 kV line
rxs	rxs	SLG fault with breaker failure (83L) at Boswell 230 kV on the Blackberry 230 kV line
rys	ryc	SLG fault with breaker failure (95L) at Boswell 230 kV on the Blackberry 230 kV line
rzs	rzc	SLG fault with breaker failure (94L) at Boswell 230 kV on the Shannon 230 kV line
taz	taz	3PH fault at Sherco 345 kV on the Parker Lake line
tbz	tbz	3PH fault at Coon Creek 345 kV on the Dickinson line
tcz	tcz	3PH fault at Dickinson 345 kV on the line to Parker Lake
tkz	tkz	3PH fault at King 345 kV trip King -Eau Claire - Arpin 345 kV line
va3	va3	3PH fault at Forbes 230 kV on the Arrowhead 230 kV line
vas	vac	SLG fault with breaker failure (80-90LW) at Forbes 230 kV on the Arrowhead 230 kV line
wa3	wa3	3PH fault at Shannon 230 kV on the Minntac 230 kV line

Benchmark Case Without G519	G519 Case	Description
was	wac	SLG fault with breaker failure (94-96LW) at Shannon 230 kV on the Minntac 230 kV line
xa3	xa3	3PH fault at Minntac 230 kV on the Forbes 230 kV line
xas	xac	SLG fault with breaker failure (80-96LW) at Minntac 230 kV on the Forbes 230 kV line
ya3	ya3	3PH fault at Arrowhead 345 kV on the Gardner Park 345 kV line *
yas	yac	SLG fault with breaker failure at Arrowhead 230 kV on the Gardner Park 345 kV line
ybs	ybs	3PH fault at Gardner Park 345 kV breaker stuck open Gardner Park 345/115 kV transformer
yy3	yy3	3PH fault at Gardner Park 345 kV on the Central Wisconsin 345 kV line **
yz3	yz3	3PH fault at Gardner Park 345 kV on the Rocky Run 345 kV line ***

\* also performed with prior outage Eau Claire – Arpin 345 kV line

\*\* also with prior outage Garner Park – Rocky Run 345 kV

\*\*\* also with prior outage Garner Park – C. Wisconsin 345 kV

### 5.1.5 Performance Criteria

Performance of the benchmark and G519 study models was evaluated using the MAPP Planning Standards defined in the MAPP Reliability Handbook and specific criteria in the MAPP Reliability Studies Manual.

## 5.2 Results

Tables summarizing performance of the benchmark and G519 study models are in Appendix F. All simulations are stable and within damping criteria.

Transient voltage limits were violated during some simulations:

- nbz: Several buses in the MP area violate 0.8 pu low voltage limits including 98L Tap (0.79 pu), Arrowhead (0.79 pu), Hilltop (0.79 pu).
- yac: Several buses in the MP area violate 0.8 pu low voltage limits
- Simulations listed below exhibit transient voltage violations that are not impacted by the project:
  - nmz
  - oas
  - pac



Transient voltage violations are attributed to the G519 project. However, Table 5-2 shows that in the G519 study model the Forbes-Chisago 500 kV line (F601C) is overloaded and Arrowhead-Weston is loaded above its expected operating limit of 650 MW. Sensitivity analysis, presented in Section 6, was performed to verify the potential constraints with flows on F601C and Arrowhead-Weston within limits.

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## Sensitivity Stability Analysis

Stability analysis results in Section 5 indicate that voltages violate transient voltage limits in the case with G519 in service. It was also noted that the Forbes-Chisago 500 kV line segment (F601C) is overloaded in both the benchmark case without the project and the study case with the project, which is not a realistic scenario. A sensitivity analysis has been performed to verify potential constraints.

### 6.1 Study Procedure

#### 6.1.1 Methodology

The original benchmark case (b51) and G519 study case (g51) were adjusted to reduce flows on F601C. Disturbances nbz and yac were simulated to determine the impact on the transient voltage violations attributed to project G519.

#### 6.1.2 Case Development

##### 6.1.2.1 Benchmark Case without Project

Two benchmark cases were created for this sensitivity analysis by making adjustments that reducing loading of F601C. The original benchmark case had approximately 1500 MW of wind generation in southwest MN. SW MN wind generation was reduced to approximately 825 MW in the sensitivity case b5a. A second adjustment made to sensitivity case b5b was to reduce NDEX flow to 2080 MW by redirecting the output of Big Stone II to North Dakota.

The first benchmark sensitivity case (b5a) was created from the original benchmark case (b51) as listed below. As summarized in Table 6-1, flow on F601C is 103% of the 1735 MW normal limit (with A-W out) and flow on Arrowhead-Weston is 690 MW.

- Reduced generation in SW MN to approximately 825 MW and reduced load in the XEL area (zone 601) by a corresponding amount
- Modeled series compensation on Wilmarth-Lakefield
- Adjusted power flow to load NDEX to 2450 MW, MHEX to 2175 MW and MWSI to 1480 MW (A-W open)
- Adjusted Stinson PST to 110 MW

In addition to the changes described for b5a, flow on NDEX was reduced to 2080 MW in the second sensitivity case (b5b) by keeping the output of Big Stone II in North Dakota. Load in ND (zone 90) was increased by 370 MW and load in the XEL area (zone 601) was

decreased by a corresponding amount. Finally, the Arrowhead PST was adjusted to reduce flow on Arrowhead-Weston to approximately 650 MW. As summarized in Table 6-1, flow on F601C is 99% of the 1735 MW normal limit (with A-W out) and flow on Arrowhead-Weston is 646 MW.

**Table 6-1: Benchmark Case Transfer Levels**

Case	A-W Closed					A-W Open	
	NDEX	MHEX	MWSI	F601C <sup>1</sup>	A-W	MWSI	F601C <sup>1</sup>
b51-s709aa.Ezpo044	2452 MW	2177 MW	1221 MW	1560 MW	726 MW	1533 MW	1826 MW
b5a-s709aa.Ezo0444	2445 MW	2176 MW	1174 MW	1533 MW	690 MW	1474 MW	1791 MW
b5b-s709aa.xyp0444	2079 MW	2165 MW	1183 MW	1482 MW	646 MW	1466 MW	1724 MW

Note 1: F601C flow at Chisago

### 6.1.2.2 Study Case with G519 Project

The G519 project increases flow on F601C by around 200 MW (A-W open) so the adjustments made to the benchmark sensitivity cases are not sufficient to reduce F601C loading to normal limits. Four G519 study cases were created for this sensitivity analysis where each successive case has less flow on F601C as shown in Table 6-2.

The first sensitivity G519 case (g5a) was created from the original G519 study case (g51) as listed below. Flow on F601C is 114% of the 1735 MW normal limit (with A-W out) and flow on Arrowhead-Weston is 771 MW.

- Reduced generation in SW MN to approximately 825 MW and reduced load in the XEL area (zone 601) by a corresponding amount
- Modeled series compensation on Wilmarth-Lakefield
- Adjusted power flow to load NDEX to 2450 MW, MHEX to 2175 MW and MWSI to 1480 MW (A-W open)
- Adjusted Stinson PST to 110 MW

In addition to the changes described for g5a, flow on NDEX was reduced to 2080 MW in the second sensitivity case (g5b) by keeping the output of Big Stone II in North Dakota. Load in ND (zone 90) was increased by 370 MW and load in the XEL area (zone 601) was decreased by a corresponding amount. Flow on F601C is 111% of the 1735 MW normal limit (with A-W out) and flow on Arrowhead-Weston is 735 MW.

In addition to the changes described for g5b, flow on F601C in the third sensitivity case (g5c) was further decreased by reducing generation in northeast Minnesota by 450 MW. Generation in northeast Minnesota (MP control area) was scaled according to Pgen-Pmin and load in the XEL area (zone 601) was decreased by a corresponding amount. Finally, the Arrowhead PST was adjusted to reduce flow on Arrowhead-Weston to approximately 650 MW. Flow on F601C is 100% of the 1735 MW normal limit (with A-W out) and flow on Arrowhead-Weston is 644 MW.

A fourth sensitivity case, g5d, has Arrowhead-Weston in service at 650 MW and F601C near the 1735 normal limit with A-W in service. In addition to the changes described for g5b, flow on Arrowhead-Weston was reduced to 650 MW using the Arrowhead PST.

**Table 6-2: G519 Study Case Transfer Levels**

Case	A-W Closed					A-W Open	
	NDEX	MHEX	MWSI	F601C <sup>1</sup>	A-W	MWSI	F601C <sup>1</sup>
G51-s709aa.Ezq0444	2463 MW	2179 MW	1243 MW	1763 MW	771 MW	1548 MW	2032 MW
g5a-s709aa.Eyo0444	2450 MW	2166 MW	1167 MW	1722 MW	748 MW	1472 MW	1985 MW
g5b-s709aa.xzo0444	2082 MW	2174 MW	1167 MW	1670 MW	735 MW	1471 MW	1932 MW
g5c-s709aa.xyp0444	2081 MW	2174 MW	1186 MW	1494 MW	644 MW	1467 MW	1728 MW
g5d-s709aa.xyp0444	2081 MW	2170 MW	1199 MW	1714 MW	645 MW	1468 MW	1943 MW

Note 1: F601C flow at Chisago

### 6.1.3 Disturbance Criteria

The stability simulations performed as part of this sensitivity analysis considered the contingencies listed in Table 6-3.

**Table 6-3: Contingencies for Sensitivity Analysis**

Benchmark Case Without G519	G519 Case	Description
nbz	nbz	3PH fault at Chisago County 500 kV on the Forbes 500 kV line trip F601C and cross trip D602
yas	yac	SLG fault with breaker failure at Arrowhead 230 kV on the Gardner Park 345 kV line

## 6.2 Results

Tables summarizing performance of the sensitivity benchmark and G519 study models are in Appendix G. All simulations are stable and within damping criteria.

The adjustments made to reduce F601C loading in sensitivity case g5a (SW MN generation reduction) eliminate transient voltage violations attributed to the G519 project during simulations nbz and yac. There are no transient low voltage violations for the contingencies simulated on cases g5a, g5b, g5c or g5d.

Figure 6-1 shows the impact of the adjustments made to reduce F601C loading on voltage at the Arrowhead 230 kV bus during simulation nbz.

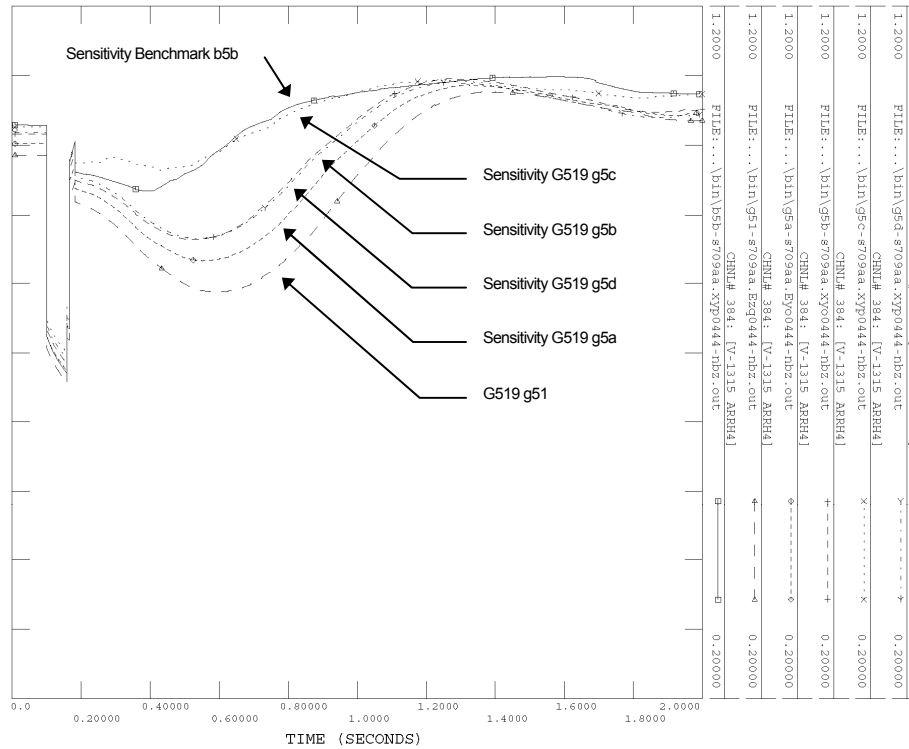


Figure 6-1: Arrowhead 230 kV Voltage during Simulation nbz

Additional sensitivity analysis was performed to identify any issues that might result from opening the Grand Rapids-Hill City-Riverton 115 kV circuit. Select simulations were repeated on sensitivity G519 study model g5d with the Riverton-Hill City 115 kV out of service. Tables summarizing performance of the sensitivity study model g5d with the 115 kV out of service are included at the end of Appendix G. All simulations are stable and within damping criteria; bus voltages are within transient limits.

For the contingencies simulated in the sensitivity analysis, voltages are within transient limits when pre-contingency flow on the F601C line is within normal limits.

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## Conclusions

G519 caused one transmission line to overload for system intact conditions. The Grand Rapids-Hill City-Riverton 115 kV circuit overloads in the summer peak case. This is not an injection limit and opening this line to simulate the existing operating guide adequately addressed this issue.

The N-1 contingency analysis found that G519 causes the Blackberry-Riverton 230 kV circuit to overload. Because this facility is a direct outlet from the G519 POI, this is an injection overload and must be mitigated. A new 73-mile 230 kV circuit from Boswell to Riverton is proposed to mitigate the identified injection overload. This new line was found to mitigate the identified G519 injection overload without causing any new issues.

Under high off peak transfer conditions G519 aggravates voltage problems at 230 kV, 161 kV and 115 kV buses around Arrowhead and Stone Lake. N-2 contingency analysis results with the Boswell-Riverton 230 kV line do not indicate any threat for cascading outages.

The constrained interface analysis found that G519 has a distribution factor greater than the applicable 5% (PTDF flowgates) or 3% (OTDF flowgates) threshold on the following flowgates:

- FORCHS - 26% (with reinforcements)
- MWSI - 14% (with reinforcements)
- PR\_ISL\_BYRON - 9% (with reinforcements)

The conclusion of the stability analysis is that all design standards are maintained as long as loading of Forbes-Chisago is within limits and flow on Arrowhead-Weston is limited to not more than 750 MW.

The conclusion of the short circuit analysis is that the interconnection of G519 at the Blackberry 230 kV substation causes four breakers at the Nashwauk 115 kV bus to become overdutied. These four 115 kV circuit breakers need to be replaced due to the addition of G519.

Study results with the Grand Rapids-Hill City-Riverton 115 kV circuit open indicate that after addition of the new 230 kV line from Boswell to Riverton the primary need for the 115 kV circuit is to serve Hill City load. Two assumptions incorporated in the cost estimate are that the 230 kV line route will use the 115 kV line right-of-way and that a new 230 kV substation will be constructed at Hill City. Maintaining the 115 kV circuit needs to be evaluated as part of the long term planning process.

The following network upgrades described in Table 7-1 are required to connect G519 as an Energy Resource:

- Add new 230 kV line from Boswell to Riverton
- New 230 kV bus position for Boswell-Riverton line at Boswell
- New 230 kV bus position for Boswell-Riverton line at Riverton
- New 230 kV substation at Hill City
- Replace 4 115 kV circuit breakers at Nashwauk

Costs shown in Table 7-1 are good faith estimates and will be further developed and refined in the Facility Study. Additional deliverability analysis will be performed by MISO to evaluate if G519 can be certified as NR.

**Table 7-1: Cost Estimate for Network Upgrades**

Location	Facilities	Good Faith Cost Estimate <sup>1</sup>
Boswell-Riverton	Add new Boswell-Riverton 230 kV line	\$45 million <sup>2</sup>
Boswell 230 kV Substation	Add new 230 kV bus position for new Boswell-Riverton 230 kV line.	\$1.9 million <sup>3</sup>
Riverton 230 kV Substation	Add new 230 kV bus position for new Boswell-Riverton 230 kV line.	\$1.7 million <sup>4</sup>
Hill City 230 kV Substation	Add new 230 kV substation at Hill City	\$3.5 million <sup>5</sup>
Nashwauk 115 kV Substation	Replace 4 115 kV circuit breakers	\$720,000

**Notes**

- 1: Cost estimate provided by MP
- 2: Estimate for new 230 kV line form Boswell to Riverton incorporates a new route from Boswell, south to Hill City. The route from Hill City to Riverton would use 11 Line right-of-way. Assumptions are: single circuit, wood H-frame construction, 954 ACSR (54/7) conductor, one 3/8 steel shield wire, and one 528 (24 fiber) OPGW. Cost includes permitting, engineering, right-of-way, clearing, removals, material, inspection, construction, and restoration. This route would be approximately 73 miles in length.
- 3: Estimate (+/- 40%) for terminating a line in the Boswell 230 kV substation.
- 4: Estimate (+/- 40%) for terminating a line in the Riverton 230 kV substation.
- 5: Estimate (+/- 40%) for constructing a new 230 kV Substation at Hill City (land, 2-230 kV line breakers, 230/12.5 kV 20 MVA Transformer, Control Building, Line Panels, etc.)





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## G519 Model Parameters

### a) Combustion Units Models

```
** GENROU ** BUS X-- NAME --XBASEKV MC CONS STATES  
61821 G519 G1 18.000 1 128882-128895 48056-48061
```

```
MBASE ZSORCE XTRAN GENTAP  
255.0 0.00000+J 0.20190 0.00000+J 0.00000 1.00000
```

```
T'D0 T"D0 T'Q0 T"Q0 H DAMP XD XQ X'D X'Q X"D XL  
10.48 0.048 1.16 0.082 5.00 0.00 2.1165 2.0616 0.2686 0.4544 0.2019 0.1716
```

```
S(1.0) S(1.2)  
0.6909 2.9500
```

```
** ESAC2A ** BUS X-- NAME --XBASEKV MC CONS STATES  
61821 G519 G1 18.000 1 128924-128945 48074-48078
```

```
TR TB TC KA TA VAMAX VAMIN KB VRMAX VRMIN  
0.000 0.000 0.000 400.0 0.020 10.000 -10.000 1.0 47.9 -38.3
```

```
TE VFEMAX KH KF TF KC KD KE  
0.800 18.500 0.000 0.030 1.000 0.640 1.000 1.000
```

```
E1 S(E1) E2 S(E2)  
4.5300 0.0100 6.0400 0.2200
```

```
** WESGOV ** BUS X-- NAME --XBASEKV MC CONS STATES VARS ICONS  
61821 G519 G1 18.000 1 128980-128988 48088-48090 11966-11971 5933-5934
```

```
DTC DTP DROOP KP TI T1 T2 ALIM TPE  
0.1000 0.1000 0.0400 7.66 1.60 0.5000 0.5900 0.3000 0.1000
```

**b) Steam Unit Models**

\*\* GENROU \*\* BUS X-- NAME --XBASEKV/MC CONS STATES  
 61823 G519 G3 18.000 3 128910-128923 48068-48073

MBASE ZSORCE XTRAN GENTAP  
 333.0 0.00000+J 0.25460 0.00000+J 0.00000 1.00000

T'D0 T"D0 T'Q0 T"Q0 H DAMP XD XQ X'D X'Q X"D XL  
 6.64 0.046 0.74 0.076 6.00 0.00 1.7610 1.7292 0.3255 0.5369 0.2546 0.2089

S(1.0) S(1.2)  
 0.5200 2.4900

\*\* EXST1 \*\* BUS X-- NAME --XBASEKV/MC CONS STATES  
 61823 G519 G3 18.000 3 128968-128979 48084-48087

TR VIMAX VIMIN TC TB KA TA  
 0.000 0.170 -0.170 1.000 8.000 250.0 0.020

VRMAX VRMIN KC KF TF  
 4.617 -4.155 0.111 0.050 1.000

\*\* IEEEG1 \*\* BUS X-- NAME --XBASEKV/MC CONS STATES VARS  
 61823 G519 G3 18.000 3 128998-129017 48094-48099 11978-11979

K T1 T2 T3 UO UC PMAX PMIN T4 K1  
 20.00 0.000 0.000 0.075 0.300 -0.300 1.0000 0.0000 0.300 0.200

K2 T5 K3 K4 T6 K5 K6 T7 K7 K8  
 0.000 10.000 0.350 0.000 0.600 0.450 0.000 0.000 0.000 0.000

Appendix

**B**

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## **Steady State Results – Summer Peak**

# Comparison of Branch Violations - G519 Without Reinforcements

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 17:36  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N10B-09SUPK.SAV - G519 600 MW, CAP-X,09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N10b-f-09supk.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 16:46  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_ATC.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

\*\*\*\*\* Report on violations \*\*\*\*\*

With G519 <span style="float: right;">600.0 MW</span>											Base-Without New Generation						
Branches with MVA flow more than 100.0 % of nominal rating											Assumed Max. Loading 85%						
**	From bus	** **	To bus	**	CKT	Type	ContMVA	BaseFlow	Rating	Loading%	Ncon	Contingency		ContMVA	BaseFlow	Loading%	TDF - %
60290	ST LAKE5 161 69561	WASHCO 5 161 1	LN				145.6	87.8	132.0	110.3	2298	015 2		#N/A	#N/A	#N/A	5.13 %
61612	RIVERTN4 230 61625	BLCKBRY4 230 1	LN				487.9	366.4	415.8	117.3	2298	015 2		#N/A	#N/A	#N/A	21.03 %

# Comparison of Branch Violations - With Reinforcement Option 1

MUST 7.0e -- Managing and Utilizing System Transmission -- FRI, APR 28 2006 15:15  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N12B-09SUPK.SAV - G519 600 MW, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N12b-f-09supk.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 16:46  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_ATC.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

\*\*\*\*\* Report on violations \*\*\*\*\*

Branches with MVA flow more than 100.0 % of nominal rating											Base-Without New Generation								
With G519 600.0 MW											Assumed Min. Loading 85%								
**	From bus	**	**	To bus	**	CKT	Type	ContMVA	BaseFlow	Rating	Loading%	Ncon	Contingency		Pointer	ContMVA	BaseFlow	Loading%	TDF - %
60290	ST LAKE5	161	69561	WASHCO 5	161	1	LN	133.7	84.4	132.0	101.3	2299	015	2	#N/A	#N/A	#N/A	#N/A	3.14 %

# Comparison of N-2 Branch Violations - G519 Without Reinforcements

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 20:08  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N10B-09SUPK.SAV - G519 600 MW, CAP-X,09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N10b-f-09supk.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519 Double.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 19:56  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_ATC.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519 Double.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

\*\*\*\*\* Report on violations \*\*\*\*\*

With G519 600.0 MW

Base-Without New Generation

Branches with MVA flow more than 100.0 % of nominal rating

Assumed Min. Loading 85%

**	From bus	** **	To bus	** CKT	Type	ContMVA	BaseFlow	Rating	Loading%	Ncon	Contingency	Pointer	ContMVA	BaseFlow	Loading%	TDF - %
61576	HILTPJCT	115 61616	HILLTOP4	230 1	TR	239.2	85.0	233.0	102.7	169	D:RIVERTN4-BLCKBRY41 +98L TAP4-ARROWHD41	#N/A	#N/A	#N/A	#N/A	8.80 %
61576	HILTPJCT	115 61672	HILLTOP7	115 1	TR	239.2	84.8	233.0	102.7	169	D:RIVERTN4-BLCKBRY41 +98L TAP4-ARROWHD41	#N/A	#N/A	#N/A	#N/A	8.80 %
61612	RIVERTN4	230 61625	BLCKBRY4	230 1	LN	506.0	366.4	415.8	121.7	230	D:98L TAP4-BLCKBRY41 +FORBES 4-BLCKBRY41	#N/A	#N/A	#N/A	#N/A	28.89 %
61614	98L TAP4	230 61616	HILLTOP4	230 1	LN	238.1	83.4	205.0	116.1	169	D:RIVERTN4-BLCKBRY41 +98L TAP4-ARROWHD41	#N/A	#N/A	#N/A	#N/A	12.35 %
61624	FORBES 4	230 61625	BLCKBRY4	230 1	LN	575.3	257.1	407.0	141.3	171	D:RIVERTN4-BLCKBRY41 +98L TAP4-BLCKBRY41	#N/A	#N/A	#N/A	#N/A	41.62 %
61663	FLDWDTP7	115 61670	MDWLND7	115 1	LN	108.5	55.1	99.0	109.6	171	D:RIVERTN4-BLCKBRY41 +98L TAP4-BLCKBRY41	#N/A	#N/A	#N/A	#N/A	4.88 %
61663	FLDWDTP7	115 61739	BLCKBRY7	115 1	LN	124.4	68.3	99.0	125.6	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	7219	88.3	47.8	89.2	6.02 %
61668	CLOQUET7	115 61671	BURNETT7	115 1	LN	108.0	52.2	99.0	109.1	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	#N/A	#N/A	#N/A	#N/A	4.80 %
61670	MDWLND7	115 61671	BURNETT7	115 1	LN	109.6	53.8	99.0	110.7	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	#N/A	#N/A	#N/A	#N/A	5.07 %
61673	ARROWHD7	115 62447	BERGNT7	115 1	LN	114.0	43.5	99.0	115.2	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	7225	88.0	36.1	88.9	4.33 %
61718	16L TAP7	115 61720	COTTNT7	115 1	LN	117.4	46.9	99.0	118.5	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	9599	91.3	39.5	92.2	4.35 %
61720	COTTNT7	115 62447	BERGNT7	115 1	LN	115.5	45.0	99.0	116.7	226	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	9600	89.4	37.6	90.3	4.35 %
61722	FORBES 7	115 61730	78L TAP7	115 1	LN	88.5	11.1	88.0	100.5	176	D:RIVERTN4-BLCKBRY41 +FORBES 4-BLCKBRY41	#N/A	#N/A	#N/A	#N/A	3.02 %
61730	78L TAP7	115 61733	NATIONL7	115 1	LN	159.4	31.3	88.0	181.1	303	D:FORBES 4-BLCKBRY41 +BOSWELL4-SHANNON41	#N/A	#N/A	#N/A	#N/A	14.83 %
61731	14L TAP7	115 61737	NASHWAK7	115 1	LN	186.3	75.3	158.0	117.9	303	D:FORBES 4-BLCKBRY41 +BOSWELL4-SHANNON41	#N/A	#N/A	#N/A	#N/A	9.98 %
61733	NATIONL7	115 61737	NASHWAK7	115 1	LN	162.6	68.8	158.0	102.9	303	D:FORBES 4-BLCKBRY41 +BOSWELL4-SHANNON41	#N/A	#N/A	#N/A	#N/A	6.03 %

## Comparison of N-2 Branch Violations - G519 with Reinforcement Option 2

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 21:50  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N11B-09SUPK.SAV - G519 600 MW, CAP-X,09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N11b-f-09supk\_reinf.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519 Double.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 19:56  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_ATC.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519 Double.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

\*\*\*\*\* Report on violations \*\*\*\*\*

With G519 600.0 MW

Base-Without New Generation

Branches with MVA flow more than 100.0 % of nominal rating

Assumed Min. Loading 85%

**	From bus	** **	To bus	** CKT	Type	ContMVA	BaseFlow	Rating	Loading%	Ncon	Contingency	Pointer	ContMVA	BaseFlow	Loading%	TDF - %
61730	78L TAP7 115	61733	NATIONL7 115 1	LN		112.6	19.3	88.0	127.9	318	D:FORBES 4-BLCKBRY41 +BOSWELL4-SHANNON41	#N/A	#N/A	#N/A	#N/A	7.03 %
61663	FLDWDTP7 115	61739	BLCKBRY7 115 1	LN		108.9	59.4	99.0	110.0	236	D:98L TAP4-BLCKBRY41 +ARROWHD4-FORBES 41	7219	88.3	47.8	89.2	3.43 %
61653	RIVERTN7 115	61796	RIVERJCT 115 1	TR		240.3	114.9	233.0	103.1	84	D:BADOURA4-RIVERTN41 +RIVERTN4-MUDLAKE41	#N/A	#N/A	#N/A	#N/A	8.98 %
61652	BRAINRD7 115	61653	RIVERTN7 115 1	LN		107.2	32.6	99.0	108.3	131	D:WINGRIV4-RIVERTN41 +RIVERTN4-MUDLAKE41	#N/A	#N/A	#N/A	#N/A	4.67 %
61612	RIVERTN4 230	61796	RIVERJCT 115 1	TR		242.2	115.8	233.0	103.9	84	D:BADOURA4-RIVERTN41 +RIVERTN4-MUDLAKE41	#N/A	#N/A	#N/A	#N/A	9.30 %

Appendix

C

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## Steady State Results – Light Load High Transfers



# Comparison of Branch Violations

## N-1 Contingency Analysis With and Without G519 - Light Load

MES N10B-S709AA.EYP0444.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2453,MH=2170,MW=1187,OHMH=-3,OHMP=150,EWTW=161,BD=168  
 CASE C:\Client Files\MISO\G519\N10b-S709AA.EYP0444.sav WAS SAVED ON WED, JAN 18 2006  
 SUBSYSTEM DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_psse.sub  
 MONITORED ELEMENT FILE: C:\Client Files\MISO\G519\G519\_PSSE.mon  
 CONTINGENCY DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_PSSE.CON

MES N00B-S709AA.EYP0444.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2453,MH=2170,MW=1187,OHMH=-3,OHMP=150,EWTW=161,BD=168  
 CASE C:\Client Files\MISO\G519\N00b-s709aa.Eyp0444.sav  
 SUBSYSTEM DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_psse.sub  
 MONITORED ELEMENT FILE: C:\Client Files\MISO\G519\G519\_PSSE.mon  
 CONTINGENCY DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_PSSE.CON

\*\*\*\*\* Report on violations \*\*\*\*\*

G519                      600.0 MW

Base-Without New Generation

### Branches with MVA flow more than 100.0 % of nominal rating

Assumed N 100%

**	From bus	** **	To bus	**	Type	ContMVA	Rating	Loading%	Contingency	Pointer	ContMVA	Loading%	TDF - %
	CKT		CKT										
39448	AHD PST	230 39449*	AHD 345 345 1		TR	827.8	800.0	103.5	050 2	10361	803.9	100.5	3.98 %
39448	AHD PST	230 39449*	AHD 345 345 1		TR	832.4	800.0	104.0	BUS 61683 [STIN-MN7115.00] TO BUS 61684 [STIN-WI7115.00] CKT 1	#N/A	#N/A	#N/A	5.40 %
39448	AHD PST	230 39449*	AHD 345 345 1		TR	832.8	800.0	104.1	ATC-ARPG2	10355	810.6	101.3	3.70 %
39448	AHD PST	230 39449*	AHD 345 345 1		TR	833.2	800.0	104.1	NSP 2	10356	811.0	101.4	3.70 %
39448	AHD PST	230 39449*	AHD 345 345 1		TR	833.5	800.0	104.2	NSP 2	10357	810.8	101.3	3.78 %
39448	AHD PST	230 39449*	AHD 345 345 1		TR	838.2	800.0	104.8	NSP 1	10363	816.2	102.0	3.67 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	827.9	800.0	103.5	050 2	10376	803.7	100.5	4.03 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	831.4	800.0	103.9	BUS 61683 [STIN-MN7115.00] TO BUS 61684 [STIN-WI7115.00] CKT 1	#N/A	#N/A	#N/A	5.23 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	832.9	800.0	104.1	ATC-ARPG2	10370	810.5	101.3	3.73 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	833.3	800.0	104.2	NSP 2	10371	810.9	101.4	3.73 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	833.6	800.0	104.2	NSP 2	10372	810.7	101.3	3.82 %
39448	AHD PST	230 61615*	ARROWHD4 230		LN	838.3	800.0	104.8	NSP 1	10367	816.2	102.0	3.68 %
39676	GDP 345 345	39785*	ROCKY RN 345 1		LN	826.5	717.0	115.8	BUS 39602 [CWI 345 345.00] TO BUS 39676 [GDP 345 345.00] CKT 1	10379	802.7	111.9	3.97 %
60173	ROSEAUN2 500	67564*	DORSEY 2 500		LN	2034.4	1905.3	103.8	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] CKT 1	#N/A	#N/A	#N/A	21.52 %
60173*	ROSEAUN2 500	60174	ROSEAUS2 500		LN	2003.8	1905.0	100.2	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] CKT 1	#N/A	#N/A	#N/A	16.47 %
60197	CHIS CO2 500	61493*	CHIS D1Y 110 10		TR	1731.3	1385.0	125.0	BUS 60197 [CHIS CO2500.00] TO BUS 61494 [CHIS D2Y110.00] CKT 1	13038	1534.0	110.8	32.88 %
60197	CHIS CO2 500	61493*	CHIS D1Y 110 10		TR	1724.2	1385.0	124.5	BUS 60199 [CHIS CO3345.00] TO BUS 61494 [CHIS D2Y110.00] CKT 1	13039	1526.7	110.2	32.92 %
60197	CHIS CO2 500	61494*	CHIS D2Y 110 9		TR	1731.3	1385.0	125.0	BUS 60197 [CHIS CO2500.00] TO BUS 61493 [CHIS D1Y110.00] CKT 1	13040	1534.0	110.8	32.88 %
60197	CHIS CO2 500	61494*	CHIS D2Y 110 9		TR	1724.2	1385.0	124.5	BUS 60199 [CHIS CO3345.00] TO BUS 61493 [CHIS D1Y110.00] CKT 1	13041	1526.7	110.2	32.92 %
60197*	CHIS CO2 500	60198	CHIS-N 2 500 1		LN	2039.8	1905.0	108.9	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] CKT 1	#N/A	#N/A	#N/A	22.47 %
60197*	CHIS CO2 500	60198	CHIS-N 2 500 1		LN	2039.8	1905.0	108.9	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT 1	#N/A	#N/A	#N/A	22.47 %
60197*	CHIS CO2 500	60198	CHIS-N 2 500 1		LN	2022.2	1905.0	107.7	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT 1	#N/A	#N/A	#N/A	19.53 %
60197*	CHIS CO2 500	60198	CHIS-N 2 500 1		LN	1958.0	1905.0	103.9	BUS 39450 [STL 345 345.00] TO BUS 39676 [GDP 345 345.00] CKT 1	#N/A	#N/A	#N/A	8.83 %
60199*	CHIS CO3 345	61493	CHIS D1Y 110 10		TR	1728.5	1385.0	124.8	BUS 60197 [CHIS CO2500.00] TO BUS 61494 [CHIS D2Y110.00] CKT 1	13042	1529.7	110.4	33.13 %
60199*	CHIS CO3 345	61493	CHIS D1Y 110 10		TR	1721.5	1385.0	124.3	BUS 60199 [CHIS CO3345.00] TO BUS 61494 [CHIS D2Y110.00] CKT 1	13043	1522.9	110.0	33.10 %

60199*CHIS CO3 345 61494 CHIS D2Y 110 9	TR	1728.5	1385.0	124.8	BUS 60197 [CHIS CO2500.00] TO BUS 61493 [CHIS D1Y110.00] CKT	13044	1529.7	110.4	33.13 %
60199*CHIS CO3 345 61494 CHIS D2Y 110 9	TR	1721.5	1385.0	124.3	BUS 60199 [CHIS CO3345.00] TO BUS 61493 [CHIS D1Y110.00] CKT	13045	1522.9	110.0	33.10 %
60290 ST LAKE5 161 61631*MINONG 5 161 1	LN	208.8	183.7	120.2	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT 1	13083	187.7	107.1	3.52 %
60290*ST LAKE5 161 69561 WASHCO 5 161 1	LN	247.8	132.0	186.1	BUS 39450 [STL 345 345.00] TO BUS 39676 [GDP 345 345.00] CKT 1	13084	226.7	166.0	3.52 %
61614*98L TAP4 230 61616 HILLTOP4 230 1	LN	241.3	205.0	120.7	BUS 61614 [98L TAP4230.00] TO BUS 61615 [ARROWHD4230.00] CKT	#N/A	#N/A	#N/A	6.05 %
61624 FORBES 4 230 61625*BLCKBRY4 230	LN	440.4	407.0	106.0	BUS 61614 [98L TAP4230.00] TO BUS 61625 [BLCKBRY4230.00] CKT	#N/A	#N/A	#N/A	5.57 %
61624 FORBES 4 230 61625*BLCKBRY4 230	LN	438.9	407.0	105.6	620	#N/A	#N/A	#N/A	5.32 %
61624 FORBES 4 230 61625*BLCKBRY4 230	LN	438.9	407.0	105.6	620	#N/A	#N/A	#N/A	5.32 %
61651 MUDLAKE7 115 61652*BRAINRD7 115	LN	139.0	107.8	128.1	BUS 61612 [RIVERTN4230.00] TO BUS 61617 [MUDLAKE4230.00] CKT	#N/A	#N/A	#N/A	5.20 %
61663 FLDWDTP7 115 61739*BLCKBRY7 115	LN	124.4	99.0	123.4	BUS 61614 [98L TAP4230.00] TO BUS 61625 [BLCKBRY4230.00] CKT	#N/A	#N/A	#N/A	4.23 %
61663 FLDWDTP7 115 61739*BLCKBRY7 115	LN	125.9	99.0	124.9	620	#N/A	#N/A	#N/A	4.48 %
61663 FLDWDTP7 115 61739*BLCKBRY7 115	LN	125.9	99.0	124.9	620	#N/A	#N/A	#N/A	4.48 %
61691*SLVRBYH7 115 61692 SLVRBAY7 115	LN	131.7	107.0	121.2	BUS 61614 [98L TAP4230.00] TO BUS 61625 [BLCKBRY4230.00] CKT	#N/A	#N/A	#N/A	4.12 %
61691*SLVRBYH7 115 61692 SLVRBAY7 115	LN	132.1	107.0	121.7	620	#N/A	#N/A	#N/A	4.18 %
61691*SLVRBYH7 115 61692 SLVRBAY7 115	LN	132.1	107.0	121.7	620	#N/A	#N/A	#N/A	4.18 %
61718*16L TAP7 115 62454 PEARY 7 115 1	LN	118.4	99.0	124.3	BUS 61721 [ETCO 7115.00] TO BUS 61722 [FORBES 7115.00] CKT 1	#N/A	#N/A	#N/A	3.23 %
62005*KERKHOT7 115 62006 KERKHO 7 115	LN	51.2	32.9	159.3	BUS 60196 [CHISAGO7115.00] TO BUS 60199 [CHIS CO3345.00] CKT	#N/A	#N/A	#N/A	3.05 %
62005*KERKHOT7 115 62006 KERKHO 7 115	LN	56.1	32.9	176.2	BUS 63314 [BIGSTON4230.00] TO BUS 63317 [CANBY 4230.00] CKT	#N/A	#N/A	#N/A	3.87 %
62005*KERKHOT7 115 62006 KERKHO 7 115	LN	56.4	32.9	177.6	BUS 66503 [BLAIR 4230.00] TO BUS 66550 [GRANITF4230.00] CKT 1	#N/A	#N/A	#N/A	3.92 %
62005*KERKHOT7 115 62006 KERKHO 7 115	LN	58.0	32.9	181.7	550	#N/A	#N/A	#N/A	4.18 %
66563 SPENCER5 161 34137*TRIBOJIS 161 1	LN	223.1	195.0	113.1	BUS 60196 [CHISAGO7115.00] TO BUS 60199 [CHIS CO3345.00] CKT	#N/A	#N/A	#N/A	4.68 %
66563 SPENCER5 161 34137*TRIBOJIS 161 1	LN	222.9	195.0	112.8	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] CKT	#N/A	#N/A	#N/A	4.65 %
69557 BARRON 5 161 69561*WASHCO 5 161	LN	190.7	132.0	146.8	BUS 39450 [STL 345 345.00] TO BUS 39676 [GDP 345 345.00] CKT 1	59863	172.1	129.1	3.10 %

## Comparison of Voltage Violations

### N-1 Contingency Analysis With and Without G519 - Light Load

MES N10B-S709AA.EYP0444.SAV; SUMMER: OP LD 70%; SYSTEM INTACT

ND=2453,MH=2170,MW=1187,OHMH=-3,OHMP=150,EWTW=161,BD=168

CASE C:\Client Files\MISO\G519\N10b-S709AA.EYP0444.sav WAS SAVED ON WED, JAN 18 2006 14:4

SUBSYSTEM DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_psse.sub

MONITORED ELEMENT FILE: C:\Client Files\MISO\G519\G519\_PSSE.mon

CONTINGENCY DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_PSSE.CON

MES N00B-S709AA.EYP0444.SAV; SUMMER: OP LD 70%; SYSTEM INTACT

ND=2453,MH=2170,MW=1187,OHMH=-3,OHMP=150,EWTW=161,BD=168

CASE C:\Client Files\MISO\G519\N00b-s709aa.Eyp0444.sav

SUBSYSTEM DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_psse.sub

MONITORED ELEMENT FILE: C:\Client Files\MISO\G519\G519\_PSSE.mon

CONTINGENCY DESCRIPTION FILE: C:\Client Files\MISO\G519\G519\_PSSE.CON

\*\*\*\*\* Report on violations \*\*\*\*\*

G519 100.0 MW

Base-Without New Generation

#### Buses with voltage violations

Bus #	Bus Name	KV	Area	Zone	ContVol t	BaseVol t	Low Limit	Upper Limit	Viol	Contin.Description	Pointer	ContVol t	BaseVol t	Viol	Degradatio n
61686	15TH AV7	115	0	0	0.9093	0.9873	0.950	1.050	L	050 2	13	0.9425	1.0051	H	0.0332
61686	15TH AV7	115	0	0	0.9317	0.9873	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0183
61686	15TH AV7	115	0	0	0.9003	0.9873	0.950	1.050	L	ATC-ARPG2	3	0.9355	1.0051	H	0.0352
61686	15TH AV7	115	0	0	0.9299	0.9873	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0201
61686	15TH AV7	115	0	0	0.9157	0.9873	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2	0.9453	1.0051	H	0.0296
61686	15TH AV7	115	0	0	0.9326	0.9873	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0174
61686	15TH AV7	115	0	0	0.9383	0.9873	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0117
61686	15TH AV7	115	0	0	0.9157	0.9873	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	1	0.9453	1.0051	H	0.0296
61686	15TH AV7	115	0	0	0.8875	0.9873	0.900	1.100	L	NSP 2	5	0.9268	1.0051	H	0.0393
61686	15TH AV7	115	0	0	0.8814	0.9873	0.900	1.100	L	NSP 1	6	0.9204	1.0051	H	0.0390
61686	15TH AV7	115	0	0	0.8865	0.9873	0.900	1.100	L	NSP 2	7	0.9255	1.0051	H	0.0390
61614	98L TAP4	230	0	0	0.9177	0.9951	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0323
61614	98L TAP4	230	0	0	0.9386	0.9951	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0114
61614	98L TAP4	230	0	0	0.9083	0.9951	0.950	1.050	L	ATC-ARPG2	16	0.9431	1.0144	L	0.0348
61614	98L TAP4	230	0	0	0.9367	0.9951	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0133
61614	98L TAP4	230	0	0	0.9390	0.9951	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0110
61614	98L TAP4	230	0	0	0.9390	0.9951	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0110
61614	98L TAP4	230	0	0	0.8966	0.9951	0.900	1.100	L	NSP 2	18	0.9347	1.0144	H	0.0381
61614	98L TAP4	230	0	0	0.8905	0.9951	0.900	1.100	L	NSP 1	19	0.9284	1.0144	H	0.0379
61614	98L TAP4	230	0	0	0.8953	0.9951	0.900	1.100	L	NSP 2	20	0.9333	1.0144	L	0.0380
39449	AHD 345	345	0	0	0.8891	0.9976	0.900	1.100	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0109
39448	AHD PST	230	0	0	0.8900	0.9960	0.900	1.100	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0100
61615	ARROWHD	230	0	0	0.9176	0.9956	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0324
61615	ARROWHD	230	0	0	0.9387	0.9956	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0113
61615	ARROWHD	230	0	0	0.9082	0.9956	0.950	1.050	L	ATC-ARPG2	38	0.9431	1.0148	L	0.0349
61615	ARROWHD	230	0	0	0.9367	0.9956	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0133
61615	ARROWHD	230	0	0	0.9389	0.9956	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0111

61615	ARROWHD	230	0	0	0.9389	0.9956	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0111
61615	ARROWHD	230	0	0	0.8964	0.9956	0.900	1.100	L	NSP 2	40	0.9346	1.0148	H	0.0382
61615	ARROWHD	230	0	0	0.8902	0.9956	0.900	1.100	L	NSP 1	41	0.9283	1.0148	L	0.0381
61615	ARROWHD	230	0	0	0.8951	0.9956	0.900	1.100	L	NSP 2	42	0.9333	1.0148	H	0.0382
61673	ARROWHD	115	0	0	0.9158	0.9907	0.950	1.050	L	050 2	58	0.9476	1.0087	H	0.0318
61673	ARROWHD	115	0	0	0.9370	0.9907	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0130
61673	ARROWHD	115	0	0	0.9070	0.9907	0.950	1.050	L	ATC-ARPG2	48	0.9408	1.0087	H	0.0338
61673	ARROWHD	115	0	0	0.9352	0.9907	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0148
61673	ARROWHD	115	0	0	0.9296	0.9907	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0204
61673	ARROWHD	115	0	0	0.9384	0.9907	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0116
61673	ARROWHD	115	0	0	0.9296	0.9907	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0204
61673	ARROWHD	115	0	0	0.8949	0.9907	0.900	1.100	L	NSP 2	50	0.9323	1.0087	H	0.0374
61673	ARROWHD	115	0	0	0.8889	0.9907	0.900	1.100	L	NSP 1	51	0.9261	1.0087	H	0.0372
61673	ARROWHD	115	0	0	0.8938	0.9907	0.900	1.100	L	NSP 2	52	0.9311	1.0087	H	0.0373
61554	AWHD1JCT	115	0	0	0.9158	0.9897	0.950	1.050	L	050 2	71	0.9469	1.0073	H	0.0311
61554	AWHD1JCT	115	0	0	0.9369	0.9897	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0131
61554	AWHD1JCT	115	0	0	0.9072	0.9897	0.950	1.050	L	ATC-ARPG2	61	0.9405	1.0073	H	0.0333
61554	AWHD1JCT	115	0	0	0.9352	0.9897	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0148
61554	AWHD1JCT	115	0	0	0.9284	0.9897	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0216
61554	AWHD1JCT	115	0	0	0.9380	0.9897	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0120
61554	AWHD1JCT	115	0	0	0.9283	0.9897	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0217
61554	AWHD1JCT	115	0	0	0.8949	0.9897	0.900	1.100	L	NSP 2	63	0.9321	1.0073	H	0.0372
61554	AWHD1JCT	115	0	0	0.8890	0.9897	0.900	1.100	L	NSP 1	64	0.9259	1.0073	H	0.0369
61554	AWHD1JCT	115	0	0	0.8939	0.9897	0.900	1.100	L	NSP 2	65	0.9308	1.0073	H	0.0369
61556	AWHD2JCT	115	0	0	0.9159	0.9898	0.950	1.050	L	050 2	82	0.947	1.0074	H	0.0311
61556	AWHD2JCT	115	0	0	0.9370	0.9898	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0130
61556	AWHD2JCT	115	0	0	0.9073	0.9898	0.950	1.050	L	ATC-ARPG2	72	0.9406	1.0074	H	0.0333
61556	AWHD2JCT	115	0	0	0.9353	0.9898	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0147
61556	AWHD2JCT	115	0	0	0.9286	0.9898	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0214
61556	AWHD2JCT	115	0	0	0.9380	0.9898	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0120
61556	AWHD2JCT	115	0	0	0.9285	0.9898	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0215
61556	AWHD2JCT	115	0	0	0.8950	0.9898	0.900	1.100	L	NSP 2	74	0.9322	1.0074	H	0.0372
61556	AWHD2JCT	115	0	0	0.8891	0.9898	0.900	1.100	L	NSP 1	75	0.926	1.0074	H	0.0369
61556	AWHD2JCT	115	0	0	0.8940	0.9898	0.900	1.100	L	NSP 2	76	0.9309	1.0074	H	0.0369
63055	BEARCK 4	230	0	0	0.9322	0.9900	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0178
63055	BEARCK 4	230	0	0	0.9322	0.9900	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0178
63055	BEARCK 4	230	0	0	0.9338	0.9900	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0162
63055	BEARCK 4	230	0	0	0.9298	0.9900	0.950	1.050	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0202
63055	BEARCK 4	230	0	0	0.9322	0.9900	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0178
62446	BERGNLK7	115	0	0	0.9304	0.9850	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0196
62446	BERGNLK7	115	0	0	0.9241	0.9850	0.950	1.050	L	ATC-ARPG2	85	0.9485	0.9989	H	0.0244
62446	BERGNLK7	115	0	0	0.9147	0.9850	0.950	1.050	L	NSP 2	87	0.9416	0.9989	H	0.0269
62446	BERGNLK7	115	0	0	0.9103	0.9850	0.950	1.050	L	NSP 1	88	0.9369	0.9989	H	0.0266
62446	BERGNLK7	115	0	0	0.9138	0.9850	0.950	1.050	L	NSP 2	89	0.9406	0.9989	H	0.0268
62447	BERGNTP7	115	0	0	0.9306	0.9851	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0194
62447	BERGNTP7	115	0	0	0.9243	0.9851	0.950	1.050	L	ATC-ARPG2	95	0.9486	0.999	H	0.0243
62447	BERGNTP7	115	0	0	0.9149	0.9851	0.950	1.050	L	NSP 2	97	0.9417	0.999	H	0.0268
62447	BERGNTP7	115	0	0	0.9105	0.9851	0.950	1.050	L	NSP 1	98	0.9371	0.999	H	0.0266
62447	BERGNTP7	115	0	0	0.9140	0.9851	0.950	1.050	L	NSP 2	99	0.9407	0.999	H	0.0267

67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 60196 [CHISAGO7115.00] TO BUS 60199 [CHIS CO3345.00] C	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61821 [G519 G118.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61822 [G519 G218.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61823 [G519 G318.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0473
67772	BRERTON7	110	0	0	1.1473	1.1473	0.900	1.100	H	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] C	#N/A	#N/A	#N/A	#N/A	0.0473
61671	BURNETT7	115	0	0	0.9325	0.9872	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0175
61671	BURNETT7	115	0	0	0.9264	0.9872	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0236
61671	BURNETT7	115	0	0	0.9170	0.9872	0.950	1.050	L	NSP 2	2699	0.9451	1.0025	H	0.0281
61671	BURNETT7	115	0	0	0.9125	0.9872	0.950	1.050	L	NSP 1	2700	0.9403	1.0025	H	0.0278
61671	BURNETT7	115	0	0	0.9161	0.9872	0.950	1.050	L	NSP 2	2701	0.9441	1.0025	H	0.0280
61668	CLOQUET7	115	0	0	0.9269	0.9943	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0231
61668	CLOQUET7	115	0	0	0.9193	0.9943	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0307
61668	CLOQUET7	115	0	0	0.9395	0.9943	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0105
61668	CLOQUET7	115	0	0	0.9395	0.9943	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0105
61668	CLOQUET7	115	0	0	0.9080	0.9943	0.950	1.050	L	NSP 2	2717	0.9427	1.0105	H	0.0347
61668	CLOQUET7	115	0	0	0.9026	0.9943	0.950	1.050	L	NSP 1	2718	0.937	1.0105	H	0.0344
61668	CLOQUET7	115	0	0	0.9070	0.9943	0.950	1.050	L	NSP 2	2719	0.9416	1.0105	H	0.0346
61688	COLBYVL7	115	0	0	0.9191	0.9842	0.950	1.050	L	050 2	2736	0.9444	1	H	0.0253
61688	COLBYVL7	115	0	0	0.9390	0.9842	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0110
61688	COLBYVL7	115	0	0	0.9110	0.9842	0.950	1.050	L	ATC-ARPG2	2726	0.9411	1	H	0.0301
61688	COLBYVL7	115	0	0	0.9374	0.9842	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0126
61688	COLBYVL7	115	0	0	0.9340	0.9842	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0160
61688	COLBYVL7	115	0	0	0.9399	0.9842	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0101
61688	COLBYVL7	115	0	0	0.9339	0.9842	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0161
61688	COLBYVL7	115	0	0	0.8991	0.9842	0.900	1.100	L	NSP 2	2728	0.9327	1	H	0.0336
61688	COLBYVL7	115	0	0	0.8935	0.9842	0.900	1.100	L	NSP 1	2729	0.9269	1	H	0.0334
61688	COLBYVL7	115	0	0	0.8980	0.9842	0.900	1.100	L	NSP 2	2730	0.9315	1	H	0.0335
61720	COTTNTP7	115	0	0	0.9346	0.9843	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0154
61720	COTTNTP7	115	0	0	0.9315	0.9843	0.950	1.050	L	NSP 1	2737	0.9497	0.9947	H	0.0182
61720	COTTNTP7	115	0	0	0.9340	0.9843	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0160
62452	COTTON 7	115	0	0	0.9346	0.9843	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0154
62452	COTTON 7	115	0	0	0.9315	0.9843	0.950	1.050	L	NSP 1	2739	0.9497	0.9947	H	0.0182
62452	COTTON 7	115	0	0	0.9340	0.9843	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0160
61632	DAHLBRG7	115	0	0	0.9028	0.9863	0.950	1.050	L	050 2	2756	0.9388	1.006	H	0.0360
61632	DAHLBRG7	115	0	0	0.9311	0.9863	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0189
61632	DAHLBRG7	115	0	0	0.8957	0.9863	0.900	1.100	L	ATC-ARPG2	2746	0.9334	1.006	H	0.0377
61632	DAHLBRG7	115	0	0	0.9297	0.9863	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0203
61632	DAHLBRG7	115	0	0	0.8570	0.9863	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2743	0.8998	1.006	H	0.0428
61632	DAHLBRG7	115	0	0	0.9012	0.9863	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	2745	0.9331	1.006	H	0.0319
61632	DAHLBRG7	115	0	0	0.9272	0.9863	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0228
61632	DAHLBRG7	115	0	0	0.9375	0.9863	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0125
61632	DAHLBRG7	115	0	0	0.8570	0.9863	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2741	0.8998	1.006	H	0.0428
61632	DAHLBRG7	115	0	0	0.8784	0.9863	0.900	1.100	L	NSP 2	2748	0.9242	1.006	H	0.0458
61632	DAHLBRG7	115	0	0	0.8731	0.9863	0.900	1.100	L	NSP 1	2749	0.9174	1.006	H	0.0443
61632	DAHLBRG7	115	0	0	0.8795	0.9863	0.900	1.100	L	NSP 2	2750	0.923	1.006	H	0.0435
61663	FLDWDTP7	115	0	0	0.9386	0.9846	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0114
61663	FLDWDTP7	115	0	0	0.9314	0.9846	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0186

61663	FLDWDP7	115	0	0	0.9280	0.9846	0.950	1.050	L	NSP 1		2770	0.9467	0.9966	H	0.0187
61663	FLDWDP7	115	0	0	0.9307	0.9846	0.950	1.050	L	NSP 2		2771	0.9498	0.9966	H	0.0191
61669	FLDWOOD	115	0	0	0.9344	0.9763	0.950	1.050	L	050 2		#N/A	#N/A	#N/A	#N/A	0.0156
61669	FLDWOOD	115	0	0	0.9298	0.9763	0.950	1.050	L	ATC-ARPG2		2775	0.9478	0.9884	H	0.0180
61669	FLDWOOD	115	0	0	0.9225	0.9763	0.950	1.050	L	NSP 2		2777	0.9418	0.9884	H	0.0193
61669	FLDWOOD	115	0	0	0.9190	0.9763	0.950	1.050	L	NSP 1		2778	0.938	0.9884	H	0.0190
61669	FLDWOOD	115	0	0	0.9218	0.9763	0.950	1.050	L	NSP 2		2779	0.9411	0.9884	H	0.0193
61666	FONDULAC	115	0	0	0.9328	1.0078	0.950	1.050	L	ATC-ARPG2		#N/A	#N/A	#N/A	#N/A	0.0172
61666	FONDULAC	115	0	0	0.9212	1.0078	0.950	1.050	L	NSP 2		#N/A	#N/A	#N/A	#N/A	0.0288
61666	FONDULAC	115	0	0	0.9156	1.0078	0.950	1.050	L	NSP 1		#N/A	#N/A	#N/A	#N/A	0.0344
61666	FONDULAC	115	0	0	0.9202	1.0078	0.950	1.050	L	NSP 2		#N/A	#N/A	#N/A	#N/A	0.0298
60293	FRMSINN5	161	0	0	0.9060	1.0095	0.920	1.100	L	NSP 2		#N/A	#N/A	#N/A	#N/A	0.0140
60293	FRMSINN5	161	0	0	0.9025	1.0095	0.920	1.100	L	NSP 1		#N/A	#N/A	#N/A	#N/A	0.0175
60293	FRMSINN5	161	0	0	0.9099	1.0095	0.920	1.100	L	NSP 2		#N/A	#N/A	#N/A	#N/A	0.0101
61689	FRNCHRV7	115	0	0	0.9206	0.9746	0.950	1.050	L	050 2		2798	0.9393	0.9881	H	0.0187
61689	FRNCHRV7	115	0	0	0.9386	0.9746	0.950	1.050	L	050 3		#N/A	#N/A	#N/A	#N/A	0.0114
61689	FRNCHRV7	115	0	0	0.9133	0.9746	0.950	1.050	L	ATC-ARPG2		2788	0.9394	0.9881	H	0.0261
61689	FRNCHRV7	115	0	0	0.9372	0.9746	0.950	1.050	L	ATC-ARPG3		#N/A	#N/A	#N/A	#N/A	0.0128
61689	FRNCHRV7	115	0	0	0.9351	0.9746	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0149
61689	FRNCHRV7	115	0	0	0.9391	0.9746	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0109
61689	FRNCHRV7	115	0	0	0.9382	0.9746	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0118
61689	FRNCHRV7	115	0	0	0.9351	0.9746	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C		#N/A	#N/A	#N/A	#N/A	0.0149
61689	FRNCHRV7	115	0	0	0.9021	0.9746	0.950	1.050	L	NSP 2		2790	0.9314	0.9881	H	0.0293
61689	FRNCHRV7	115	0	0	0.8970	0.9746	0.900	1.100	L	NSP 1		2791	0.9261	0.9881	H	0.0291
61689	FRNCHRV7	115	0	0	0.9010	0.9746	0.950	1.050	L	NSP 2		2792	0.9302	0.9881	H	0.0292
61679	GARY 7	115	0	0	0.9065	0.9871	0.950	1.050	L	050 2		2813	0.9408	1.0062	H	0.0343
61679	GARY 7	115	0	0	0.9305	0.9871	0.950	1.050	L	050 3		#N/A	#N/A	#N/A	#N/A	0.0195
61679	GARY 7	115	0	0	0.8977	0.9871	0.900	1.100	L	ATC-ARPG2		2803	0.934	1.0062	H	0.0363
61679	GARY 7	115	0	0	0.9287	0.9871	0.950	1.050	L	ATC-ARPG3		#N/A	#N/A	#N/A	#N/A	0.0213
61679	GARY 7	115	0	0	0.8956	0.9871	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT		2802	0.9295	1.0062	H	0.0339
61679	GARY 7	115	0	0	0.9305	0.9871	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0195
61679	GARY 7	115	0	0	0.9371	0.9871	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0129
61679	GARY 7	115	0	0	0.8956	0.9871	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C		2801	0.9295	1.0062	H	0.0339
61679	GARY 7	115	0	0	0.8839	0.9871	0.900	1.100	L	NSP 2		2805	0.9251	1.0062	H	0.0412
61679	GARY 7	115	0	0	0.8779	0.9871	0.900	1.100	L	NSP 1		2806	0.9184	1.0062	H	0.0405
61679	GARY 7	115	0	0	0.8834	0.9871	0.900	1.100	L	NSP 2		2807	0.9238	1.0062	H	0.0404
61674	HANESRD7	115	0	0	0.9119	0.9836	0.950	1.050	L	050 2		2835	0.9414	1.0008	H	0.0295
61674	HANESRD7	115	0	0	0.9327	0.9836	0.950	1.050	L	050 3		#N/A	#N/A	#N/A	#N/A	0.0173
61674	HANESRD7	115	0	0	0.9032	0.9836	0.950	1.050	L	ATC-ARPG2		2825	0.9358	1.0008	H	0.0326
61674	HANESRD7	115	0	0	0.9309	0.9836	0.950	1.050	L	ATC-ARPG3		#N/A	#N/A	#N/A	#N/A	0.0191
61674	HANESRD7	115	0	0	0.9262	0.9836	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0238
61674	HANESRD7	115	0	0	0.9339	0.9836	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0161
61674	HANESRD7	115	0	0	0.9377	0.9836	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT		#N/A	#N/A	#N/A	#N/A	0.0123
61674	HANESRD7	115	0	0	0.9261	0.9836	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C		#N/A	#N/A	#N/A	#N/A	0.0239
61674	HANESRD7	115	0	0	0.8911	0.9836	0.900	1.100	L	NSP 2		2827	0.9274	1.0008	H	0.0363
61674	HANESRD7	115	0	0	0.8852	0.9836	0.900	1.100	L	NSP 1		2828	0.9212	1.0008	H	0.0360
61674	HANESRD7	115	0	0	0.8900	0.9836	0.900	1.100	L	NSP 2		2829	0.9261	1.0008	H	0.0361
61676	HIBBARD7	115	0	0	0.9115	0.9903	0.950	1.050	L	050 2		2849	0.9451	1.0074	H	0.0336
61676	HIBBARD7	115	0	0	0.9345	0.9903	0.950	1.050	L	050 3		#N/A	#N/A	#N/A	#N/A	0.0155

61676	HIBBARD7	115	0	0	0.9027	0.9903	0.950	1.050	L	ATC-ARPG2	2839	0.9381	1.0074	H	0.0354
61676	HIBBARD7	115	0	0	0.9327	0.9903	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0173
61676	HIBBARD7	115	0	0	0.9117	0.9903	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2838	0.9429	1.0074	H	0.0312
61676	HIBBARD7	115	0	0	0.9350	0.9903	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0150
61676	HIBBARD7	115	0	0	0.9117	0.9903	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2837	0.9429	1.0074	H	0.0312
61676	HIBBARD7	115	0	0	0.8896	0.9903	0.900	1.100	L	NSP 2	2841	0.9295	1.0074	H	0.0399
61676	HIBBARD7	115	0	0	0.8835	0.9903	0.900	1.100	L	NSP 1	2842	0.923	1.0074	H	0.0395
61676	HIBBARD7	115	0	0	0.8888	0.9903	0.900	1.100	L	NSP 2	2843	0.9282	1.0074	H	0.0394
61616	HILLTOP4	230	0	0	0.9158	0.9935	0.950	1.050	L	050 2	2860	0.9493	1.0126	L	0.0335
61616	HILLTOP4	230	0	0	0.9371	0.9935	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0129
61616	HILLTOP4	230	0	0	0.9065	0.9935	0.950	1.050	L	ATC-ARPG2	2850	0.9415	1.0126	L	0.0350
61616	HILLTOP4	230	0	0	0.9352	0.9935	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0148
61616	HILLTOP4	230	0	0	0.9336	0.9935	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0164
61616	HILLTOP4	230	0	0	0.9393	0.9935	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0107
61616	HILLTOP4	230	0	0	0.9336	0.9935	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0164
61616	HILLTOP4	230	0	0	0.8946	0.9935	0.900	1.100	L	NSP 2	2852	0.933	1.0126	H	0.0384
61616	HILLTOP4	230	0	0	0.8884	0.9935	0.900	1.100	L	NSP 1	2853	0.9266	1.0126	L	0.0382
61616	HILLTOP4	230	0	0	0.8933	0.9935	0.900	1.100	L	NSP 2	2854	0.9316	1.0126	H	0.0383
61672	HILLTOP7	115	0	0	0.9119	0.9904	0.950	1.050	L	050 2	2873	0.9454	1.0078	H	0.0335
61672	HILLTOP7	115	0	0	0.9346	0.9904	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0154
61672	HILLTOP7	115	0	0	0.9029	0.9904	0.950	1.050	L	ATC-ARPG2	2863	0.9383	1.0078	H	0.0354
61672	HILLTOP7	115	0	0	0.9328	0.9904	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0172
61672	HILLTOP7	115	0	0	0.9153	0.9904	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2862	0.9457	1.0078	H	0.0304
61672	HILLTOP7	115	0	0	0.9353	0.9904	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0147
61672	HILLTOP7	115	0	0	0.9153	0.9904	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2861	0.9457	1.0078	H	0.0304
61672	HILLTOP7	115	0	0	0.8901	0.9904	0.900	1.100	L	NSP 2	2865	0.9297	1.0078	H	0.0396
61672	HILLTOP7	115	0	0	0.8840	0.9904	0.900	1.100	L	NSP 1	2866	0.9232	1.0078	H	0.0392
61672	HILLTOP7	115	0	0	0.8892	0.9904	0.900	1.100	L	NSP 2	2867	0.9284	1.0078	H	0.0392
61576	HILTPJCT	115	0	0	0.9125	0.9910	0.950	1.050	L	050 2	2886	0.9459	1.0081	H	0.0334
61576	HILTPJCT	115	0	0	0.9353	0.9910	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0147
61576	HILTPJCT	115	0	0	0.9036	0.9910	0.950	1.050	L	ATC-ARPG2	2876	0.9389	1.0081	H	0.0353
61576	HILTPJCT	115	0	0	0.9335	0.9910	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0165
61576	HILTPJCT	115	0	0	0.9149	0.9910	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2875	0.9457	1.0081	H	0.0308
61576	HILTPJCT	115	0	0	0.9359	0.9910	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0141
61576	HILTPJCT	115	0	0	0.9149	0.9910	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2874	0.9457	1.0081	H	0.0308
61576	HILTPJCT	115	0	0	0.8907	0.9910	0.900	1.100	L	NSP 2	2878	0.9303	1.0081	H	0.0396
61576	HILTPJCT	115	0	0	0.8846	0.9910	0.900	1.100	L	NSP 1	2879	0.9238	1.0081	H	0.0392
61576	HILTPJCT	115	0	0	0.8898	0.9910	0.900	1.100	L	NSP 2	2880	0.929	1.0081	H	0.0392
60291	INOPUMP7	115	0	0	0.8722	0.9940	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2899	0.9123	1.0118	H	0.0401
60291	INOPUMP7	115	0	0	0.9078	0.9940	0.920	1.100	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0122
60291	INOPUMP7	115	0	0	0.8721	0.9940	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2898	0.9123	1.0118	H	0.0402
60292	IRONRIV7	115	0	0	0.9097	0.9891	0.920	1.100	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0103
60292	IRONRIV7	115	0	0	0.9046	0.9891	0.920	1.100	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0154
60292	IRONRIV7	115	0	0	0.8589	0.9891	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2901	0.9014	1.0079	H	0.0425
60292	IRONRIV7	115	0	0	0.8588	0.9891	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2900	0.9014	1.0079	H	0.0426
60292	IRONRIV7	115	0	0	0.8856	0.9891	0.900	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0144
60292	IRONRIV7	115	0	0	0.8812	0.9891	0.900	1.100	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0188
60292	IRONRIV7	115	0	0	0.8879	0.9891	0.900	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0121
61681	LSPI 7	115	0	0	0.9112	0.9900	0.950	1.050	L	050 2	2960	0.9449	1.0072	H	0.0337

61681	LSPI 7	115	0	0	0.9342	0.9900	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0158
61681	LSPI 7	115	0	0	0.9023	0.9900	0.950	1.050	L	ATC-ARPG2	2950	0.9378	1.0072	H	0.0355
61681	LSPI 7	115	0	0	0.9324	0.9900	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0176
61681	LSPI 7	115	0	0	0.9117	0.9900	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2949	0.9429	1.0072	H	0.0312
61681	LSPI 7	115	0	0	0.9347	0.9900	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0153
61681	LSPI 7	115	0	0	0.9117	0.9900	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2948	0.9429	1.0072	H	0.0312
61681	LSPI 7	115	0	0	0.8893	0.9900	0.900	1.100	L	NSP 2	2952	0.9292	1.0072	H	0.0399
61681	LSPI 7	115	0	0	0.8832	0.9900	0.900	1.100	L	NSP 1	2953	0.9227	1.0072	H	0.0395
61681	LSPI 7	115	0	0	0.8884	0.9900	0.900	1.100	L	NSP 2	2954	0.9279	1.0072	H	0.0395
61656	MAHTOWA	115	0	0	0.9383	1.0074	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0117
61656	MAHTOWA	115	0	0	0.9332	1.0074	0.950	1.050	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0168
61656	MAHTOWA	115	0	0	0.9370	1.0074	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0130
61670	MDWLND	115	0	0	0.9386	0.9847	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0114
61670	MDWLND	115	0	0	0.9314	0.9847	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0186
61670	MDWLND	115	0	0	0.9279	0.9847	0.950	1.050	L	NSP 1	2967	0.9467	0.9966	H	0.0188
61670	MDWLND	115	0	0	0.9306	0.9847	0.950	1.050	L	NSP 2	2968	0.9497	0.9966	H	0.0191
61687	MIDWAY 7	115	0	0	0.9151	0.9903	0.950	1.050	L	050 2	2982	0.947	1.0083	H	0.0319
61687	MIDWAY 7	115	0	0	0.9364	0.9903	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0136
61687	MIDWAY 7	115	0	0	0.9063	0.9903	0.950	1.050	L	ATC-ARPG2	2972	0.9402	1.0083	H	0.0339
61687	MIDWAY 7	115	0	0	0.9346	0.9903	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0154
61687	MIDWAY 7	115	0	0	0.9282	0.9903	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0218
61687	MIDWAY 7	115	0	0	0.9377	0.9903	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0123
61687	MIDWAY 7	115	0	0	0.9282	0.9903	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0218
61687	MIDWAY 7	115	0	0	0.8941	0.9903	0.900	1.100	L	NSP 2	2974	0.9317	1.0083	H	0.0376
61687	MIDWAY 7	115	0	0	0.8881	0.9903	0.900	1.100	L	NSP 1	2975	0.9255	1.0083	H	0.0374
61687	MIDWAY 7	115	0	0	0.8930	0.9903	0.900	1.100	L	NSP 2	2976	0.9304	1.0083	H	0.0374
61631	MINONG 5	161	0	0	0.9107	1.0018	0.950	1.050	L	050 2	2997	0.9471	1.0235	L	0.0364
61631	MINONG 5	161	0	0	0.9349	1.0018	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0151
61631	MINONG 5	161	0	0	0.9009	1.0018	0.950	1.050	L	ATC-ARPG2	2987	0.9381	1.0235	L	0.0372
61631	MINONG 5	161	0	0	0.9319	1.0018	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0181
61631	MINONG 5	161	0	0	0.9089	1.0018	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	2986	0.9425	1.0235	H	0.0336
61631	MINONG 5	161	0	0	0.9088	1.0018	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	2985	0.9425	1.0235	H	0.0337
61631	MINONG 5	161	0	0	0.8874	1.0018	0.900	1.100	L	NSP 2	2989	0.9319	1.0235	L	0.0445
61631	MINONG 5	161	0	0	0.8828	1.0018	0.900	1.100	L	NSP 1	2990	0.923	1.0235	L	0.0402
61631	MINONG 5	161	0	0	0.8903	1.0018	0.900	1.100	L	NSP 2	2991	0.9304	1.0235	H	0.0401
66790	MORANV1	115	0	0	1.0607	1.0382	0.950	1.050	H	BUS 66719 [MORANV17115.00] TO BUS 66790 [MORANV1T115.00]	#N/A	#N/A	#N/A	#N/A	0.0107
61678	NEMADJ17	115	0	0	0.9072	0.9914	0.950	1.050	L	050 2	3033	0.9429	1.0109	H	0.0357
61678	NEMADJ17	115	0	0	0.9331	0.9914	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0169
61678	NEMADJ17	115	0	0	0.8984	0.9914	0.900	1.100	L	ATC-ARPG2	3023	0.9362	1.0109	H	0.0378
61678	NEMADJ17	115	0	0	0.9312	0.9914	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0188
61678	NEMADJ17	115	0	0	0.8788	0.9914	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	3022	0.9177	1.0109	H	0.0389
61678	NEMADJ17	115	0	0	0.9265	0.9914	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0235
61678	NEMADJ17	115	0	0	0.9322	0.9914	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0178
61678	NEMADJ17	115	0	0	0.9398	0.9914	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0102
61678	NEMADJ17	115	0	0	0.8788	0.9914	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	3021	0.9177	1.0109	H	0.0389
61678	NEMADJ17	115	0	0	0.8835	0.9914	0.900	1.100	L	NSP 2	3025	0.9273	1.0109	H	0.0438
61678	NEMADJ17	115	0	0	0.8776	0.9914	0.900	1.100	L	NSP 1	3026	0.9202	1.0109	H	0.0426
61678	NEMADJ17	115	0	0	0.8836	0.9914	0.900	1.100	L	NSP 2	3027	0.9259	1.0109	H	0.0423
69105	PILSEN7	115	0	0	0.8740	0.9946	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	3039	0.9138	1.0123	H	0.0398



69105	PILSEN7	115	0	0	0.9092	0.9946	0.920	1.100	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0108
69105	PILSEN7	115	0	0	0.8739	0.9946	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	3038	0.9138	1.0123	H	0.0399
69105	PILSEN7	115	0	0	0.9000	0.9946	0.920	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0200
61667	POTLTCH7	115	0	0	0.9297	0.9968	0.950	1.050	L	050 2	#N/A	#N/A	#N/A	#N/A	0.0203
61667	POTLTCH7	115	0	0	0.9221	0.9968	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0279
61667	POTLTCH7	115	0	0	0.9108	0.9968	0.950	1.050	L	NSP 2	5630	0.9454	1.013	H	0.0346
61667	POTLTCH7	115	0	0	0.9053	0.9968	0.950	1.050	L	NSP 1	5631	0.9398	1.013	H	0.0345
61667	POTLTCH7	115	0	0	0.9098	0.9968	0.950	1.050	L	NSP 2	5632	0.9443	1.013	H	0.0345
61675	RIDGEVW7	115	0	0	0.9124	0.9822	0.950	1.050	L	050 2	5662	0.9406	0.999	H	0.0282
61675	RIDGEVW7	115	0	0	0.9329	0.9822	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0171
61675	RIDGEVW7	115	0	0	0.9039	0.9822	0.950	1.050	L	ATC-ARPG2	5652	0.9358	0.999	H	0.0319
61675	RIDGEVW7	115	0	0	0.9312	0.9822	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0188
61675	RIDGEVW7	115	0	0	0.9269	0.9822	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0231
61675	RIDGEVW7	115	0	0	0.9340	0.9822	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0160
61675	RIDGEVW7	115	0	0	0.9373	0.9822	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0127
61675	RIDGEVW7	115	0	0	0.9269	0.9822	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0231
61675	RIDGEVW7	115	0	0	0.8918	0.9822	0.900	1.100	L	NSP 2	5654	0.9273	0.999	H	0.0355
61675	RIDGEVW7	115	0	0	0.8860	0.9822	0.900	1.100	L	NSP 1	5655	0.9213	0.999	H	0.0353
61675	RIDGEVW7	115	0	0	0.8907	0.9822	0.900	1.100	L	NSP 2	5656	0.926	0.999	H	0.0353
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 60196 [CHISAGO7115.00] TO BUS 60199 [CHIS CO3345.00] C	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61821 [G519 G118.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61822 [G519 G218.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61823 [G519 G318.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0475
67770	SK1 SUB7	110	0	0	1.1475	1.1475	0.900	1.100	H	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] C	#N/A	#N/A	#N/A	#N/A	0.0475
60290	ST LAKE5	161	0	0	0.9032	1.0107	0.920	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0168
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 60196 [CHISAGO7115.00] TO BUS 60199 [CHIS CO3345.00] C	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 61625 [BLCKBRY4230.00] TO BUS 61824 [G519 230.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61821 [G519 G118.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61822 [G519 G218.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 61824 [G519 230.00] TO BUS 61823 [G519 G318.000] CKT 1	#N/A	#N/A	#N/A	#N/A	0.0462
67771	STAR LK7	110	0	0	1.1462	1.1462	0.900	1.100	H	BUS 66752 [DRAYTON4230.00] TO BUS 67557 [LETELER4230.00] C	#N/A	#N/A	#N/A	#N/A	0.0462
61683	STIN-MN7	115	0	0	0.9074	0.9917	0.950	1.050	L	050 2	13395	0.9431	1.0113	H	0.0357
61683	STIN-MN7	115	0	0	0.9333	0.9917	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0167
61683	STIN-MN7	115	0	0	0.8986	0.9917	0.900	1.100	L	ATC-ARPG2	13385	0.9364	1.0113	H	0.0378
61683	STIN-MN7	115	0	0	0.9315	0.9917	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0185
61683	STIN-MN7	115	0	0	0.8782	0.9917	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13384	0.9173	1.0113	H	0.0391
61683	STIN-MN7	115	0	0	0.9258	0.9917	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0242
61683	STIN-MN7	115	0	0	0.9324	0.9917	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0176
61683	STIN-MN7	115	0	0	0.8781	0.9917	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13383	0.9173	1.0113	H	0.0392
61683	STIN-MN7	115	0	0	0.8837	0.9917	0.900	1.100	L	NSP 2	13387	0.9275	1.0113	H	0.0438
61683	STIN-MN7	115	0	0	0.8777	0.9917	0.900	1.100	L	NSP 1	13388	0.9204	1.0113	H	0.0427
61683	STIN-MN7	115	0	0	0.8837	0.9917	0.900	1.100	L	NSP 2	13389	0.9262	1.0113	H	0.0425
61570	STINSJCT	115	0	0	0.9069	0.9916	0.950	1.050	L	050 2	13408	0.9427	1.0112	H	0.0358
61570	STINSJCT	115	0	0	0.9329	0.9916	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0171
61570	STINSJCT	115	0	0	0.8981	0.9916	0.900	1.100	L	ATC-ARPG2	13398	0.936	1.0112	H	0.0379
61570	STINSJCT	115	0	0	0.9310	0.9916	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0190

61570	STINSJCT	115	0	0	0.8760	0.9916	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13397	0.9155	1.0112	H	0.0395
61570	STINSJCT	115	0	0	0.9235	0.9916	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0265
61570	STINSJCT	115	0	0	0.9320	0.9916	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0180
61570	STINSJCT	115	0	0	0.9397	0.9916	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0103
61570	STINSJCT	115	0	0	0.8760	0.9916	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13396	0.9155	1.0112	H	0.0395
61570	STINSJCT	115	0	0	0.8831	0.9916	0.900	1.100	L	NSP 2	13400	0.9271	1.0112	H	0.0440
61570	STINSJCT	115	0	0	0.8772	0.9916	0.900	1.100	L	NSP 1	13401	0.9199	1.0112	H	0.0427
61570	STINSJCT	115	0	0	0.8832	0.9916	0.900	1.100	L	NSP 2	13402	0.9257	1.0112	H	0.0425
61630	STINSON5	161	0	0	0.9132	1.0009	0.950	1.050	L	050 2	13421	0.9497	1.0213	L	0.0365
61630	STINSON5	161	0	0	0.9389	1.0009	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0111
61630	STINSON5	161	0	0	0.9040	1.0009	0.950	1.050	L	ATC-ARPG2	13411	0.942	1.0213	H	0.0380
61630	STINSON5	161	0	0	0.9366	1.0009	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0134
61630	STINSON5	161	0	0	0.8819	1.0009	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13410	0.9228	1.0213	H	0.0409
61630	STINSON5	161	0	0	0.9262	1.0009	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0238
61630	STINSON5	161	0	0	0.8818	1.0009	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13409	0.9228	1.0213	L	0.0410
61630	STINSON5	161	0	0	0.8893	1.0009	0.900	1.100	L	NSP 2	13413	0.934	1.0213	H	0.0447
61630	STINSON5	161	0	0	0.8838	1.0009	0.900	1.100	L	NSP 1	13414	0.9262	1.0213	H	0.0424
61630	STINSON5	161	0	0	0.8904	1.0009	0.900	1.100	L	NSP 2	13415	0.9326	1.0213	H	0.0422
61684	STIN-WI7	115	0	0	0.9075	0.9919	0.950	1.050	L	050 2	13434	0.9433	1.0114	H	0.0358
61684	STIN-WI7	115	0	0	0.9334	0.9919	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0166
61684	STIN-WI7	115	0	0	0.8987	0.9919	0.900	1.100	L	ATC-ARPG2	13424	0.9366	1.0114	H	0.0379
61684	STIN-WI7	115	0	0	0.9316	0.9919	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0184
61684	STIN-WI7	115	0	0	0.8782	0.9919	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13423	0.9173	1.0114	H	0.0391
61684	STIN-WI7	115	0	0	0.9258	0.9919	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0242
61684	STIN-WI7	115	0	0	0.9326	0.9919	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0174
61684	STIN-WI7	115	0	0	0.8781	0.9919	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13422	0.9173	1.0114	H	0.0392
61684	STIN-WI7	115	0	0	0.8838	0.9919	0.900	1.100	L	NSP 2	13426	0.9276	1.0114	H	0.0438
61684	STIN-WI7	115	0	0	0.8778	0.9919	0.900	1.100	L	NSP 1	13427	0.9205	1.0114	H	0.0427
61684	STIN-WI7	115	0	0	0.8839	0.9919	0.900	1.100	L	NSP 2	13428	0.9263	1.0114	H	0.0424
39450	STL 345	345	0	0	0.8836	0.9982	0.900	1.100	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0164
39450	STL 345	345	0	0	0.8736	0.9982	0.900	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0264
39450	STL 345	345	0	0	0.8657	0.9982	0.900	1.100	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0343
39450	STL 345	345	0	0	0.8748	0.9982	0.900	1.100	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0252
61703	STSN GTG	115	0	0	0.9074	0.9917	0.950	1.050	L	050 2	13447	0.9431	1.0113	H	0.0357
61703	STSN GTG	115	0	0	0.9333	0.9917	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0167
61703	STSN GTG	115	0	0	0.8986	0.9917	0.900	1.100	L	ATC-ARPG2	13437	0.9364	1.0113	H	0.0378
61703	STSN GTG	115	0	0	0.9315	0.9917	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0185
61703	STSN GTG	115	0	0	0.8782	0.9917	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13436	0.9173	1.0113	H	0.0391
61703	STSN GTG	115	0	0	0.9258	0.9917	0.950	1.050	L	BUS 39449 [AHD 345 345.00] TO BUS 39450 [STL 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0242
61703	STSN GTG	115	0	0	0.9324	0.9917	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0176
61703	STSN GTG	115	0	0	0.8781	0.9917	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13435	0.9173	1.0113	H	0.0392
61703	STSN GTG	115	0	0	0.8837	0.9917	0.900	1.100	L	NSP 2	13439	0.9275	1.0113	H	0.0438
61703	STSN GTG	115	0	0	0.8777	0.9917	0.900	1.100	L	NSP 1	13440	0.9204	1.0113	H	0.0427
61703	STSN GTG	115	0	0	0.8837	0.9917	0.900	1.100	L	NSP 2	13441	0.9262	1.0113	H	0.0425
61665	THOMSON	115	0	0	0.9362	1.0091	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0138
61665	THOMSON	115	0	0	0.9249	1.0091	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0251
61665	THOMSON	115	0	0	0.9194	1.0091	0.950	1.050	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0306
61665	THOMSON	115	0	0	0.9238	1.0091	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0262
61690	TWO HBR7	115	0	0	0.9271	0.9663	0.950	1.050	L	050 2	13465	0.9377	0.977	H	0.0106

61690	TWO HBR7	115	0	0	0.9211	0.9663	0.950	1.050	L	ATC-ARPG2	13454	0.9421	0.977	H	0.0210
61690	TWO HBR7	115	0	0	0.9398	0.9663	0.950	1.050	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0102
61690	TWO HBR7	115	0	0	0.9380	0.9663	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0120
61690	TWO HBR7	115	0	0	0.9398	0.9663	0.950	1.050	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	#N/A	#N/A	#N/A	#N/A	0.0102
61690	TWO HBR7	115	0	0	0.9110	0.9663	0.950	1.050	L	NSP 2	13457	0.9348	0.977	H	0.0238
61690	TWO HBR7	115	0	0	0.9067	0.9663	0.950	1.050	L	NSP 1	13458	0.9303	0.977	H	0.0236
61690	TWO HBR7	115	0	0	0.9101	0.9663	0.950	1.050	L	NSP 2	13459	0.9338	0.977	H	0.0237
62170	WALDO 7	115	0	0	0.9252	0.9674	0.950	1.050	L	ATC-ARPG2	13472	0.9453	0.9776	H	0.0201
62170	WALDO 7	115	0	0	0.9154	0.9674	0.950	1.050	L	NSP 2	13474	0.9383	0.9776	H	0.0229
62170	WALDO 7	115	0	0	0.9112	0.9674	0.950	1.050	L	NSP 1	13475	0.9339	0.9776	H	0.0227
62170	WALDO 7	115	0	0	0.9145	0.9674	0.950	1.050	L	NSP 2	13476	0.9373	0.9776	H	0.0228
61680	WNTR ST7	115	0	0	0.9074	0.9886	0.950	1.050	L	050 2	13546	0.942	1.0067	H	0.0346
61680	WNTR ST7	115	0	0	0.9317	0.9886	0.950	1.050	L	050 3	#N/A	#N/A	#N/A	#N/A	0.0183
61680	WNTR ST7	115	0	0	0.8986	0.9886	0.900	1.100	L	ATC-ARPG2	13536	0.9351	1.0067	H	0.0365
61680	WNTR ST7	115	0	0	0.9299	0.9886	0.950	1.050	L	ATC-ARPG3	#N/A	#N/A	#N/A	#N/A	0.0201
61680	WNTR ST7	115	0	0	0.8954	0.9886	0.900	1.100	L	BUS 39448 [AHD PST 230.00] TO BUS 39449 [AHD 345 345.00] CKT	13535	0.93	1.0067	H	0.0346
61680	WNTR ST7	115	0	0	0.9315	0.9886	0.950	1.050	L	BUS 60186 [AS KING3345.00] TO BUS 60304 [EAU CL 3345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0185
61680	WNTR ST7	115	0	0	0.9383	0.9886	0.950	1.050	L	BUS 60304 [EAU CL 3345.00] TO BUS 39244 [ARP 345 345.00] CKT	#N/A	#N/A	#N/A	#N/A	0.0117
61680	WNTR ST7	115	0	0	0.8954	0.9886	0.900	1.100	L	BUS 61615 [ARROWHD4230.00] TO BUS 39448 [AHD PST 230.00] C	13534	0.93	1.0067	H	0.0346
61680	WNTR ST7	115	0	0	0.8847	0.9886	0.900	1.100	L	NSP 2	13538	0.9263	1.0067	H	0.0416
61680	WNTR ST7	115	0	0	0.8786	0.9886	0.900	1.100	L	NSP 1	13539	0.9195	1.0067	H	0.0409
61680	WNTR ST7	115	0	0	0.8842	0.9886	0.900	1.100	L	NSP 2	13540	0.925	1.0067	H	0.0408
61664	WRENSHL	115	0	0	0.9389	1.0085	0.950	1.050	L	ATC-ARPG2	#N/A	#N/A	#N/A	#N/A	0.0111
61664	WRENSHL	115	0	0	0.9278	1.0085	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0222
61664	WRENSHL	115	0	0	0.9224	1.0085	0.950	1.050	L	NSP 1	#N/A	#N/A	#N/A	#N/A	0.0276
61664	WRENSHL	115	0	0	0.9267	1.0085	0.950	1.050	L	NSP 2	#N/A	#N/A	#N/A	#N/A	0.0233

Appendix

**D**

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# Transfer Analysis

## FCITC Single Study

MUST 7.0e -- Managing and Utilizing System Transmission -- THU, JAN 12 2006 20:27  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_ATC.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

Study transfer level - 600.0 MW. Total violations: 24  
 First violation - 267.3 MW.

Study transfer. From G519\_EXP To G519\_SINK . Transfer level - 600.0 MW

Violations report ordered by transfer capability. Total 24 violations

N	FCITC L:	Limiting constraint	PreShift	MW	TDF	PTDF	=Base Case Flow=	
		C: Contingency description	Ncon	Flow	Rating	LODF	Init	Final
1	267.3	L:60290 ST LAKE5 161 69561 WASHCO 5 161 1	116.1	132.0	0.05963	0.02741	76.5	83.9
		C:015 2	2293					
		Open 60101 FORBES 2 500 60198 CHIS-N 2 500 1			0.08788	0.36659	1154.7	1252.7
		Open 60197 CHIS CO2 500 60198 CHIS-N 2 500 1			-0.03395	0.00000	21.6	21.6
		Change bus 67503 DORSEY 4 230 load by 1329.0 MW dispatch						
2	364.8	L:61612 RIVERTN4 230 61625 BLCKBRY4 230 1	-313.2	-415.8	-0.28136	-0.20369	-243.8	-318.1
		C:015 2	2293					
		Open 60101 FORBES 2 500 60198 CHIS-N 2 500 1			-0.21186	0.36659	1154.7	1288.4
		Open 60197 CHIS CO2 500 60198 CHIS-N 2 500 1			0.02416	0.00000	21.6	21.6
		Change bus 67503 DORSEY 4 230 load by 1329.0 MW dispatch						
3	442.6	L:60290 ST LAKE5 161 69561 WASHCO 5 161 1	101.5	132.0	0.06889	0.02741	76.5	88.7
		C:015 1	2292					
		Open 60101 FORBES 2 500 61550 FORB1JCT 230 1	NA					
		Open 61550 FORB1JCT 230 61624 FORBES 4 230 1			-0.05425	-0.21609	51.3	-44.3
		Open 61550 FORB1JCT 230 61551 FORB1TR934.5 1	NA					
		Open 60101 FORBES 2 500 61552 FORB2JCT 230 1	NA					
		Open 61552 FORB2JCT 230 61624 FORBES 4 230 1			-0.05425	-0.21681	51.5	-44.4
		Open 61552 FORB2JCT 230 61553 FORB2TR934.5 1	NA					
		Open 60101 FORBES 2 500 60198 CHIS-N 2 500 1			0.04910	0.36659	1154.7	1316.9
		Open 67564 DORSEY 2 500 67621 RIEL 2 500 1			0.01673	0.00000	58.4	58.4
		Open 60173 ROSEAUN2 500 60174 ROSEAUS2 500 1	NA					
		Open 60101 FORBES 2 500 60174 ROSEAUS2 500 1	NA					
		Change bus 67503 DORSEY 4 230 load by 1329.0 MW dispatch						
4	545.2	L:61612 RIVERTN4 230 61625 BLCKBRY4 230 1	-238.9	-415.8	-0.32446	-0.20369	-243.8	-354.8
		C:015 1	2292					
		Open 60101 FORBES 2 500 61550 FORB1JCT 230 1	NA					
		Open 61550 FORB1JCT 230 61624 FORBES 4 230 1			0.25230	-0.21609	51.3	-66.5
		Open 61550 FORB1JCT 230 61551 FORB1TR934.5 1	NA					
		Open 60101 FORBES 2 500 61552 FORB2JCT 230 1	NA					
		Open 61552 FORB2JCT 230 61624 FORBES 4 230 1			0.25230	-0.21681	51.5	-66.7
		Open 61552 FORB2JCT 230 61553 FORB2TR934.5 1	NA					
		Open 60101 FORBES 2 500 60198 CHIS-N 2 500 1			-0.03151	0.36659	1154.7	1354.6
		Open 67564 DORSEY 2 500 67621 RIEL 2 500 1			-0.01472	0.00000	58.4	58.4
		Open 60173 ROSEAUN2 500 60174 ROSEAUS2 500 1	NA					

```
Open 60101 FORBES 2 500 60174 ROSEAUS2 500 1 NA
Change bus 67503 DORSEY 4 230 load by 1329.0 MW dispatch
5 557.9*L:60290 ST LAKE5 161 69561 WASHCO 5 161 1 106.4 132.0 0.04589 0.02741 76.5 91.8
C:39450 ST LAKE 345 39676 GARDR PK 345 1 2185
Open 39450 ST LAKE 345 39676 GARDR PK 345 1 0.26597 0.06949 112.3 151.1
```

## FCITC Single Study - With Reinforcement Option 2

MUST 7.0e -- Managing and Utilizing System Transmission -- WED, JAN 18 2006 11:41  
 2004 MAPP SERIES FINAL 2009 SUMMER PEAK  
 N00B-09SUPK.SAV - PRE-G519, CAP-X, 09 ADD, BL LAKE, IN Q  
 Case.File C:\Client Files\MISO\G519\N00b-f-09supk\_reinf.sav  
 Subsys.File C:\Client Files\MISO\G519\G519.sub  
 Monit.File C:\Client Files\MISO\G519\G519.mon  
 Contin.File C:\Client Files\MISO\G519\G519.CON  
 Exclud.File C:\Client Files\MISO\G519\G519\_DC.exc

Study transfer level - 600.0 MW. Total violations: 20  
 First violation - 484.3 MW.

Study transfer. From G519\_EXP To G519\_SINK . Transfer level - 600.0 MW

Violations report ordered by transfer capability. Total 20 violations

N	FCITC L: Limiting constraint	PreShift	MW	TDF		PTDF	=Base Case Flow=	
	C: Contingency description	Ncon	Flow	Rating	LODF		Init	Final
1	484.3 L:60290 ST LAKE5 161 69561 WASHCO 5 161 1	106.4	132.0	0.05285		0.02540	73.5	85.8
	C:015 2	2292						
	Open 60101 FORBES 2 500 60198 CHIS-N 2 500 1				0.08214	0.33427	1096.2	1258.1
	Open 60197 CHIS CO2 500 60198 CHIS-N 2 500 1				-0.03330	0.00000	19.4	19.4
	Change bus 67503 DORSEY 4 230 load by	1329.0	MW dispatch					

Appendix

**E**

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# Stability Case Development



## Development of the G519 Stability Models<sup>1</sup>:

### 2009 Summer Off Peak (70%) Load from the MAPP 2004 model series

#### **A. Idevs / Projects incorporated by PTI for the thermal analysis:**

##### 1.0 Idevs Provided from MAPP to update the standard series model:

wapaxfmrtap-nu-ma-allmods.idv	2/23/2004	All	WAPA	Changes transformer taps.
wapa-sf-uticapurge-allmods.idv	2/23/2004	All	WAPA	Purges branch 66523 - 66526 ckt 1
jordan-newprague69sum.idv	3/4/2004	All	XEL	Changes branch data parameters.
mmu-summer.idv	3/23/2004	All	XEL	Branch data.
i-delete.idv	3/5/2004	All	GRE	Purges buses and branches.
i-summer-add.idv	3/5/2004	All	GRE	Changes branch data parameters.
madelia-area-reconfig-allmodels.idv	3/29/2004	All	GRE/MEC	Topology changes, move, purge, extract.
gre-pass2-i-loadarea.idv	-		09	Reassigns load area numbers
grntco-alexss-all-mod.idv	3/29/2004	All	OTP	Branch Rating Correction
purgeRPGIloads.idv	4/2/2004	09	MEC	Purge duplicate loads; RPGI loads
MEC-SummerRatings-Updates.idv	4/13/2004	All	MEC	Purge duplicate line, and line ratings.
BEPC_RapidCity_Updates	5/17/2004	All	BEPC	Broad range of changes mostly for RCDC

##### 1.1 Idevs Provided to PTI Related to Bigstone II:

i-addBGSII.idv	Add Bigstone II Project with Transmission Alternative 1
i-addBGSGrntFlls230.idv	"
i-addBGSMrrs230.idv	"
i-add-alt1-int_upgrades.idv	"

##### 1.2 Idevs Provided to PTI for other miscellaneous projects as per the ad-hoc study group:

i-1-caps-hootlk-henning.idv	
i-2-genremove-cnck-rose.idv	
i-3-airlk-verm-emp-su.idv	
i-4-basslk69lines-purge.idv	
i-5-lakefld-watonwan.idv	
i-6-linerremove-elkhk-jorprtn-hansalbn.idv	
i-7-ApltnDwsnCbny.idv	
i-8-WILMARTHadd667gen-stab.idv	
i-9-bll17gen170.idv	
i-10-xel-wind825-sum.idv	
i-11-ANSONadd170gen.idv	
i-add_mcnelus_wind_Adams69.idv	
fix_martinco_yankee_base_case.idv	
mp_summer_ratings.idv	
i-bad-birchlk-peq.idv	
i-bax-sthdl-short.idv	
mp_summer_gen_pattern.idv	
gre-line-ratings.idv	
mp_area_interchange.idv	Revised area interchange for the nearby areas
i-gre-gen.idv	Redispatch of resources for GRE
atc_rev.idv	

##### 1.3 Idevs Provided to PTI Related to Arrowhead - Weston:

01_06_GDP.idv
02_06_STL.idv
03_G477_06_WWT.idv
04_G477_08_ARH.idv
05_08_STL.idv
06_G477_08_WES_G4.idv
07_09_CWI.idv
08_G477_WP2_Option1.idv

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<sup>1</sup> Documentation provided by Minnesota Power

## **B. Additional Modifications needed for Stability Model – completed by MP**

2.1 Addition of standard areas , zones and generation pattern for stability model incorporated by using set-gen-dc.ipl and findzone90.ipl

2.2 Misc Idevs from pkg 2003 that still need to be applied

adams\_split.idv  
fix-bigbnd.idv  
xcel-line-remove.idv  
Young2-reg.idv

2.3 NW Ontario Updates Required for Compatibility with snapshot from IESO

rezone_nw.idv	glp_system.idv	ken_veyh-09sopk.idv	genbus-code.idv
anji_mckay.idv	atik-lt-buses.idv	aubrey.idv	ear_falls.idv
ftfr3.idv	hi_falls.idv	mooselake.idv	musselwh.idv
voyageur.idv	wawa_rx.idv	wells.idv	update_nw_load.idv
mapp-purg43.idv	anji_mckay2.idv	ff-reactr-chg.idv	ft-fran-taps.idv
glp-115kv-loop-os.idv		glp-gen-xd-2p.idv	glp-genbus-kv.idv
high-falls-chng-area-44.idv		nw-gen-xd-2p.idv	sk1-rstr.idv
thby-purg.idv	wawa-rc.idv		

2.4 Miscellaneous MP Changes

mp-boise-caps.idv  
mp-run-reacts-off.idv  
xl-lock-69-caps.idv  
mp-crit-area.idv  
otp\_05supk.idv

2.5 Basin Updates 3/16/05 - OTP Updates from 3-2005 and other misc fixes found in model build process

bepc\_updates.idv  
bepc\_2005 summer changes.idv  
lock-pipe-caps.idv  
recn-bd3.idv  
kettle-mbase.idv  
mccs-150we.idv  
fix-dc-params-04-series.idv  
ebsmk-rate.idv  
otp correction idev 4-29-2005.idv  
otp big stone step up trans.idv

2.6 Iowa MEC - updates from Terry Harbour - 3/16/05

IDEV1-Add-2005-Louisa-CB3-Upgrades-Rev29.idv  
IDEV2-Add-2005-CBPC-69-Loops-Rev29.idv  
IDEV3-Add-2005-FortDodge-69kV-Loop-Rev29.idv  
IDEV4-Add-2005-Goldfield-Loop-Rev29.idv

## 2.7 Additional minor Changes - DSM 3/16/05

bigbend.idv  
mh-collector-gens.idv  
imo-govs.idv  
spc-09suop.idv  
MH-upd-09suop-NMORWG.idv

2.8 At this point, setexports.ipl is applied to adjust the Northern MAPP interfaces to their simultaneous maximum capabilities. NDEX = 1950, MHEX = 2175 MW, MWSI = 1480 MW (w/o A-W line)

2.9 Next, all of the machines with older versions of the PTI GE wind dynamic models are removed, so that the older dynamic models can be removed (Chanarambie, Buffalo Ridge, Clipper, Enexco, and Edgeley) – The older PTI dynamics models were causing spurious failures of the dynamic simulation, and should all be removed and replaced with the newest version as per recommendation by PTI's user support.

update-ge-wind-part1-r1.idv  
fix-cap.idv  
fix-line-r.idv  
chnng-yank-code.idv

2.10 The Higher queued projects (all projects > 50 MW in Northern MAPP) are now added into the model. See the idev names for each project that was added. (Note that some projects were added earlier in the idevs supplied to PTI for the thermal analysis – i.e. Bigstone II)

g162-rev2.DAT  
g164-rev2.DAT  
g173.DAT  
g176-rev2.DAT  
g186.DAT  
g255-rev2.DAT  
g261-rev2.DAT  
g263-rev2.DAT  
g287-rev2.DAT  
g298.DAT  
g349-rev2.DAT  
g386-rev2.DAT  
gi108-dsm.DAT  
gi303-rev2.DAT  
gi316.DAT  
g380.idv  
nebraskacity2.idv  
g358-dsm.idv  
councilbluffs.idv

2.11 The GE wind models that were removed are now added back in with a representation consistent with the newest GE wind models from PTI

ge-wind-new.DAT  
update-ge-wind-part2-r1.idv  
update-ge-wind-part3-r1.idv  
buscodes.idv

2.12 The Lakefield – Nobles 345 kV line was out of service in the original idevs provided by XEL so it is now placed in service.

close-nobles-lkfld.idv

2.13 The new generation is now sinked to a combination of Northern MAPP load, swing bus, and load in the southeastern U.S. This was done in a manner such that MWSI flow would remain at levels consistent with todays limit of 1480 MW (if the Arrowhead – Weston line is opened). The ND units are also increased to URGE levels in this step. XEL load increased to nearly 100% other Northern MAPP loads increased 15 – 20%.

sink-new-gens.idv  
urggennew#.idv  
turn-off-zero-inertia-mach.idv

2.14 At this point, setexports.ipl is applied to adjust the Northern MAPP interfaces to their simultaneous maximum capabilities. NDEX = 1950, MHEX = 2175 MW, MWSI = 1480 MW (w/o A-W line)

2.15 G424, G502, and G509 were missed in earlier steps, so they are now added.

add-buses-g502-g509-g424.idv  
add-g502-g509-g424-gens.idv

2.16 Square Butte HVDC is now increased to 505 MW to carry the incremental flow from G502, and the excess power from these projects is sinked to Northern MAPP Loads.

set-sqbdc-500.idv  
sink-gen-mapp-rev4.idv

2.17 Additional changes were made to the powerflow to add the caps necessary for the NDEX = 2080 (Caps at Huron, Watertown Groton), to update MP & GRE ratings, to add new planned cap banks in the MP system at BPC & Two Harbors, to turn on the Bigstone II station load, and to add the 3 x 60 MVar banks proposed by the Group 2 projects at Riverton. The Riverton shunt caps were the only proposed group 2 facilities added, as the steady state voltage in this region was below criteria.

misc-update1.idv  
misc-update2.idv  
misc-update3.idv

2.18 The powerflow is now adjusted to increase NDEX to 2450 MW (Bigstone II increase [2450 = existing 2080 MW limit + 370 increment for BGSII]), via setexports. MHEX and MWSI are also adjusted to maintain current limits.

Appendix

**F**

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## **Stability Analysis - Summary Tables**

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	ag1		ag3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-ag1	g51-s709aa.Ezq0444-ag1	b51-s709aa.Ezpb044-ag3	g51-s709aa.Ezq0444-ag3
3	Disturbance	ag1	ag1	ag3	ag3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 20:33	FEB 03 2006 22:02	JAN 30 2006 20:36	FEB 03 2006 22:06
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	3.35	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.99   1.04	0.95   1.00	0.98   1.03	0.95   1.00
35	Boise 115	1.00   1.04	0.99   1.04	1.00   1.04	0.99   1.04
36	Dorsey 230	1.03   1.06	1.03   1.06	1.03   1.05	1.03   1.06
37	Forbes 230	0.98   1.02	0.97   1.01	0.98   1.02	0.97   1.01
38	Riverton 230	0.98   1.06	0.99   1.05	0.97   1.05	0.99   1.05
39	Coal Creek 230	0.96   1.12	0.96   1.12	0.96   1.12	0.96   1.12
40	Dickinson 345	0.94   1.04	0.94   1.04	0.94   1.04	0.94   1.04
41	Drayton 230	0.98   1.09	0.97   1.09	0.96   1.09	0.97   1.09
42	Groton 345	0.91   1.07	0.90   1.07	0.91   1.07	0.90   1.06
43	Tioga 230	0.98   1.05	0.98   1.05	0.98   1.05	0.98   1.05
44	Wahpeton 115	0.95   1.08	0.95   1.09	0.93   1.07	0.94   1.08
45	Watertown 345	0.96   1.04	0.95   1.04	0.96   1.04	0.95   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 74.46%	MNTCE3 / 73.89%	MNTCE3 / 76.15%	MNTCE3 / 75.87%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	3.97	403%	388%	401%
57	K22W (max +dP @ t, d-ang)	6.1@(2.63332,1.7)	5.7@(2.68332,2.8)	6.9@(2.60832,1.7)	7.9@(2.64999,2.0)
58	K22W (max -dP @ t, d-ang)	22.2@(0.80833,4.9)	23.6@(0.81666,5.2)	23.9@(0.76666,5.8)	24.7@(0.77500,6.1)
59	K22W (max d-ang @ t, dP)	7.6@(1.12500,-9.3)	8.4@(1.17500,-9.0)	8.9@(1.10000,-11.5)	9.5@(1.13333,-11.4)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	163% / 253%	155% / 240%	159% / 246%	151% / 234%
63	B2R at Rugby/L20D at Drayton	999% / 711%	999% / 681%	999% / 708%	999% / 672%
64	R50M / F3M	654% / 273%	688% / 264%	642% / 272%	675% / 263%
65	B10T	1.9	186%	182%	180%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   1   0)	(0   1   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   6   2) / (1   2   1)	(2   6   2) / (1   2   1)	(2   5   2) / (1   2   1)	(2   6   2) / (1   2   1)
70	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)
71	Shey 115 / s7lit Rock 115	(1   5   3) / (0   0   0)	(1   5   2) / (0   0   0)	(1   5   3) / (0   0   0)	(1   5   2) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	ei2		eq1	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-ei2	g51-s709aa.Ezq0444-ei2	b51-s709aa.Ezpb044-eq1	g51-s709aa.Ezq0444-eq1
3	Disturbance	ei2	ei2	eq1	eq1
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 20:39	FEB 03 2006 22:09	JAN 30 2006 20:43	FEB 03 2006 22:13
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.96   1.06	0.91   1.03	0.98   1.05	0.94   1.02
35	Boise 115	0.98   1.04	0.98   1.04	1.00   1.04	0.99   1.04
36	Dorsey 230	1.02   1.06	1.02   1.06	1.03   1.06	1.03   1.06
37	Forbes 230	0.95   1.02	0.92   1.01	0.97   1.02	0.96   1.01
38	Riverton 230	0.89   1.07	0.91   1.07	0.92   1.06	0.95   1.06
39	Coal Creek 230	1.01   1.12	1.01   1.12	0.95   1.16	0.95   1.16
40	Dickinson 345	0.98   1.06	0.97   1.06	1.00   1.08	0.99   1.08
41	Drayton 230	0.94   1.10	0.95   1.09	0.97   1.08	0.98   1.08
42	Groton 345	0.91   1.10	0.90   1.09	0.92   1.08	0.91   1.08
43	Tioga 230	0.99   1.05	0.99   1.05	1.00   1.04	1.00   1.04
44	Wahpeton 115	0.86   1.09	0.87   1.10	0.88   1.07	0.90   1.08
45	Watertown 345	0.92   1.08	0.91   1.07	0.94   1.06	0.93   1.05
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 42.05%	SHERC3 / 43.36%	SHERC3 / 36.66%	SHERC3 / 33.87%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	507%	507%	507%	507%
57	K22W (max +dP @ t, d-ang)	61.1@(2.16666,-32.2)	61.0@(2.24166,-33.0)	39.6@(2.85832,-20.0)	41.6@(2.87498,-20.2)
58	K22W (max -dP @ t, d-ang)	14.5@(0.54166,1.7)	15.9@(0.60000,2.3)	9.2@(0.69166,1.2)	9.6@(0.55000,1.6)
59	K22W (max d-ang @ t, dP)	-49.2@(10.00821,34.1)	-48.6@(10.00821,33.2)	-28.5@(10.00821,18.9)	-28.3@(10.00821,19.0)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	112% / 168%	108% / 164%	146% / 226%	144% / 222%
63	B2R at Rugby/L20D at Drayton	212% / 575%	232% / 538%	999% / 585%	999% / 597%
64	R50M / F3M	563% / 205%	624% / 201%	627% / 243%	697% / 229%
65	B10T	107%	99%	155%	149%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   1   0)	(0   1   0)
68	Eau Cl 345 / Park Lk 115	(3   3   2) / (0   0   0)	(3   3   2) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   8   2) / (1   2   1)	(2   7   2) / (1   2   0)	(2   4   2) / (1   2   1)	(2   5   2) / (1   2   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   0   0) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   5   2) / (0   1   1)	(1   5   1) / (0   1   1)	(1   5   3) / (0   1   1)	(1   5   3) / (0   1   1)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	ev1		fd3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-ev1	g51-s709aa.Ezq0444-ev1	b51-s709aa.Ezpb044-fd3	g51-s709aa.Ezq0444-fd3
3	Disturbance	ev1	ev1	fd3	fd3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:59	FEB 04 2006 8:26	JAN 30 2006 22:56	FEB 04 2006 8:22
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.00   1.06	1.00   1.04	0.96   1.04	0.93   1.01
35	Boise 115	0.99   1.04	0.99   1.03	1.00   1.04	1.00   1.04
36	Dorsey 230	1.03   1.06	1.03   1.06	1.03   1.06	1.03   1.06
37	Forbes 230	0.99   1.03	0.99   1.01	0.98   1.03	0.97   1.01
38	Riverton 230	0.94   1.05	1.00   1.06	0.94   1.07	0.96   1.07
39	Coal Creek 230	0.94   1.13	0.97   1.11	0.96   1.14	0.95   1.14
40	Dickinson 345	0.93   1.05	0.95   1.04	0.93   1.05	0.93   1.06
41	Drayton 230	0.99   1.11	0.99   1.10	0.98   1.11	0.96   1.11
42	Groton 345	0.93   1.07	0.97   1.09	0.93   1.09	0.92   1.08
43	Tioga 230	1.00   1.05	1.00   1.04	0.99   1.04	0.98   1.04
44	Wahpeton 115	0.89   1.06	0.97   1.08	0.88   1.09	0.89   1.09
45	Watertown 345	0.95   1.05	0.99   1.06	0.95   1.06	0.95   1.06
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 72.09%	SHERC3 / 52.23%	MNTCE3 / 71.00%	MNTCE3 / 71.90%
55	Dorsey SUVP / UdHold			/ 0.183	
56	Forbes DC Red (DCAR)	387%	495%	340%	344%
57	K22W (max +dP @ t, d-ang)	13.5@(2.81665,-3.0)	43.7@(2.53332,-18.6)	17.8@(2.70832,-2.1)	18.9@(2.74165,-2.4)
58	K22W (max -dP @ t, d-ang)	24.8@(0.79166,3.3)	5.0@(0.38333,0.0)	21.4@(0.90833,6.6)	22.0@(0.95833,7.2)
59	K22W (max d-ang @ t, dP)	6.9@(1.20833,-11.7)	-24.6@(10.00821,22.2)	8.2@(1.14166,-12.6)	8.6@(1.17500,-12.6)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	153% / 235%	169% / 263%	166% / 259%	160% / 249%
63	B2R at Rugby/L20D at Drayton	246% / 637%	999% / 611%	999% / 654%	999% / 623%
64	R50M / F3M	621% / 264%	712% / 231%	669% / 281%	724% / 269%
65	B10T	201%	144%	158%	156%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   1   0)	(0   0   0)	(0   1   0)	(0   1   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   7   2) / (1   2   1)	(2   6   2) / (1   1   0)	(2   6   2) / (1   2   1)	(2   6   2) / (1   2   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   5   4) / (0   1   1)	(1   4   1) / (0   0   0)	(1   5   2) / (0   0   0)	(1   5   2) / (0   1   1)



## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	mad		mqs	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-mad	g51-s709aa.Ezq0444-mad	b51-s709aa.Ezpb044-mqs	g51-s709aa.Ezq0444-mqs
3	Disturbance	mad	mad	mqs	mqs
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 20:46	FEB 03 2006 22:16	JAN 30 2006 20:50	FEB 03 2006 22:20
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.06   1.09	1.04   1.07	0.97   1.06	0.92   1.03
35	Boise 115	0.94   1.03	0.92   1.03	0.98   1.04	0.98   1.04
36	Dorsey 230	1.04   1.18	1.04   1.19	1.02   1.05	1.02   1.05
37	Forbes 230	0.97   1.03	0.98   1.01	0.97   1.02	0.95   1.01
38	Riverton 230	0.94   1.04	0.97   1.05	0.94   1.03	0.95   1.03
39	Coal Creek 230	1.01   1.09	1.01   1.09	0.96   1.06	0.96   1.06
40	Dickinson 345	0.98   1.05	0.99   1.05	0.93   1.04	0.93   1.04
41	Drayton 230	0.98   1.07	0.98   1.08	0.98   1.06	0.99   1.05
42	Groton 345	1.01   1.06	1.01   1.06	0.97   1.06	0.96   1.06
43	Tioga 230	1.01   1.04	1.01   1.04	0.99   1.04	0.98   1.04
44	Wahpeton 115	0.91   1.03	0.93   1.05	0.95   1.04	0.96   1.04
45	Watertown 345	1.01   1.04	1.01   1.04	0.97   1.05	0.96   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	67564 [DORSEY 2] 1.21	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 34.17%	KING 3 / 34.68%	KING 3 / 62.78%	KING 3 / 62.59%
55	Dorsey SUVP / UdHold	/ 0.133	/ 0.133		
56	Forbes DC Red (DCAR)	507%	507%	507%	507%
57	K22W (max +dP @ t, d-ang)	94.5@(0.40000,-13.5)	99.4@(0.40000,-13.5)	67.4@(2.35832,-30.4)	66.7@(2.40832,-30.2)
58	K22W (max -dP @ t, d-ang)	22.7@(0.85833,-26.8)	17.8@(0.84166,-27.6)	25.4@(0.35833,4.5)	26.5@(0.37500,4.9)
59	K22W (max d-ang @ t, dP)	-83.9@(10.00821,42.4)	-85.1@(10.00821,45.9)	-39.3@(10.00821,27.5)	-39.7@(10.00821,28.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	0.16667 sec / 0.16667 sec	0.16667 sec / 0.16667 sec	120% / 180%	111% / 164%
63	B2R at Rugby/L20D at Drayton	999% / 767%	999% / 693%	999% / 615%	999% / 580%
64	R50M / F3M	355% / 129%	343% / 118%	545% / 233%	582% / 225%
65	B10T	306%	301%	134%	130%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   2) / (0   0   0)	(3   3   2) / (0   0   0)	(3   4   2) / (0   3   3)	(3   4   3) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   4   2) / (1   1   1)	(2   4   2) / (1   1   1)	(2   3   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   2   1) / (1   4   3)	(0   2   1) / (1   4   3)	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   5   5) / (0   0   0)	(1   5   5) / (0   0   0)	(1   5   5) / (0   0   0)	(1   4   4) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	mss		msz	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-mss	g51-s709aa.Ezq0444-mss	b51-s709aa.Ezpb044-msz	g51-s709aa.Ezq0444-msz
3	Disturbance	mss	mss	msz	msz
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 20:53	FEB 04 2006 16:25	JAN 30 2006 20:56	FEB 03 2006 22:23
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.97   1.04	0.93   1.01	0.96   1.04	0.92   1.01
35	Boise 115	1.00   1.05	1.00   1.05	1.00   1.05	1.00   1.05
36	Dorsey 230	1.03   1.06	1.03   1.06	1.03   1.05	1.03   1.05
37	Forbes 230	1.00   1.03	0.98   1.01	0.99   1.03	0.98   1.01
38	Riverton 230	0.98   1.04	1.00   1.04	1.00   1.03	1.01   1.04
39	Coal Creek 230	0.96   1.07	0.96   1.07	0.97   1.07	0.97   1.07
40	Dickinson 345	0.92   1.04	0.91   1.04	0.93   1.04	0.92   1.03
41	Drayton 230	1.00   1.03	1.00   1.04	1.00   1.03	1.00   1.03
42	Groton 345	0.99   1.05	0.98   1.05	1.00   1.05	0.99   1.04
43	Tioga 230	1.00   1.03	0.99   1.03	0.99   1.03	0.99   1.03
44	Wahpeton 115	0.98   1.03	0.99   1.04	0.99   1.02	1.00   1.04
45	Watertown 345	1.00   1.04	0.99   1.04	1.00   1.04	1.00   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	MNTCE3 / 81.88%	MNTCE3 / 79.25%	KING 3 / 82.02%	KING 3 / 80.33%
55	Dorsey SUVP / UdHold			/ 0.150	/ 0.158
56	Forbes DC Red (DCAR)	334%	327%	325%	293%
57	K22W (max +dP @ t, d-ang)	26.0@(2.64999,-8.2)	28.9@(2.70832,-9.2)	26.2@(2.63332,-8.5)	28.2@(2.87498,-9.6)
58	K22W (max -dP @ t, d-ang)	27.9@(1.07500,14.6)	28.7@(1.08333,15.9)	33.5@(1.10000,17.5)	34.0@(1.09166,18.8)
59	K22W (max d-ang @ t, dP)	14.6@(1.07500,-27.9)	15.9@(1.08333,-28.7)	17.6@(1.05000,-33.1)	18.8@(1.05833,-33.8)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	154% / 236%	143% / 219%	153% / 234%	143% / 219%
63	B2R at Rugby/L20D at Drayton	999% / 696%	999% / 650%	999% / 690%	999% / 648%
64	R50M / F3M	618% / 293%	647% / 282%	607% / 297%	636% / 291%
65	B10T	184%	178%	175%	169%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   4   3) / (0   3   3)	(3   4   4) / (0   3   3)	(3   4   3) / (0   3   3)	(3   4   4) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   1   1)	(0   1   1) / (1   1   1)	(0   1   1) / (1   1   1)	(0   1   1) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	mts		mtz	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-mts	g51-s709aa.Ezq0444-mts	b51-s709aa.Ezpb044-mtz	g51-s709aa.Ezq0444-mtz
3	Disturbance	mts	mts	mtz	mtz
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 20:59	FEB 03 2006 22:26	JAN 30 2006 21:02	FEB 03 2006 22:30
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.98   1.04	0.94   1.00	0.99   1.04	0.95   1.01
35	Boise 115	1.01   1.04	1.00   1.04	1.00   1.04	1.00   1.04
36	Dorsey 230	1.03   1.05	1.03   1.05	1.03   1.05	1.03   1.05
37	Forbes 230	1.00   1.03	0.98   1.01	1.00   1.03	0.98   1.01
38	Riverton 230	0.99   1.04	1.00   1.05	1.00   1.04	1.01   1.04
39	Coal Creek 230	0.97   1.07	0.97   1.07	0.99   1.07	0.99   1.07
40	Dickinson 345	0.93   1.04	0.92   1.04	0.97   1.05	0.97   1.05
41	Drayton 230	1.01   1.04	1.00   1.04	1.00   1.03	1.00   1.03
42	Groton 345	0.99   1.05	0.98   1.05	1.00   1.05	0.99   1.05
43	Tioga 230	1.00   1.03	1.00   1.03	1.00   1.03	1.00   1.03
44	Wahpeton 115	0.98   1.04	0.99   1.05	0.98   1.03	1.00   1.03
45	Watertown 345	1.00   1.04	0.99   1.04	1.00   1.04	1.00   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	MNTCE3 / 80.69%	MNTCE3 / 79.77%	SHERC3 / 80.50%	KING 3 / 78.30%
55	Dorsey SUVP / UdHold			/ 0.158	
56	Forbes DC Red (DCAR)	365%	365%	361%	337%
57	K22W (max +dP @ t, d-ang)	21.0@(2.63332,-6.0)	20.4@(2.69165,-5.4)	22.8@(2.64999,-8.0)	24.5@(2.64999,-8.7)
58	K22W (max -dP @ t, d-ang)	22.0@(1.02500,11.7)	23.9@(1.04166,13.0)	25.5@(1.05833,13.1)	24.4@(1.04166,13.5)
59	K22W (max d-ang @ t, dP)	11.7@(1.06666,-21.8)	13.1@(1.09166,-23.6)	13.2@(1.00000,-24.9)	13.6@(1.00000,-24.2)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	166% / 257%	157% / 243%	161% / 248%	152% / 234%
63	B2R at Rugby/L20D at Drayton	999% / 723%	999% / 681%	999% / 712%	999% / 674%
64	R50M / F3M	650% / 302%	693% / 293%	635% / 298%	669% / 287%
65	B10T	200%	197%	186%	184%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   3) / (0   3   3)	(3   3   3) / (0   3   3)	(3   3   3) / (0   3   3)	(3   4   4) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	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)
71	Shey 115 / s7lit Rock 115	(1   3   3) / (0   0   0)	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	nad		nbz	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-nad	g51-s709aa.Ezq0444-nad	b51-s709aa.Ezpb044-nbz	g51-s709aa.Ezq0444-nbz
3	Disturbance	nad	nad	nbz	nbz
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:05	FEB 03 2006 22:33	JAN 30 2006 21:09	FEB 03 2006 22:37
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.05   1.10	1.00   1.08	0.92   1.11	(0.59)0.79   1.08
35	Boise 115	0.89   1.03	0.90   1.03	0.93   1.04	0.96   1.05
36	Dorsey 230	1.05   1.15	1.05   1.16	1.04   1.19	1.05   1.20
37	Forbes 230	0.97   1.03	0.97   1.01	0.94   1.08	0.88   1.06
38	Riverton 230	0.91   1.04	0.96   1.06	0.88   1.06	0.84   1.07
39	Coal Creek 230	1.00   1.09	1.00   1.10	0.94   1.09	0.93   1.12
40	Dickinson 345	0.96   1.05	0.98   1.06	0.93   1.06	0.91   1.08
41	Drayton 230	0.98   1.07	0.97   1.08	0.99   1.07	1.00   1.08
42	Groton 345	0.97   1.06	0.97   1.06	0.92   1.08	0.90   1.08
43	Tioga 230	0.99   1.04	0.99   1.04	0.99   1.05	0.99   1.06
44	Wahpeton 115	0.88   1.03	0.91   1.05	0.86   1.07	0.87   1.07
45	Watertown 345	0.98   1.05	0.98   1.05	0.93   1.06	0.90   1.06
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	67564 [DORSEY 2] 1.21	61614 [98L TAP4] 0.79
48					61615 [ARROWHD4] 0.79
49					61616 [HILLTOP4] 0.80
50					61673 [ARROWHD7] 0.80
51					61674 [HANESRD7] 0.80
52					61675 [RIDGEVW7] 0.80
53					1679 [GARY 7] 0.80 +mor
54	Worst Case Angle Damping	KING 3 / 41.16%	KING 3 / 41.42%	KING 3 / 33.47%	KING 3 / 30.84%
55	Dorsey SUVP / UdHold	/ 0.133	/ 0.133	/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	507%	507%	507%	507%
57	K22W (max +dP @ t, d-ang)	87.4@(2.05833,-49.9)	96.3@(2.05000,-50.5)	129.0@(2.74165,-64.0)	144.6@(2.70832,-64.9)
58	K22W (max -dP @ t, d-ang)	113.2@(0.26667,10.6)	112.6@(0.26667,10.4)	66.4@(0.24167,6.3)	66.6@(0.24167,6.1)
59	K22W (max d-ang @ t, dP)	-82.3@(10.00821,42.3)	-81.9@(10.00821,44.2)	-87.9@(10.00821,74.1)	-85.7@(10.00821,75.6)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	0.16667 sec / 0.16667 sec	0.16667 sec / 0.16667 sec	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec
63	B2R at Rugby/L20D at Drayton	999% / 429%	999% / 419%	999% / 582%	999% / 555%
64	R50M / F3M	243% / 97%	274% / 105%	340% / 141%	454% / 139%
65	B10T	199%	192%	146%	122%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   1   0)
68	Eau Cl 345 / Park Lk 115	(3   3   2) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   5   2) / (1   1   1)	(2   5   2) / (1   1   1)	(2   5   2) / (1   1   1)	(2   4   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   2   1) / (1   6   3)	(0   2   1) / (1   6   3)	(0   1   0) / (1   3   1)	(0   0   0) / (1   3   1)
71	Shey 115 / s7lit Rock 115	(1   5   5) / (0   0   0)	(1   5   4) / (0   0   0)	(1   5   4) / (0   1   1)	(1   5   3) / (0   1   1)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	nmz		oas	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-nmz	g51-s709aa.Ezq0444-nmz	b51-s709aa.Ezpb044-oas	g51-s709aa.Ezq0444-oas
3	Disturbance	nmz	nmz	oas	oas
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:13	FEB 03 2006 22:41	JAN 30 2006 21:41	FEB 03 2006 23:10
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.96   1.08	0.84   1.04	1.08   1.14	1.05   1.12
35	Boise 115	0.93   1.04	0.95   1.06	0.94   1.04	0.92   1.04
36	Dorsey 230	1.04   1.19	1.05   1.20	1.05   1.28(0.42)	1.05   1.28(0.42)
37	Forbes 230	0.97   1.03	0.96   1.02	1.06   1.10	1.04   1.09
38	Riverton 230	0.89   1.05	0.87   1.05	0.96   1.07	0.99   1.09
39	Coal Creek 230	0.95   1.10	0.94   1.10	1.00   1.09	1.00   1.10
40	Dickinson 345	0.93   1.06	0.91   1.07	0.98   1.07	0.98   1.08
41	Drayton 230	0.99   1.08	0.99   1.08	1.01   1.14	1.01   1.12
42	Groton 345	0.92   1.08	0.91   1.08	1.00   1.08	0.99   1.08
43	Tioga 230	0.99   1.05	0.99   1.05	0.99   1.05	0.99   1.05
44	Wahpeton 115	0.86   1.07	0.88   1.06	0.91   1.05	0.92   1.07
45	Watertown 345	0.93   1.06	0.91   1.06	1.00   1.06	0.99   1.06
46	<b>Dynamic Voltage Warnings</b>				
47		67564 [DORSEY 2] 1.22	67564 [DORSEY 2] 1.22	67700 [DORSEYS4] 1.28 67530 [ROSSER 4] 1.27 67559 [LAVAREN4] 1.27 67560 [RIDGEWY4] 1.25 67558 [STVITAL4] 1.25 67579 [SILVER 4] 1.25	67700 [DORSEYS4] 1.28 67530 [ROSSER 4] 1.27 67559 [LAVAREN4] 1.27 67579 [SILVER 4] 1.26 67560 [RIDGEWY4] 1.25 67558 [STVITAL4] 1.25
48				574 [PORTSOU4] 1.25 +m	574 [PORTSOU4] 1.25 +m
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 34.14%	KING 3 / 30.44%	KING 3 / 38.12%	KING 3 / 38.58%
55	Dorsey SUVP / UdHold	/ 0.133	/ 0.133	/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	507%	507%	507%	507%
57	K22W (max +dP @ t, d-ang)	124.2@(2.74165,-62.0)	137.1@(2.69999,-62.2)	166.7@(1.97500,-72.8)	172.5@(1.98333,-74.4)
58	K22W (max -dP @ t, d-ang)	67.4@(0.23333,5.9)	67.3@(0.23333,5.8)	67.7@(0.35000,6.6)	65.1@(0.35000,6.7)
59	K22W (max d-ang @ t, dP)	-87.7@(10.00821,72.7)	-84.9@(10.00821,75.6)	-108.7@(10.00821,97.0)	-108.9@(10.00821,99.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	0.16667 sec / 0.16667 sec	0.16667 sec / 0.16667 sec
63	B2R at Rugby/L20D at Drayton	999% / 585%	999% / 570%	272% / 508%	999% / 479%
64	R50M / F3M	361% / 148%	446% / 159%	220% / 105%	274% / 108%
65	B10T	155%	132%	246%	242%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   5   2) / (1   1   1)	(2   3   2) / (1   1   1)	(2   5   2) / (1   1   1)	(2   5   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   2   0) / (1   4   2)	(0   1   0) / (1   3   1)	(0   1   0) / (1   3   1)	(0   1   0) / (1   3   1)
71	Shey 115 / s7lit Rock 115	(1   5   4) / (0   1   1)	(1   5   3) / (0   1   1)	(1   5   4) / (0   0   0)	(1   5   3) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	pac		pcs	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-pas	g51-s709aa.Ezq0444-pac	b51-s709aa.Ezpb044-pcs	g51-s709aa.Ezq0444-pcs
3	Disturbance	pas	pac	pcs	pcs
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:45	FEB 03 2006 23:14	JAN 30 2006 21:17	FEB 03 2006 22:45
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.02   1.09	0.94   1.05	0.91   0.98	0.85   0.94
35	Boise 115	0.95   1.04	0.97   1.04	1.01   1.05	1.01   1.05
36	Dorsey 230	1.04   1.20	1.04   1.21	1.03   1.08	1.03   1.07
37	Forbes 230	0.99   1.06	0.95   1.04	0.99   1.03	0.97   1.02
38	Riverton 230	0.92   1.04	0.93   1.03	1.00   1.03	1.01   1.03
39	Coal Creek 230	0.99   1.09	0.98   1.09	0.99   1.08	0.98   1.07
40	Dickinson 345	0.97   1.06	0.96   1.06	0.98   1.05	0.98   1.05
41	Drayton 230	0.98   1.07	0.98   1.08	1.00   1.03	1.00   1.03
42	Groton 345	0.98   1.06	0.97   1.05	1.00   1.04	0.99   1.04
43	Tioga 230	0.99   1.04	1.00   1.04	1.00   1.03	1.00   1.03
44	Wahpeton 115	0.90   1.03	0.93   1.04	1.00   1.03	1.00   1.03
45	Watertown 345	0.98   1.04	0.97   1.04	1.01   1.03	1.00   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		67564 [DORSEY 2] 1.21	67564 [DORSEY 2] 1.21	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 43.48%	ANTEL3 / 42.57%	SHERC3 / 72.73%	ANTEL3 / 68.97%
55	Dorsey SUVP / UdHold	/ 0.141	/ 0.133		
56	Forbes DC Red (DCAR)	507%	390%	254%	211%
57	K22W (max +dP @ t, d-ang)	79.9@(2.08333,-45.7)	85.1@(2.79165,-45.2)	0.0@(0.03333,0.0)	0.0@(-0.01667,0.0)
58	K22W (max -dP @ t, d-ang)	81.3@(0.28333,6.5)	83.1@(0.28333,7.3)	42.0@(1.67500,17.8)	51.9@(1.75000,20.6)
59	K22W (max d-ang @ t, dP)	-77.7@(10.00821,46.4)	-76.0@(10.00821,49.4)	21.4@(1.25000,-40.8)	24.2@(1.29166,-44.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	0.38333 sec / 0.18333 sec	0.38333 sec / 0.18333 sec	183% / 285%	181% / 283%
63	B2R at Rugby/L20D at Drayton	999% / 489%	999% / 469%	999% / 684%	999% / 652%
64	R50M / F3M	294% / 157%	328% / 153%	639% / 332%	699% / 327%
65	B10T	213%	202%	206%	210%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   3) / (0   3   3)	(3   3   3) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   4   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   0) / (1   3   2)	(0   0   0) / (1   4   2)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   5   5) / (0   0   0)	(1   5   5) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	pct		pys	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-pct	g51-s709aa.Ezq0444-pct	b51-s709aa.Ezpb044-pys	g51-s709aa.Ezq0444-pys
3	Disturbance	pct	pct	pys	pys
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:20	FEB 03 2006 22:48	JAN 30 2006 21:23	FEB 03 2006 22:51
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.94   0.98	0.90   0.95	1.00   1.02	0.96   0.98
35	Boise 115	1.02   1.03	1.02   1.03	1.01   1.05	1.01   1.05
36	Dorsey 230	1.04   1.05	1.04   1.05	1.04   1.06	1.04   1.06
37	Forbes 230	1.00   1.01	0.98   1.00	1.00   1.03	0.99   1.02
38	Riverton 230	1.01   1.03	1.02   1.04	1.01   1.04	1.02   1.04
39	Coal Creek 230	1.02   1.04	1.02   1.04	0.99   1.07	0.99   1.07
40	Dickinson 345	0.99   1.01	0.98   1.01	0.98   1.04	0.98   1.04
41	Drayton 230	1.01   1.03	1.02   1.03	1.01   1.04	1.01   1.04
42	Groton 345	1.02   1.04	1.02   1.04	1.00   1.04	1.00   1.04
43	Tioga 230	1.02   1.03	1.02   1.03	1.00   1.03	1.00   1.03
44	Wahpeton 115	1.01   1.03	1.02   1.04	0.99   1.03	1.00   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.01   1.03	1.01   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 55.85%	KING 3 / 48.71%	SHERC3 / 80.62%	SHERC3 / 80.06%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	303%	277%	320%	305%
57	K22W (max +dP @ t, d-ang)	0.0@(0.03333,0.0)	0.0@(0.19167,0.0)	0.7@(2.66665,2.9)	0.0@(-0.01667,0.0)
58	K22W (max -dP @ t, d-ang)	31.8@(2.09999,13.6)	35.5@(2.13333,15.3)	25.5@(0.96666,12.2)	27.3@(1.80833,9.2)
59	K22W (max d-ang @ t, dP)	13.7@(2.18333,-31.6)	15.3@(2.24166,-35.3)	13.6@(1.18333,-20.8)	14.5@(1.21666,-21.5)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	209% / 329%	203% / 323%	187% / 292%	182% / 285%
63	B2R at Rugby/L20D at Drayton	999% / 833%	999% / 787%	999% / 736%	999% / 701%
64	R50M / F3M	728% / 332%	803% / 327%	694% / 331%	748% / 326%
65	B10T	289%	286%	225%	228%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   2) / (0   0   0)	(3   3   2) / (0   0   0)	(3   4   4) / (0   0   0)	(3   4   4) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	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)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	pyt		qa3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-pyt	g51-s709aa.Ezq0444-pyt	b51-s709aa.Ezpb044-qa3	g51-s709aa.Ezq0444-qa3
3	Disturbance	pyt	pyt	qa3	qa3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:26	FEB 03 2006 22:54	JAN 30 2006 21:49	FEB 03 2006 23:18
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.00   1.02	0.97   0.99	0.90   1.03	0.84   1.00
35	Boise 115	1.02   1.04	1.02   1.03	1.02   1.05	1.02   1.05
36	Dorsey 230	1.04   1.05	1.04   1.05	1.03   1.05	1.03   1.05
37	Forbes 230	1.00   1.02	0.99   1.00	0.95   1.03	0.92   1.01
38	Riverton 230	1.02   1.04	1.03   1.04	0.98   1.03	0.94   1.04
39	Coal Creek 230	1.02   1.04	1.02   1.04	1.00   1.06	0.99   1.06
40	Dickinson 345	0.99   1.01	0.99   1.01	0.96   1.02	0.94   1.02
41	Drayton 230	1.02   1.03	1.02   1.03	1.01   1.02	1.00   1.03
42	Groton 345	1.03   1.04	1.02   1.03	1.02   1.04	1.01   1.04
43	Tioga 230	1.02   1.03	1.02   1.03	1.01   1.03	1.00   1.03
44	Wahpeton 115	1.02   1.03	1.03   1.04	1.00   1.02	1.00   1.03
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.01   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 71.34%	KING 3 / 65.03%	SHERC3 / 81.75%	ANTEL3 / 79.01%
55	Dorsey SUVP / UdHold			/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	363%	346%	373%	279%
57	K22W (max +dP @ t, d-ang)	0.0@(0.03333,0.0)	0.0@(-0.01667,0.0)	9.9@(2.93332,-2.7)	13.3@(2.84165,-5.2)
58	K22W (max -dP @ t, d-ang)	18.5@(1.87500,7.6)	20.6@(1.93333,8.3)	27.9@(1.19166,5.4)	28.5@(1.22500,7.1)
59	K22W (max d-ang @ t, dP)	7.9@(2.19999,-16.9)	8.6@(2.22499,-18.7)	9.4@(0.55833,-1.7)	10.9@(0.68333,-8.6)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	182% / 283%	162% / 252%
63	B2R at Rugby/L20D at Drayton	999% / 849%	999% / 803%	999% / 760%	999% / 738%
64	R50M / F3M	768% / 332%	844% / 327%	679% / 296%	699% / 308%
65	B10T	293%	291%	254%	245%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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   4   4) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   2   2)	(0   0   0) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)



## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	qaa		qb3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-qas	g51-s709aa.Ezq0444-qac	b51-s709aa.Ezpb044-qb3	g51-s709aa.Ezq0444-qb3
3	Disturbance	qas	qac	qb3	qb3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:52	FEB 03 2006 23:21	JAN 30 2006 21:55	FEB 03 2006 23:24
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.93   1.03	0.85   1.00	0.94   1.03	0.86   1.00
35	Boise 115	1.03   1.05	1.03   1.06	1.02   1.05	1.02   1.05
36	Dorsey 230	1.03   1.07	1.03   1.07	1.03   1.05	1.03   1.05
37	Forbes 230	0.96   1.03	0.91   1.02	0.96   1.03	0.91   1.01
38	Riverton 230	0.99   1.03	0.93   1.05	0.96   1.03	0.93   1.04
39	Coal Creek 230	1.00   1.06	0.99   1.06	1.01   1.06	0.99   1.05
40	Dickinson 345	0.97   1.02	0.94   1.03	0.96   1.01	0.93   1.02
41	Drayton 230	1.01   1.02	1.01   1.03	1.01   1.03	1.01   1.03
42	Groton 345	1.03   1.04	1.02   1.04	1.02   1.04	1.01   1.04
43	Tioga 230	1.01   1.02	1.01   1.03	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.00   1.02	1.00   1.04	1.00   1.02	1.00   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.01   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 79.77%	ANTEL3 / 78.55%	SHERC3 / 81.97%	ANTEL3 / 79.21%
55	Dorsey SUVP / UdHold			/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	391%	275%	400%	312%
57	K22W (max +dP @ t, d-ang)	8.0@(3.04165,-1.9)	11.7@(2.94998,-4.7)	8.6@(2.91665,-1.9)	10.9@(2.87498,-3.1)
58	K22W (max -dP @ t, d-ang)	17.2@(1.25833,2.7)	22.9@(1.30000,5.0)	28.2@(1.17500,5.8)	29.4@(1.23333,8.0)
59	K22W (max d-ang @ t, dP)	6.8@(0.62500,4.0)	9.4@(0.73333,-5.4)	8.9@(0.55000,-1.1)	11.0@(0.70833,-8.9)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	179% / 291%	157% / 260%	179% / 278%	163% / 255%
63	B2R at Rugby/L20D at Drayton	999% / 774%	999% / 744%	999% / 822%	999% / 783%
64	R50M / F3M	714% / 306%	702% / 314%	686% / 303%	730% / 319%
65	B10T	272%	258%	267%	254%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   0   0) / (1   2   2)	(0   0   0) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	qba		qc3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-qbs	g51-s709aa.Ezq0444-qbc	b51-s709aa.Ezpb044-qc3	g51-s709aa.Ezq0444-qc3
3	Disturbance	qbs	qbc	qc3	qc3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:58	FEB 03 2006 23:28	JAN 30 2006 22:04	FEB 03 2006 23:31
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.96   1.04	0.87   1.01	0.91   1.04	0.84   1.00
35	Boise 115	1.03   1.05	1.02   1.06	1.02   1.05	1.03   1.06
36	Dorsey 230	1.03   1.07	1.03   1.07	1.03   1.05	1.03   1.06
37	Forbes 230	0.96   1.03	0.90   1.01	0.98   1.03	0.93   1.01
38	Riverton 230	0.96   1.03	0.92   1.05	0.95   1.03	0.92   1.05
39	Coal Creek 230	1.01   1.05	1.00   1.06	1.00   1.06	0.99   1.06
40	Dickinson 345	0.97   1.01	0.94   1.02	0.96   1.02	0.94   1.02
41	Drayton 230	1.02   1.03	1.01   1.04	1.01   1.03	1.01   1.04
42	Groton 345	1.03   1.04	1.02   1.04	1.02   1.04	1.01   1.04
43	Tioga 230	1.02   1.02	1.01   1.03	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.01   1.03	1.01   1.05	1.00   1.02	1.00   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.01   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 80.58%	ANTEL3 / 77.34%	SHERC3 / 81.67%	SHERC3 / 79.25%
55	Dorsey SUVP / UdHold			/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	407%	297%	382%	292%
57	K22W (max +dP @ t, d-ang)	6.7@(2.98331,-1.8)	10.9@(2.99165,-4.0)	9.7@(2.87498,-3.2)	14.7@(2.78332,-5.1)
58	K22W (max -dP @ t, d-ang)	18.5@(1.23333,2.5)	22.6@(1.32500,5.0)	25.7@(1.15833,4.7)	27.4@(1.15833,6.9)
59	K22W (max d-ang @ t, dP)	6.0@(0.58333,2.7)	9.4@(0.75000,-6.2)	8.1@(0.53333,3.1)	9.1@(0.66666,-2.6)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	177% / 287%	152% / 251%	180% / 279%	155% / 241%
63	B2R at Rugby/L20D at Drayton	999% / 841%	999% / 790%	999% / 841%	999% / 809%
64	R50M / F3M	725% / 303%	708% / 314%	666% / 295%	732% / 312%
65	B10T	287%	260%	273%	268%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   0   0) / (1   2   2)	(0   1   1) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   3   3) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	qca		rx3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-qcs	g51-s709aa.Ezq0444-qcc	b51-s709aa.Ezpb044-rx3	g51-s709aa.Ezq0444-rx3
3	Disturbance	qcs	qcc	rx3	rx3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:07	FEB 03 2006 23:34	JAN 30 2006 22:10	FEB 03 2006 23:37
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.95   1.04	0.85   1.01	0.95   1.03	0.92   1.00
35	Boise 115	1.03   1.05	1.02   1.06	1.02   1.04	1.03   1.05
36	Dorsey 230	1.03   1.07	1.03   1.07	1.03   1.05	1.04   1.05
37	Forbes 230	0.99   1.02	0.94   1.02	0.98   1.02	0.98   1.01
38	Riverton 230	0.96   1.04	0.91   1.06	0.98   1.03	0.98   1.04
39	Coal Creek 230	1.01   1.05	1.00   1.06	1.02   1.05	1.02   1.05
40	Dickinson 345	0.97   1.02	0.95   1.03	0.98   1.01	0.97   1.01
41	Drayton 230	1.02   1.03	1.01   1.05	1.01   1.02	1.01   1.03
42	Groton 345	1.03   1.04	1.02   1.04	1.03   1.04	1.02   1.03
43	Tioga 230	1.02   1.03	1.01   1.03	1.02   1.03	1.01   1.03
44	Wahpeton 115	1.01   1.02	1.01   1.06	1.01   1.02	1.02   1.03
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 79.09%	SHERC3 / 78.49%	SHERC3 / 82.89%	ANTEL3 / 80.83%
55	Dorsey SUVP / UdHold			/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	405%	301%	410%	372%
57	K22W (max +dP @ t, d-ang)	8.0@(2.66665,-3.3)	13.9@(2.76665,-5.4)	7.1@(2.93332,-1.7)	7.0@(2.79998,-2.5)
58	K22W (max -dP @ t, d-ang)	11.6@(1.18333,1.8)	16.0@(1.22500,4.3)	18.7@(1.16666,3.0)	17.6@(1.14166,2.9)
59	K22W (max d-ang @ t, dP)	4.6@(0.60833,6.5)	6.9@(0.76666,-1.9)	6.0@(0.50833,4.1)	5.5@(0.52500,1.0)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	188% / 299%	160% / 250%	189% / 294%	183% / 287%
63	B2R at Rugby/L20D at Drayton	999% / 870%	999% / 816%	999% / 846%	999% / 816%
64	R50M / F3M	742% / 306%	759% / 308%	688% / 296%	782% / 319%
65	B10T	294%	275%	291%	289%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   0   0) / (1   2   2)	(0   0   0) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   3   3) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	rxa		rya	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-rxs	g51-s709aa.Ezq0444-rcx	b51-s709aa.Ezpb044-rys	g51-s709aa.Ezq0444-ryc
3	Disturbance	rxs	rcx	rys	ryc
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:13	FEB 03 2006 23:40	JAN 30 2006 22:16	FEB 03 2006 23:43
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.93   1.04	0.92   1.00	0.93   1.04	0.92   1.00
35	Boise 115	1.03   1.05	1.04   1.05	1.03   1.05	1.04   1.05
36	Dorsey 230	1.03   1.06	1.04   1.06	1.03   1.06	1.04   1.06
37	Forbes 230	0.96   1.03	0.97   1.01	0.96   1.03	0.97   1.01
38	Riverton 230	0.96   1.03	0.96   1.05	0.96   1.04	0.97   1.05
39	Coal Creek 230	1.01   1.05	1.01   1.05	1.01   1.05	1.01   1.05
40	Dickinson 345	0.97   1.02	0.97   1.02	0.97   1.02	0.97   1.02
41	Drayton 230	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
42	Groton 345	1.03   1.04	1.02   1.03	1.03   1.04	1.02   1.03
43	Tioga 230	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
44	Wahpeton 115	1.00   1.03	1.02   1.04	1.01   1.03	1.02   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	STANT4 / 80.77%	ANTEL3 / 79.11%	STANT4 / 80.90%	ANTEL3 / 79.18%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	391%	372%	389%	371%
57	K22W (max +dP @ t, d-ang)	8.2@(3.00831,-2.5)	7.2@(2.82498,-3.1)	8.1@(2.99165,-2.5)	7.1@(2.82498,-3.0)
58	K22W (max -dP @ t, d-ang)	16.7@(1.22500,1.9)	13.8@(1.16666,1.3)	16.8@(1.22500,1.9)	13.8@(1.16666,1.3)
59	K22W (max d-ang @ t, dP)	5.7@(0.56666,5.7)	4.2@(0.54166,3.8)	5.7@(0.56666,5.6)	4.3@(0.54166,3.7)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	170% / 275%	172% / 277%	170% / 276%	172% / 278%
63	B2R at Rugby/L20D at Drayton	999% / 820%	999% / 804%	999% / 820%	999% / 804%
64	R50M / F3M	629% / 289%	710% / 321%	629% / 290%	710% / 321%
65	B10T	293%	298%	294%	298%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	rza		taz	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-rzs	g51-s709aa.Ezq0444-rzc	b51-s709aa.Ezpb044-taz	g51-s709aa.Ezq0444-taz
3	Disturbance	rzs	rzc	taz	taz
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:19	FEB 03 2006 23:46	JAN 30 2006 21:29	FEB 03 2006 22:57
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.92   1.04	0.91   1.00	0.96   1.04	0.92   1.01
35	Boise 115	1.02   1.05	1.02   1.05	1.00   1.05	1.00   1.05
36	Dorsey 230	1.03   1.06	1.04   1.06	1.03   1.05	1.03   1.05
37	Forbes 230	0.96   1.03	0.97   1.01	0.99   1.03	0.98   1.01
38	Riverton 230	0.95   1.04	0.95   1.04	0.99   1.03	1.01   1.04
39	Coal Creek 230	1.01   1.05	1.01   1.05	0.97   1.07	0.97   1.07
40	Dickinson 345	0.97   1.02	0.97   1.02	0.93   1.04	0.92   1.03
41	Drayton 230	1.02   1.03	1.02   1.04	1.00   1.03	1.00   1.03
42	Groton 345	1.03   1.04	1.02   1.04	1.00   1.05	0.99   1.04
43	Tioga 230	1.02   1.03	1.02   1.03	0.99   1.03	0.99   1.03
44	Wahpeton 115	1.01   1.03	1.02   1.04	0.99   1.02	1.00   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.00   1.04	1.00   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 80.32%	ANTEL3 / 79.46%	KING 3 / 82.00%	KING 3 / 80.32%
55	Dorsey SUVP / UdHold			/ 0.150	/ 0.158
56	Forbes DC Red (DCAR)	370%	354%	326%	293%
57	K22W (max +dP @ t, d-ang)	3.7@(3.06665,-3.5)	3.3@(2.74998,-4.0)	26.3@(2.63332,-8.6)	28.2@(2.87498,-9.6)
58	K22W (max -dP @ t, d-ang)	17.8@(1.20833,1.5)	15.0@(1.08333,1.6)	33.5@(1.10000,17.5)	34.1@(1.09166,18.8)
59	K22W (max d-ang @ t, dP)	-4.1@(2.63332,3.0)	-4.0@(2.82498,3.1)	17.6@(1.05000,-33.1)	18.9@(1.05833,-33.9)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	175% / 283%	173% / 278%	153% / 234%	143% / 219%
63	B2R at Rugby/L20D at Drayton	999% / 847%	999% / 824%	999% / 690%	999% / 649%
64	R50M / F3M	618% / 277%	668% / 269%	607% / 297%	636% / 291%
65	B10T	301%	304%	174%	169%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   4   3) / (0   3   3)	(3   4   4) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   1   1) / (1   1   1)	(0   1   1) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	tbz		tcz	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-tbz	g51-s709aa.Ezq0444-tbz	b51-s709aa.Ezpb044-tcz	g51-s709aa.Ezq0444-tcz
3	Disturbance	tbz	tbz	tcz	tcz
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:32	FEB 03 2006 23:01	JAN 30 2006 21:35	FEB 03 2006 23:04
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.98   1.04	0.94   1.01	1.00   1.03	0.96   1.00
35	Boise 115	1.01   1.04	1.00   1.04	1.01   1.03	1.01   1.03
36	Dorsey 230	1.03   1.05	1.03   1.05	1.03   1.05	1.03   1.05
37	Forbes 230	0.99   1.03	0.98   1.01	1.00   1.02	0.98   1.00
38	Riverton 230	0.99   1.04	1.01   1.04	1.00   1.04	1.01   1.04
39	Coal Creek 230	0.99   1.07	0.98   1.07	0.99   1.07	0.99   1.07
40	Dickinson 345	0.94   1.06	0.95   1.06	0.97   1.06	0.97   1.05
41	Drayton 230	0.99   1.03	1.00   1.03	1.00   1.03	1.01   1.03
42	Groton 345	1.00   1.05	0.99   1.05	1.00   1.05	0.99   1.05
43	Tioga 230	1.00   1.03	1.00   1.03	1.01   1.03	1.00   1.03
44	Wahpeton 115	0.98   1.03	1.00   1.03	0.97   1.03	0.99   1.04
45	Watertown 345	1.00   1.04	1.00   1.04	1.00   1.04	1.00   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 78.08%	KING 3 / 75.57%	MNTCE3 / 75.37%	MNTCE3 / 73.99%
55	Dorsey SUVP / UdHold	/ 0.150			
56	Forbes DC Red (DCAR)	340%	334%	407%	389%
57	K22W (max +dP @ t, d-ang)	24.9@(2.97498,-7.4)	25.6@(2.94998,-8.7)	14.8@(2.72499,-4.8)	14.4@(2.79998,-4.4)
58	K22W (max -dP @ t, d-ang)	32.3@(1.10000,14.5)	29.5@(1.07500,14.9)	17.5@(1.00000,8.4)	18.1@(1.00000,9.0)
59	K22W (max d-ang @ t, dP)	14.7@(1.01666,-30.7)	15.1@(1.00000,-28.2)	8.4@(1.00833,-17.5)	9.0@(1.01666,-18.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	162% / 249%	151% / 231%	178% / 276%	172% / 267%
63	B2R at Rugby/L20D at Drayton	999% / 710%	999% / 674%	999% / 751%	999% / 714%
64	R50M / F3M	628% / 302%	650% / 289%	678% / 307%	736% / 305%
65	B10T	185%	182%	214%	213%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   3) / (0   3   3)	(3   4   4) / (0   3   3)	(3   3   3) / (0   3   3)	(3   3   3) / (0   3   3)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	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)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	tkz		va3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-tkz	g51-s709aa.Ezq0444-tkz	b51-s709aa.Ezpb044-va3	g51-s709aa.Ezq0444-va3
3	Disturbance	tkz	tkz	va3	va3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 21:38	FEB 03 2006 23:07	JAN 30 2006 22:22	FEB 03 2006 23:50
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.92   0.98	0.87   0.95	0.93   1.04	0.89   1.00
35	Boise 115	1.01   1.04	1.01   1.04	1.03   1.05	1.03   1.05
36	Dorsey 230	1.03   1.05	1.04   1.06	1.03   1.05	1.03   1.06
37	Forbes 230	0.99   1.02	0.98   1.00	0.99   1.03	0.98   1.02
38	Riverton 230	1.00   1.03	1.02   1.04	0.98   1.03	0.98   1.04
39	Coal Creek 230	1.00   1.07	1.00   1.07	0.99   1.07	0.98   1.06
40	Dickinson 345	0.99   1.05	0.99   1.05	0.94   1.02	0.93   1.01
41	Drayton 230	1.01   1.03	1.01   1.03	1.01   1.03	1.01   1.03
42	Groton 345	1.01   1.04	1.00   1.04	1.02   1.04	1.01   1.04
43	Tioga 230	1.00   1.03	1.00   1.03	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.00   1.03	1.01   1.04	1.00   1.03	1.01   1.03
45	Watertown 345	1.01   1.03	1.01   1.03	1.02   1.03	1.01   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	MNTCE3 / 72.92%	SHERC3 / 69.16%	SHERC3 / 78.85%	SHERC3 / 78.08%
55	Dorsey SUVP / UdHold	/ 0.133	/ 0.150	/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	264%	254%	377%	313%
57	K22W (max +dP @ t, d-ang)	0.0@(0.03333,0.0)	3.2@(3.59164,2.4)	10.8@(2.79998,-3.2)	10.4@(2.79998,-2.9)
58	K22W (max -dP @ t, d-ang)	41.6@(1.11666,18.4)	42.8@(1.11666,19.7)	44.4@(1.11666,7.5)	43.3@(1.11666,8.1)
59	K22W (max d-ang @ t, dP)	18.7@(1.21666,-39.9)	20.0@(1.23333,-40.6)	11.8@(0.50833,-6.1)	11.3@(0.53333,-4.8)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	183% / 285%	180% / 282%	166% / 264%	163% / 259%
63	B2R at Rugby/L20D at Drayton	999% / 742%	999% / 707%	999% / 679%	999% / 654%
64	R50M / F3M	655% / 332%	730% / 327%	654% / 318%	717% / 313%
65	B10T	222%	224%	241%	246%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   2) / (0   3   3)	(3   3   3) / (0   3   3)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	vac		wa3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-vas	g51-s709aa.Ezq0444-vac	b51-s709aa.Ezpb044-wa3	g51-s709aa.Ezq0444-wa3
3	Disturbance	vac	vac	wa3	wa3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:25	FEB 04 2006 7:51	JAN 30 2006 22:28	FEB 04 2006 7:54
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.92   1.05	0.89   1.00	1.00   1.03	0.96   0.99
35	Boise 115	1.03   1.05	1.04   1.05	1.02   1.04	1.03   1.04
36	Dorsey 230	1.04   1.09	1.04   1.09	1.04   1.05	1.04   1.05
37	Forbes 230	0.96   1.03	0.96   1.02	1.00   1.02	0.99   1.00
38	Riverton 230	0.96   1.03	0.97   1.04	1.01   1.03	1.01   1.03
39	Coal Creek 230	0.99   1.06	0.99   1.06	1.03   1.04	1.03   1.04
40	Dickinson 345	0.94   1.02	0.94   1.01	0.99   1.01	0.99   1.01
41	Drayton 230	1.01   1.03	1.01   1.03	1.02   1.02	1.02   1.03
42	Groton 345	1.02   1.04	1.02   1.04	1.03   1.04	1.03   1.03
43	Tioga 230	1.01   1.03	1.01   1.03	1.02   1.02	1.02   1.02
44	Wahpeton 115	1.00   1.03	1.01   1.03	1.01   1.02	1.02   1.03
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 76.64%	SHERC3 / 75.85%	SHERC3 / 81.70%	SHERC3 / 80.46%
55	Dorsey SUVP / UdHold	/ 0.141	/ 0.141	/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	376%	321%	476%	456%
57	K22W (max +dP @ t, d-ang)	10.0@(2.90832,-3.3)	9.9@(2.90832,-3.0)	15.7@(0.46666,5.8)	15.7@(0.45833,5.3)
58	K22W (max -dP @ t, d-ang)	40.8@(1.20833,6.1)	40.3@(0.38333,9.3)	14.1@(1.10833,1.5)	11.7@(1.10000,1.3)
59	K22W (max d-ang @ t, dP)	11.8@(0.59166,-2.5)	11.1@(0.60833,-1.7)	5.9@(0.42500,15.1)	5.4@(0.41666,15.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	100% / 172%	96% / 165%	190% / 299%	185% / 291%
63	B2R at Rugby/L20D at Drayton	999% / 639%	999% / 618%	999% / 831%	999% / 801%
64	R50M / F3M	562% / 318%	635% / 322%	783% / 332%	864% / 327%
65	B10T	243%	250%	301%	304%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   2)	(0   1   1) / (1   2   2)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)



## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	wac		xa3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-was	g51-s709aa.Ezq0444-wac	b51-s709aa.Ezpb044-xa3	g51-s709aa.Ezq0444-xa3
3	Disturbance	was	wac	xa3	xa3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:31	FEB 04 2006 7:57	JAN 30 2006 22:34	FEB 04 2006 8:00
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.00   1.03	0.97   0.99	0.99   1.03	0.96   0.99
35	Boise 115	1.03   1.05	1.03   1.05	1.02   1.04	1.03   1.04
36	Dorsey 230	1.04   1.06	1.04   1.06	1.04   1.05	1.04   1.05
37	Forbes 230	1.00   1.02	0.99   1.00	1.00   1.02	0.99   1.00
38	Riverton 230	1.01   1.03	1.01   1.03	1.01   1.03	1.01   1.03
39	Coal Creek 230	1.03   1.04	1.03   1.04	1.02   1.05	1.02   1.05
40	Dickinson 345	0.99   1.00	0.99   1.00	0.99   1.01	0.98   1.01
41	Drayton 230	1.02   1.03	1.02   1.03	1.02   1.02	1.02   1.03
42	Groton 345	1.03   1.04	1.03   1.03	1.03   1.04	1.02   1.03
43	Tioga 230	1.02   1.02	1.02   1.02	1.02   1.02	1.02   1.02
44	Wahpeton 115	1.01   1.02	1.02   1.03	1.01   1.02	1.02   1.03
45	Watertown 345	1.03   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 79.04%	ANTEL3 / 78.06%	SHERC3 / 81.18%	SHERC3 / 80.03%
55	Dorsey SUVP / UdHold			/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	477%	468%	473%	449%
57	K22W (max +dP @ t, d-ang)	16.7@(0.38333,4.7)	17.1@(0.38333,4.3)	11.8@(0.54166,5.5)	11.4@(0.54166,5.1)
58	K22W (max -dP @ t, d-ang)	12.4@(1.13333,-0.7)	11.5@(1.10000,-0.8)	14.8@(1.10833,2.3)	12.3@(1.10000,2.1)
59	K22W (max d-ang @ t, dP)	4.7@(0.38333,16.7)	4.3@(0.38333,17.1)	5.9@(0.45000,9.0)	5.3@(0.45000,9.0)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	190% / 300%	185% / 293%	186% / 293%	181% / 285%
63	B2R at Rugby/L20D at Drayton	999% / 859%	999% / 822%	999% / 810%	999% / 780%
64	R50M / F3M	589% / 299%	637% / 291%	783% / 332%	864% / 327%
65	B10T	321%	325%	294%	297%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   1)	(0   1   1) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	xac		ya3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-xas	g51-s709aa.Ezq0444-xac	b51-s709aa.Ezpb044-ya3	g51-s709aa.Ezq0444-ya3
3	Disturbance	xas	xac	ya3	ya3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:37	FEB 04 2006 8:03	JAN 30 2006 22:40	FEB 04 2006 8:06
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.01   1.03	0.98   0.99	0.98   1.01	0.96   0.98
35	Boise 115	1.04   1.06	1.04   1.06	1.03   1.05	1.02   1.05
36	Dorsey 230	1.04   1.06	1.04   1.06	1.04   1.05	1.04   1.06
37	Forbes 230	1.01   1.02	0.99   1.00	0.99   1.02	0.97   1.00
38	Riverton 230	1.01   1.03	1.02   1.03	1.01   1.03	1.01   1.03
39	Coal Creek 230	1.03   1.04	1.03   1.04	1.01   1.05	1.01   1.05
40	Dickinson 345	1.00   1.00	0.99   1.00	0.96   1.00	0.96   1.00
41	Drayton 230	1.02   1.03	1.02   1.03	1.01   1.04	1.01   1.04
42	Groton 345	1.03   1.04	1.03   1.03	1.02   1.04	1.01   1.03
43	Tioga 230	1.02   1.02	1.02   1.02	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.01   1.02	1.02   1.03	1.01   1.03	1.02   1.05
45	Watertown 345	1.03   1.03	1.02   1.03	1.02   1.03	1.01   1.02
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 79.93%	SHERC3 / 77.67%	SHERC3 / 53.15%	SHERC3 / 49.40%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	473%	471%	339%	325%
57	K22W (max +dP @ t, d-ang)	11.8@(0.52500,2.7)	11.7@(0.52500,2.4)	0.0@(0.03333,0.0)	0.0@(-0.01667,0.0)
58	K22W (max -dP @ t, d-ang)	5.8@(1.10833,0.0)	4.2@(1.09166,0.1)	35.1@(1.80833,17.2)	41.9@(1.74166,19.6)
59	K22W (max d-ang @ t, dP)	3.3@(0.38333,7.7)	3.0@(0.38333,8.1)	17.2@(1.92500,-34.5)	19.8@(1.92500,-40.1)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	195% / 309%	190% / 301%	203% / 321%	196% / 312%
63	B2R at Rugby/L20D at Drayton	999% / 864%	999% / 824%	999% / 760%	999% / 715%
64	R50M / F3M	694% / 332%	767% / 327%	783% / 332%	864% / 327%
65	B10T	320%	321%	257%	246%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   4   4) / (0   0   0)	(3   4   4) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   1   1) / (1   2   1)	(0   1   1) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	yac		ybs	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-yas	g51-s709aa.Ezq0444-yac	b51-s709aa.Ezpb044-ybs	g51-s709aa.Ezq0444-ybs
3	Disturbance	yas	yac	ybs	ybs
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:43	FEB 04 2006 8:10	JAN 30 2006 22:46	FEB 04 2006 8:13
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.88   0.96	0.86   0.94	1.01   1.05	0.97   1.02
35	Boise 115	1.03   1.06	1.02   1.04	1.01   1.05	1.01   1.05
36	Dorsey 230	1.04   1.07	1.04   1.07	1.03   1.05	1.04   1.05
37	Forbes 230	0.98   1.02	0.96   1.00	1.00   1.04	0.98   1.02
38	Riverton 230	0.97   1.02	0.98   1.02	1.00   1.05	1.01   1.05
39	Coal Creek 230	0.98   1.06	0.98   1.05	1.00   1.06	1.00   1.06
40	Dickinson 345	0.94   1.00	0.92   1.00	0.96   1.02	0.96   1.02
41	Drayton 230	1.01   1.03	1.01   1.03	1.01   1.04	1.01   1.04
42	Groton 345	1.02   1.03	1.01   1.03	1.02   1.04	1.02   1.04
43	Tioga 230	1.01   1.03	1.00   1.03	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.00   1.02	1.01   1.04	0.99   1.04	1.01   1.05
45	Watertown 345	1.02   1.03	1.01   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		39449 [AHD 345] 1.27	61632 [DAHLBRG7] 0.79 61570 [STINSJCT] 0.81 61678 [NEMADJ17] 0.81 61683 [STIN-MN7] 0.81 61684 [STIN-WI7] 0.81 61703 [STSN GTG] 0.81 39449 [AHD 345] 1.25	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	ANTEL3 / 77.48%	ANTEL3 / 71.59%	MNTCE3 / 79.97%	MNTCE3 / 79.68%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	434%	415%	288%	315%
57	K22W (max +dP @ t, d-ang)	0.0@(0.03333,0.0)	0.0@(-0.01667,0.0)	8.0@(3.59164,-0.9)	8.3@(3.59164,-1.2)
58	K22W (max -dP @ t, d-ang)	31.9@(1.34166,14.2)	37.2@(1.65833,16.2)	19.2@(1.56666,7.2)	20.4@(1.60833,7.2)
59	K22W (max d-ang @ t, dP)	14.2@(1.37500,-31.8)	17.0@(1.32500,-31.4)	9.2@(1.09166,-13.3)	9.5@(1.09166,-13.2)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	186% / 292%	181% / 285%	184% / 288%	179% / 281%
63	B2R at Rugby/L20D at Drayton	999% / 780%	999% / 735%	999% / 830%	999% / 781%
64	R50M / F3M	725% / 332%	811% / 327%	694% / 308%	762% / 305%
65	B10T	261%	251%	261%	253%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   4   4) / (0   0   0)	(3   4   4) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	Roseau 230 / Running 230	(0   0   0) / (1   2   2)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	yy3		yz3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-s709aa.Ezpb044-yy3	g51-s709aa.Ezq0444-yy3	b51-s709aa.Ezpb044-yz3	g51-s709aa.Ezq0444-yz3
3	Disturbance	yy3	yy3	yz3	yz3
4	Prior Outage	None	None	None	None
5	Date/Time	JAN 30 2006 22:50	FEB 04 2006 8:16	JAN 30 2006 22:53	FEB 04 2006 8:19
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2452 / 435	2463 / 359	2452 / 435	2463 / 359
10	MHEX / L20D	2177 / 229	2179 / 240	2177 / 229	2179 / 240
11	ECL-ARP / PRI-BYN	575 / 646	572 / 671	575 / 646	572 / 671
12	MWSI / MNEX	1221 / 0	1243 / 0	1221 / 0	1243 / 0
13	D602F / F601C	1866 / 1604	1854 / 1821	1866 / 1604	1854 / 1821
14	B10T / MH>s7C	164 / 37	164 / 38	164 / 37	164 / 38
15	OH E-W / OH>MH	163 / 0	164 / 0	163 / 0	164 / 0
16	R50M / OH>MP	157 / 149	148 / 150	157 / 149	148 / 150
17	G82R	-76	-63	-76	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	258 / -7	224 / 19	258 / -7	224 / 19
20	Forbes SVC / MSC	9 / 600	36 / 600	9 / 600	36 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.033 / 1.045	1.031 / 1.045	1.033 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.000	1.061 / 0.987	1.062 / 1.000	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.003 / 1.020	0.991 / 1.015	1.003 / 1.020	0.991 / 1.015
26	Int Falls 115/Badoura 115	1.023 / 1.021	1.022 / 1.030	1.023 / 1.021	1.022 / 1.030
27	Drayton 230/Groton 345	1.021 / 1.035	1.024 / 1.031	1.021 / 1.035	1.024 / 1.031
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	210% / 331%	206% / 325%	210% / 331%	206% / 325%
30	B2R at Rugby/L20D at Drayton	999% / 905%	999% / 857%	999% / 905%	999% / 857%
31	R50M/F3M	783% / 332%	864% / 327%	783% / 332%	864% / 327%
32	B10T	335%	333%	335%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.02   1.05	0.98   1.01	1.02   1.05	0.98   1.01
35	Boise 115	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04
36	Dorsey 230	1.04   1.05	1.04   1.05	1.04   1.05	1.04   1.05
37	Forbes 230	1.00   1.03	0.99   1.01	1.00   1.03	0.99   1.01
38	Riverton 230	1.01   1.04	1.02   1.04	1.01   1.04	1.02   1.04
39	Coal Creek 230	1.02   1.05	1.02   1.05	1.02   1.05	1.02   1.05
40	Dickinson 345	0.98   1.02	0.98   1.02	0.98   1.01	0.98   1.01
41	Drayton 230	1.01   1.03	1.02   1.03	1.02   1.03	1.02   1.03
42	Groton 345	1.03   1.04	1.02   1.04	1.03   1.04	1.02   1.03
43	Tioga 230	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
44	Wahpeton 115	1.00   1.03	1.01   1.04	1.00   1.03	1.01   1.04
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 83.33%	KING 3 / 83.36%	MNTCE3 / 83.05%	SHERC3 / 83.60%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	351%	359%	378%	391%
57	K22W (max +dP @ t, d-ang)	1.6@(3.53331,0.9)	1.5@(3.53331,0.8)	3.0@(3.54997,0.4)	3.1@(3.53331,0.2)
58	K22W (max -dP @ t, d-ang)	11.0@(1.58333,3.8)	11.8@(1.60833,3.9)	9.9@(1.52500,3.6)	10.7@(1.56666,3.6)
59	K22W (max d-ang @ t, dP)	4.9@(1.06666,-6.8)	5.1@(1.05833,-6.8)	4.6@(1.02500,-6.2)	4.8@(1.01666,-6.3)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	200% / 315%	195% / 308%	200% / 314%	194% / 306%
63	B2R at Rugby/L20D at Drayton	999% / 860%	999% / 813%	999% / 865%	999% / 817%
64	R50M / F3M	745% / 327%	818% / 322%	745% / 323%	815% / 319%
65	B10T	284%	284%	292%	288%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	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)
69	Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
70	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)
71	Shey 115 / s7lit Rock 115	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	ya3		yy3	
1	Case No.	BASE	G519	BASE	G519
2	Case Name	b51-ea09aa.Ezp0444-ya3	g51-ea09aa.Ezq0444-ya3	b51-gr09aa.Ezp0444-yy3	g51-gr09aa.Ezq0444-yy3
3	Disturbance	ya3	ya3	yy3	yy3
4	Prior Outage	Eau claire - Arpin 345	Eau claire - Arpin 345	Gardner Park-Rocky Run 345	Gardner Park-Rocky Run 345
5	Date/Time	JAN 31 2006 11:32	JAN 31 2006 9:39	JAN 31 2006 9:03	JAN 31 2006 9:50
6	Comments				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2464 / 511	2472 / 434	2453 / 432	2463 / 357
10	MHEX / L20D	2177 / 209	2173 / 224	2176 / 229	2179 / 241
11	ECL-ARP / PRI-BYN	0 / 484	0 / 497	646 / 651	647 / 673
12	MWSI / MNEX	484 / 0	497 / 0	1297 / 0	1320 / 0
13	D602F / F601C	1877 / 1348	1861 / 1564	1865 / 1629	1853 / 1842
14	B10T / MH>s7C	164 / 37	165 / 39	164 / 38	164 / 38
15	OH E-W / OH>MH	163 / 0	161 / -1	161 / 0	164 / 0
16	R50M / OH>MP	192 / 150	182 / 150	157 / 148	147 / 150
17	G82R	-102	-95	-75	-63
18	Dorsey bipole / CU bipole	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	296 / 22	268 / 1	267 / -5	227 / 20
20	Forbes SVC / MSC	51 / 600	15 / 600	25 / 600	35 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.035 / 1.045	1.034 / 1.045	1.034 / 1.045	1.032 / 1.045
24	Roseau 500/Forbes 500	1.063 / 1.013	1.062 / 1.001	1.062 / 1.002	1.061 / 0.987
25	Chisago 500/EauClaire 345	1.016 / 1.039	1.008 / 1.038	1.003 / 1.004	0.990 / 1.011
26	Int Falls 115/Badoura 115	1.020 / 1.006	1.022 / 1.016	1.025 / 1.021	1.020 / 1.031
27	Drayton 230/Groton 345	1.019 / 1.018	1.014 / 1.032	1.022 / 1.035	1.024 / 1.030
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	214% / 336%	212% / 334%	211% / 333%	206% / 326%
30	B2R at Rugby/L20D at Drayton	999% / 999%	999% / 912%	999% / 904%	999% / 854%
31	R50M/F3M	623% / 330%	684% / 331%	791% / 336%	871% / 325%
32	B10T	337%	330%	333%	333%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.99   1.01	0.97   1.00	1.03   1.08	1.00   1.05
35	Boise 115	1.02   1.04	1.02   1.05	1.02   1.05	1.02   1.04
36	Dorsey 230	1.04   1.05	1.04   1.06	1.04   1.05	1.04   1.05
37	Forbes 230	1.01   1.04	0.99   1.02	1.01   1.04	0.99   1.02
38	Riverton 230	1.02   1.04	1.01   1.04	1.01   1.05	1.02   1.05
39	Coal Creek 230	1.02   1.06	1.00   1.06	1.01   1.05	1.01   1.05
40	Dickinson 345	0.98   1.02	0.97   1.01	0.97   1.01	0.97   1.01
41	Drayton 230	1.01   1.04	1.00   1.04	1.01   1.04	1.01   1.04
42	Groton 345	1.01   1.02	1.01   1.04	1.02   1.04	1.02   1.04
43	Tioga 230	1.02   1.03	1.01   1.04	1.02   1.03	1.02   1.03
44	Wahpeton 115	1.00   1.03	1.00   1.04	1.00   1.04	1.01   1.05
45	Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 59.83%	SHERC3 / 64.20%	STANT4 / 79.12%	STANT4 / 76.40%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	291%	265%	320%	330%
57	K22W (max +dP @ t, d-ang)	0.0@(-0.01667,0.0)	0.0@(-0.01667,0.0)	0.0@(-0.01667,0.0)	0.0@(0.10000,0.0)
58	K22W (max -dP @ t, d-ang)	28.3@(1.77500,14.4)	33.7@(1.71666,15.9)	22.8@(1.74166,8.4)	24.4@(1.78333,8.8)
59	K22W (max d-ang @ t, dP)	14.6@(2.00000,-26.1)	15.9@(1.53333,-31.0)	8.6@(1.92500,-19.7)	9.0@(1.98333,-20.6)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	214% / 336%	209% / 332%	204% / 321%	198% / 313%
63	B2R at Rugby/L20D at Drayton	999% / 860%	999% / 765%	999% / 820%	999% / 775%
64	R50M / F3M	623% / 330%	684% / 331%	762% / 336%	831% / 325%
65	B10T	272%	248%	270%	264%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)
68	Eau Cl 345 / Park Lk 115	(2 2 2)/(0 0 0)	(2 2 2)/(0 0 0)	(3 3 3)/(0 0 0)	(4 4 4)/(0 0 0)
69	Prairie 115 / Ramsey 230	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)
70	Roseau 230 / Running 230	(1 1 1)/(1 1 1)	(1 1 1)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
71	Shey 115 / s7lit Rock 115	(2 2 2)/(0 0 0)	(2 2 2)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)

## POWER FLOW AND STABILITY SUMMARY TABLE

###	Disturbance	yz3	
1	Case No.	BASE	G519
2	Case Name	b51-gw09aa.Ezp0444-yz3	g51-gw09aa.Ezq0444-yz3
3	Disturbance	yz3	yz3
4	Prior Outage	ardner Park-C Wisconsin 34	ardner Park-C Wisconsin 345
5	Date/Time	JAN 31 2006 9:17	JAN 31 2006 10:10
6	Comments		
7			
8	<b>Steady State Flows</b>		
9	NDEX / EAST BIAS	2453 / 430	2463 / 355
10	MHEX / L20D	2178 / 231	2179 / 242
11	ECL-ARP / PRI-BYN	566 / 666	561 / 690
12	MWSI / MNEX	1233 / 0	1251 / 0
13	D602F / F601C	1864 / 1619	1851 / 1830
14	B10T / MH>s7C	164 / 37	164 / 38
15	OH E-W / OH>MH	164 / 0	164 / 0
16	R50M / OH>MP	156 / 149	147 / 150
17	G82R	-74	-61
18	Dorsey bipole / CU bipole	-149 / 1103	-149 / 1104
19	Dorsey Reserve / Wtrtn SVC	270 / -5	232 / 20
20	Forbes SVC / MSC	25 / 600	33 / 600
21	Arrowhd-Wstrn/ RCDC	/ -199	/ -199
22	<b>Steady State Vltgs</b>		
23	Dorsey 500/Dorsey 230	1.034 / 1.045	1.032 / 1.045
24	Roseau 500/Forbes 500	1.062 / 1.003	1.061 / 0.988
25	Chisago 500/EauClaire 345	1.004 / 1.016	0.992 / 1.011
26	Int Falls 115/Badoura 115	1.024 / 1.022	1.020 / 1.031
27	Drayton 230/Groton 345	1.022 / 1.035	1.024 / 1.030
28	<b>SS OS Relay Margins</b>		
29	D602F at Forbes/Dorsey	212% / 334%	207% / 328%
30	B2R at Rugby/L20D at Drayton	999% / 898%	999% / 849%
31	R50M/F3M	793% / 330%	871% / 325%
32	B10T	335%	333%
33	<b>Min/MaxTransientVltg</b>		
34	Arrowhd 230	1.02   1.07	1.00   1.05
35	Boise 115	1.02   1.05	1.01   1.04
36	Dorsey 230	1.04   1.05	1.04   1.05
37	Forbes 230	1.00   1.04	0.99   1.02
38	Riverton 230	1.01   1.05	1.02   1.05
39	Coal Creek 230	1.01   1.05	1.01   1.05
40	Dickinson 345	0.97   1.01	0.97   1.01
41	Drayton 230	1.01   1.04	1.01   1.04
42	Groton 345	1.02   1.04	1.02   1.04
43	Tioga 230	1.01   1.03	1.01   1.03
44	Wahpeton 115	1.00   1.04	1.01   1.05
45	Watertown 345	1.02   1.03	1.02   1.03
46	<b>Dynamic Voltage Warnings</b>		
47		none	none
48			
49			
50			
51			
52			
53			
54	Worst Case Angle Damping	STANT4 / 76.81%	STANT4 / 79.97%
55	Dorsey SUVP / UdHold		
56	Forbes DC Red (DCAR)	331%	343%
57	K22W (max +dP @ t, d-ang)	0.0@(-0.01667,0.0)	0.2@(3.47497,2.2)
58	K22W (max -dP @ t, d-ang)	22.6@(1.71666,8.2)	22.6@(1.75000,7.8)
59	K22W (max d-ang @ t, dP)	8.7@(1.18333,-11.8)	9.1@(1.19166,-12.0)
60	<b>OS Rel Trip / Marg</b>		
61	MH - OH		
62	D602F at Forbes/Dorsey	201% / 315%	192% / 302%
63	B2R at Rugby/L20D at Drayton	999% / 813%	999% / 770%
64	R50M / F3M	754% / 330%	809% / 325%
65	B10T	268%	258%
66	<b>FSCAPS (SS/Unav/Final)</b>		
67	Balta 230	( 0   0   0 )	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   4   4 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 1   1   1 )	( 2   2   2 ) / ( 1   1   1 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / s7lit Rock 115	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )



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## Sensitivity Analysis - Summary Tables

## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	Base - Sensitivity b5b	G519 - Original g51	G519 - Sensitivity g5a	G519 - Sensitivity g5b	G519 - Sensitivity g5c	G519 - Sensitivity g5d
Case Name	b5b-s709aa.xyp0444-nbz	g51-s709aa.Ezq0444-nbz	g5a-s709aa.Eyo0444-nbz	g5b-s709aa.xyo0444-nbz	g5c-s709aa.xyp0444-nbz	g5d-s709aa.xyp0444-nbz
Disturbance	nbz	nbz	nbz	nbz	nbz	nbz
Prior Outage	None	None	None	None	None	None
Date/Time	MAR 13 2006 8:21	JAN 30 2006 15:18	MAR 13 2006 7:32	MAR 13 2006 7:43	MAR 13 2006 7:53	MAR 21 2006 9:39
Comments						
<b>Steady State Flows</b>						
NDEX / EAST BIAS	2079 / 310	2463 / 359	2450 / 298	2081 / 231	2081 / 260	2081 / 224
MHEX / L20D	2165 / 288	2179 / 240	2166 / 261	2174 / 299	2174 / 290	2170 / 302
ECL-ARP / PRI-BYN	541 / 641	572 / 671	521 / 646	520 / 647	534 / 652	541 / 658
MWSI / MNEX	1183 / 0	1243 / 0	1167 / 0	1167 / 0	1186 / 0	1199 / 0
D602F / F601C	1764 / 1520	1854 / 1821	1807 / 1776	1760 / 1719	1767 / 1532	1754 / 1765
B10T / MH>SPC	164 / 38	164 / 38	167 / 41	166 / 39	165 / 38	165 / 39
OH E-W / OH>MH	163 / -1	164 / -1	160 / -3	162 / -1	163 / -1	163 / -1
R50M / OH>MP	143 / 151	148 / 150	142 / 151	136 / 151	148 / 151	133 / 151
G82R	-31	-63	-44	-22	-31	-20
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
Dorsey Reserve / Wtrtn SVC	417 / -18	225 / 19	308 / 29	401 / -26	419 / -40	404 / -23
Forbes SVC / MSC	25 / 600	36 / 600	25 / 600	41 / 600	24 / 600	51 / 600
Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>						
Dorsey 500/Dorsey 230	1.041 / 1.045	1.031 / 1.045	1.035 / 1.045	1.040 / 1.045	1.041 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.069 / 1.023	1.061 / 0.987	1.064 / 0.997	1.068 / 1.015	1.069 / 1.022	1.068 / 1.014
Chisago 500/EauClaire 345	1.017 / 1.030	0.991 / 1.015	0.997 / 1.025	1.011 / 1.029	1.017 / 1.029	1.008 / 1.026
Int Falls 115/Badoura 115	1.020 / 1.037	1.022 / 1.030	1.025 / 1.034	1.027 / 1.039	1.019 / 1.042	1.021 / 1.038
Drayton 230/Groton 345	1.009 / 1.015	1.024 / 1.031	1.020 / 1.021	1.027 / 1.031	1.029 / 1.033	1.026 / 1.031
<b>SS OS Relay Margins</b>						
D602F at Forbes/Dorsey	253% / 399%	206% / 325%	225% / 357%	249% / 395%	251% / 397%	250% / 397%
82R at Rugby/L20D at Drayton	999% / 653%	999% / 857%	999% / 765%	999% / 642%	999% / 674%	999% / 635%
R50M/F3M	915% / 322%	864% / 327%	927% / 329%	998% / 330%	875% / 321%	999% / 322%
B10T	333%	333%	323%	327%	331%	330%
<b>Min/MaxTransientVltg</b>						
Arrowhd 230	0.93   1.10	(0.59)0.79   1.08	0.83   1.09	0.86   1.10	0.96   1.09	0.87   1.09
Boise 115	0.94   1.03	0.96   1.05	0.95   1.05	0.95   1.05	0.94   1.03	0.95   1.04
Dorsey 230	1.04   1.17	1.05   1.20	1.04   1.19	1.04   1.18	1.04   1.17	1.04   1.18
Forbes 230	0.96   1.07	0.88   1.06	0.91   1.06	0.92   1.06	0.98   1.06	0.93   1.06
Riverton 230	0.93   1.07	0.84   1.07	0.87   1.07	0.90   1.07	0.96   1.08	0.89   1.07
Coal Creek 230	0.95   1.08	0.93   1.11	0.94   1.10	0.94   1.09	0.96   1.08	0.94   1.09
Dickinson 345	0.95   1.05	0.91   1.08	0.92   1.07	0.93   1.07	0.96   1.05	0.93   1.07
Drayton 230	0.99   1.07	1.00   1.08	0.99   1.08	1.00   1.09	1.00   1.09	1.00   1.10
Groton 345	0.92   1.06	0.90   1.08	0.88   1.08	0.92   1.08	0.94   1.08	0.92   1.08
Tioga 230	0.99   1.05	0.99   1.06	0.99   1.06	0.99   1.05	0.99   1.05	0.99   1.05
Wahpeton 115	0.91   1.08	0.87   1.07	0.89   1.07	0.92   1.07	0.93   1.08	0.92   1.07
Watertown 345	0.94   1.06	0.90   1.06	0.89   1.06	0.93   1.07	0.95   1.06	0.93   1.07
<b>Dynamic Voltage Warnings</b>						
	none	61614 [98L TAP4] 0.79 61615 [ARROWHD4] 0.79 61616 [HILLTOP4] 0.80 61673 [ARROWHD7] 0.80 61674 [HANESRD7] 0.80 61675 [RIDGEVW7] 0.80 1679 [GARY 7] 0.80 +mo	67564 [DORSEY 2] 1.21	none	none	none
Worst Case Angle Damping	KING 3 / 36.94%	KING 3 / 30.79%	KING 3 / 32.85%	KING 3 / 36.55%	KING 3 / 35.95%	KING 3 / 36.16%
Dorsey SUVP / UdHold	/ 0.133	/ 0.133	/ 0.133	/ 0.133	/ 0.133	/ 0.133
Forbes DC Red (DCAR)	507%	507%	507%	507%	507%	507%
K22W (max +dP @ t, d-ang)	121.4@(2.15833,-56.9)	144.8@(2.70832,-65.0)	135.6@(2.65832,-60.7)	125.5@(2.63332,-56.7)	118.0@(2.18333,-57.4)	124.3@(2.60832,-56.4)
K22W (max -dP @ t, d-ang)	61.5@(0.24167,6.0)	66.6@(0.24167,6.1)	64.5@(0.24167,6.0)	61.6@(0.24167,5.9)	61.4@(0.24167,5.7)	61.7@(0.24167,5.9)
K22W (max d-ang @ t, dP)	-80.7@(10.00821,68.8)	-85.8@(10.00821,75.8)	-81.5@(10.00821,72.7)	-78.0@(10.00821,71.3)	-80.8@(10.00821,69.2)	-77.7@(10.00821,70.6)
<b>OS Rel Trip / Marg</b>						
MH - OH						
D602F at Forbes/Dorsey	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec
82R at Rugby/L20D at Drayton	999% / 477%	999% / 555%	999% / 493%	999% / 427%	999% / 479%	999% / 422%
R50M / F3M	441% / 149%	454% / 139%	477% / 150%	521% / 151%	414% / 142%	548% / 152%
B10T	137%	122%	116%	124%	141%	125%
<b>FSCAPS (SS/Unav/Final)</b>						
Balta 230	(0   0   0)	(0   1   0)	(0   0   0)	(0   0   0)	(0   0   0)	(0   0   0)
Eau Cl 345 / Park Lk 115	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)	(3   3   1) / (0   0   0)
Prairie 115 / Ramsey 230	(2   4   2) / (1   1   1)	(2   4   2) / (1   1   1)	(2   3   2) / (1   1   1)	(2   3   2) / (1   1   1)	(2   3   2) / (1   1   1)	(2   3   2) / (1   1   1)
Roseau 230 / Running 230	(0   1   0) / (1   3   1)	(0   0   0) / (1   3   1)	(0   1   0) / (1   2   1)	(0   0   0) / (1   2   0)	(0   1   0) / (1   3   1)	(0   0   0) / (1   2   1)
Shey 115 / Split Rock 115	(1   5   3) / (0   1   1)	(1   5   3) / (0   1   1)	(1   5   2) / (0   1   1)	(1   5   2) / (0   1   1)	(1   5   3) / (0   1   1)	(1   5   2) / (0   1   1)



## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	Base - Sensitivity b5b	G519 - Original g51	G519 - Sensitivity g5a	G519 - Sensitivity g5b	G519 - Sensitivity g5c	G519 - Sensitivity g5d
Case Name	b5b-s709aa.xyp0444-yas	g51-s709aa.Ezq0444-yac	g5a-s709aa.Eyo0444-yac	g5b-s709aa.xyo0444-yac	g5c-s709aa.xyp0444-yac	g5d-s709aa.xyp0444-yac
Disturbance	yas	yac	yac	yac	yac	yac
Prior Outage	None	None	None	None	None	None
Date/Time	MAR 13 2006 8:26	JAN 30 2006 17:35	MAR 13 2006 7:37	MAR 13 2006 7:48	MAR 13 2006 7:58	MAR 21 2006 11:25
Comments						
<b>Steady State Flows</b>						
NDEX / EAST BIAS	2079 / 310	2463 / 359	2450 / 298	2081 / 231	2081 / 260	2081 / 224
MHEX / L20D	2165 / 288	2179 / 240	2166 / 261	2174 / 299	2174 / 290	2170 / 302
ECL-ARP / PRI-BYN	541 / 641	572 / 671	521 / 646	520 / 647	534 / 652	541 / 658
MWSI / MNEX	1183 / 0	1243 / 0	1167 / 0	1167 / 0	1186 / 0	1199 / 0
D602F / F601C	1764 / 1520	1854 / 1821	1807 / 1776	1760 / 1719	1767 / 1532	1754 / 1765
B10T / MH>SPC	164 / 38	164 / 38	167 / 41	166 / 39	165 / 38	165 / 39
OH E-W / OH>MH	163 / -1	164 / 0	160 / -3	162 / -1	163 / -1	163 / -1
R50M / OH>MP	143 / 151	148 / 150	142 / 151	136 / 151	148 / 151	133 / 151
G82R	-31	-63	-44	-22	-31	-20
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104	-149 / 1104
Dorsey Reserve / Wtrtn SVC	417 / -18	225 / 19	308 / 29	401 / -26	419 / -40	404 / -23
Forbes SVC / MSC	25 / 600	36 / 600	25 / 600	41 / 600	24 / 600	51 / 600
Arrowhd-Wstrn/ RCDC	/ -199	/ -199	/ -199	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>						
Dorsey 500/Dorsey 230	1.041 / 1.045	1.031 / 1.045	1.035 / 1.045	1.040 / 1.045	1.041 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.069 / 1.023	1.061 / 0.987	1.064 / 0.997	1.068 / 1.015	1.069 / 1.022	1.068 / 1.014
Chisago 500/EauClaire 345	1.017 / 1.030	0.991 / 1.015	0.997 / 1.025	1.011 / 1.030	1.017 / 1.029	1.008 / 1.026
Int Falls 115/Badoura 115	1.020 / 1.037	1.022 / 1.030	1.025 / 1.034	1.027 / 1.039	1.019 / 1.042	1.021 / 1.038
Drayton 230/Groton 345	1.009 / 1.015	1.024 / 1.031	1.020 / 1.021	1.027 / 1.031	1.029 / 1.033	1.026 / 1.031
<b>SS OS Relay Margins</b>						
D602F at Forbes/Dorsey	253% / 399%	206% / 325%	225% / 357%	249% / 395%	251% / 397%	250% / 397%
82R at Rugby/L20D at Drayton	999% / 653%	999% / 857%	999% / 765%	999% / 642%	999% / 674%	999% / 635%
R50M/F3M	915% / 322%	864% / 327%	927% / 329%	998% / 330%	875% / 321%	999% / 322%
B10T	333%	333%	323%	327%	331%	330%
<b>Min/MaxTransientVltg</b>						
Arrowhd 230	0.90   0.98	0.86   0.94	0.87   0.95	0.89   0.96	0.92   0.98	0.89   0.97
Boise 115	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04
Dorsey 230	1.04   1.07	1.04   1.07	1.04   1.07	1.04   1.07	1.04   1.07	1.04   1.07
Forbes 230	1.00   1.03	0.96   1.00	0.97   1.00	0.99   1.02	1.01   1.03	0.99   1.02
Riverton 230	0.99   1.03	0.98   1.02	0.98   1.03	0.99   1.03	1.01   1.04	0.99   1.03
Coal Creek 230	0.99   1.05	0.98   1.05	0.98   1.05	0.98   1.05	0.99   1.05	0.98   1.05
Dickinson 345	0.95   1.01	0.92   1.00	0.93   1.00	0.94   1.01	0.96   1.01	0.94   1.01
Drayton 230	0.99   1.02	1.01   1.03	1.00   1.03	1.01   1.04	1.02   1.04	1.01   1.04
Groton 345	1.00   1.01	1.01   1.03	1.00   1.02	1.01   1.03	1.02   1.03	1.01   1.03
Tioga 230	1.01   1.03	1.00   1.03	1.00   1.03	1.01   1.03	1.01   1.03	1.01   1.03
Wahpeton 115	1.01   1.03	1.01   1.04	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04
Watertown 345	1.02   1.03	1.01   1.03	1.01   1.02	1.01   1.03	1.02   1.03	1.02   1.03
<b>Dynamic Voltage Warnings</b>						
	39449 [AHD 345] 1.23	61632 [DAHLBRG7] 0.79 61570 [STINSJCT] 0.81 61678 [NEMADJ7] 0.81 61683 [STIN-MN7] 0.81 61684 [STIN-WI7] 0.81 61703 [STSN GTG] 0.81 39449 [AHD 345] 1.25	39449 [AHD 345] 1.28	39449 [AHD 345] 1.28	39449 [AHD 345] 1.24	39449 [AHD 345] 1.25
Worst Case Angle Damping	ANTEL3 / 82.06%	ANTEL3 / 71.78%	SHERC3 / 79.76%	ANTEL3 / 79.67%	SHERC3 / 81.09%	SHERC3 / 80.74%
Dorsey SUVP / UdHold						
Forbes DC Red (DCAR)	454%	416%	446%	446%	437%	454%
K22W (max +dP @ t, d-ang)	0.0@(0.05833,0.0)	0.0@(0.10000,0.0)	0.0@(0.10000,0.0)	0.0@(0.05833,0.0)	0.0@(0.10000,0.0)	0.0@(0.10000,0.0)
K22W (max -dP @ t, d-ang)	26.6@(1.34166,12.7)	37.0@(1.65833,16.1)	31.6@(1.63333,13.9)	30.3@(1.63333,13.4)	23.7@(1.67500,10.8)	27.5@(1.61666,12.1)
K22W (max d-ang @ t, dP)	12.7@(1.31666,-26.6)	16.9@(1.31666,-31.1)	15.1@(1.22500,-25.2)	14.5@(1.21666,-24.1)	12.0@(1.23333,-20.9)	13.6@(1.18333,-22.1)
<b>OS Rel Trip / Marg</b>						
MH - OH						
D602F at Forbes/Dorsey	229% / 360%	181% / 285%	198% / 314%	225% / 356%	233% / 369%	223% / 353%
82R at Rugby/L20D at Drayton	999% / 572%	999% / 735%	999% / 660%	999% / 564%	999% / 601%	999% / 559%
R50M / F3M	854% / 322%	812% / 327%	867% / 329%	942% / 330%	844% / 321%	950% / 322%
B10T	259%	251%	243%	247%	263%	251%
<b>FSCAPS (SS/Unav/Final)</b>						
Balta 230	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)
Eau Cl 345 / Park Lk 115	(3 3 3)/(0 0 0)	(3 4 4)/(0 0 0)	(3 4 4)/(0 0 0)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)	(3 4 4)/(0 0 0)
Prairie 115 / Ramsey 230	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)	(2 2 2)/(1 1 1)
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 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
Shey 115 / Split Rock 115	(1 1 1)/(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 0 0)	(1 1 1)/(0 0 0)

## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	1	2	3	4	5
Case Name	g5d-s709aa.Fyp0444-qa3	g5d-s709aa.Fyp0444-qac	g5d-s709aa.Fyp0444-qb3	g5d-s709aa.Fyp0444-qbc	g5d-s709aa.Fyp0444-qc3
Disturbance	qa3	qac	qb3	qbc	qc3
Prior Outage	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115
Date/Time	MAY 05 2006 18:03	MAY 05 2006 18:11	MAY 05 2006 18:14	MAY 05 2006 18:17	MAY 05 2006 18:20
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 228	2080 / 228	2080 / 228	2080 / 228	2080 / 228
MHEX / L20D	2169 / 303	2169 / 303	2169 / 303	2169 / 303	2169 / 303
ECL-ARP / PRI-BYN	540 / 658	540 / 658	540 / 658	540 / 658	540 / 658
MWSI / MNEX	1199 / 0	1199 / 0	1199 / 0	1199 / 0	1199 / 0
D602F / F601C	1752 / 1774	1752 / 1774	1752 / 1774	1752 / 1774	1752 / 1774
B10T / MH>SPC	166 / 39	166 / 39	166 / 39	166 / 39	166 / 39
OH E-W / OH>MH	163 / -1	163 / -1	163 / -1	163 / -1	163 / -1
R50M / OH>MP	133 / 151	133 / 151	133 / 151	133 / 151	133 / 151
G82R	-19	-19	-19	-19	-19
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1103	-149 / 1103	-149 / 1103	-149 / 1103
Dorsey Reserve / Wtrtn SVC	405 / -24	405 / -24	405 / -24	405 / -24	405 / -24
Forbes SVC / MSC	55 / 600	55 / 600	55 / 600	55 / 600	55 / 600
Arrowhd-Wstn/ RCDC	/ -199	/ -199	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014
Chisago 500/EauClaire 345	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026
Int Falls 115/Badoura 115	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038
Drayton 230/Groton 345	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	251% / 399%	251% / 399%	251% / 399%	251% / 399%	251% / 399%
B2R at Rugby/L20D at Drayton	999% / 629%	999% / 629%	999% / 629%	999% / 629%	999% / 629%
R50M/F3M	999% / 324%	999% / 324%	999% / 324%	999% / 324%	999% / 324%
B10T	328%	328%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.89   1.03	0.90   1.03	0.93   1.03	0.93   1.04	0.90   1.04
Boise 115	1.02   1.05	1.01   1.05	1.02   1.05	1.01   1.05	1.02   1.05
Dorsey 230	1.03   1.05	1.03   1.07	1.03   1.05	1.03   1.07	1.03   1.05
Forbes 230	0.95   1.03	0.94   1.04	0.95   1.03	0.94   1.03	0.97   1.04
Riverton 230	0.96   1.05	0.94   1.06	0.94   1.05	0.92   1.05	0.93   1.05
Coal Creek 230	1.00   1.06	1.00   1.06	1.00   1.05	1.00   1.05	1.00   1.06
Dickinson 345	0.95   1.03	0.96   1.03	0.95   1.02	0.96   1.03	0.96   1.03
Drayton 230	1.00   1.03	1.01   1.03	1.01   1.03	1.01   1.04	1.01   1.04
Groton 345	1.01   1.04	1.02   1.04	1.02   1.04	1.02   1.04	1.02   1.04
Tioga 230	1.01   1.03	1.01   1.03	1.01   1.03	1.01   1.03	1.01   1.03
Wahpeton 115	1.00   1.04	1.00   1.05	1.01   1.04	1.01   1.05	1.01   1.04
Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
SHERC3 / 78.90%	SHERC3 / 78.90%	SHERC3 / 78.15%	SHERC3 / 79.56%	SHERC3 / 78.26%	SHERC3 / 78.61%
Dorsey SUVP / UdHold	/ 0.133		/ 0.133		/ 0.133
Forbes DC Red (DCAR)	316%	315%	336%	332%	315%
K22W (max +dP @ t, d-ang)	9.3@(2.17499,-0.8)	12.6@(2.23333,-1.1)	8.4@(2.93332,-2.5)	9.7@(2.21666,-0.5)	10.8@(2.78332,-4.2)
K22W (max -dP @ t, d-ang)	23.8@(1.22500,5.5)	15.0@(1.30833,4.3)	24.0@(1.20833,5.7)	15.3@(1.30000,4.3)	21.8@(1.13333,5.3)
K22W (max d-ang @ t, dP)	10.0@(0.65833,-6.4)	8.7@(0.71666,-3.6)	9.6@(0.65833,-5.5)	8.1@(0.71666,-3.4)	8.1@(0.64166,1.3)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	211% / 332%	202% / 335%	209% / 328%	199% / 331%	199% / 312%
B2R at Rugby/L20D at Drayton	999% / 553%	999% / 548%	999% / 590%	999% / 582%	999% / 604%
R50M / F3M	852% / 301%	827% / 293%	868% / 305%	832% / 293%	831% / 298%
B10T	246%	254%	257%	267%	269%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   0   0)	(0   0   0)	(0   0   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   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
Roseau 230 / Running 230	(0   0   0) / (1   2   2)	(0   1   0) / (1   2   1)	(0   0   0) / (1   2   2)	(0   1   0) / (1   2   1)	(0   0   0) / (1   2   2)
Shey 115 / Split Rock 115	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	6	7	8	9	10
Case Name	g5d-s709aa.Fyp0444-qcc	g51-s709aa.Ezq0444-rx3	g5d-s709aa.Fyp0444-rxc	g5d-s709aa.Fyp0444-ryc	g5d-s709aa.Fyp0444-rzs
Disturbance	qcc	rx3	rx3	ryc	rzs
Prior Outage	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115
Date/Time	MAY 05 2006 18:22	FEB 03 2006 23:37	MAY 05 2006 18:31	MAY 05 2006 18:33	MAY 08 2006 8:42
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 228	2463 / 359	2080 / 228	2080 / 228	2080 / 228
MHEX / L20D	2169 / 303	2179 / 240	2169 / 303	2169 / 303	2169 / 303
ECL-ARP / PRI-BYN	540 / 658	572 / 671	540 / 658	540 / 658	540 / 658
MWSI / MNEX	1199 / 0	1243 / 0	1199 / 0	1199 / 0	1199 / 0
D602F / F601C	1752 / 1774	1854 / 1821	1752 / 1774	1752 / 1774	1752 / 1774
B10T / MH>SPC	166 / 39	164 / 38	166 / 39	166 / 39	166 / 39
OH E-W / OH>MH	163 / -1	164 / 0	163 / -1	163 / -1	163 / -1
R50M / OH>MP	133 / 151	148 / 150	133 / 151	133 / 151	133 / 151
G82R	-19	-63	-19	-19	-19
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1104	-149 / 1103	-149 / 1103	-149 / 1103
Dorsey Reserve / Wtrtn SVC	405 / -24	224 / 19	405 / -24	405 / -24	405 / -24
Forbes SVC / MSC	55 / 600	36 / 600	55 / 600	55 / 600	55 / 600
Arrowhd-Wstn/ RCDC	/ -199	/ -199	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.040 / 1.045	1.031 / 1.045	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.068 / 1.014	1.061 / 0.987	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014
Chisago 500/EauClaire 345	1.007 / 1.026	0.991 / 1.015	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026
Int Falls 115/Badoura 115	1.021 / 1.038	1.022 / 1.030	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038
Drayton 230/Groton 345	1.026 / 1.031	1.024 / 1.031	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	251% / 399%	206% / 325%	251% / 399%	251% / 399%	251% / 399%
B2R at Rugby/L20D at Drayton	999% / 629%	999% / 857%	999% / 629%	999% / 629%	999% / 629%
R50M/F3M	999% / 324%	864% / 327%	999% / 324%	999% / 324%	999% / 324%
B10T	328%	333%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.91   1.04	0.92   1.00	0.97   1.03	0.97   1.03	0.96   1.03
Boise 115	1.01   1.05	1.03   1.05	1.02   1.05	1.02   1.04	1.01   1.03
Dorsey 230	1.03   1.07	1.04   1.05	1.04   1.06	1.04   1.06	1.04   1.06
Forbes 230	0.97   1.04	0.98   1.01	1.00   1.03	0.99   1.03	1.00   1.03
Riverton 230	0.92   1.06	0.98   1.04	0.97   1.05	0.97   1.05	0.97   1.05
Coal Creek 230	1.00   1.06	1.02   1.05	1.02   1.05	1.02   1.05	1.02   1.05
Dickinson 345	0.97   1.03	0.97   1.01	0.98   1.02	0.98   1.02	0.98   1.02
Drayton 230	1.01   1.04	1.01   1.03	1.02   1.03	1.02   1.03	1.02   1.04
Groton 345	1.02   1.04	1.02   1.03	1.02   1.03	1.03   1.03	1.03   1.04
Tioga 230	1.01   1.03	1.01   1.03	1.02   1.03	1.02   1.03	1.02   1.03
Wahpeton 115	1.01   1.05	1.02   1.03	1.02   1.04	1.02   1.04	1.02   1.04
Watertown 345	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03	1.02   1.03
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold	SHERC3 / 78.50%	ANTEL3 / 80.83%	SHERC3 / 80.51%	SHERC3 / 79.46%	SHERC3 / 79.26%
Forbes DC Red (DCAR)	328%	372%	394%	392%	389%
K22W (max +dP @ t, d-ang)	13.2@(2.30833,-2.5)	7.0@(2.79998,-2.5)	6.1@(2.84165,-1.8)	7.2@(2.12499,-1.6)	2.7@(2.18333,-2.7)
K22W (max -dP @ t, d-ang)	9.8@(1.13333,4.5)	17.6@(1.14166,2.9)	9.8@(1.16666,1.5)	10.0@(1.17500,1.1)	9.7@(1.05833,1.2)
K22W (max d-ang @ t, dP)	5.8@(0.80833,-2.2)	5.5@(0.52500,1.0)	4.0@(0.53333,4.1)	4.2@(0.55833,4.8)	-3.2@(2.57499,1.5)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	203% / 319%	183% / 287%	217% / 353%	218% / 353%	221% / 358%
B2R at Rugby/L20D at Drayton	999% / 609%	999% / 816%	999% / 594%	999% / 594%	999% / 610%
R50M / F3M	872% / 289%	782% / 319%	846% / 310%	846% / 307%	821% / 275%
B10T	279%	289%	298%	295%	304%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   0   0)	(0   0   0)	(0   0   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   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
Roseau 230 / Running 230	(0   1   0) / (1   2   1)	(0   0   0) / (1   2   2)	(0   1   1) / (1   2   1)	(0   1   1) / (1   1   1)	(0   1   1) / (1   1   1)
Shey 115 / Split Rock 115	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   2   2) / (0   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	11	12	13	14	15
Case Name	g5d-s709aa.Fyp0444-va3	g5d-s709aa.Fyp0444-vac	g5d-s709aa.Fyp0444-wa3	g5d-s709aa.Fyp0444-wac	g5d-s709aa.Fyp0444-xa3
Disturbance	va3	vac	wa3	wac	xa3
Prior Outage	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115
Date/Time	MAY 05 2006 18:36	MAY 08 2006 8:45	MAY 05 2006 18:39	MAY 05 2006 18:41	MAY 05 2006 18:44
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 228	2080 / 228	2080 / 228	2080 / 228	2080 / 228
MHEX / L20D	2169 / 303	2169 / 303	2169 / 303	2169 / 303	2169 / 303
ECL-ARP / PRI-BYN	540 / 658	540 / 658	540 / 658	540 / 658	540 / 658
MWSI / MNEX	1199 / 0	1199 / 0	1199 / 0	1199 / 0	1199 / 0
D602F / F601C	1752 / 1774	1752 / 1774	1752 / 1774	1752 / 1774	1752 / 1774
B10T / MH>SPC	166 / 39	166 / 39	166 / 39	166 / 39	166 / 39
OH E-W / OH>MH	163 / -1	163 / -1	163 / -1	163 / -1	163 / -1
R50M / OH>MP	133 / 151	133 / 151	133 / 151	133 / 151	133 / 151
G82R	-19	-19	-19	-19	-19
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1103	-149 / 1103	-149 / 1103	-149 / 1103
Dorsey Reserve / Wtrtn SVC	405 / -24	405 / -24	405 / -24	405 / -24	405 / -24
Forbes SVC / MSC	55 / 600	55 / 600	55 / 600	55 / 600	55 / 600
Arrowhd-Wstn/ RCDC	/ -199	/ -199	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014
Chisago 500/EauClaire 345	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026
Int Falls 115/Badoura 115	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038
Drayton 230/Groton 345	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	251% / 399%	251% / 399%	251% / 399%	251% / 399%	251% / 399%
B2R at Rugby/L20D at Drayton	999% / 629%	999% / 629%	999% / 629%	999% / 629%	999% / 629%
R50M/F3M	999% / 324%	999% / 324%	999% / 324%	999% / 324%	999% / 324%
B10T	328%	328%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.94   1.03	0.94   1.04	1.00   1.02	1.01   1.02	1.00   1.02
Boise 115	1.02   1.03	1.02   1.05	1.03   1.03	1.02   1.05	1.03   1.03
Dorsey 230	1.03   1.05	1.04   1.10	1.04   1.05	1.04   1.06	1.04   1.05
Forbes 230	1.00   1.03	0.99   1.04	1.01   1.02	1.01   1.02	1.01   1.02
Riverton 230	1.00   1.05	0.99   1.05	1.02   1.04	1.02   1.04	1.02   1.04
Coal Creek 230	0.99   1.07	1.00   1.06	1.03   1.04	1.03   1.04	1.03   1.05
Dickinson 345	0.95   1.02	0.96   1.02	1.00   1.01	1.00   1.01	1.00   1.01
Drayton 230	1.01   1.03	1.01   1.03	1.02   1.03	1.02   1.03	1.02   1.03
Groton 345	1.01   1.04	1.02   1.04	1.03   1.03	1.03   1.03	1.03   1.03
Tioga 230	1.01   1.03	1.01   1.02	1.02   1.02	1.02   1.02	1.02   1.02
Wahpeton 115	1.02   1.05	1.02   1.04	1.03   1.03	1.03   1.03	1.03   1.03
Watertown 345	1.02   1.03	1.02   1.03	1.03   1.03	1.03   1.03	1.02   1.03
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
	SHERC3 / 79.96%	SHERC3 / 77.31%	SHERC3 / 79.59%	SHERC3 / 78.47%	SHERC3 / 79.79%
Dorsey SUVP / UdHold	/ 0.133	/ 0.133	/ 0.133		/ 0.133
Forbes DC Red (DCAR)	368%	358%	461%	474%	450%
K22W (max +dP @ t, d-ang)	9.7@(2.79998,-2.4)	9.1@(2.88332,-2.2)	16.6@(0.44166,5.1)	18.3@(0.38333,4.2)	11.9@(0.52500,4.8)
K22W (max -dP @ t, d-ang)	36.2@(0.27500,7.3)	35.2@(0.38333,8.7)	9.8@(1.09166,0.9)	10.2@(1.09166,-0.7)	10.1@(1.09166,1.6)
K22W (max d-ang @ t, dP)	10.7@(0.53333,-1.7)	10.0@(0.59166,-0.3)	5.1@(0.41666,16.3)	4.2@(0.38333,18.3)	5.0@(0.44166,9.8)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	206% / 329%	129% / 228%	232% / 368%	230% / 366%	227% / 360%
B2R at Rugby/L20D at Drayton	999% / 506%	999% / 476%	999% / 600%	999% / 608%	999% / 586%
R50M / F3M	855% / 310%	757% / 319%	999% / 324%	696% / 285%	999% / 324%
B10T	237%	249%	302%	321%	296%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   0   0)	(0   0   0)	(0   0   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   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)	(2   2   2) / (1   1   1)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   1   1) / (1   2   1)	(0   0   0) / (1   1   1)	(0   1   0) / (1   2   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(1   2   2) / (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   0   0)

## POWER FLOW AND STABILITY SUMMARY TABLE

Case No.	16	17	18
Case Name	g5d-s709aa.Fyp0444-xas	g5d-s709aa.Fyp0444-ya3	g5d-s709aa.Fyp0444-yac
Disturbance	xas	ya3	yac
Prior Outage	Riverton-Hill City 115	Riverton-Hill City 115	Riverton-Hill City 115
Date/Time	MAY 05 2006 18:47	MAY 05 2006 18:49	MAY 05 2006 18:52
Comments			
<b>Steady State Flows</b>			
NDEX / EAST BIAS	2080 / 228	2080 / 228	2080 / 228
MHEX / L20D	2169 / 303	2169 / 303	2169 / 303
ECL-ARP / PRI-BYN	540 / 658	540 / 658	540 / 658
MWSI / MNEX	1199 / 0	1199 / 0	1199 / 0
D602F / F601C	1752 / 1774	1752 / 1774	1752 / 1774
B10T / MH>SPC	166 / 39	166 / 39	166 / 39
OH E-W / OH>MH	163 / -1	163 / -1	163 / -1
R50M / OH>MP	133 / 151	133 / 151	133 / 151
G82R	-19	-19	-19
Dorsey bipole / CU bipole	-149 / 1103	-149 / 1103	-149 / 1103
Dorsey Reserve / Wtrtn SVC	405 / -24	405 / -24	405 / -24
Forbes SVC / MSC	55 / 600	55 / 600	55 / 600
Arrowhd-Wstn/ RCDC	/ -199	/ -199	/ -199
<b>Steady State Vltgs</b>			
Dorsey 500/Dorsey 230	1.040 / 1.045	1.040 / 1.045	1.040 / 1.045
Roseau 500/Forbes 500	1.068 / 1.014	1.068 / 1.014	1.068 / 1.014
Chisago 500/EauClaire 345	1.007 / 1.026	1.007 / 1.026	1.007 / 1.026
Int Falls 115/Badoura 115	1.021 / 1.038	1.021 / 1.038	1.021 / 1.038
Drayton 230/Groton 345	1.026 / 1.031	1.026 / 1.031	1.026 / 1.031
<b>SS OS Relay Margins</b>			
D602F at Forbes/Dorsey	251% / 399%	251% / 399%	251% / 399%
B2R at Rugby/L20D at Drayton	999% / 629%	999% / 629%	999% / 629%
R50M/F3M	999% / 324%	999% / 324%	999% / 324%
B10T	328%	328%	328%
<b>Min/MaxTransientVltg</b>			
Arrowhd 230	1.01   1.02	0.98   1.00	0.89   0.97
Boise 115	1.03   1.05	1.02   1.04	1.02   1.04
Dorsey 230	1.04   1.06	1.04   1.05	1.04   1.07
Forbes 230	1.01   1.03	1.00   1.02	0.98   1.02
Riverton 230	1.03   1.04	1.01   1.03	0.99   1.03
Coal Creek 230	1.03   1.04	1.02   1.05	0.98   1.05
Dickinson 345	1.00   1.01	0.97   1.00	0.94   1.01
Drayton 230	1.02   1.03	1.01   1.04	1.01   1.03
Groton 345	1.03   1.03	1.01   1.03	1.01   1.03
Tioga 230	1.02   1.02	1.01   1.03	1.01   1.03
Wahpeton 115	1.03   1.03	1.02   1.04	1.01   1.04
Watertown 345	1.03   1.03	1.02   1.03	1.01   1.03
<b>Dynamic Voltage Warnings</b>			
	none	none	39449 [AHD 345] 1.25
<b>Worst Case Angle Damping</b>			
	SHERC3 / 78.76%	SHERC3 / 66.27%	SHERC3 / 80.58%
<b>Dorsey SUVP / UdHold</b>			
	472%	398%	455%
<b>Forbes DC Red (DCAR)</b>			
	472%	398%	455%
K22W (max +dP @ t, d-ang)	12.1@(0.55000,2.1)	0.0@(0.10000,0.0)	0.0@(0.10000,0.0)
K22W (max -dP @ t, d-ang)	2.3@(1.05833,0.2)	32.1@(1.68333,14.9)	28.0@(1.61666,12.3)
K22W (max d-ang @ t, dP)	2.8@(0.38333,9.2)	15.0@(1.56666,-31.1)	13.8@(1.17500,-21.9)
<b>OS Rel Trip / Marg</b>			
MH - OH			
D602F at Forbes/Dorsey	235% / 375%	244% / 389%	223% / 354%
B2R at Rugby/L20D at Drayton	999% / 611%	999% / 548%	999% / 553%
R50M / F3M	897% / 324%	999% / 324%	955% / 324%
B10T	318%	248%	249%
<b>FSCAPS (SS/Unav/Final)</b>			
Balta 230	( 0   0   0 )	( 0   0   0 )	( 0   0   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   4   4 ) / ( 0   0   0 )	( 3   4   4 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 1   1   1 )	( 2   2   2 ) / ( 1   1   1 )	( 2   2   2 ) / ( 1   1   1 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )