RPU-2014-0002

R020-12 (Final)

R39 Definitive Planning Phase

Prepared for

MISO Energy

FILED WITH
Executive Secretary
October 10, 2014
IOWA UTILITIES BOARD

Submitted by:
Yaming Zhu, Senior Staff Consultant
Bo Gong, Senior Consultant
Douglas R. Brown, Manager

April 3, 2012

Siemens PTI Project P/21-113494

Siemens Energy, Inc.
Siemens Power Technologies International
10900 Wayzata Boulevard
Minnetonka, MN 55305 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice v

Executive Summary vii

Steady State Contingency Analysis vii

Off Peak System Conditions viii

Summer Peak Contingency Analysis viii

Network Upgrades for Mitigating Injection Constraints viii

Deliverability Study viii

Stability Analysis ix

Sensitivity Analysis ix

MVP Scenario 1 ix

MVP Scenario 2 ix

Summary ix

Section 1 Introduction 1-1

Section 2 Description of Requests 2-1

Section 3 Steady-State Analysis 3-4

3.1 Procedure 3-4

3.1.1 Computer Programs 3-4

3.1.2 Methodology 3-4

3.1.3 Model Development 3-4

3.2 Contingency Criteria 3-6

3.3 Monitored Elements 3-7

3.4 Performance Criteria 3-7

3.5 Summer Off Peak Contingency Analysis Results 3-8

3.5.1 SUOP System Intact Conditions 3-8

3.5.2 SUOP Single Event Contingencies 3-8

3.6 Summer Peak Contingency Analysis Results 3-8

3.6.1 SUPK System Intact Conditions 3-8

3.6.2 SUPK Single Event Contingencies 3-8

3.7 Network Upgrades for Mitigating Injection Constraints 3-9
3.8 Deliverability Study 3-9
3.8.1 Introduction 3-9
3.8.2 Study Methodology 3-9
3.8.3 Assumptions 3-9
3.8.4 Determining the MW restriction 3-9
3.8.5 Deliverability Study Result 3-10

Section 4 Stability Analysis 4-1
4.1 Procedure 4-1
4.1.1 Computer Programs 4-1
4.1.2 Methodology 4-1
4.1.3 Case Development 4-1
4.2 Disturbance Criteria 4-3
4.3 Performance Criteria 4-6
4.4 Stability Results 4-6
4.5 Network Upgrades Identified in Stability Analysis 4-6

Section 5 Sensitivity Analysis for MVP Projects 5-1
5.1 MVP Scenario 1 5-1
5.1.1 Modeling Details in MVP Scenario 1 5-1
5.1.2 Steady State Contingency Analysis Results in MVP Scenario 1 5-1
5.1.3 Stability Analysis Results in MVP Scenario 1 5-1
5.2 MVP Scenario 2 5-2
5.2.1 Modeling Details in MVP Scenario 2 5-2
5.2.2 Steady State Contingency Analysis Results in MVP Scenario 2 5-2
5.3 Sensitivity Analysis Conclusions 5-3

Appendix A Model Development for Steady-State Analysis A-1
A.1 MTEP11 Appendix A Projects Added to the Models A-1
A.2 Model Changes and Updates A-3
A.3 Competing Generation Dispatch Assumptions A-6
A.4 Study Sink for Steady State Analysis A-14

Appendix B Model Data B-1
B.1 Steady State Analysis Model Data B-1

B.2 Stability Analysis Model Data B-4
B.3 Slider Diagrams B-15

Appendix C Steady State AC Contingency Analysis Results C-1
C.1 Summer Off Peak Contingency Analysis Results C-1
C.2 Summer Peak Contingency Analysis Results C-3

Appendix D Model Development for Stability Analysis D-1
D.1 Stability Model Changes and Updates D-1
D.2 Competing Generation Dispatch Assumptions in Stability Model D-3
D.3 Study Sink for Stability Analysis D-10

Appendix E Stability Analysis Results – Summary Tables E-1

Appendix F Sensitivity Analysis Results for MVP Projects F-1
F.1 Stability Analysis Results in MVP Scenario 1 ..... F-1

This page intentionally left blank.

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of MISO Energy. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor MISO Energy, nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and MISO Energy from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Executive Summary

This report presents the restudy results of a System Impact Study (SIS) performed to evaluate the interconnection of a 500 MW wind farm located in O'Brien County, Iowa. The Interconnection Customer has requested Network Resource Interconnection Service (NRIS). The R39 project has a queue date of March 8, 2007.

The R39 System Impact Study was originally performed by MidAmerican prior to MidAmerican becoming a MISO member. This MISO Restudy is performed to identify R39 thermal and stability constraints on the MISO system.

The R39 generating facility is listed in Table E-1.

Table E-1: R39 Generator Interconnection Service Request

MISO Project #	Queue Date	Service Type	Control Area	County, State	Point of Interconnection	Pmax (MW)	Fuel Type
R39	3/8/2007	NR	MEC	O'Brien, IA	Raun – Lakefield Junction 345 kV	500	Wind

The total cost of facility improvements in the interconnection plan required for R39 generation project is listed in Table E-2.

Table E-2: Total Cost of Facility Improvements for R39

Project ID	ERIS Network Upgrades ($M)			NRIS Network Upgrades ($M)	Interconnection Facilities ($M)	Total Cost ($M)
	Thermal	Stability	Short-circuit	Deliverability		
R39	0.00	0.00	TBD	0.00	7.95	7.95

The study was performed under the direction of MISO by Siemens PTI and an ad hoc study group. The ad hoc study group was formed to review the study scope, methodology, models and results. The ad hoc study group consisted of representatives from the following utility companies – Central Iowa Power Cooperative, Corn Belt Power Cooperative, Dairyland Power, ITC Midwest, Great River Energy, MidAmerican Energy Company, MISO, Missouri River Energy Services, Otter Tail Power, Southern Minnesota Municipal Power Agency, Western Area Power Administration, and Xcel Energy.

Steady State Contingency Analysis

A steady state contingency analysis was performed to identify thermal and voltage upgrades required to interconnect the R39 generating facility to the transmission system.

Benchmark power flow models (summer peak and off-peak) representing out-year system conditions were created without the R39 generating facility, study cases were created by adding and dispatching the R39 generating facility. The incremental impact of the R39 generating facility was evaluated by comparing the steady-state performance of the transmission system in the benchmark and study cases. Network upgrades are required to mitigate any identified constraints.

Off Peak System Conditions

A nonlinear (ac) contingency analysis was performed to analyze off peak system conditions. R39 generating facility is dispatched at full output in the off peak power flow model.

Off Peak System Intact Conditions

No thermal or voltage constraints were identified for NERC category A (system intact) conditions in the off peak scenario.

Off Peak Single-Event Contingencies

No thermal or voltage constraints were identified for NERC category B or category C single event contingencies.

Summer Peak Contingency Analysis

A nonlinear (ac) contingency analysis was performed to analyze summer peak system conditions. R39 generating facility is dispatched at 20% of the nameplate rating in the summer peak power flow model.

No thermal or voltage constraints were identified in the summer peak scenario for NERC category A (system intact) conditions.

No thermal or voltage constraints were identified in the summer peak scenario for NERC category B or category C single event contingencies.

Network Upgrades for Mitigating Injection Constraints

There were no injection constraints identified in the steady state analyses. So network upgrades are not required.

Deliverability Study

The R39 deliverability study was performed at 20% of the requested output.

No constraints were identified in the deliverability analysis. The R39 generation project is fully deliverable for 100.5 MW (20% of the requested output).

Stability Analysis

A stability analysis was performed using an off peak power flow model to evaluate the transient stability of the R39 generating facility and the impact of the generating facility on the region. The analysis was performed using a UIP study package that was updated by the NMORWG in December, 2008. Regional disturbances were simulated, as well as disturbances local to the R39 generating facility.

All of the simulated disturbances meet transient-period performance criteria.

Tables summarizing the transient stability performance of the R39 study model are in Appendix E. No network upgrades are required to address any stability issues.

Sensitivity Analysis

Seventeen (17) Multi Value Projects (MVP) have been approved as MISO Appendix A projects in MTEP11. These MVP projects will create a regional network that provides reliability, public policy and economic benefits spread across MISO. In the R39 Restudy base models, there are only three MVP transmission projects (Brookings Co. – Hampton Corner 345 kV, N. La Crosse – Cardinal 345 kV, Pleasant Prairie – Zion 2nd 345 kV line) modeled. AC contingency analysis and stability analyses have been performed to determine the sensitivity of the steady state and stability analysis results to the MVP projects.

MVP Scenario 1

MVP Scenario 1 represents an off peak scenario with an addition of one MVP project (Lakefield – Winnebago – Burt – Sheldon – Burt – Webster 345 kV) and the R39 generation project being interconnected at the new Sheldon 345 kV substation. The new Sheldon 345 kV substation is also located on the Raun - Lakefield Junction 345 kV line.

AC contingency analysis and stability analysis were performed. No thermal/voltage injection constraints or stability constraints were identified for the interconnection of R39 in the MVP Scenario 1 case.

MVP Scenario 2

MVP Scenario 2 represents an off peak scenario with all MISO approved MVP projects modeled and the R39 generation project being interconnected at the new Sheldon 345 kV substation.

AC contingency analysis was performed. No thermal or voltage injection constraints were identified for the interconnection of R39 in the MVP Scenario 2 case.

Summary

The R39 interconnection system impact restudy did not identify any injection constraints, or deliverability constraints, or stability constraints. Network Upgrades are not required for the interconnection of the R39 generation project.

This page intentionally left blank.

Final Report

Section

1

Introduction

This report presents the restudy results of a System Impact Study (SIS) performed to evaluate the interconnection of a 500 MW wind farm located in O'Brien County, Iowa. The Interconnection Customer has requested Network Resource Interconnection Service (NRIS). The R39 project has a queue date of March 8, 2007.

The R39 System Impact Study was originally performed by MidAmerican prior to MidAmerican becoming a MISO member. This MISO Restudy is performed to identify R39 thermal and stability constraints on the MISO system.

The study was performed under the direction of MISO by Siemens PTI and an ad hoc study group. The ad hoc study group was formed to review the study scope, methodology, models and results. The ad hoc study group consisted of representatives from the following utility companies – Central Iowa Power Cooperative, Corn Belt Power Cooperative, Dairyland Power, ITC Midwest, Great River Energy, MidAmerican Energy Company, MISO, Missouri River Energy Services, Otter Tail Power, Southern Minnesota Municipal Power Agency, Western Area Power Administration, and Xcel Energy.

This page intentionally left blank.

Section 2

Description of Requests

The Interconnection Customer has requested to interconnect 500 MW of wind generation located in O'Brien County, IA to the Energy (MISO) transmission network. The interconnection customer proposes to interconnect at a new 345 kV substation to be located on the Raun-Lakefield Junction 345 kV line. The R39 generating facility is listed in Table 2-1, and the approximate geographic location of its Point of Interconnection (POI) is shown in Figure 2-1.

Table 2-1: R39 Generator Interconnection Service Request

MISO Project #	Queue Date	Service Type	Control Area	County, State	Point of Interconnection	Pmax (MW)	Fuel Type
R39	3/8/2007	NR	MEC	O'Brien, IA	Raun – Lakefield Junction 345 kV	500	Wind

The R39 project has a rated output of 500 MW provided by 334 GE 1.5 MW turbines. Its generating facility is modeled using three equivalent generators. The three 345-34.5 kV substation transformers are modeled but collector system impedances are not. A 345 kV interconnection radial line from the R39 location to the POI is also modeled. The R39 generating facility models and parameters are documented in Appendix B.

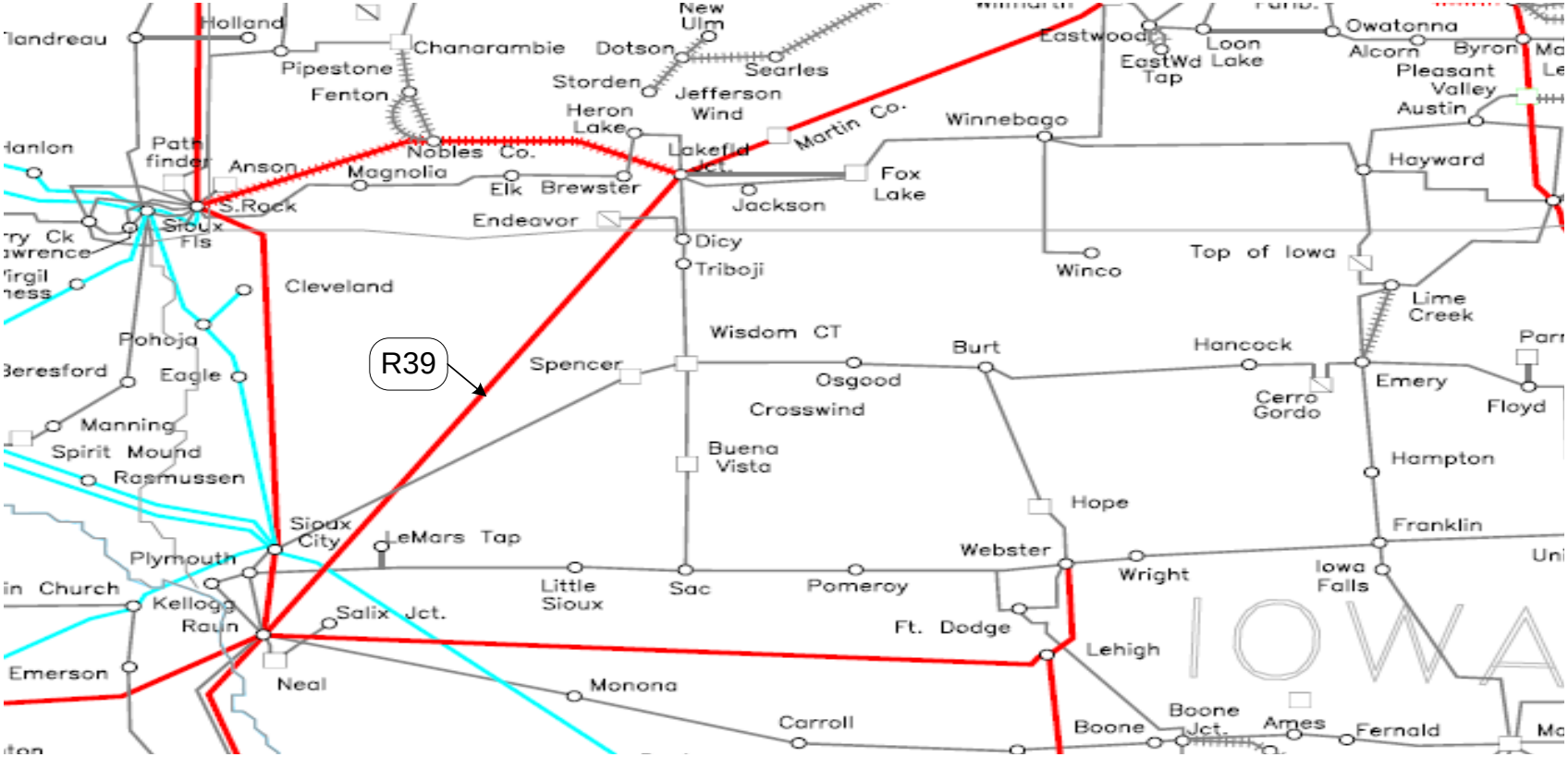

Figure 2-1: Geographic Location of R39 Generation Project

Section
3

Steady-State Analysis

Steady-state analysis was performed to identify thermal and voltage upgrades required to interconnect the R39 generating facility to the transmission system.

3.1 Procedure

3.1.1 Computer Programs

Steady-state analyses were performed using PSS®E version 31.2 and PSS®MUST version 10.2.

3.1.2 Methodology

Benchmark cases representing out-year (2016) summer off peak and summer peak system conditions were created without the R39 generation project. Study cases were created by adding the R39 generating facility to the benchmark cases. Nonlinear (AC) contingency analysis was performed on both the benchmark and study cases and the incremental impacts of the R39 generating facility was evaluated by comparing the steady-state performance of the transmission system in the benchmark and study cases.

3.1.3 Model Development

3.1.3.1 Benchmark Cases

The out-year benchmark cases (off peak, summer peak) were developed from the MISO Group 5 Restudy models ("2013-SUOP_Grp5Model_04-08-11_v9-BRK-NLAX-261-169MW.sav", "Post_G5_SUPK_2013_R5_041111_v1_BRK-NLAX.sav"). The original Group 5 Restudy models were developed from the July 2009 Definitive Planning Phase (DPP) Minnesota Study models, which were based on the MTEP08 Summer 2013 model. The details of the original Group 5 Restudy benchmark and study model development are described in Section 8.1 of the Group 5 Restudy final report [1].

The R39 Restudy benchmark cases were created from the MISO Group 5 Restudy models (off peak, summer peak) with the following assumptions and changes:

[1] Generator Interconnection System Impact Study - MN Group 5 Re-Study, May 19, 2011, updated on June 15, 2011, prepared by MISO, available from https://www.midwestiso.org/Planning/GeneratorInterconnection/Pages/GeneratorInterconnection.aspx

- New MTEP11 Appendix A projects in Appendix A.1, Table A-1 were added to the models.
- The MPC Center – Grand Forks 345 kV project was added.
- The Square Butte dc line maximum loading was increased to 550 MW. The shunt capacitor at the Square Butte 230 kV was also increased to 175 Mvar.
- The MISO MVP project Pleasant Prairie – Zion Energy Center 2nd 345 kV line was added.
- MISO Group 5 Restudy network upgrades for CMVP scenario were added.
- The following generation projects have been withdrawn from MISO or WAPA Generator Interconnection Queue and were removed from the model: G239, G248, G438, G489, G552, G576, G630, IP03, GI-0108, G608, G618, G698, and G744.
- MP Bison wind project and Oliver County #3 wind project were added. Bison wind generation was dispatched at 20% of 450 MW, and Oliver County wind generation was dispatched at 20% of 150 MW in both off peak and summer peak models.
- ND Coal Field generation was dispatched at Cruise level.
- MEC prior queued wind generation projects (prior to R39) were added and dispatched.
- Model changes and updates applied to the MISO Group 5 Restudy models are listed in Appendix A.3, Table A-3.
- Baseload generating facilities were dispatched at 100% in both summer peak and off peak scenarios.
- Peaking generating facilities were dispatched at 100% in summer peak and 0% off peak.
- MISO wind generating facilities in the study area were dispatched at 100% in off peak and 20% in summer peak. MISO competing wind generating facilities remote from the study area were dispatched at 20% in both summer peak and off peak scenarios. Details of competing MISO generating facilities are listed in Appendix A.3, Table A-3.
- Neighboring queued generating facilities remote from the study area with completed impact studies were modeled per their transmission provider's criteria. These are listed in Appendix A.3, Table A-4.
- Models were reviewed by the Ad Hoc study members (transmission owners and customers). Model changes were made based on the comments and feedback. These modeling changes are also listed in Appendix A.3, Table A-3.

The following major transmission projects were included in the models:

- CapX 2020 Group 1 projects:
  - Brookings Co. - Lyon Co. – Franklin – Helena - Lake Marion - Hampton Corner 345 kV line (MISO MVP project);
  - Bison – Alexandria – Quarry - Monticello 345 kV line;
  - Hampton Corner - North Rochester - North La Crosse 345 kV;
  - Bemidji – Boswell 230 kV line
- MISO MVP projects:
  - Brookings Co. - Lyon Co. – Franklin – Helena - Lake Marion - Hampton Corner 345 kV line
  - N. La Crosse – N. Madison – Cardinal 345 kV line
  - Pleasant Prairie – Zion Energy Center 2nd 345 kV line
- MPC Center - Grand Forks 345 kV line;
- MISO Group 5 Restudy network upgrades
- RIGO facilities: 2nd Pleasant Valley 345/161 transformer and Pleasant Valley - Byron 161 kV line;

- Hazleton - Salem 345 kV and 2nd Salem 345/161 kV transformer.

Interface loadings were set as follows:

- MHEX was set at 1848 MW (firm TSR level) in both the off peak and summer peak cases.
- Miles City dc tie was set at 150 MW west to east. Rapid City dc tie was set at 200 MW west to east. CU dc line was set at 1147 MW at the rectifier. Square Butte dc line was set at 20% of 550 MW at the rectifier.

The power flow cases were solved with transformer tap adjustment enabled, area interchange disabled, phase shifter adjustment enabled and switched shunt adjustment enabled.

3.1.3.2 Study Cases

The R39 generating facility was added to the benchmark cases as described in Section 2. The generating facility was dispatched to the MISO market outside the study region (Table A-5), where generation was scaled in proportion to Pgen – Pmin.

Table 3-1: Generation Dispatch for R39 Generation

MISO Project #	Service Type	Pmax (MW)	Fuel Type	SUOP Dispatch (MW)	SUPK Dispatch (MW)
R39	NR	500	Wind	500	100

3.2 Contingency Criteria

A variety of contingencies were considered for steady-state analysis:

- NERC Category A with system intact (no contingencies)

- NERC Category B contingencies
  - Single element outages, at buses with a nominal voltage of 69 kV and above, in the following areas: XEL (area 600), MP (area 608), SMMPA (area 613), GRE (area 615), OTP (area 620), ITCMW (area 627), MEC (area 635), ATCLLC (area 295, areas 694 – 698), WAPA (area 652), DPC (area 680)
  - multiple-element outages initiated by a fault with normal clearing such as multi-terminal lines, in Iowa, Minnesota, Dakotas, Manitoba

- NERC Category C
  - Any two circuits of a common tower line, in Iowa, Minnesota, Dakotas, Manitoba
  - Select stuck breaker events provided by the Ad Hoc Study Group

For all contingency and post-disturbance analyses, cases were solved with transformer tap adjustment enabled, area interchange adjustment disabled, phase shifter adjustment disabled (fixed) and switched shunt adjustment enabled.

3.3 Monitored Elements

Facilities listed in Table 3-2 were monitored for system intact and contingency conditions. Under NERC category A conditions (system intact) branches were monitored for loading above the normal (PSS®E rate A) rating. Under NERC category B and C conditions branches were monitored for loading as shown in the column labeled "Post-Disturbance Thermal Limits".

Table 3-2: Monitored Elements

Owner / Area	Monitored Facilities	Thermal Limits [1]		Voltage Limits [2]	
		Pre-Disturbance	Post-Disturbance	Pre-Disturbance	Post-Disturbance
ATCLLC	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
BEPC	69 kV and above	100% of Rate A	100% of Rate A	1.05/0.95	1.1/0.9
DPC	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.9	1.05/0.9
GRE	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.92
ITCMW	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
MDU	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
MEC	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.96/0.95	1.1/1.05/0.94/0.93/0.9
MP	69 kV and above	100% of Rate A	100% of Rate B	1.05/1.0/0.95	1.05/0.95
MRES	69 kV and above	100% of Rate A	100% of Rate A	1.05/0.95	1.1/0.9
OTP	69 kV and above	100% of Rate A	100% of Rate B	1.07/1.05/0.97/0.95	1.1/0.92
RPU	69 kV and above	100% of Rate A	100% of Rate A	1.05/0.95	1.1/0.9
SMMPA	69 kV and above	100% of Rate A	100% of Rate B	1.05/0.95	1.1/0.9
WAPA	69 kV and above	100% of Rate A	100% of Rate A	1.05/0.95	1.1/0.9
XEL	69 kV and above	100% of Rate A	100% of Rate B	1.05/1.005/1.0/0.95	1.1/0.95/0.93/0.9

Notes

1: PSS®E Rate A, Rate B or Rate C

2: Limits dependent on nominal bus voltage

3.4 Performance Criteria

A branch is considered a thermal injection constraint if both of the following two conditions are met:

1) the branch is loaded above its applicable normal or emergency rating for the post-change case, and

2) the generator (NR/ER) has a larger than 20% DF on the overloaded facility under post contingent condition or 5% DF under system intact condition; or the overloaded facility or the overload-causing contingency is at generator's outlet

A bus is considered a voltage constraint if both of the following conditions are met. All voltage constraints must be resolved before a project can receive interconnection service.

1) the bus voltage is outside of applicable normal or emergency limits for the post-change case,
2) the change in bus voltage is greater than 0.01 per unit.

All generators must mitigate thermal injection constraints and voltage constraints in order to obtain any type of Interconnection Service.

Further, all generators requesting Network Resource Interconnection Service (NRIS) must mitigate constraints found by using the deliverability algorithm, to meet the system performance criteria for NERC category A, B and selected C events, if the constraint demonstrates an incremental flow caused by the generator equal to or greater than 5% of the generator's maximum dispatch level in each case.

3.5 Summer Off Peak Contingency Analysis Results

The incremental impact of the proposed interconnection on individual facilities was evaluated by comparing flows and voltages without and with the project. Analysis was performed using PSS®MUST.

3.5.1 SUOP System Intact Conditions

No thermal constraints or voltage constraints were identified for NERC category A (system intact) conditions.

3.5.2 SUOP Single Event Contingencies

The results in this Section are for analysis of conditions following NERC Category B contingencies and Category C contingencies with a single initiating event such as a breaker failure or a fault on any two circuits of a multiple circuit towerline.

No thermal constraints or voltage constraints were identified following NERC Category B contingencies or Category C contingencies with a single initiating event.

3.6 Summer Peak Contingency Analysis Results

3.6.1 SUPK System Intact Conditions

There were no thermal or voltage constraints identified in the summer peak case for NERC category A conditions (system intact).

3.6.2 SUPK Single Event Contingencies

No thermal constraints or voltage constraints were identified in the summer peak case following NERC Category B contingencies or Category C contingencies with a single initiating event.

3.7 Network Upgrades for Mitigating Injection Constraints

There were no injection constraints identified in the steady state analyses. So network upgrades are not required.

3.8 Deliverability Study

3.8.1 Introduction

Generator interconnection projects have to be deliverable to the MISO network load to be granted Network Resource Interconnection Services (NRIS). The project can choose to accept the level of NRIS available without additional upgrades, or make the required network improvements to obtain NRIS.

The R39 deliverability study was performed at 20% of the requested output.

3.8.2 Study Methodology

MISO Generator Deliverability Study white paper describing the algorithm can be found at "http://www.midwestmarket.org/publish/Document/3e2d0_106c60936d4_-767f0a48324a"

3.8.3 Assumptions

The deliverability study case was derived from the R39 summer peak restudy case (details in Section 3.1.3). ER impacts were not considered and higher queued NR generators were modeled up to their deliverable output.

The monitored facilities in the deliverability study are: 69 kV and above branches/ties in OTP, GRE, MP, NSP, DPC, SMP, RPU, ITCMW, WAPA, MRES, BEPC, MDU, MEC, and ATCLLC. The contingencies in this deliverability study are those used in the R39 ERIS analysis.

3.8.4 Determining the MW restriction

If one facility is overloaded based on the assessed "severe yet credible dispatch" scenario described in the study methodology, and the generator under study is in the "Top 30 DF List" (see white paper for detail), part or all of its output is not deliverable. The restricted MW is calculated as following:

(MW restricted) = (worst loading – MW rating) / (generator sensitivity factor)

If the result is larger than the maximum output of the generator, 100% of this generator's output is not deliverable.

The generator is also responsible for any NEW base case (pre-shift) overload or NEW "severe yet credible dispatch overload" where the generator is not in the "Top 30 DF List", if the generator's DF is greater than 5%. Please see the white paper for detail. The formula above also applies to these situations.

3.8.5 Deliverability Study Result

No deliverability constraints were identified. The R39 generation project is fully deliverable for 100.5 MW (20% of the requested output).

Table 3-3 provides the amount of R39 generation that is deliverable without any additional mitigation.

Table 3-3: Amount of deliverable generation without further upgrades

Project #	Max Generation (MW)	Generation Deliverable (MW)	Deliverable %
R39	500	100.5	20%

This page intentionally left blank.

Final Report

Section
4

Stability Analysis

Stability analysis was performed to evaluate the transient stability of the R39 generating facility and the impact of the R39 project on the region.

4.1 Procedure

4.1.1 Computer Programs

Analysis was performed using PSS®E revision 29.5 and a UIP study package that was updated by the NMORWG in December, 2008.

4.1.2 Methodology

A benchmark case was developed representing summer off peak conditions without the R39 generating facility. A study case was created by adding the R39 generating facility to the benchmark case. Disturbances were simulated to evaluate the transient stability of the R39 generating facility and the impact of the project on the region. If a simulation for the study case violates MAPP System Design Standards the simulation was repeated on the benchmark case to assess the impact of the generating facility on the violation.

4.1.3 Case Development

4.1.3.1 Benchmark Case

A benchmark case without the R39 generating facility was developed from the final case ("G5S-so15aa.withCMVPP1c1.sav", "nmorwg08-CS5-Restudy_2011D.snp") used in the MISO Group 5 Restudy completed in June, 2011[1]. This case is a 2015 summer off peak (70%) case with heavy exports.

The R39 stability benchmark case was created from the Group 5 Restudy stability model as follows:

- New MTEP11 Appendix A projects in Appendix A.1, Table A-1 were added to the models.
- The MPC Center – Grand Forks 345 kV project was added.
- The Square Butte dc line maximum loading was increased to 550 MW. The shunt capacitor at the Square Butte 230 kV was also increased to 175 Mvar.
- The MISO MVP project Pleasant Prairie – Zion Energy Center 2nd 345 kV line was added.

- MISO Group 5 Restudy network upgrades for CMVP scenario were added.
- The following generation projects have been withdrawn from MISO or WAPA Generator Interconnection Queue and were removed from the model: G608, G618, and GI-0108.
- MP Bison wind project and Oliver County #3 wind project were added. Bison wind generation was dispatched at 20% of 450 MW, and Oliver County wind generation was dispatched at 20% of 150 MW.
- MEC prior queued wind generation projects (prior to R39) were added and dispatched.
- Model changes and updates applied to the MISO Group 5 Restudy stability model are listed in Appendix D.1, Table D-1.
- MISO competing generating facilities in the study region were modeled (Table D-2). Generally, baseload generating facilities were dispatched at 100%, peaking generating facilities were not dispatched, wind generating facilities in the study region were dispatched at 100%, and wind generating facilities in other areas were dispatched at 20%.
- Neighboring queued generating facilities with completed impact studies were modeled per their transmission provider's criteria. These are listed in Appendix D.2, Table D-3.
- Miles City dc tie was set at 150 MW west to east. Rapid City dc tie was set at 200 MW west to east. CU dc line was set at 1147 MW at the rectifier. Square Butte dc line was set at 20% of 550 MW at the rectifier.
    - The interface transfer levels were set as in Table 4-1 in the pre-benchmark stability case for Group 5 Restudy, which was described in Section 5.1.1 of the Group 5 Restudy final report[1].
- In the R39 stability benchmark case, the MHEX interface transfer level was reset at 2175 MW. The MWEX and NDEX interface transfer levels were allowed to float and were not reset.
- The stability model was reviewed by the Ad Hoc study members (transmission owners and customers). Model corrections and updates were made (Table D-1) per TOs' comments.

Table 4-1: Interface Transfer Levels in Group 5 Restudy Pre-Benchmark Stability Case

Interface	Xfer Level (MW)
MHEX	2172 MW
MWEX	1666 MW
NDEX (existing)	2080 MW
MH-OH phase shifter	196 MW
OH-MP phase shifter	149 MW
Boundary Dam – Tioga (south)	166 MW
Stinson phase shifter (MN-WI)	30 MW
Arrowhead – Stone Lake	723 MW

The following major transmission projects were included in the stability model:

- CapX 2020 Group 1 projects:
  - Brookings Co. - Lyon Co. – Franklin – Helena - Lake Marion - Hampton Corner 345 kV line (MISO MVP project);
  - Bison – Alexandria – Quarry - Monticello 345 kV line;
  - Hampton Corner - North Rochester - North La Crosse 345 kV;
  - Bemidji – Boswell 230 kV line
- MISO MVP projects:
  - Brookings Co. - Lyon Co. – Franklin – Helena - Lake Marion - Hampton Corner 345 kV line
  - N. La Crosse – N. Madison – Cardinal 345 kV line
  - Pleasant Prairie – Zion Energy Center 2nd 345 kV line
- MPC Center - Grand Forks 345 kV line;
- MISO Group 5 Restudy network upgrades
- RIGO facilities: 2nd Pleasant Valley 345/161 transformer and Pleasant Valley - Byron 161 kV line;
- Hazleton - Salem 345 kV and 2nd Salem 345/161 kV transformer.

4.1.3.2 Study Case

The R39 generating facility was added to the benchmark case as described in Section 2. The 500 MW output of the R39 generating facility was sunk to generation in the MISO market outside the study region (Table D-4).

The MHEX interface transfer level was reset at 2175 MW. The MWEX and NDEX interface transfer levels were allowed to float and were not reset.

In the R39 stability study case, the load levels in North Dakota, Xcel, and Manitoba Hydro are shown in Table 4-2.

Table 4-2: Load Levels as Percent of 2015 Summer Peak in R39 Study Case

Area	Load (MW)	% of 2015 Peak Load
North Dakota (Zone 90, 990)	2146.1	66.0% of 3251.0 MW
Xcel (Area 600)	9026.6	75.9% of 11889.0 MW
MH (Area 667)	2348.2	76.3% of 3076.0 MW

4.2 Disturbance Criteria

The stability simulations performed as part of this study considered the regional and local contingencies listed in Table 4-3.

Table 4-3: Regional and Local Disturbance Descriptions

Fault Code	Description	Region
ei2	CU DC Permanent Bipole fault with tripping of both Coal Creek units	North Dakota
mts	SLG fault at Monticello with 8N6 stuck breaker, CU DC block, clear by disconnecting Monticello 345 kV bus	Twin Cities Metro
wls	SLGBF fault at Wilmarth 345 kV on WLM-BLL line with WLM 8S22 stuck Trip BLL-WLM & WLM-LFD	Twin Cities Metro
nmz	3.5 cycle 3PH fault at Chisago county on the Forbes 500 kV line D601C	ISG Area
nad	4 cycle 3PH fault at Forbes on the Dorsey 500 kV line D602F	ISG Area
pas	SLG fault with breaker failure at Forbes on the Dorsey 500 kV line with 602L stuck. Trip D602F	ISG Area
pcs	SLG fault at King on the Eau Claire 345 kV line with a stuck breaker, trip King – Eau Claire – Arpin and King – Chisago	Twin Cities Metro
pys	14 cycle SLG fault at Prairie Island on the Byron 345 kV line, trip Byron – Prairie Island	Twin Cities Metro
ya3	4 cycle 3PH fault at Arrowhead on the Gardner Park 345 kV line, trip Arrowhead – Gardner Park	Twin Cities Metro
yas	4 cycle SLG fault with breaker failure at Arrowhead on the Gardner Park, trip Arrowhead – Gardner Park 230 kV in 17 cycle	Arrowhead – Gardner Park
swz	4 cycle 3PH fault at White on Split Rock 345 kV line, trip White-Split Rock	SW MN
wss	SLG fault at Split Rock on White 345 kV line; Breaker failure at Split Rock, trip Split Rock-White @4 cycle; Clear the fault @11 cycle by tripping Split Rock 345-115 tx #10	SW MN
snz	4 cycle 3PH fault at Split Rock on Nobles 345 kV line, trip Split Rock-Nobles	SW MN
sns	SLG fault at Split Rock on Nobles 345 kV line; Breaker failure at Split Rock, trip Split Rock-Nobles @4 cycle; Clear the fault @11 cycle by tripping Split Rock- Sioux City 345 kV line	SW MN
nns	SLG fault at Split Rock on Nobles 345 kV line; Breaker failure at Nobles, trip Split Rock-Nobles @4 cycle; Clear the fault @11 cycle by tripping Nobles 345-115 tx #1	SW MN
ssz	4 cycle 3PH fault at Split Rock on Sioux City 345 kV line, trip Split Rock-Sioux City	SW MN
sss	SLG fault at Split Rock on Sioux City 345 kV line; Breaker failure at Split Rock, trip Split Rock-Sioux City @4 cycle; Clear the fault @11 cycle by tripping Split Rock- Nobles 345 kV line	SW MN
nlz	4 cycle 3PH fault at Nobles on Lakefield Jct. 345 kV line, trip Nobles-Lakefield Jct.	SW MN
nls	SLG fault at Nobles on Lakefield Jct. 345 kV line; Breaker failure at Nobles, trip Nobles-Lakefield Jct. @4 cycle; Clear the fault @11 cycle by tripping Nobles 345-115 tx #1	SW MN
vts	4 cycle 3PH fault at Lakefield Gen on Wilmarth 345 kV line, trip Fieldon-Wilmarth and bypass Fieldon series cap	SW MN
wds	4 cycle 3PH fault at Lakefield Gen on Wilmarth 345 kV line, trip all Lakefield generators, close Fieldon bypass, and trip Wilmarth-Lakefield Jct. 345 kV line.	SW MN

Fault Code	Description	Region
wts	SLG fault at Wilmarth on Fieldon 345 kV line; Breaker failure at 8S32, trip Wilmarth-Fieldon @4 cycle; Clear the fault @7 cycle by tripping all Lakefield generators, closing Fieldon bypass, and tripping Wilmarth-Lakefield Jct. 345 kV line	SW MN
lgs	3PH fault at Lakefield Gen on Lakefield Jct. 345 kV line, bypass Fieldon series compensator, trip Lakefield Jct.-Nobles 345 kV line @ 6 cycle.	SW MN
fbs	Bypass Fieldon series cap without a fault for 5 cycle	SW MN
01s	4 cycle 3PH fault at Raun on Hoskins 345 kV line, trip Raun-Hoskins	Local (R39)
02s	4 cycle 3PH fault at Raun on R39_Tap 345 kV line, trip Raun-R39_Tap	Local (R39)
03s	4 cycle 3PH fault at Raun on S3451 345 kV line, trip Raun-S3451	Local (R39)
04s	4 cycle 3PH fault at Lakefield Jct. on R39_Tap 345 kV line, trip Lakefield Jct.-R39_Tap	Local (R39)
j03	4 cycle 3PH fault at R39_Tap on Lakefield Jct. 345 kV line, trip R39_Tap-Lakefield Jct.	Local (R39)
j13	4 cycle 3PH fault at R39_Tap on Raun 345 kV line, trip R39_Tap-Raun	Local (R39)
j23	4 cycle 3PH fault at Raun on Lehigh 345 kV line, trip Raun-Lehigh	Local (R39)
j33	4 cycle 3PH fault at Raun on Sioux City 345 kV line, trip Raun-Sioux City	Local (R39)
ljs	3-phase fault at Lakefield Jct. on Lakefield Jct.-LGS 345 kV, trip LGS-Lakefield Jct. 345 kV, bypass Fieldon Series compensator, trip Lakefield Jct.-Nobles Co. 345 kV	Local (R39)
j0s	SLG fault at Raun on Hoskins 345 kV line; BRK failure at Raun BRK# 0270, trip Raun-Hoskins @4 cycle; Clear the fault @13.6 cycle by tripping Raun-S3451 345 kV line	Local (R39)
08s	SLG fault at Raun on R39_Tap 345 kV line; BRK failure at Raun BRK# 0150, trip Raun-R39_Tap @4 cycle; Clear the fault @13.6 cycle by tripping Raun-Lehigh 345 kV line	Local (R39)
07s	SLG fault at Raun on S3451 345 kV line; BRK failure at Raun BRK# 0270, trip Raun-S3451 @4 cycle; Clear the fault @13.6 cycle by tripping Raun-Hoskins 345 kV line	Local (R39)
06s	SLG fault at Lakefield on R39_Tap 345 kV line; BRK failure at Lakefield BRK# 884, trip Lakefield-R39_Tap @4 cycle; Clear the fault @13.6 cycle by tripping Lakefield-Lakefield Gen. 345 kV line	Local (R39)
j1s	SLG fault at R39_Tap on Lakefield 345 kV line with delayed clearing, trip R39_Tap-Lakefield @4 cycle; delayed clearing of fault @11 cycle	Local (R39)
j2s	SLG fault at R39_Tap on Raun 345 kV line with delayed clearing, trip R39_Tap-Raun @4 cycle; delayed clearing of fault @11 cycle	Local (R39)
j3s	SLG fault at Raun on Lehigh 345 kV line; BRK failure at Raun BRK# 0150, trip Raun-Lehigh @4 cycle; Clear the fault @13.6 cycle by tripping Raun-R39_Tap 345 kV line	Local (R39)
09s	SLG fault at Raun on Sioux City 345 kV line; BRK failure at Raun BRK# 0120, trip Raun-Sioux City @4 cycle; Clear the fault @13.6 cycle	Local (R39)
lns	SLG fault at Lakefield Jct. on Nobles 345 kV line; BRK failure at Lakefield Jct., trip Lakefield Jct.-Nobles @4 cycle; Clear the fault @11.3 cycle by tripping Lakefield Jct. 345/161xfmr #2	Local (R39)

The fault admittances for single line to ground fault (SLG) were estimated using the CAPE program based on a short circuit database provided by MISO. The positive sequence Thevenin impedance ratio between R39 study case and CAPE short circuit database was applied to scale the negative sequence and zero sequence Thevenin impedance calculated from CAPE short circuit database. The fault admittance was calculated based on the new scaled negative sequence and zero sequence Thevenin impedances.

4.3 Performance Criteria

Performance of the R39 study model was evaluated using the MAPP Planning Standards defined in the MAPP Reliability Handbook and specific criteria in the MAPP Reliability Criteria and Study Procedures Manual.

4.4 Stability Results

Tables summarizing the performance of the R39 study model are in Appendix E. Simulations were performed with a 0.1 second steady-state run followed by the appropriate disturbance. Simulations were run for a 10-second duration.

All simulations are stable, and no transient-period criteria violations were noted in any of the simulations.

4.5 Network Upgrades Identified in Stability Analysis

No network upgrades are required to address any stability issues.

Section

5

Sensitivity Analysis for MVP Projects

Seventeen (17) Multi Value Projects (MVP) have been approved as MISO Appendix A projects in MTEP11. These MVP projects will create a regional network that provides reliability, public policy and economic benefits spread across MISO. In the R39 Restudy base models, there are only three MVP transmission projects (Brookings Co. – Hampton Corner 345 kV, N. La Crosse – Cardinal 345 kV, Pleasant Prairie – Zion 2nd 345 kV line) modeled. Sensitivity analyses have been performed to determine the sensitivity of the steady state and stability analysis results to the MVP projects.

5.1 MVP Scenario 1

MVP Scenario 1 represents an off peak scenario with an addition of one MVP project (Lakefield – Winnebago – Burt – Sheldon – Burt – Webster 345 kV) and the R39 generation project being interconnected at the new Sheldon 345 kV substation. The new Sheldon 345 kV substation is also located on the Raun - Lakefield Junction 345 kV line.

5.1.1 Modeling Details in MVP Scenario 1

Starting from the R39 steady-state and stability off peak cases, the MVP Scenario 1 cases were created as follows:

- The Lakefield – Winnebago – Burt – Sheldon – Burt – Webster 345 kV MVP project was added.
- POI of the R39 generation project was moved to the new Sheldon 345 kV substation.

5.1.2 Steady State Contingency Analysis Results in MVP Scenario 1

AC contingency analysis was performed to evaluate the incremental impact of the R39 interconnection on individual facilities, using the same monitored elements, contingency criteria, and performance criteria as the base analysis in Section 3. No R39 thermal constraints or voltage constraints were identified for NERC category A (system intact) conditions, or NERC Category B contingencies or Category C contingencies with a single initiating event.

5.1.3 Stability Analysis Results in MVP Scenario 1

Stability analysis was performed to evaluate the transient stability of the R39 generating facility and the impact of the R39 project on the region. Tables summarizing the performance of the R39 study model are in Appendix F.1. Simulations were performed with a 0.1 second

steady-state run followed by the appropriate disturbance. Simulations were run for a 10-second duration.

All simulations are stable, and no transient-period criteria violations were noted in any of the simulations.

5.2 MVP Scenario 2

MVP Scenario 2 represents an off peak scenario with all MISO approved MVP projects modeled and the R39 generation project being interconnected at the new Sheldon 345 kV substation.

5.2.1 Modeling Details in MVP Scenario 2

Starting from the R39 steady-state off peak benchmark and study cases, the MVP Scenario 2 steady-state benchmark and study cases were created as follows:

- The Lakefield – Winnebago – Burt – Sheldon – Burt – Webster 345 kV MVP project was added.
- POI of the R39 generation project was moved to the new Sheldon 345 kV substation.
- Big Stone – Brookings 345 kV MVP project was added.
- Winco – Lime Creek – Emery – Black Hawk - Hazleton 345 kV MVP project was added.
- Dubuque – Spring Creek - Cardinal 345 kV MVP project was added.
- Ellendale – Big Stone 345 kV MVP project was added.
- Ottumwa – Adair 345 kV MVP project was added.
- West Adair – Palmyra 345 kV MVP project was added.
- Palmyra – Quincy – Meredosia – Ipava & Meredosia - Pawnee 345 kV MVP project was added.
- New Pawnee – Pana 345 kV MVP project was added.
- Pana – Mt. Zion – Kansas – Sugar Creek 345 kV MVP project was added.
- Reynolds – Burr Oak - Hiple 345 kV MVP project was added.
- Michigan Thumb Loop Expansion MVP project
- Greentown – New Reynolds 765 kV MVP project was added.
- Oak Grove – Galesburg - Fargo 345 kV MVP project was added.
- Sidney – Rising 345 kV MVP project was added.

5.2.2 Steady State Contingency Analysis Results in MVP Scenario 2

AC contingency analysis was also performed on the MVP Scenario 2 power flow cases, using the same monitored elements, contingency criteria, and performance criteria as the base analysis in Section 3. No R39 thermal constraints or voltage constraints were identified for NERC category A (system intact) conditions, or NERC Category B contingencies or Category C contingencies with a single initiating event.

5.3 Sensitivity Analysis Conclusions

There were no thermal or voltage injection constraints identified in the MVP Scenario 1 or Scenario 2 steady-state cases. There were no stability constraints identified in the MVP Scenario 1 stability case.

This page intentionally left blank.

Final Report

Appendix

A

Model Development for Steady-State Analysis

A.1 MTEP11 Appendix A Projects Added to the Models

Table A-1: MTEP11 Appendix A Projects Added to the Models

TO System	Change Name	Project Description
GRE	GRE-2563-ATHENS-MARTINLAKE69.prj.py	Athens to Martin Lake 69kV System Upgrades and Permitting
GRE	GRE-2643-PARKERSPRAIRIE115.prj.py	Parkers Prairie 115 kV conversion
GRE	GRE-2671-SODERV-HAMLK-JOHNSV69.prj.py	Soderville-Ham Lake-Johnsville (6.18 mi.) Retemp
ITCMW	ITCM_2365_Lansing-Genoa_Upgrades.prj.py	Upgrade terminal equipment to Winter conductor limit,
GRE	GRE-2833-LAKECAROLINE69.prj.py	Lake Caroline (WH) 69 kV Distribution Substation
MEC	MEC-3268-MISO-lehighReactorAddition.prj.py	Lehigh: 345 kV 50 MVAr Reactor
MEC	MEC-MISO-3270-CBEC-RiverBend161kvRebuild.prj.py	CBEC-River Bend 161 kV Rebuild
Xcel	MEC-MISO-3271-RiverBend-Bunge161kvRebuild.prj.py	River Bend-Bunge 161 kV Rebuild
Xcel	XEL-3310-WWACONIA-SCOTTCO.prj.py	Highway 212 Corridor upgrade
Xcel	XEL-3312-MINN_VALLEY-KERKHOVEN_TAP.prj.py	Minn Valley - Maynard - Kerkhoven tap upgrade
Xcel	XEL-3314-KOHLMAN_LAKE-LONG_LAKE_2ND_CRT.prj.py	New Prague switch
Xcel	XEL-3315-CHISAGO_TR5.prj.py	Chisago County 2nd 345/115 kV transformer
Xcel	XEL-3316-APACHE-RIVERSIDE.prj.py	Riverside - Apache lie upgrade
Xcel	XEL-3317-GOOSE_LAKE-KOHLMAN_LAKE_2ND_CRT.prj.py	Goose Lake - Kohlman Lake 2nd circuit
Xcel	XEL-3322-CLEAR_LAKE-CEDAR_FALLS.prj.py	Cedar Falls - Clear Lake Rebuild
Xcel	XEL-3323-PARK_FALLS_BIO_REFINERY.prj.py	Park Falls Bio-Refinery
Xcel	XEL-3326-BLACK_DOG-SAVAGE_REBUILD	Black Dog Outlet
Xcel	XEL-3327-EAU_CLAIRE-MADISON_STREET.prj.py	Eau Claire - Madison Street Rebuild
DPC	DPC-3397-GNO-LACTAP.prj.py	Genoa to La Crosse Tap 161 Rebuild

TO System	Change Name	Project Description
ITCMW	ITCM_3406_Adams-Rochester_161kV_TEQ.prj.py	Adams-Rochester Terminal Upgrades
ITCMW	ITCM_3407_3412_Ft_Madison_Bluff_Subs_69_kV.prj.py	Bluff Substation Additions
ITCMW	ITCM_3408_Quartz_Subs_69_kV.prj.py	BooneQuartz Sustation
ITCMW	ITCM_3409_Bricelyn-Waleters_69kV.prj.py	Bricelyn-Walters Rebuild
ITCMW	ITCM_3410_Bridgeport_161kV_TEQ.prj.py	Bridgeport Terminal Upgrades
ITCMW	ITCM_3413_Gladbrook_161kV.prj.py	Gladbrook 161kV tap
ITCMW	ITCM_3414_Magnolia_69_kV_Cap.prj.py	Magnolia 7.1 MVAR 69kV Cap
ITCMW	ITCM_3415_Marion_115kV_TEQ.prj.py	Marion Terminal Upgrades
ITCMW	ITCM_3421_S_Centerville_69kV_7MVAR.prj.py	Centerville 7.1 MVAR 69kV Cap
ITCMW	ITCM_3422_S_Broadway_69kV_TEQ.prj.py	South Broadway TEQ
ITCMW	ITCM_3423_Truro_69_kV.prj.py	Truro Line Rebuild
ITCMW	ITCM_3426_DPC_ITC_OSAGE_69kV.prj.py	DPC/ITC Interconnect move
DPC	DPC-project-3434-LufkintoDPClines.prj.py	Lufkin 161 kV substation
Xcel	XEL-3454-HOLLYDALE_115KV_UPGRADE_1.prj.py	Hollydale 115 kV upgrade
Xcel	XEL-3473-SIOUX_FALLS_115KV_PHASE_1_REV.1.prj.py	Sioux Falls 115 kV Phase 1
Xcel	XEL-3474-ADAMS_2ND_REACTOR.prj.py	Adams 345 kV Reactor Installation
Xcel	XEL-3475-PRAIRIE_3RD_TR.prj.py	Prairie 3rd transformer
Xcel	XEL-3509-STINSON_BAYFRONT_REBUILD.py	Stinson to Bayfront 115 kV line rebuild

A.2 Model Changes and Updates

Table A-2: Model Changes and Updates

TO System	Change Name	Description	SUOP OutYear	SUPK OutYear
MPC	Rem_Winger_2_3_tfmr.idv	Remove 2nd and 3rd 230/115/13 transformer at winger	×	×
MPC	Add_Karlstad_115_14Mvar.idv	Add 2*7 MVar capacitors at the Karlstad 115 kV bus	×	×
GRE	Fix_Ortonvl-JohnsJct_115.idv	Fix rating for Ortonville -- Johnson Jct. 115 Kv line	×	×
GRE	Fix_Morris-JohnsJct_115.idv	Fix rating for Johnson Jct. -- Morris 115 Kv line	×	×
OTP	Fix_Ortonvl-Quarry_115.idv	Fix rating for Ortonville -- Quarry 115 Kv line	×	×
MPC	Fix_Hensel-Langdon_115.idv	Fix rating for Hensel -- Langdon 115 Kv line	×	×
OTP	Fix_TRFall-PlummerP_115.idv	Fix rating for Thief river fall to Plummer Pipe 115 KV line	×	×
OTP	Fix_Vikings-TRFall_115.idv	Fix rating for Thief river fall to Vikings 115 KV line	×	×
MPC	Fix_Oslo-OsloTn_115.idv	Fix rating for Oslo to Oslo Town 115 KV line	×	×
MPC	Fix_Langdon-SweetWater_115.idv	Fix rating for Langdon to SweetWater 115 KV line	×	×
OTP	Fix_Brwsvl-Hankson_230.idv	Fix rating for Browns Valley to Hankinson 230 KV line	×	×
MPC	Add_Center_GrandForks_345.idv	Add the center -- Grand Forks 345KV project	×	×
OTP	Fix_Sheyenne-Audubon_230.idv	Fix emergency rating for Sheyenne -- Audubon 230 Kv line	×	×
OTP	Fix_Maple River-Frontier_230.idv	Fix emergency rating for Maple River -- Frontier 230 Kv line	×	×
ITCMW	Fix_Boone_161.idv	Fix modeling error with the Boone-Marshalltown-Nuthatch 161 kV	×	×
MISO	Rem_G698_G744.idv	Remove G698 and G744	×	×
ITCMW	Rem_Ottumwa-ThomasHl_345.idv	Remove Ottumwa - Thomas Hill 345 kV line	×	×
MRES	Add_Alex-Bison_345_40Mvar.idv	Add 40 Mvar line reactor at the Alexandria - Bison 345 kV line	×	×
Xcel	Rep_Alex_345_115_Tfmr.idv	Replace Alexandria 345/115 kV two winding transformer with a three winding transformer and add a 50 Mvar switch shunt at the tertiary	×	×
Xcel	Add_Monroe-CouncilCrk_161.idv	Add Monroe County- Council Creek 161 kV line	×	×
ITCMW	Fix_MarshallTwn_Gen.idv	Fix Marshall town area generation	×	×
Xcel	Fix_Maple River-Sheynne_230.idv	Fix ratings for Maple river - Sheyenne 230 kV line	×	×
OTP	Fix_Prairie_Ramsey_230.idv	Fix ratings for Prairie - Ramsey 230 kV line	×	×
OTP	Fix_Bemidji-Helga-Nary_115.idv	Fix rating for Bemidji-Helga-Nary 115 kV line	×	×
MPC	Add_2ndThiefRiverFall_15Mvar_cap.idv	Add second 15 Mvar capacitor to Thief River Falls	×	×
MISO	Rem_G248.idv	Remove G248	×	
MISO	Rem_G248_supk.idv	Remove G248		×

TO System	Change Name	Description	SUOP OutYear	SUPK OutYear
BEPC	Fix_Ecklund_Tfmr.idv	Fix Ecklund zero impedance transformer	×	×
MPC	Upd_LangdonWind.idv	Update Langdon Wind layout	×	
MPC	Upd_LangdonWind_supk.idv	Update Langdon Wind layout		×
MPC	Upd_Ashtabula_wind.idv	Update Ashtabula wind layout	×	
MPC	Upd_Ashtabula_wind_supk.idv	Update Ashtabula wind layout		×
ATCLLC	Rem_Ecomet Wind.idv	Remove Ecomet Wind	×	×
DPC	Fix_Jerico_Howard_69.idv	Fix rating for Jerico-Howard 69kV line	×	×
DPC	Fix_Saratga-Howard_69.idv	Fix rating for Howard Tap to Saratoga 69 kV	×	×
OTP	Set_Solway_Pmax.idv	Set Solway generation to Pmax	×	
OTP	Set_Solway_Pmax_supk.idv	Set Solway generation to Pmax		×
ITCMW	Fix_Rice-BeaverCrk_161.idv	Fix rating for Rice and Beaver Crk 161 kV line	×	×
ITCMW	Fix_NIW-LimeCrk_161.idv	Fix rating for NIW - LimeCrk 161 kV line	×	×
Xcel	Add_Monticelo_exp.idv	Add Monticello G929 Expansion	×	
Xcel	Add_Monticelo_exp_supk.idv	Add Monticello G929 Expansion		×
GRE	Add_CoalCrk_G876_G877.idv	Add coal creek G876 and G877	×	×
ITCMW	Fix_Ames-Bnejct_161.idv	Fix rating Ames-Boone Jct 161 kV	×	×
NPPD	Add_Postrock-Spearvil_345.idv	Add Postrock-Spearvil 345 line	×	×
NPPD	Add_NPPD_capacitor.idv	Add various capacitor in NPPD area	×	×
OPPD	Fix_S1221-S1255_161.idv	Fix rating S1221-S1255 161kV line	×	×
MISO	Rem_G608.idv	Remove group 5 project G608	×	×
MISO	Rem_G618.idv	Remove group 5 project G618	×	×
MPC	Upd_LangdonWind_dispatch.idv	Turn Langdon wind on to 20% Pmax	×	
MPC	Upd_LangdonWind_dispatch_supk.idv	Turn Langdon wind on to 20% Pmax		×
MPC	Upd_Ashtabula_wind_dispatch.idv	Turn Ashtabula Wind on to 20% Pmax	×	
MPC	Upd_Ashtabula_wind_dispatch_supk.idv	Turn Ashtabula Wind on to 20% Pmax		×
MP	Upd_OlivCty.idv	Turn Oliver County 2 Wind on to 20% Pmax, Adjust Arrowhead DC line to 20% of 550 MW	×	
MP	Upd_OlivCty_supk.idv	Turn Oliver County 2 Wind on to 20% Pmax, Adjust Arrowhead DC line to 20% of 550 MW		×
WAPA	WAPA_Add_GI0614a_V31.idv	Add and dispatch generation project GI-0614a (7.5 MW)	×	
WAPA	WAPA_Add_GI0614a_V31_supk.idv	Add and dispatch generation project GI-0614a (7.5 MW)		×
WAPA	WAPA_CoalField_Cruise_V31.idv	Set ND Coal Field generation at Cruise level, delete generation project GI-0108 (terminated)	×	×
WAPA	WAPA_del-GI-0108_V31.idv	Delete generation project GI-0108 (terminated)	×	

TO System	Change Name	Description	SUOP OutYear	SUPK OutYear
WAPA	WAPA_del-GI-0108_V31_supk.idv	Delete generation project GI-0108 (terminated)		×
MISO	Grp5_Upgrades_V31.idv	Add Group 5 restudy Network Upgrades for CMVP scenario	×	×
ATCLLC	ATC_(1731)_Blount-Ruskin-Underground.py	Add Blount-Ruskin-Underground upgrade	×	×
ATCLLC	Update_rating_Zion-PleasantPrairie345kV(1201-1479).py	Update ratings of Zion-Pleasant Prairie 345 kV line	×	×
ATCLLC	ATC_2843_(z2)_Autrain_Uprate[1].py	Add ATC Austrain uprating project	×	×
ATCLLC	Correct_rating_FRY-MUN.py	Correct ratings of Forsyth-Munising 138 kV line	×	×
MP	MP-MISO-2552-Skibo-HoytLakes_MP.py	Add Skibo-Hoyt Lakes project	×	×
SMMPA	SMP-2167-REDWOODFALLS[1].py	Add Redwood Falls project	×	×
MISO	Add_Bison-Wind_V31.idv	Add Bison wind farm and dispatch at 20% of 450 MW	×	×
DPC	i-dpc-chng.idv	DPC transmission line impedance / rating corrections	×	×
GRE	GRE_Fix_Morris-JohnsJct_115.idv	The Morris - Johnson Jct. 115 kV line should have the ratings of 92.2/92.2 MVA	×	×
MRES	MRES_Fix_Ortonvl-JohnsJct_115.idv	The Ortonville - Johnson Jct. 115 kV line should be restored to the original impedance/ratings due to the withdrawal of G618	×	×
MEC	teakwood.py	adds a 161-69 kV transformer at the R32 Walnut wind farm interconnection substation	×	×
MEC	dpp2ratings.idv	changes some MEC line ratings	×	
MEC	dpp2ratings_supk.idv	Change some MEC line ratings		×
MEC	indCrLoad.py	adjusts a large industrial load	×	×
MEC	MEC_Wind_Dispatch_R39.idv	dispatch MEC prior queued wind generation	×	
MEC	MEC_Wind_Dispatch_R39_supk.idv	Dispatch MEC prior queued wind generation at 20%		×
MEC	removePonyCrLoad.py	Adjust a large industrial load at Pony Creek		×
MEC	mecNonWindDispatchR39supk.py	Turn off some peaking units unlikely to be dispatched during 2013 summer peak		×
XEL	XEL_Corrections_V31.idv	Correct ratings and modeling errors in XEL systems	×	×

A.3 Competing Generation Dispatch Assumptions

MISO generating facilities listed in Table A-3 were dispatched to generation in the MISO market outside the study region. This was accomplished by scaling generation in the control areas listed in Table A-5 .

Neighboring queued generating facilities in the study vicinity with completed impact studies were modeled per their transmission provider's criteria as listed in Table A-4.

Table A-3: MISO Competing Generating Facilities

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #
G162	NR	XEL	Noble	MN	Fenton 115 kV	200	Wind	200	40	600068, 600096, 600097, 600098
G164	NR	ITCM	Martin	MN	Lakefield Jct. 345 kV	200	Wind	202.5	40	629001 - 629008
G172	ER	XEL	Mower	MN	Mitchell Co. 345 kV	300	Wind	300	60	631157, 631158
G176	NR	XEL	Lincoln	MN	Yankee 115 kV	100	Wind	100	20	600077, 600099
G251	ER	GRE	Jackson	MN	Chris Juhl 69 kV (West Lakefield 69 kV)	6	Wind	5.7	1.2	617327
G252	NR	GRE	Murray	MN	Chandler Tap 69 kV (Fenton 69 kV)	10	Wind	10	2	618916
G255	NR	XEL	Brookings	SD	Yankee 115 kV	100	Wind	100	20	600069, 600078
G287	NR	XEL	Nobles	MN	Nobles County 115 kV	200	Wind	201	40	600101, 600112, 600113, 600114
G297	ER	MDU	Edmunds	SD	Glenham 115 kV	39	Wind	39	7.8	961004, 961005
G311	ER	MDU	Bowman	ND	Gascoyn 115 kV	19	Wind	19	3.8	961051, 961052
G330	ER	ITCM	Mower	MN	Adams 69 kV	19	Wind	19	3.8	920151
G349	NR	XEL	Lincoln	MN	Yankee 115 kV	200	Wind	200	40	907994, 907995

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #
G358	ER	ITCM	Faribault	MN	Faribault 161 kV (Winco to Winnebago 161 kV)	36	Wind	35	7	629983
G359	ER	MDU	Dickey	ND	Ellendale 230 kV	150	Wind	150	30	961604, 961605
G362	NR	GRE	Mower	MN	Pleasant Valley 161 kV	200	Wind	200	40	915024, 915025
G375	NR	ITCM	Cottonwood	MN	Mountain Lake to Bat Lake 69 kV	20	Wind	19.8	4	629009
G389	NR	GRE	Sherburne	MN	Elk River 69 kV	200	Gas	0	200	615388
G390	NR	GRE	Sherburne	MN	Elk River 69 kV	100	Gas	0	100	615389
G424	ER	MP	St. Louis	MN	Minntac 115 kV	25	Wind	25	5	911999
G426	ER	ITCM	Jackson	MN	Oseola 161 kV (Dickinson 161 kV)	101	Wind	100	20	629010
G442	ER	ITCM	Cottonwood	MN	Storden 69 kV	50	Wind	50	10	932952, 932953
G474	ER	OTP	Grant	MN	Elbow Lake 115 kV	20	Wind	20	4	924998, 924999
G481	ER	OTP	Rolette	ND	Rolette 69 kV	1	Wind	1	0.2	920201, 920202
G514	ER	XEL	Jackson	MN	Lakefield 345 kV	150	Wind	150	30	907998, 907999
G517	ER	ITCM	Cottonwood	MN	Cottonwood 161 kV	130	Wind	130	26	932940, 932941
G518	ER	ITCM	Jackson	MN	West Lakefield 69 kV (Miloma to Round Lake 69 kV)	8	Wind	8	1.6	932937, 932938
G519	NR	MP	Itasca	MN	Blackberry 230 kV	600	Coal	603	603	608619, 608620, 608621
G520	ER	XEL	Lyon	MN	Garvin 115 kV (Lyon County to Lake Yankton 115 kV)	150	Wind	150	30	600117, 600118
G532	ER	ITCM	Cottonwood	MN	Odin 69 kV	20	Wind	20	4	932945, 932946
G536	ER	ITCM	Jackson	MN	West Lakefield 69 kV (Miloma to Round Lake 69 kV)	20	Wind	20	4	932943, 932944

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #
G538	NR	ITCM	Dickinson	IA	Dickinson County 161 kV	50	Wind	50	10	930010, 930011
R1		MEC		IA		112	Wind	112	22.4	635280
R8, R19	NR	MEC	Wright	IA	Wright-Franklin 161 kV	200	Wind	201	40	636238
R13, R19	NR	MEC	SAC	IA	SAC-Little Souix	175	Wind	175	35	635352
R15	NR	MEC	Pocahontas	IA	Pomeroy 161 kV	80	Wind	80	16	636038
R21	NR	MEC	Carroll	IA	Monona-Carroll 161 kV	99	Wind	99	19.8	635312
R22, R35	NR	MEC	Pocahomtas	IA	Pomeroy 161 kV	249	Wind	249	49.8	636027, 636033, 636035
R23	NR	MEC	Crawford	IA	Monona-Carroll 161 kV	100	Wind	100	20	635332
R25	NR	MEC	Crawford	IA	Monona-Carroll 161 kV	50	Wind	50	10	635410
R26	ER	AMRN	Atchinson	MO	Cooper-Booneville 345 kV	400	Wind	80	80	635016, 635020
R31, R45	NR	MEC	Anita	IA	Atlantic-Earlham 161 kV	175	Wind	34.5	34.5	635637, 635638
R32	NR	MEC	Avoca	IA	Avoca-Atlantic 161 kV	150	Wind	30	30	635044, 635045
R33	NR	MEC	Carroll	IA	Carroll 161 kV	150	Wind	150	30	635316, 635317
R34	NR	MEC	Madison	IA	Council Bluffs-Madison County 345 kV	250	Wind	49.5	49.5	635088, 635089
R37	NR	MEC	Charles City	IA	Charles City 69 kV	75	Wind	75	15	636309
R38	NR	MEC	Adair & Guthrie	IA	Council Bluffs - Grimes 345 kV line	200	Wind	40	40	635592
G540	NR	627 ITCM	Worth	IA	Lime Creek-Adams 161 kV	80	Wind	80	16	932997, 932998
G548	NR	627 ITCM	Worth	IA	Lime Creek-Adams 161 kV	80	Wind	80	16	932995, 932996
G549	NR	600 XEL	Pope	MN	Williams-Lake Johanna 69 kV	20	Wind	20	4	900001, 900002
G551	NR	696 WPS	Howard	IA	Rice 161 kV	99	Wind	99	19.8	693756

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #
G555	NR	620 OTP	Stevens	MN	Grant Co.-Morris 115 kV	100	Wind	100	20	920060, 920061
G573	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	80	Wind	80	16	930001, 930002
G574	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	80	Wind	80	16	930004, 930005
G575	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	40	Wind	40	8	930007, 930008
G586	NR	600 XEL	Lincoln	MN	Yankee 115 kV	30	Wind	30	6	900007, 900008
G587	NR	600 XEL	Sibley	MN	Cairo (Gibbon)-Cornish 69 kV	20	Wind	20	4	900010, 900011
G593	NR	627 ITCM	Jackson	MN	Dickinson Co. 161 kV	100	Wind	100	20	932977, 932978
G594	NR	627 ITCM	Jackson	MN	Dickinson Co. 161 kV	50	Wind	50	10	927001, 927002
G595	ER	627 ITCM	Hancock	IA	Lime Creek 161 kV	150	Wind	150	30	927008, 927009
G602	NR	600 XEL	Nobles	MN	Nobles 115 kV	32	Wind	31.5	6.4	900013, 900014
G604	ER	627 ITCM	Steele	MN	Pratt (Steel Center)-River Point 69 kV	44	Wind	44	8.8	932975, 932976
G612	ER	627 ITCM	Story	IA	Fernald-Highland 161 kV	150	Wind	150	30	932949, 932950
G614	NR	627 ITCM	Emmet / Dickinson	IA	Jackson 161 kV	200	Wind	200	40	927004, 927005
G617	ER	627 ITCM	Blue Earth	MN	Willow Creek Tap-Willow Creek 69 kV	50	Wind	49.5	10	932971, 932972
G619	NR	620 OTP	Otter Tail	MN	Tamarck 115 kV	50	Wind	50	10	920012, 920013
G620	ER	600 XEL	Goodhue	MN	Claremont Jct-Kenyon 69 kV	19	Wind	19	3.8	907991, 907992
G621	NR	600 XEL	Pipestone	MN	Rock Tap-South Ridge 69 kV	20	Wind	20	4	900019, 900020
G626	NR	600 XEL	Brown	MN	Morgan-Sleepy Jct. 69 kV	32	Wind	31.5	6.4	900023, 900024
G628	ER	627 ITCM	Brown	MN	Mt. Lake-Comfrey 69 kV	32	Wind	31.5	6.4	932967, 932968
G631	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	3.8	932992, 932993
G632	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	3.8	932989, 932990

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #
G633	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	3.8	932986, 932987
G634	ER	600 XEL	Brookings	SD	Brookings County 115 kV	96	Wind	96	19.2	900026, 900027
G635	ER	620 OTP	Deuel	SD	Toronto 115 kV	101	Wind	100.5	20.1	924978, 924979

Table A-4: Neighboring Queued Generating Facilities

Project ID	Queue	Service Type	County	State	POI	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #	Comments
Ashtabula	MPC Queue	NR	Cass	ND	Maple River 230 kV	428.4	Wind	85.68	85.68	657737, 657985, 657964	
Langdon	MPC Queue	ER	Cavalier	ND	Langdon 115 kV	199.5	Wind	39.9	39.9	620412, 620413, 657600, 657601	
St. Joseph's wind farm	MH Queue	NR	-	Manitoba (Canada)	Letellier 230 kV	138	Wind	48.3	60	667825	
St. Leon wind farm	MH Queue	NR	-	Manitoba (Canada)	St. Leon 230 kV	99	Wind	35	19.8	669830	
G502	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	50	Wind	10	10	608603	MP Oliver Co #1
GS659	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	50	Wind	10	10	608606	MP Oliver Co #2
GS661	Square Butte Queue	NR/ER	Oliver	ND	Square Butte 230 kV Yard	48	Wind	9.6	9.6	608585	MP Oliver Co #3
GS660	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	75.9	Wind	15	15	608594	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS662	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	20	608595	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.

Project ID	Queue	Service Type	County	State	POI	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #	Comments
GS663	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	20	608596	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS664	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	20	608597	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS665	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	17.4	17.4	608598	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS666	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	0	0	608599	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GI-0208	WAPA Queue	Network	LaMoure	ND	Edgeley 115kV [Pomona 115kV]	40.5	Wind	8.1	8.1	659290	TSR
GI-0209	WAPA Queue	Network	Buffalo	ND	Ft Thompson 69kV [Hyde 69kV]	40.5	Wind	8.1	8.1	659291	TSR
GI-0404	WAPA Queue	Network	Dunn	ND	Killdeer	7.5	Biomass	7.5	7.5	659129	TSR
GI-0503	WAPA Queue	NR & ER	Ward	ND	Max-Mallard 115kV	99.9	Wind	20	20	659194	
GI-0508	WAPA Queue	NR & ER	Burleigh	ND	Hilken 230kV (Bismarck-Garrison 230kV #1) [Ecklund 230kV]	49.5	Wind	10	9.9	659294	
GI-0614a	WAPA Queue	Network	Roosevelt	MT	Culbertson 115kV	7.5	Biomass	7.5	7.5	659270-2	TSR

Project ID	Queue	Service Type	County	State	POI	Pmax (MW)	Fuel Type	SUOP Dispatch	SUPK Dispatch	Bus #	Comments
GI-0614	WAPA Queue	NR & ER	Mountrail	ND	Tioga-Logan 230kV	99	Wind	0	0	923121, 923122	suspend
GI-0615	WAPA Queue	NR & ER	Burleigh	ND	Hilken 230kV (Bismarck-Garrison 230kV #1) [Ecklund 230kV]	49.5	Wind	10	9.9	659294	

A.4 Study Sink for Steady State Analysis

Table A-5: Study Sink for Steady State Analysis

Area #	Area Name
207	HE
208	DEM
210	SIGE
216	IPL
217	NIPS
218	METC
219	ITC
295	WEC
333	CWLD
356	AMMO
357	AMIL
360	CWLP

Area #	Area Name
361	SIPC
600	XEL
608	MP
613	SMMPA
615	GRE
620	OTP
680	DPC
694	ALTE
696	WPS
697	MGE
698	UPPC

Final Report

Appendix

B

Model Data

B.1 Steady State Analysis Model Data

```
DATA FOR BUS 635399 [R39  TP3    345.00] RESIDING IN AREA  627, ZONE  665, OWNER  627:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01879  74.19

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1 OWN2 FRAC2
OWN3 FRAC3 OWN4 FRAC4
 631138 LAKEFLD3    345.00  1   0.00277  0.02740  0.43719  1  T   864.0  864.0  864.0    0.0       1 1.000
 635200 RAUN   3    345.00  1   0.00313  0.03090  0.49301  1  F   864.0  864.0  864.0    0.0       1 1.000
 635400 R39    3    345.00  1   0.00021  0.00208  0.03322  1  F   859.0  859.0    0.0    0.0     627 1.000
 935000 R67         345.00  1   0.00000  0.00001  0.00000  1  F   157.0  157.0  157.0    1.0     888 1.000


 DATA FOR BUS 635400 [R39    3    345.00] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.01807  74.76

 X------- TO BUS --------X
   BUS# X-- NAME --X BASKV CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1 OWN2 FRAC2
OWN3 FRAC3 OWN4 FRAC4
 635399 R39  TP3    345.00  1   0.00021  0.00208  0.03322  1  T   859.0  859.0    0.0    0.0     627 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635401 R39_1  9    34.500  1              1 T T 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0
 635402 R39_2  9    34.500  1              1 T T 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0
 635403 R39_3  9    34.500  1              1 T T 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635401 R39_1  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000
 635402 R39_2  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000
 635403 R39_3  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000

 X------- TO BUS --------X     W C                                       X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635401 R39_1  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33
 635402 R39_2  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33
 635403 R39_3  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33


 DATA FOR BUS 635401 [R39_1  9    34.500] RESIDING IN AREA  635, ZONE  635, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02299  83.46

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635400 R39    3    345.00  1              1 F F 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0
 635404 R39   1W    0.5750  1              1 F F 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635400 R39    3    345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000
 635404 R39   1W    0.5750  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                       X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635400 R39    3    345.00  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33
 635404 R39   1W    0.5750  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33
```

```
 DATA FOR BUS 635402 [R39_2  9    34.500] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02299  83.46

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635400 R39    3    345.00  1               1 F F 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0
 635405 R39   2W    0.5750  1               1 F F 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635400 R39    3    345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000
 635405 R39   2W    0.5750  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                       X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635400 R39    3    345.00  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33
 635405 R39   2W    0.5750  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33


 DATA FOR BUS 635403 [R39_3  9    34.500] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02292  83.54

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635400 R39    3    345.00  1               1 F F 1 1  0.01200  0.09500  100.0  0.00000  0.00000  0
 635406 R39   3W    0.5750  1               1 F F 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635400 R39    3    345.00  1  1 1.00000 0.0000    0.0 1.00000 0.0000  187.0  187.0  187.0  635 1.000
 635406 R39   3W    0.5750  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                       X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635400 R39    3    345.00  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33
 635406 R39   3W    0.5750  1  F 1  0 1.10000 0.90000 1.10000 0.90000   33


 DATA FOR BUS 635404 [R39   1W    0.5750] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02960  86.13

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     166.5     4.7    52.0   -52.0 1.02960 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4 WMOD   WPF
 W1 1  166.5    4.7   52.0  -52.0  185.4 0.0000 0.8000 0.0000 0.0000 1.0000  166.5    0.0  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635401 R39_1  9    34.500  1               1 T T 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635401 R39_1  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                       X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635401 R39_1  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33


 DATA FOR BUS 635405 [R39   2W    0.5750] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02960  86.13

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     166.5     4.7    52.0   -52.0 1.02960 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4 WMOD   WPF
 W2 1  166.5    4.7   52.0  -52.0  185.4 0.0000 0.8000 0.0000 0.0000 1.0000  166.5    0.0  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
```

```
 635402 R39_2  9    34.500  1               1 T T 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635402 R39_2  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635402 R39_2  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33


 DATA FOR BUS 635406 [R39   3W    0.5750] RESIDING IN AREA  635, ZONE  679, OWNER  635:

 CODE PLOAD   QLOAD     I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0 1.02960  86.23

                                                X--------- REMOTE BUS ----------X
 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED  PCT Q   BUS# X-- NAME --X BASKV VOLTAGE
     168.0     4.9    52.5   -52.5 1.02960 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4 WMOD   WPF
 W3 1  168.0    4.9   52.5  -52.5  187.0 0.0000 0.8000 0.0000 0.0000 1.0000  168.0    0.0  635 1.000

 X------- TO BUS --------X        XFRMER    S W M C C      SPECIFIED              MAGNETIZING Y        TBL CORRECTED
   BUS# X-- NAME --X BASKV CKT X-- NAME --X T 1 T Z M   R 1-2    X 1-2  SBAS1-2   MAG1     MAG2  TBL  R 1-2    X 1-2
 635403 R39_3  9    34.500  1               1 T T 1 1  0.00393  0.02954  100.0  0.00000  0.00000  0

 X------- TO BUS --------X     C
   BUS# X-- NAME --X BASKV CKT W  WINDV1  NOMV1  ANGLE  WINDV2  NOMV2  RATEA  RATEB  RATEC OWN1 FRAC1 OWN2 FRAC2 OWN3
FRAC3 OWN4 FRAC4
 635403 R39_3  9    34.500  1  1 1.00000 0.0000    0.0 1.00000 0.0000  196.0  196.0    0.0  635 1.000

 X------- TO BUS --------X     W C                                        X---- CONTROLLED BUS ----X
   BUS# X-- NAME --X BASKV CKT 1 W CN   RMAX    RMIN    VMAX    VMIN  NTPS    BUS# X-- NAME --X BASKV    CR      CX
 635403 R39_3  9    34.500  1  T 1  0 1.10000 0.90000 1.10000 0.90000   33
```

B.2 Stability Analysis Model Data

R39 Dynamic

```
PLANT MODELS

 REPORT FOR ALL MODELS                        BUS 63922 [R39_G2  0.5750] MODELS


 ** GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
             63922     R39_G2   0.5750 1  179834-179846  61015-61019   34210-34231   17107

     XEQ        LA        LM        R1        L1        H         DAMP
   0.8000    0.1714    2.9040    0.0050    0.1563    0.5580    0.0000

      -SLIP        TIpcmd      TEqcmd
       0.2000      0.0200      0.0200

      Kpll        PLLMX      PLLMN
      30.0000      0.1000     -0.1000



 ** GECNA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
                        63922     R39_G2   0.5750 1  179873-179898  61030-61039   34276-34285   17110-17113

     TFV      KPV      KIV       RC        XC        TFP         KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    2.7000

     KIP       PMX     PMN        QMX        QMN      IPMAX     TRV
   0.5400    1.0100    0.0900    0.2960   -0.4390    1.1100    0.0500

     RPMX      RPMN    T_POWER
   0.4000   -0.4000    5.0000

     KQi     VMINCL    VMAXCL    KVi    XIQmin    XIQmax
   0.0500    0.9000    1.1000   40.0000 -0.5000    0.4000

     Tv       Tp          Fn
   0.0500    0.0500    1.0000


                Remote controlled Bus #     63976
                VARFLG =  1 PFAFLG =  0

PLANT MODELS

 REPORT FOR ALL MODELS                        BUS 63926 [R39_G1  0.5750] MODELS


 ** GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
             63926     R39_G1   0.5750 1  179847-179859  61020-61024   34232-34253   17108

     XEQ        LA        LM        R1        L1        H         DAMP
   0.8000    0.1714    2.9040    0.0050    0.1563    0.5580    0.0000

      -SLIP        TIpcmd      TEqcmd
       0.2000      0.0200      0.0200

      Kpll        PLLMX      PLLMN
      30.0000      0.1000     -0.1000



 ** GECNA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
                        63926     R39_G1   0.5750 1  179899-179924  61040-61049   34286-34295   17114-17117

     TFV      KPV      KIV       RC        XC        TFP         KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    2.7000

     KIP       PMX     PMN        QMX        QMN      IPMAX     TRV
   0.5400    1.0100    0.0900    0.2960   -0.4390    1.1100    0.0500

     RPMX      RPMN    T_POWER
   0.4000   -0.4000    5.0000

     KQi     VMINCL    VMAXCL    KVi    XIQmin    XIQmax
   0.0500    0.9000    1.1000   40.0000 -0.5000    0.4000

     Tv       Tp          Fn
```

```
  0.0500    0.0500    1.0000


               Remote controlled Bus #     63976
               VARFLG =  1 PFAFLG =  0

PLANT MODELS

 REPORT FOR ALL MODELS                        BUS 63930 [R39_G3  0.5750] MODELS


 ** GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
            63930     R39_G3   0.5750 1  179860-179872  61025-61029   34254-34275   17109

     XEQ        LA        LM        R1        L1        H         DAMP
  0.8000    0.1714    2.9040    0.0050    0.1563    0.5580    0.0000

      -SLIP        TIpcmd      TEqcmd
       0.2000      0.0200      0.0200

      Kpll        PLLMX      PLLMN
      30.0000      0.1000     -0.1000



 ** GECNA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S        VAR         ICON
                        63930     R39_G3   0.5750 1  179925-179950  61050-61059   34296-34305   17118-17121

     TFV      KPV      KIV       RC        XC        TFP         KPP
  0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    2.7000

     KIP       PMX     PMN        QMX        QMN      IPMAX     TRV
  0.5400    1.0100    0.0900    0.2960   -0.4390    1.1100    0.0500

     RPMX      RPMN    T_POWER
  0.4000   -0.4000    5.0000

     KQi     VMINCL    VMAXCL    KVi    XIQmin    XIQmax
  0.0500    0.9000    1.1000   40.0000 -0.5000    0.4000

     Tv       Tp          Fn
  0.0500    0.0500    1.0000


               Remote controlled Bus #     63976
               VARFLG =  1 PFAFLG =  0

CONEC MODELS

 REPORT FOR ALL MODELS                        BUS 63922 [R39_G2  0.5750] MODELS


                *** CALL WGUSTA( 17122,179951,     0, 34306) ***


  ** WGUSTA ** BUS X-- NAME --X BASEKV MC    C O N S       V A R S        ICONS
            63922 R39_G2       0.5750 1  179951-179957  34306-34308   17122-17123

     VWB     T1G      TG    MAXG     T1R     T2R    MAXR
 12.0009999.000   5.000  30.0009999.0009999.000  30.000

              Wind generator Bus #  63922
              Wind Generator ID        1


 ** W2MSFA for a machine **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63922     R39_G2   0.5750 1  179958-179962   61060-61061   34309-34311   17124-17126

          D12       K12         Ta1            p         Rq
      1.3500       1.0000       7.7840       3.0000      72.0000


              Wind Generator Bus #  63922
              Wind Generator ID        1


 ** GEAERA for GEDFA **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        63922     R39_G2   0.5750 1  179963-179974   61062-61062   34312-34315   17127-17129

     VWinit      Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta
      12.0000      20.0000       0.0000      27.0000      -4.0000       0.0000

      RHO       Radius          GB_RATIO     SYNCHR       Power_Rate      MBASE1
      1.2250      35.2500      72.0000       1200.0       1500.0       1.6670
```

```
              Wind Generator Bus #  63922
              Wind Generator ID        1


 ** GEPCHA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63922     R39_G2   0.5750 1  179975-179984   61063-61065   34316-34318   17130-17132

        Tp            Kpp        Kip           Kpc           Kic
       0.3000     150.0000      25.0000       3.0000      30.0000
         TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
         -4.0000   27.0000  -10.0000   10.0000    0.9100


              Wind Generator Bus #  63922
              Wind Generator ID        1

CONEC MODELS

 REPORT FOR ALL MODELS                        BUS 63926 [R39_G1  0.5750] MODELS


                *** CALL WGUSTA( 17133,179985,     0, 34319) ***


  ** WGUSTA ** BUS X-- NAME --X BASEKV MC    C O N S       V A R S        ICONS
            63926 R39_G1       0.5750 1  179985-179991  34319-34321   17133-17134

     VWB     T1G      TG    MAXG     T1R     T2R    MAXR
  12.0009999.000   5.000  30.0009999.0009999.000  30.000

              Wind generator Bus #  63926
              Wind Generator ID        1


 ** W2MSFA for a machine **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63926     R39_G1   0.5750 1  179992-179996   61066-61067   34322-34324   17135-17137

           D12       K12         Ta1            p         Rq
       1.3500       1.0000       7.7840       3.0000      72.0000


              Wind Generator Bus #  63926
              Wind Generator ID        1


 ** GEAERA for GEDFA **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        63926     R39_G1   0.5750 1  179997-180008   61068-61068   34325-34328   17138-17140

     VWinit      Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta
      12.0000      20.0000       0.0000      27.0000      -4.0000       0.0000

       RHO       Radius          GB_RATIO     SYNCHR       Power_Rate      MBASE1
       1.2250      35.2500      72.0000       1200.0       1500.0       1.6670


              Wind Generator Bus #  63926
              Wind Generator ID        1


 ** GEPCHA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63926     R39_G1   0.5750 1  180009-180018   61069-61071   34329-34331   17141-17143

        Tp            Kpp        Kip           Kpc           Kic
       0.3000     150.0000      25.0000       3.0000      30.0000
         TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
         -4.0000   27.0000  -10.0000   10.0000    0.9100


              Wind Generator Bus #  63926
              Wind Generator ID        1

CONEC MODELS

 REPORT FOR ALL MODELS                        BUS 63930 [R39_G3  0.5750] MODELS


                *** CALL WGUSTA( 17144,180019,     0, 34332) ***


  ** WGUSTA ** BUS X-- NAME --X BASEKV MC    C O N S       V A R S        ICONS
            63930 R39_G3       0.5750 1  180019-180025  34332-34334   17144-17145

     VWB     T1G      TG    MAXG     T1R     T2R    MAXR
  12.0009999.000   5.000  30.0009999.0009999.000  30.000

              Wind generator Bus #  63930
              Wind Generator ID        1
```

```
 ** W2MSFA for a machine **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63930     R39_G3   0.5750 1  180026-180030   61072-61073   34335-34337   17146-17148

           D12       K12         Ta1            p         Rq
       1.3500       1.0000       7.7840       3.0000      72.0000


               Wind Generator Bus #  63930
               Wind Generator ID        1


 ** GEAERA for GEDFA **      BUS X-- NAME --X BASEKV MC    C O N S        STATE         VAR         ICON
                        63930     R39_G3   0.5750 1  180031-180042   61074-61074   34338-34341   17149-17151

     VWinit      Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta
      12.0000      20.0000       0.0000      27.0000      -4.0000       0.0000

       RHO       Radius          GB_RATIO     SYNCHR       Power_Rate      MBASE1
       1.2250      35.2500      72.0000       1200.0       1500.0       1.6670


               Wind Generator Bus #  63930
               Wind Generator ID        1


 ** GEPCHA for GEDFA **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR         ICON
                        63930     R39_G3   0.5750 1  180043-180052   61075-61077   34342-34344   17152-17154

        Tp            Kpp        Kip            Kpc           Kic
       0.3000     150.0000      25.0000       3.0000      30.0000
         TetaMin   TetaMax   RTetaMin   RTetaMax    PMX
         -4.0000   27.0000  -10.0000   10.0000    0.9100


               Wind Generator Bus #  63930
               Wind Generator ID        1

CONET MODELS

 REPORT FOR ALL MODELS                        BUS 63922 [R39_G2  0.5750] MODELS


               *** CALL VTGTPA( 17155,180053,     0, 34345) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               63922 R39_G2  .575           63922 R39_G2  .575    1

                    I C O N S      C O N S       V A R
                   17155-17160  180053-180056   34345

                      VLO       VUP      PICKUP     TB
                      0.300     5.000     0.200     0.080


               *** CALL VTGTPA( 17161,180057,     0, 34346) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               63922 R39_G2  .575           63922 R39_G2  .575    1

                    I C O N S      C O N S       V A R
                   17161-17166  180057-180060   34346

                      VLO       VUP      PICKUP     TB
                      0.600     5.000     1.800     0.080


               *** CALL VTGTPA( 17167,180061,     0, 34347) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               63922 R39_G2  .575           63922 R39_G2  .575    1

                    I C O N S      C O N S       V A R
                   17167-17172  180061-180064   34347

                      VLO       VUP      PICKUP     TB
                      0.800     5.000     3.400     0.080


               *** CALL VTGTPA( 17173,180065,     0, 34348) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
               63922 R39_G2  .575           63922 R39_G2  .575    1

                    I C O N S      C O N S       V A R
                   17173-17178  180065-180068   34348
```

```
       VLO       VUP      PICKUP     TB
       0.900     5.000     4.470     0.080


 *** CALL VTGTPA( 17179,180069,     0, 34349) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63922 R39_G2  .575           63922 R39_G2  .575    1

     I C O N S      C O N S       V A R
    17179-17184  180069-180072   34349

       VLO       VUP      PICKUP     TB
       0.000     1.100     1.000     0.080


 *** CALL VTGTPA( 17185,180073,     0, 34350) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63922 R39_G2  .575           63922 R39_G2  .575    1

     I C O N S      C O N S       V A R
    17185-17190  180073-180076   34350

       VLO       VUP      PICKUP     TB
       0.000     1.150     0.100     0.080


 *** CALL VTGTPA( 17191,180077,     0, 34351) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63922 R39_G2  .575           63922 R39_G2  .575    1

     I C O N S      C O N S       V A R
    17191-17196  180077-180080   34351

       VLO       VUP      PICKUP     TB
       0.000     1.300     0.020     0.080


 *** CALL FRQTPA( 17197,180081,     0, 34352) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63922  R39_G2    .575       63922  R39_G2    .575    1

     I C O N S      C O N S       V A R
    17197-17202  180081-180084   34352

       FLO       FUP      PICKUP     TB
      56.500    66.000     0.020     0.080


 *** CALL FRQTPA( 17203,180085,     0, 34353) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63922  R39_G2    .575       63922  R39_G2    .575    1

     I C O N S      C O N S       V A R
    17203-17208  180085-180088   34353

       FLO       FUP      PICKUP     TB
      57.500    66.000    10.000     0.080


 *** CALL FRQTPA( 17209,180089,     0, 34354) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63922  R39_G2    .575       63922  R39_G2    .575    1

     I C O N S      C O N S       V A R
    17209-17214  180089-180092   34354

       FLO       FUP      PICKUP     TB
      54.000    61.500    30.000     0.080


 *** CALL FRQTPA( 17215,180093,     0, 34355) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63922  R39_G2    .575       63922  R39_G2    .575    1

     I C O N S      C O N S       V A R
    17215-17220  180093-180096   34355

       FLO       FUP      PICKUP     TB
      54.000    62.500     0.020     0.080
```

```
CONET MODELS

 REPORT FOR ALL MODELS                        BUS 63926 [R39_G1  0.5750] MODELS


              *** CALL VTGTPA( 17221,180097,     0, 34356) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17221-17226  180097-180100   34356

                     VLO       VUP      PICKUP     TB
                     0.300     5.000     0.200     0.080


              *** CALL VTGTPA( 17227,180101,     0, 34357) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17227-17232  180101-180104   34357

                     VLO       VUP      PICKUP     TB
                     0.600     5.000     1.800     0.080


              *** CALL VTGTPA( 17233,180105,     0, 34358) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17233-17238  180105-180108   34358

                     VLO       VUP      PICKUP     TB
                     0.800     5.000     3.400     0.080


              *** CALL VTGTPA( 17239,180109,     0, 34359) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17239-17244  180109-180112   34359

                     VLO       VUP      PICKUP     TB
                     0.900     5.000     4.470     0.080


              *** CALL VTGTPA( 17245,180113,     0, 34360) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17245-17250  180113-180116   34360

                     VLO       VUP      PICKUP     TB
                     0.000     1.100     1.000     0.080


              *** CALL VTGTPA( 17251,180117,     0, 34361) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17251-17256  180117-180120   34361

                     VLO       VUP      PICKUP     TB
                     0.000     1.150     0.100     0.080


              *** CALL VTGTPA( 17257,180121,     0, 34362) ***

                BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
              63926 R39_G1  .575           63926 R39_G1  .575    1

                   I C O N S      C O N S       V A R
                 17257-17262  180121-180124   34362

                     VLO       VUP      PICKUP     TB
```

```
                0.000     1.300     0.020     0.080

          *** CALL FRQTPA( 17263,180125,     0, 34363) ***

            BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
          63926  R39_G1    .575       63926  R39_G1    .575    1

              I C O N S      C O N S       V A R
             17263-17268  180125-180128   34363

                FLO       FUP      PICKUP     TB
               56.500    66.000     0.020     0.080


          *** CALL FRQTPA( 17269,180129,     0, 34364) ***

            BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
          63926  R39_G1    .575       63926  R39_G1    .575    1

              I C O N S      C O N S       V A R
             17269-17274  180129-180132   34364

                FLO       FUP      PICKUP     TB
               57.500    66.000    10.000     0.080


          *** CALL FRQTPA( 17275,180133,     0, 34365) ***

            BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
          63926  R39_G1    .575       63926  R39_G1    .575    1

              I C O N S      C O N S       V A R
             17275-17280  180133-180136   34365

                FLO       FUP      PICKUP     TB
               54.000    61.500    30.000     0.080


          *** CALL FRQTPA( 17281,180137,     0, 34366) ***

            BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
          63926  R39_G1    .575       63926  R39_G1    .575    1

              I C O N S      C O N S       V A R
             17281-17286  180137-180140   34366

                FLO       FUP      PICKUP     TB
               54.000    62.500     0.020     0.080

CONET MODELS

 REPORT FOR ALL MODELS                        BUS 63930 [R39_G3  0.5750] MODELS


          *** CALL VTGTPA( 17287,180141,     0, 34367) ***

            BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
          63930 R39_G3  .575           63930 R39_G3  .575    1

              I C O N S      C O N S       V A R
             17287-17292  180141-180144   34367

                VLO       VUP      PICKUP     TB
                0.300     5.000     0.200     0.080


          *** CALL VTGTPA( 17293,180145,     0, 34368) ***

            BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
          63930 R39_G3  .575           63930 R39_G3  .575    1

              I C O N S      C O N S       V A R
             17293-17298  180145-180148   34368

                VLO       VUP      PICKUP     TB
                0.600     5.000     1.800     0.080


          *** CALL VTGTPA( 17299,180149,     0, 34369) ***

            BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
          63930 R39_G3  .575           63930 R39_G3  .575    1

              I C O N S      C O N S       V A R
             17299-17304  180149-180152   34369
```

```
       VLO       VUP      PICKUP     TB
       0.800     5.000     3.400     0.080


 *** CALL VTGTPA( 17305,180153,     0, 34370) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63930 R39_G3  .575           63930 R39_G3  .575    1

     I C O N S      C O N S       V A R
    17305-17310  180153-180156   34370

       VLO       VUP      PICKUP     TB
       0.900     5.000     4.470     0.080


 *** CALL VTGTPA( 17311,180157,     0, 34371) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63930 R39_G3  .575           63930 R39_G3  .575    1

     I C O N S      C O N S       V A R
    17311-17316  180157-180160   34371

       VLO       VUP      PICKUP     TB
       0.000     1.100     1.000     0.080


 *** CALL VTGTPA( 17317,180161,     0, 34372) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63930 R39_G3  .575           63930 R39_G3  .575    1

     I C O N S      C O N S       V A R
    17317-17322  180161-180164   34372

       VLO       VUP      PICKUP     TB
       0.000     1.150     0.100     0.080


 *** CALL VTGTPA( 17323,180165,     0, 34373) ***

  BUS   NAME  BSKV        GENR BUS   NAME  BSKV   ID
63930 R39_G3  .575           63930 R39_G3  .575    1

     I C O N S      C O N S       V A R
    17323-17328  180165-180168   34373

       VLO       VUP      PICKUP     TB
       0.000     1.300     0.020     0.080


 *** CALL FRQTPA( 17329,180169,     0, 34374) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63930  R39_G3    .575       63930  R39_G3    .575    1

     I C O N S      C O N S       V A R
    17329-17334  180169-180172   34374

       FLO       FUP      PICKUP     TB
      56.500    66.000     0.020     0.080


 *** CALL FRQTPA( 17335,180173,     0, 34375) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63930  R39_G3    .575       63930  R39_G3    .575    1

     I C O N S      C O N S       V A R
    17335-17340  180173-180176   34375

       FLO       FUP      PICKUP     TB
      57.500    66.000    10.000     0.080


 *** CALL FRQTPA( 17341,180177,     0, 34376) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63930  R39_G3    .575       63930  R39_G3    .575    1

     I C O N S      C O N S       V A R
    17341-17346  180177-180180   34376

       FLO       FUP      PICKUP     TB
      54.000    61.500    30.000     0.080
```

```
*** CALL FRQTPA( 17347,180181,     0, 34377) ***

  BUS    NAME    BSKV      GEN BUS   NAME   BSKV   ID
63930  R39_G3    .575       63930  R39_G3    .575    1

    I C O N S      C O N S       V A R
   17347-17352  180181-180184   34377

      FLO       FUP      PICKUP     TB
    54.000    62.500     0.020     0.080
```

R39 Power Flow

```
DATA FOR BUS 63975 [R39_TP   345] RESIDING IN AREA 331, ZONE 393, OWNER 331:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 1.01960 106.13

 X-------TO-------X CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1 OWN2 FRAC2
OWN3 FRAC3 OWN4 FRAC4
 34006 LAKEFLD3 345  1   0.00277  0.02740  0.43719  1  T   859.0  859.0    0.0    0.0       1 1.000
 63875 RAUN   3 345  1   0.00313  0.03090  0.49301  1  F   859.0  859.0    0.0    0.0       1 1.000
 63976 R39_NEW  345  1   0.00021  0.00208  0.03322  1  F   859.0  859.0    0.0    0.0     331 1.000

 X-------TO-------X CKT    LINE G,B (FROM)     LINE G,B (TO)   STATUS
 34006 LAKEFLD3 345  1    0.00000  0.00000   0.00000 -0.50000     1


 DATA FOR BUS 63976 [R39_NEW  345] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 1.02000 106.69

 X-------TO-------X CKT   LINE R   LINE X CHARGING ST MET RATE-A RATE-B RATE-C LENGTH ZI OWN1 FRAC1 OWN2 FRAC2
OWN3 FRAC3 OWN4 FRAC4
 63975 R39_TP   345  1   0.00021  0.00208  0.03322  1  T   859.0  859.0    0.0    0.0     331 1.000

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63971 R39_1   34.5  1           T T 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000
 63973 R39_2   34.5  1           T T 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000
 63974 R39_3   34.5  1           T T 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63971 R39_1   34.5  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
 63973 R39_2   34.5  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
 63974 R39_3   34.5  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63971 [R39_1   34.5] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 0.98923 115.18

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63926 R39_G1  .575  1           F F 1 1 1 1  0.00388  0.02908  100.0  0.0000  0.0000  196.0  196.0    0.0
635 1.000
 63976 R39_NEW  345  1           F F 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63926 R39_G1  .575  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
 63976 R39_NEW  345  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63973 [R39_2   34.5] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 0.98933 115.10

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63922 R39_G2  .575  1           F F 1 1 1 1  0.00391  0.02934  100.0  0.0000  0.0000  194.2  194.2    0.0
635 1.000
```

```
 63976 R39_NEW  345  1           F F 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63922 R39_G2  .575  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
 63976 R39_NEW  345  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63974 [R39_3   34.5] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  1     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 0.98926 115.10

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63930 R39_G3  .575  1           F F 1 1 1 1  0.00395  0.02961  100.0  0.0000  0.0000  192.5  192.5    0.0
635 1.000
 63976 R39_NEW  345  1           F F 1 1 1 1  0.01200  0.09500  100.0  0.0000  0.0000  187.0  187.0  187.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63930 R39_G3  .575  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
 63976 R39_NEW  345  1  0.9500 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63926 [R39_G1  .575] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 1.00122 117.96

 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED X-    REMOTE BUS     VOLTAGE  Q PCT-X
     168.0    22.9    55.2   -55.2 1.02000 63976 [R39_NEW  345] 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OW1 FRAC1 OW2 FRAC2
OW3 FRAC3 OW4 FRAC4
 1  1  168.0   22.9   55.2  -55.2  187.0 0.0000 0.8000 0.0000 0.0000 1.0000  168.0    7.8 635 1.000

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63971 R39_1   34.5  1           T T 1 1 1 1  0.00388  0.02908  100.0  0.0000  0.0000  196.0  196.0    0.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63971 R39_1   34.5  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63922 [R39_G2  .575] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 1.00136 117.88

 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED X-    REMOTE BUS     VOLTAGE  Q PCT-X
     166.5    22.9    54.7   -54.7 1.02000 63976 [R39_NEW  345] 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OW1 FRAC1 OW2 FRAC2
OW3 FRAC3 OW4 FRAC4
 1  1  166.5   22.9   54.7  -54.7  185.4 0.0000 0.8000 0.0000 0.0000 1.0000  166.5    7.8 635 1.000

                                W M S C C C
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63973 R39_2   34.5  1           T T 1 1 1 1  0.00391  0.02934  100.0  0.0000  0.0000  194.2  194.2    0.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63973 R39_2   34.5  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33


 DATA FOR BUS 63930 [R39_G3  .575] RESIDING IN AREA 635, ZONE 635, OWNER 635:

 CODE PLOAD   QLOAD   I - L O A D     Y - L O A D G-SHUNT B-SHUNT VOLTAGE  ANGLE
  2     0.0     0.0    0.0    0.0     0.0     0.0     0.0     0.0 1.00140 117.90

 PLNT PGEN    QGEN    QMAX    QMIN  VSCHED X-    REMOTE BUS     VOLTAGE  Q PCT-X
     166.5    22.9    54.7   -54.7 1.02000 63976 [R39_NEW  345] 1.02000 100.00

 ID ST  PGEN   QGEN   QMAX   QMIN  MBASE  Z S O R C E    X T R A N   GENTAP   PMAX   PMIN OW1 FRAC1 OW2 FRAC2
OW3 FRAC3 OW4 FRAC4
 1  1  166.5   22.9   54.7  -54.7  185.4 0.0000 0.8000 0.0000 0.0000 1.0000  166.5    7.8 635 1.000

                                W M S C C C
```

```
 X-------TO-------X CKT X-NAME-X 1 T T Z W M   R 1-2    X 1-2  WBASE1   MAG1    MAG2  RATE-A RATE-B RATE-C
OWN1 FRAC1 OWN2 FRAC2 OWN3 FRAC3 OWN4 FRAC4
 63974 R39_3   34.5  1           T T 1 1 1 1  0.00395  0.02961  100.0  0.0000  0.0000  192.5  192.5    0.0
635 1.000

 X-------TO-------X CKT WINDV1 NOMV1 ANGLE WINDV2 NOMV2 CN  RMAX   RMIN   VMAX   VMIN  NTPS X--CONTROLLED BUS-
X    CR      CX  TBL    NOMINAL R,X
 63974 R39_3   34.5  1  1.0000 0.000   0.0 1.0000 0.000  0 1.1000 0.9000 1.1000 0.9000   33
```

B.3 Slider Diagrams

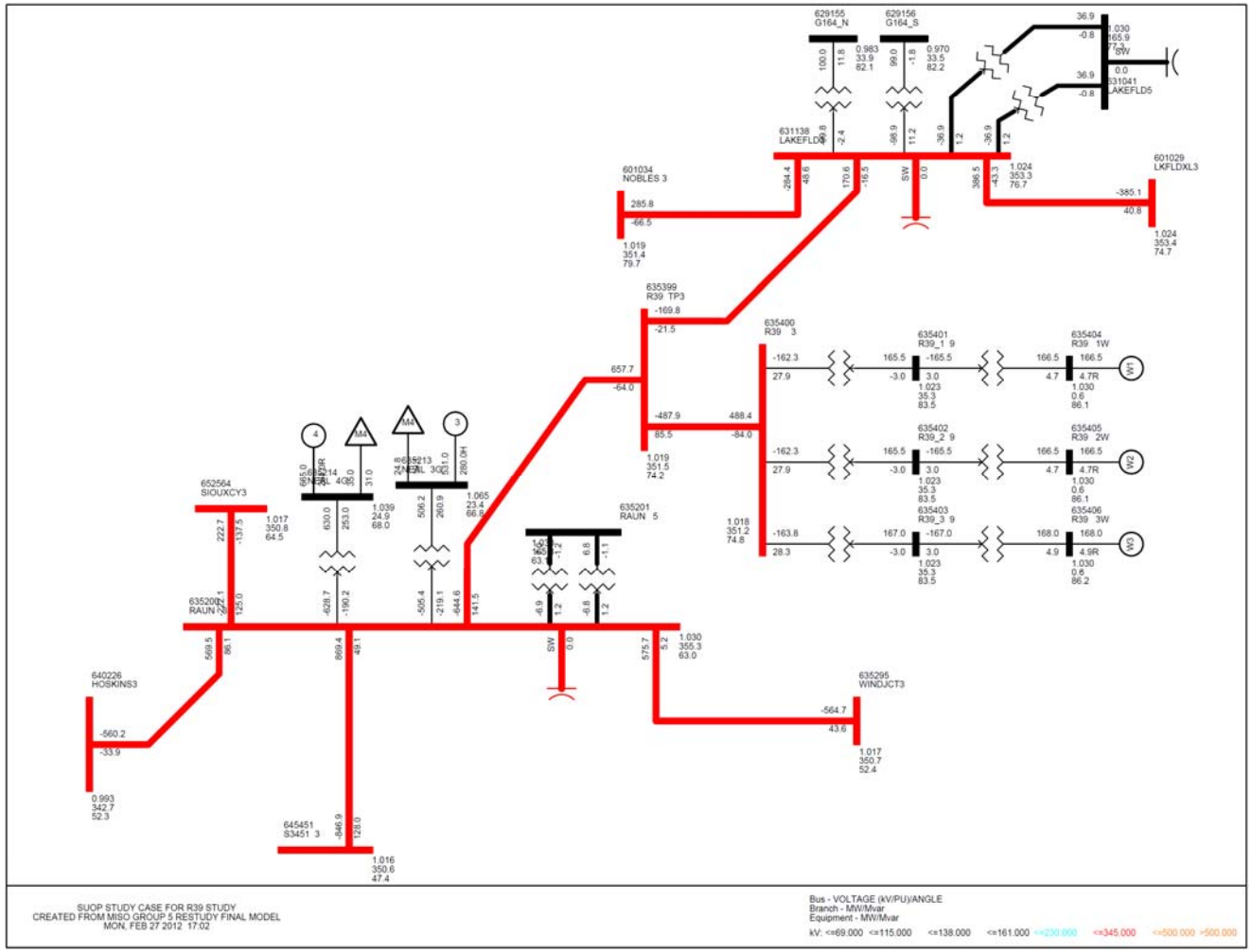

Figure B-1: Slider Diagram for R39 in SUOP Study Case

This page intentionally left blank.

Final Report

Appendix

C

Steady State AC Contingency Analysis Results

C.1 Summer Off Peak Contingency Analysis Results

Table C-1: Out Year SUOP System Intact Thermal Violations

Table C-2: Out Year SUOP System Intact Voltage Violations

Table C-3: Out Year SUOP Contingency Analysis Thermal Violations

Table C-4: Out Year SUOP Contingency Analysis Voltage Violations

Table C-1: Out Year SUOP System Intact Thermal Violations

Monitored Element	From CA	To CA	Rating (MVA)	Benchmark Case		Study Case		Contingency	R39 500 NR	GIP With Impact
				Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)			
No constraints										

Table C-2: Out Year SUOP System Intact Voltage Violations

Monitored Bus	Area	Vlow	Vhi	Benchmark Case		Study Case		delta	Contingency
				Vcont	Vbase	Vcont	Vbase		
No Constraints									

Table C-3: Out Year SUOP Contingency Analysis Thermal Violations

Monitored Element	From CA	To CA	Rating		Benchmark Case		Study Case		Contingency	Type	R39	GIP With Impact
											500	
			N/E	MVA	Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)			NR	
No constraints												

Table C-4: Out Year SUOP Contingency Analysis Voltage Violations

Monitored Bus	Area	Vlow	Vhi	Benchmark Case		Study Case		delta	Contingency
				Vcont	Vbase	Vcont	Vbase		
No Constraints									

This page intentionally left blank.

C.2 Summer Peak Contingency Analysis Results

Table C-5: Out Year SUPK System Intact Thermal Violations

Table C-6: Out Year SUPK System Intact Voltage Violations

Table C-7: Out Year SUPK Contingency Analysis Thermal Violations

Table C-8: Out Year SUPK Contingency Analysis Voltage Violations

Table C-5: Out Year SUPK System Intact Thermal Violations

Monitored Element	From CA	To CA	Rating (MVA)	Benchmark Case		Study Case		Contingency	R39 500 NR	GIP With Impact
				Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)			
No constraints										

Table C-6: Out Year SUPK System Intact Voltage Violations

Monitored Bus	Area	Vlow	Vhi	Benchmark Case		Study Case		delta	Contingency
				Vcont	Vbase	Vcont	Vbase		
No Constraints									

Table C-7: Out Year SUPK Contingency Analysis Thermal Violations

Monitored Element	From CA	To CA	Rating		Benchmark Case		Study Case		Contingency	Type	R39	GIP With Impact
											500	
			N/E	MVA	Pre Loading (MVA)	Pre Loading (%)	Post Loading (MVA)	Post Loading (%)			NR	
No constraints												

Table C-8: Out Year SUPK Contingency Analysis Voltage Violations

Monitored Bus	Area	Vlow	Vhi	Benchmark Case		Study Case		delta	Contingency
				Vcont	Vbase	Vcont	Vbase		
No Constraints									

This page intentionally left blank.

Final Report

Appendix D

Model Development for Stability Analysis

D.1 Stability Model Changes and Updates

Table D-1: Model Changes and Updates

TO System	Change Name	Description
MISO	Initialization_correction.idv	Correct the initialization issues in the original snapshot
MPC	Rem_Winger_2_3_tfmr.idv	Remove 2nd and 3rd 230/115/13 transformer at winger
MPC	Add_Karlstad_115_14Mvar.idv	Add 2*7 MVar capacitors at the Karlstad 115 kV bus
MPC	Add_Center_GrandForks_345.idv	Add the center -- Grand Forks 345KV project
MRES	Add_Alex-Bison_345_40Mvar.idv	Add 40 Mvar line reactor at the Alexandria - Bison 345 kV line
Xcel	Rep_Alex_345_115_Tfmr.idv	Replace Alexandria 345/115 kV two winding transformer with a three winding transformer and add a 50 Mvar switch shunt at the tertiary
MPC	Add_2ndThiefRiverFall_15Mvar_cap.idv	Add second 15 Mvar capacitor to Thief River Falls
MPC	Upd_LangdonWind.idv	Turn off Langdon wind generation
OTP	Set_Solway_Pmax.idv	Turn on Solway generation
Xcel	Add_Monticelo_exp.idv	Add Monticello G929 Expansion
GRE	Add_CoalCrk_G876_G877.idv	Add coal creek G876 and G877
NPPD	Add_Postrock-Spearvil_345.idv	Add Postrock-Spearvil 345 line
MISO	Rem_G608.idv	Remove group 5 project G608
MISO	Rem_G618.idv	Remove group 5 project G618
MP	Upd_OlivCty.idv	Add Oliver Co. #3 unit. Dispatch Oliver Co. #1, #2, #3 wind generation at 20%.
WAPA	WAPA_Add_GI0614a_V29.idv	Add and dispatch generation project GI-0614a
MISO	Grp5_Upgrades_V29.idv	Add Group 5 restudy Network Upgrades for CMVP scenario
ATCLLC	ATC_(1731)_Blount-Ruskin-Underground.idv	Add Blount-Ruskin-Underground upgrade
ATCLLC	ATC_2843_(z2)_Autrain_Uprate[1].idv	Add ATC Austrain uprating project
MP	MP-MISO-2552-Skibo-HoytLakes_MP.idv	Add Skibo-Hoyt Lakes project

TO System	Change Name	Description
SMMPA	SMP-2167-REDWOODFALLS[1].py	Add Redwood Falls project
MISO	Add_Bison-Wind_V29.idv	Add Bison wind farm and dispatch at 20%
DPC	i-dpc-chng_V29.idv	DPC transmission line impedance / rating corrections
MISO	Adjust_SquareButte_DC_20pct.idc	Adjust square Butte dc at 20% of 550 MW due to Bison and Oliver Co. dispatch at 20%
MEC	teakwood.idv	adds a 161-69 kV transformer at the R32 Walnut wind farm interconnection substation
MEC	dpp2ratings.idv	changes some MEC line ratings
MEC	indCrLoad.idv	adjusts a large industrial load
MEC	Add_R31-R45_V29.idv	add and dispatch R31/R45
MEC	Add_R32_V29.idv	add and dispatch R32
MEC	Add_R33_V29.idv	add and dispatch R33
MEC	Add_R37_V29.idv	add and dispatch R37
MEC	Add R34_V29.idv	add and dispatch R34
MEC	Add_R38_V29.idv	add and dispatch R38
MEC	Add_Windjct_V29.idv	add Wind Junction tap bus on Raun-Lehigh 345 kV line
MISO	Add_Zion-Pls PR_2CKT.idv	add MISO MVP project Zion-Pleasant Prairie 2nd circuit
MISO	Add_R39_V29.idv	add and dispatch R39 generation project

D.2 Competing Generation Dispatch Assumptions in Stability Model

MISO generating facilities listed in Table D-2 were dispatched to generation in the MISO market outside the study region. This was accomplished by scaling generation in the control areas listed in Table D-4 .

Neighboring queued generating facilities in the study vicinity with completed impact studies were modeled per their transmission provider's criteria as listed in Table D-3.

Table D-2: MISO Competing Generating Facilities

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #
G162	NR	XEL	Noble	MN	Fenton 115 kV	200	Wind	200	60066, 60067, 60068, 60069
G164	NR	ITCM	Martin	MN	Lakefield Jct. 345 kV	200	Wind	200	91017-91024
G172	ER	XEL	Mower	MN	Mitchell Co. 345 kV	300	Wind	300	91172
G176	NR	XEL	Lincoln	MN	Yankee 115 kV	100	Wind	100	99995, 99996
G251	ER	GRE	Jackson	MN	Chris Juhl 69 kV (West Lakefield 69 kV)	6	Wind	5.7	62371
G252	NR	GRE	Murray	MN	Chandler Tap 69 kV (Fenton 69 kV)	10	Wind	10	95252
G255	NR	XEL	Brookings	SD	Yankee 115 kV	100	Wind	100	91025-91028
G287	NR	XEL	Nobles	MN	Nobles County 115 kV	200	Wind	201	91036-91043
G297	ER	MDU	Edmunds	SD	Glenham 115 kV	39	Wind	0	67335
G311	ER	MDU	Bowman	ND	Gascoyn 115 kV	19	Wind	0	67350
G330	ER	ITCM	Mower	MN	Adams 69 kV	19	Wind	19	91330
G349	NR	XEL	Lincoln	MN	Yankee 115 kV	200	Wind	200	91048-91055
G358	ER	ITCM	Faribault	MN	Faribault 161 kV (Winco to Winnebago 161 kV)	36	Wind	36	95358

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #
G359	ER	MDU	Dickey	ND	Ellendale 230 kV	150	Wind	0	67326
G362	NR	GRE	Mower	MN	Pleasant Valley 161 kV	200	Wind	200	63999
G375	NR	ITCM	Cottonwood	MN	Mountain Lake to Bat Lake 69 kV	20	Wind	19.8	3015
G389	NR	GRE	Sherburne	MN	Elk River 69 kV	200	Gas	0	63020
G390	NR	GRE	Sherburne	MN	Elk River 69 kV	100	Gas	0	63020
G424	ER	MP	St. Louis	MN	Minntac 115 kV	25	Wind	25	91710
G426	ER	ITCM	Jackson	MN	Oseola 161 kV (Dickinson 161 kV)	101	Wind	100	95428
G442	ER	ITCM	Cottonwood	MN	Storden 69 kV	50	Wind	50	95442
G474	ER	OTP	Grant	MN	Elbow Lake 115 kV	20	Wind	21	92474
G481	ER	OTP	Rolette	ND	Rolette 69 kV	1	Wind	0	63305
G514	ER	XEL	Jackson	MN	Lakefield 345 kV	150	Wind	150	99514
G517	ER	ITCM	Cottonwood	MN	Cottonwood 161 kV	130	Wind	130	91363
G518	ER	ITCM	Jackson	MN	West Lakefield 69 kV (Miloma to Round Lake 69 kV)	8	Wind	8	96518
G519	NR	MP	Itasca	MN	Blackberry 230 kV	600	Coal	603	68617-68619
G520	ER	XEL	Lyon	MN	Garvin 115 kV (Lyon County to Lake Yankton 115 kV)	150	Wind	150	95520
G532	ER	ITCM	Cottonwood	MN	Odin 69 kV	20	Wind	20	96532
G536	ER	ITCM	Jackson	MN	West Lakefield 69 kV (Miloma to Round Lake 69 kV)	20	Wind	21	96536
G538	NR	ITCM	Dickinson	IA	Dickinson County 161 kV	50	Wind	50	96538
R1		MEC		IA		112	Wind	112	63906
R8, R19	NR	MEC	Wright	IA	Wright-Franklin 161 kV	200	Wind	201	64315

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #
R13, R19	NR	MEC	SAC	IA	SAC-Little Souix	175	Wind	175	63912
R15	NR	MEC	Pocahontas	IA	Pomeroy 161 kV	80	Wind	80	64234
R21	NR	MEC	Carroll	IA	Monona-Carroll 161 kV	99	Wind	99	63980
R22, R35	NR	MEC	Pocahomtas	IA	Pomeroy 161 kV	249	Wind	249	64217
R23	NR	MEC	Crawford	IA	Monona-Carroll 161 kV	100	Wind	100	63983
R25	NR	MEC	Crawford	IA	Monona-Carroll 161 kV	50	Wind	50	63986
R26	ER	AMRN	Atchinson	MO	Cooper-Booneville 345 kV	400	Wind	80	63993
R29	NR	MEC	Crawford	IA	Schleswig Substation	100	Wind	0	63981
R31, R45	NR	MEC	Anita	IA	Atlantic-Earlham 161 kV	175	Wind	34.5	63987, 63788, 63758
R32	NR	MEC	Avoca	IA	Avoca-Atlantic 161 kV	150	Wind	30	63988, 63989
R33	NR	MEC	Carroll	IA	Carroll 161 kV	150	Wind	150	63900
R34	NR	MEC	Madison	IA	Council Bluffs-Madison County 345 kV	250	Wind	49.5	93914, 93994
R37	NR	MEC	Charles City	IA	Charles City 69 kV	75	Wind	75	64219
R38	NR	MEC	Adair & Guthrie	IA	Council Bluffs - Grimes 345 kV line	200	Wind	40	88381
G540	NR	627 ITCM	Worth	IA	Lime Creek-Adams 161 kV	80	Wind	80	90999
G548	NR	627 ITCM	Worth	IA	Lime Creek-Adams 161 kV	80	Wind	80	90994
G549	NR	600 XEL	Pope	MN	Williams-Lake Johanna 69 kV	20	Wind	20	90993
G551	NR	696 WPS	Howard	IA	Rice 161 kV	99	Wind	99	90991
G555	NR	620 OTP	Stevens	MN	Grant Co.-Morris 115 kV	100	Wind	100.5	99989
G573	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	80	Wind	80	90107

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #
G574	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	80	Wind	80	90106
G575	NR	627 ITCM	Franklin	IA	Iowa Falls-Franklin 161 kV	40	Wind	40	90105
G586	NR	600 XEL	Lincoln	MN	Yankee 115 kV	30	Wind	29.4	99981
G587	NR	600 XEL	Sibley	MN	Cairo (Gibbon)-Cornish 69 kV	20	Wind	21	99980
G593	NR	627 ITCM	Jackson	MN	Dickinson Co. 161 kV	100	Wind	100	99976
G594	NR	627 ITCM	Jackson	MN	Dickinson Co. 161 kV	50	Wind	50	99974
G595	ER	627 ITCM	Hancock	IA	Lime Creek 161 kV	150	Wind	150	34899
G602	NR	600 XEL	Nobles	MN	Nobles 115 kV	32	Wind	31.5	99971
G604	ER	627 ITCM	Steele	MN	Pratt (Steel Center)-River Point 69 kV	44	Wind	44	99969
G612	ER	627 ITCM	Story	IA	Fernald-Highland 161 kV	150	Wind	150	99965
G614	NR	627 ITCM	Emmet / Dickinson	IA	Jackson 161 kV	200	Wind	200	99962, 99963
G617	ER	627 ITCM	Blue Earth	MN	Willow Creek Tap-Willow Creek 69 kV	50	Wind	49.5	90960
G619	NR	620 OTP	Otter Tail	MN	Tamarck 115 kV	50	Wind	50	99957
G620	ER	600 XEL	Goodhue	MN	Claremont Jct-Kenyon 69 kV	19	Wind	19	99956
G621	NR	600 XEL	Pipestone	MN	Rock Tap-South Ridge 69 kV	20	Wind	20	99954
G626	NR	600 XEL	Brown	MN	Morgan-Sleepy Jct. 69 kV	32	Wind	31.5	99953
G628	ER	627 ITCM	Brown	MN	Mt. Lake-Comfrey 69 kV	32	Wind	31.5	99951
G631	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	99949
G632	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	99947
G633	ER	627 ITCM	Nobles	MN	Magnolia-Elk 161 kV	19	Wind	18.9	99946
G634	ER	600 XEL	Brookings	SD	Brookings County 115 kV	96	Wind	100	99944

MISO Prj #	Service Type	Control Area	County	State	POI Modeled	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #
G635	ER	620 OTP	Deuel	SD	Toronto 115 kV	101	Wind	100.5	99943

Table D-3: Neighboring Queued Generating Facilities

Project ID	Queue	Service Type	County	State	POI	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #	Comments
Ashtabula	MPC Queue	NR	Cass	ND	Maple River 230 kV	428.4	Wind	0	66985, 66964	
Langdon	MPC Queue	ER	Cavalier	ND	Langdon 115 kV	199.5	Wind	0	66881, 66883	
St. Joseph's wind farm	MH Queue	NR	-	Manitoba (Canada)	Letellier 230 kV	300	Wind	300	67825	
St. Leon wind farm	MH Queue	NR	-	Manitoba (Canada)	St. Leon 230 kV	99	Wind	99	67816	
G502	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	50	Wind	10.12	61603	MP Oliver Co #1
GS659	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	50	Wind	9.9	61606	MP Oliver Co #2
GS661	Square Butte Queue	NR/ER	Oliver	ND	Square Butte 230 kV Yard	48	Wind	9.6	66733	MP Oliver Co #3
GS660	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	75.9	Wind	15	69594	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS662	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	69595	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS663	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	69596	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS664	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	20	69597	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GS665	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	17.4	69598	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.

Project ID	Queue	Service Type	County	State	POI	Pmax (MW)	Fuel Type	Stability Dispatch	Bus #	Comments
GS666	Square Butte Queue	NR	Oliver	ND	Square Butte 230 kV Yard	101.2	Wind	0	69599	OC1, 2 and Bison 1-6 Fill up the 550 MW DC.
GI-0208	WAPA Queue	Network	LaMoure	ND	Edgeley 115kV [Pomona 115kV]	40.5	Wind	10.5	67292	TSR
GI-0209	WAPA Queue	Network	Buffalo	ND	Ft Thompson 69kV [Hyde 69kV]	40.5	Wind	7.5	67293	TSR
GI-0404	WAPA Queue	Network	Dunn	ND	Killdeer	7.5	Biomass	7.5	67266	TSR
GI-0503	WAPA Queue	NR & ER	Ward	ND	Max-Mallard 115kV	99.9	Wind	22.5	67157	
GI-0508	WAPA Queue	NR & ER	Burleigh	ND	Hilken 230kV (Bismarck-Garrison 230kV #1) [Ecklund 230kV]	49.5	Wind	10.5	67295	
GI-0614a	WAPA Queue	Network	Roosevelt	MT	Culbertson 115kV	7.5	Biomass	7.5	67300	TSR
GI-0614	WAPA Queue	NR & ER	Mountrail	ND	Tioga-Logan 230kV	99	Wind	0	92614	suspend
GI-0615	WAPA Queue	NR & ER	Burleigh	ND	Hilken 230kV (Bismarck-Garrison 230kV #1) [Ecklund 230kV]	49.5	Wind	10.5	67255	

Final Report

D.3 Study Sink for Stability Analysis

Table D-4: Study Sink for Stability Analysis

Area #	Area Name	Area #	Area Name
207	HE	360	CWLP
208	DEM	361	SIPC
210	SIGE	600	XEL
216	IPL	608	MP
217	NIPS	613	SMMPA
218	METC	618	GRE
219	ITC	626	OTP
365	WEC	680	DPC
355	CWLD	364	ALTE
356	AMMO	366	WPS
357	AMIL	367	MGE
359	CILC	368	UPPC

Final Report

Appendix

E

Stability Analysis Results – Summary Tables

This Appendix summarizes the dynamic performance of the R39 study model.

Table E-1: Power Flow and Stability Summary Table

R39 POWER FLOW AND STABILITY SUMMARY TABLE

Schuster Exhibit ___ (PJS-1), Schedule 1

1	**Case No.**	1	2	3	4
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-zss	R39-so15aa.withCMVPP1c1r0-ei2	R39-so15aa.withCMVPP1c1r0-mts	R39-so15aa.withCMVPP1c1r0-wls
3	**Disturbance**	zss	ei2	mts	wls
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	JAN 10 2012 22:28	FEB 08 2012 19:12	FEB 10 2012 10:06	FEB 09 2012 14:27
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 297	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1635 / 697	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1821 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 10	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	346%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.02 | 1.02	0.97 | 1.05	0.96 | 1.04	0.99 | 1.03
35	Boise 115	1.02 | 1.02	0.97 | 1.05	1.00 | 1.06	1.00 | 1.02
36	Dorsey 230	1.04 | 1.04	1.03 | 1.06	1.03 | 1.06	1.04 | 1.05
37	Forbes 230	1.01 | 1.01	0.96 | 1.03	0.99 | 1.03	1.00 | 1.02
38	Riverton 230	1.02 | 1.02	0.90 | 1.06	0.97 | 1.05	0.96 | 1.04
39	Coal Creek 230	1.03 | 1.03	0.98 | 1.14	0.95 | 1.07	0.96 | 1.09
40	Jamestown 345	0.96 | 0.96	0.73 | 1.05	0.89 | 1.02	0.84 | 1.01
41	Drayton 230	1.02 | 1.02	0.91 | 1.11	1.00 | 1.06	0.96 | 1.06
42	Groton 345	1.01 | 1.01	0.86 | 1.08	0.94 | 1.03	0.95 | 1.03
43	Minong 161	1.04 | 1.04	1.02 | 1.10	0.96 | 1.07	1.02 | 1.06
44	Wahpeton 115	1.03 | 1.03	0.85 | 1.10	0.97 | 1.07	0.94 | 1.06
45	Watertown 345	1.02 | 1.02	0.91 | 1.07	0.97 | 1.03	0.97 | 1.03
46	**Dynamic Voltage Warnings**				
47		none		none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping		SHERC3 / 34.62%	SHERC3 / 76.42%	KING 3 / 70.88%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	507%	507%	273%	486%
57	K22W (max +dP @ t, d-ang)	0.0@(0.12500,0.0)	75.3@(2.69999,-30.8)	24.9@(3.53331,-3.9)	17.4@(3.51664,-4.8)
58	K22W (max -dP @ t, d-ang)	0.0@(4.94995,0.0)	9.3@(0.60000,1.7)	37.6@(0.70833,14.3)	10.6@(0.54166,2.2)
59	K22W (max d-ang @ t, dP)	0.0@(4.96662,0.0)	-48.9@(10.00821,35.4)	22.5@(1.13333,-34.3)	-5.9@(2.86665,13.3)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	225% / 355%	138% / 211%	174% / 270%	191% / 300%
63	82R at Rugby/L20D at Drayton	999% / 944%	999% / 527%	999% / 697%	999% / 864%
64	R50M / F3M	790% / 999%	584% / 227%	612% / 317%	706% / 317%
65	B10T	346%	72%	173%	253%
66	**FSCAPS (SS/Unav/Final)**				
67	Balta 230	(0 | 0 | 0)	(0 | 1 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 1) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 |10 | 0) / (0 | 3 | 0)	(0 | 1 | 0) / (0 | 2 | 1)	(0 | 3 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 2 | 0) / (0 | 1 | 0)	(0 | 1 | 0) / (0 | 0 | 0)	(0 | 1 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 2 | 1) / (1 | 5 | 1)	(1 | 2 | 1) / (1 | 4 | 2)	(1 | 1 | 1) / (1 | 4 | 4)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-zss	R39-so15aa.withCMVPP1c1r0-ei2	R39-so15aa.withCMVPP1c1r0-mts	R39-so15aa.withCMVPP1c1r0-wls
Disturbance	zss	ei2	mts	wls
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	5	6	7	8
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-nmz	nad	R39-so15aa.withCMVPP1c1r0-pas	R39-so15aa.withCMVPP1c1r0-pcs
3	**Disturbance**	nmz	nad	pas	pcs
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 19:37	FEB 08 2012 19:42	FEB 08 2012 19:48	FEB 08 2012 19:53
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	0.94 | 1.08	1.01 | 1.07	1.02 | 1.07	0.90 | 0.98
35	Boise 115	0.94 | 1.03	0.91 | 1.04	0.95 | 1.04	1.01 | 1.05
36	Dorsey 230	1.04 | 1.17	1.04 | 1.15	1.04 | 1.18	1.04 | 1.06
37	Forbes 230	0.98 | 1.03	0.99 | 1.03	0.99 | 1.05	0.98 | 1.04
38	Riverton 230	0.89 | 1.05	0.95 | 1.06	0.95 | 1.05	1.01 | 1.03
39	Coal Creek 230	0.92 | 1.08	0.98 | 1.09	0.97 | 1.09	0.98 | 1.08
40	Jamestown 345	0.77 | 1.02	0.84 | 1.02	0.85 | 1.01	0.92 | 1.00
41	Drayton 230	0.97 | 1.08	0.96 | 1.08	0.98 | 1.06	1.01 | 1.05
42	Groton 345	0.88 | 1.05	0.94 | 1.04	0.94 | 1.03	0.99 | 1.02
43	Minong 161	0.99 | 1.12	1.05 | 1.11	1.04 | 1.11	0.85 | 0.99
44	Wahpeton 115	0.87 | 1.08	0.93 | 1.08	0.93 | 1.07	1.01 | 1.05
45	Watertown 345	0.92 | 1.04	0.97 | 1.04	0.97 | 1.04	1.01 | 1.03
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	KING 3 / 22.31%	KING 3 / 29.93%	KING 3 / 33.68%	KING 3 / 31.73%
55	Dorsey SUVP / UdHold	/ 0.133	/ 0.133	/ 0.150	
56	Forbes DC Red (DCAR)	507%	507%	507%	150%
57	K22W (max +dP @ t, d-ang)	115.4@(2.59999,-54.2)	116.6@(1.96666,-50.1)	99.6@(1.98333,-47.2)	0.0@(0.10000,0.0)
58	K22W (max -dP @ t, d-ang)	86.3@(0.23333,7.1)	111.9@(0.25833,11.5)	88.9@(0.27500,7.6)	66.8@(1.76666,26.3)
59	K22W (max d-ang @ t, dP)	-73.6@(10.00821,44.3)	-80.5@(10.00821,46.5)	-76.7@(10.00821,48.2)	26.7@(1.98333,-60.5)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	0.18333 sec / 0.18333 sec	0.16667 sec / 0.16667 sec	0.38333 sec / 0.18333 sec	217% / 345%
63	82R at Rugby/L20D at Drayton	999% / 440%	999% / 413%	999% / 468%	999% / 726%
64	R50M / F3M	335% / 183%	270% / 144%	323% / 192%	683% / 999%
65	B10T	68%	131%	144%	252%
66	**FSCAPS (SS/Unav/Final)**				
67	Balta 230	(0 | 1 | 0)	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 0) / (3 | 3 | 3)	(3 | 3 | 1) / (3 | 3 | 3)	(3 | 3 | 0) / (3 | 3 | 3)	(3 | 4 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 5 | 0) / (0 | 3 | 0)	(0 | 5 | 0) / (0 | 0 | 0)	(0 | 2 | 1) / (0 | 1 | 0)	(0 | 0 | 0) / (0 | 1 | 1)
70	Roseau 230 / Running 230	(0 | 1 | 0) / (0 | 1 | 0)	(0 | 1 | 0) / (0 | 2 | 0)	(0 | 1 | 0) / (0 | 1 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 4 | 2) / (1 | 5 | 4)	(1 | 5 | 3) / (1 | 5 | 3)	(1 | 3 | 2) / (1 | 5 | 4)	(1 | 1 | 1) / (1 | 2 | 2)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-nmz	R39-so15aa.withCMVPP1c1r0-nad	R39-so15aa.withCMVPP1c1r0-pas	R39-so15aa.withCMVPP1c1r0-pcs
Disturbance	nmz	nad	pas	pcs
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping	(5T)(6T)	(5T)(6T)	(5T)(6T)	

R39 POWER FLOW AND STABILITY SUMMARY TABLE

Schuster Exhibit ___ (PJS-1), Schedule 1

1	**Case No.**	9	10	11	12
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-pys	R39-so15aa.withCMVPP1c1r0-ya3	R39-so15aa.withCMVPP1c1r0-yas	R39-so15aa.withCMVPP1c1r0-swz
3	**Disturbance**	pys	ya3	yas	swz
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 19:59	FEB 08 2012 20:04	FEB 08 2012 20:09	FEB 08 2012 20:14
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.00 | 1.04	1.05 | 1.07	1.00 | 1.02	1.00 | 1.02
35	Boise 115	1.00 | 1.04	1.02 | 1.04	1.02 | 1.05	1.01 | 1.03
36	Dorsey 230	1.03 | 1.07	1.04 | 1.05	1.04 | 1.07	1.04 | 1.05
37	Forbes 230	1.00 | 1.05	1.01 | 1.03	1.00 | 1.04	1.00 | 1.02
38	Riverton 230	1.01 | 1.04	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
39	Coal Creek 230	0.98 | 1.07	1.02 | 1.04	1.02 | 1.04	1.01 | 1.05
40	Jamestown 345	0.91 | 1.00	0.96 | 0.98	0.95 | 0.98	0.94 | 0.97
41	Drayton 230	1.01 | 1.04	1.02 | 1.04	1.02 | 1.04	1.01 | 1.03
42	Groton 345	0.98 | 1.02	1.00 | 1.01	1.00 | 1.01	1.00 | 1.02
43	Minong 161	0.99 | 1.07	1.03 | 1.06	0.97 | 1.05	1.02 | 1.05
44	Wahpeton 115	1.00 | 1.05	1.02 | 1.04	1.02 | 1.04	1.01 | 1.03
45	Watertown 345	1.01 | 1.03	1.01 | 1.02	1.02 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 75.85%	SHERC3 / 24.53%	SHERC3 / 33.63%	STANT4 / 66.04%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	271%	282%	366%	436%
57	K22W (max +dP @ t, d-ang)	15.5@(3.45831,-1.8)	1.6@(0.10833,0.7)	1.2@(0.10833,0.3)	5.8@(3.44164,0.2)
58	K22W (max -dP @ t, d-ang)	31.6@(1.65833,9.9)	36.5@(1.75833,16.8)	29.0@(1.69166,12.8)	18.8@(1.73333,4.6)
59	K22W (max d-ang @ t, dP)	17.5@(1.07500,-26.3)	17.9@(2.09999,-34.3)	13.4@(1.99166,-25.5)	8.3@(1.09166,-10.0)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	187% / 291%	223% / 355%	219% / 348%	202% / 317%
63	82R at Rugby/L20D at Drayton	999% / 730%	999% / 843%	999% / 847%	999% / 864%
64	R50M / F3M	640% / 999%	790% / 999%	790% / 999%	705% / 999%
65	B10T	206%	291%	293%	297%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 2 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 2 | 2)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-pys	R39-so15aa.withCMVPP1c1r0-ya3	R39-so15aa.withCMVPP1c1r0-yas	R39-so15aa.withCMVPP1c1r0-swz
Disturbance	pys	ya3	yas	swz
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	13	14	15	16
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-wss	R39-so15aa.withCMVPP1c1r0-snz	R39-so15aa.withCMVPP1c1r0-sns	R39-so15aa.withCMVPP1c1r0-nns
3	**Disturbance**	wss	snz	sns	nns
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 20:18	FEB 08 2012 20:23	FEB 08 2012 20:28	FEB 08 2012 20:33
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
35	Boise 115	1.01 | 1.03	1.01 | 1.03	1.01 | 1.03	1.01 | 1.03
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.05	1.02 | 1.05	1.02 | 1.04	1.02 | 1.04
40	Jamestown 345	0.95 | 0.97	0.95 | 0.97	0.95 | 0.97	0.95 | 0.97
41	Drayton 230	1.01 | 1.03	1.01 | 1.03	1.02 | 1.03	1.02 | 1.03
42	Groton 345	1.00 | 1.02	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.02 | 1.05	1.02 | 1.05	1.03 | 1.04	1.03 | 1.05
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	STANT4 / 76.98%	STANT4 / 75.73%	STANT4 / 58.29%	ANTEL3 / 82.76%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	438%	441%	453%	459%
57	K22W (max +dP @ t, d-ang)	6.8@(2.49999,1.4)	7.5@(3.42497,-1.5)	0.8@(2.48332,2.6)	6.2@(2.44166,0.0)
58	K22W (max -dP @ t, d-ang)	14.8@(1.77500,2.8)	12.7@(1.71666,2.7)	12.2@(1.79166,2.8)	7.8@(0.73333,2.7)
59	K22W (max d-ang @ t, dP)	7.8@(1.10000,-8.8)	6.5@(1.06666,-7.5)	5.4@(1.13333,-6.0)	4.0@(1.05000,-4.2)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	199% / 312%	206% / 323%	209% / 330%	210% / 331%
63	82R at Rugby/L20D at Drayton	999% / 842%	999% / 854%	999% / 881%	999% / 863%
64	R50M / F3M	699% / 999%	719% / 999%	732% / 999%	738% / 999%
65	B10T	278%	295%	307%	295%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-wss	R39-so15aa.withCMVPP1c1r0-snz	R39-so15aa.withCMVPP1c1r0-sns	R39-so15aa.withCMVPP1c1r0-nns
Disturbance	wss	snz	sns	nns
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	17	18	19	20
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-ssz	R39-so15aa.withCMVPP1c1r0-sss	R39-so15aa.withCMVPP1c1r0-nlz	R39-so15aa.withCMVPP1c1r0-nls
3	**Disturbance**	ssz	sss	nlz	nls
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 20:38	FEB 08 2012 20:43	FEB 08 2012 20:49	FEB 08 2012 20:54
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
35	Boise 115	1.01 | 1.03	1.01 | 1.03	1.01 | 1.03	1.01 | 1.02
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.01
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.02 | 1.04	1.02 | 1.04	1.03 | 1.04
40	Jamestown 345	0.95 | 0.97	0.95 | 0.97	0.95 | 0.96	0.95 | 0.96
41	Drayton 230	1.01 | 1.03	1.02 | 1.03	1.01 | 1.03	1.02 | 1.02
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.02 | 1.04	1.03 | 1.04	1.03 | 1.05	1.04 | 1.04
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03	1.02 | 1.02
45	Watertown 345	1.01 | 1.02	1.02 | 1.02	1.01 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	STANT4 / 64.70%	STANT4 / 60.51%	STANT4 / 72.99%	STANT4 / 55.21%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	439%	455%	474%	498%
57	K22W (max +dP @ t, d-ang)	3.8@(3.51664,0.5)	0.8@(2.45832,2.5)	4.6@(3.42497,-0.9)	0.6@(3.49997,0.2)
58	K22W (max -dP @ t, d-ang)	18.6@(1.74166,4.8)	12.3@(1.77500,2.8)	9.3@(1.73333,2.2)	4.3@(1.77500,1.0)
59	K22W (max d-ang @ t, dP)	8.2@(1.10833,-9.9)	5.4@(1.10833,-6.2)	4.6@(1.10000,-6.0)	1.9@(1.12500,-2.6)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	204% / 320%	209% / 330%	209% / 328%	216% / 341%
63	82R at Rugby/L20D at Drayton	999% / 869%	999% / 885%	999% / 901%	999% / 935%
64	R50M / F3M	709% / 999%	733% / 999%	735% / 999%	764% / 999%
65	B10T	300%	306%	319%	338%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-ssz	R39-so15aa.withCMVPP1c1r0-sss	R39-so15aa.withCMVPP1c1r0-nlz	R39-so15aa.withCMVPP1c1r0-nls
Disturbance	ssz	sss	nlz	nls
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

Schuster Exhibit ___ (PJS-1), Schedule 1

1	**Case No.**	21	22	23	24
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-vts	R39-so15aa.withCMVPP1c1r0-wds	R39-so15aa.withCMVPP1c1r0-wts	R39-so15aa.withCMVPP1c1r0-lgs
3	**Disturbance**	vts	wds	wts	lgs
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 20:59	FEB 08 2012 21:04	FEB 08 2012 21:10	FEB 08 2012 21:15
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.00 | 1.03	1.00 | 1.04	1.01 | 1.04	1.01 | 1.03
35	Boise 115	1.01 | 1.02	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.00 | 1.01	1.00 | 1.02	1.00 | 1.02	1.00 | 1.01
38	Riverton 230	1.00 | 1.01	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.01 | 1.05	1.01 | 1.05	1.01 | 1.05	1.02 | 1.05
40	Jamestown 345	0.93 | 0.96	0.93 | 0.96	0.94 | 0.96	0.94 | 0.96
41	Drayton 230	1.01 | 1.02	1.00 | 1.02	1.01 | 1.02	1.01 | 1.02
42	Groton 345	1.00 | 1.01	0.99 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.03 | 1.06	1.02 | 1.07	1.03 | 1.07	1.03 | 1.06
44	Wahpeton 115	1.00 | 1.02	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
45	Watertown 345	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 73.28%	KING 3 / 55.70%	KING 3 / 49.02%	KING 3 / 73.68%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	496%	507%	507%	476%
57	K22W (max +dP @ t, d-ang)	14.1@(3.15831,-4.5)	29.3@(2.70832,-13.1)	27.4@(2.73332,-13.2)	11.0@(3.29164,-3.7)
58	K22W (max -dP @ t, d-ang)	5.9@(1.07500,1.9)	7.3@(0.23333,0.8)	5.7@(0.30833,0.8)	7.4@(0.92500,3.5)
59	K22W (max d-ang @ t, dP)	-5.2@(3.63330,10.5)	-16.6@(9.95821,12.6)	-16.9@(9.99988,12.8)	-3.8@(3.57497,9.0)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	198% / 311%	187% / 293%	192% / 301%	203% / 319%
63	82R at Rugby/L20D at Drayton	999% / 925%	999% / 843%	999% / 865%	999% / 913%
64	R50M / F3M	722% / 331%	704% / 304%	705% / 305%	731% / 999%
65	B10T	326%	275%	283%	328%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 1 | 1)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-vts	R39-so15aa.withCMVPP1c1r0-wds	R39-so15aa.withCMVPP1c1r0-wts	R39-so15aa.withCMVPP1c1r0-lgs
Disturbance	vts	wds	wts	lgs
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	25	26	27	28
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-fbs	R39-so15aa.withCMVPP1c1r0-01s	R39-so15aa.withCMVPP1c1r0-02s	R39-so15aa.withCMVPP1c1r0-03s
3	**Disturbance**	fbs	01s	02s	03s
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 08 2012 21:20	FEB 09 2012 16:48	FEB 09 2012 16:53	FEB 09 2012 16:58
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.02 | 1.02	1.00 | 1.03	0.99 | 1.02	0.99 | 1.04
35	Boise 115	1.02 | 1.02	1.00 | 1.04	1.00 | 1.04	1.00 | 1.04
36	Dorsey 230	1.04 | 1.04	1.04 | 1.06	1.03 | 1.06	1.03 | 1.06
37	Forbes 230	1.01 | 1.01	1.00 | 1.03	1.00 | 1.03	1.00 | 1.03
38	Riverton 230	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
39	Coal Creek 230	1.03 | 1.03	1.02 | 1.04	1.02 | 1.04	1.02 | 1.05
40	Jamestown 345	0.96 | 0.96	0.94 | 0.97	0.95 | 0.97	0.94 | 0.97
41	Drayton 230	1.02 | 1.02	1.01 | 1.04	1.01 | 1.04	1.00 | 1.04
42	Groton 345	1.01 | 1.01	1.00 | 1.01	1.00 | 1.01	0.99 | 1.02
43	Minong 161	1.04 | 1.04	1.01 | 1.05	1.00 | 1.05	0.99 | 1.07
44	Wahpeton 115	1.02 | 1.02	1.01 | 1.03	1.02 | 1.03	1.01 | 1.03
45	Watertown 345	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	STANT4 / -54.68%	MNTCE3 / 75.55%	SHERC3 / 66.79%	SHERC3 / 66.65%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	503%	397%	379%	330%
57	K22W (max +dP @ t, d-ang)	1.3@(2.96665,-0.3)	10.2@(2.63332,1.6)	5.5@(3.79997,0.6)	9.1@(3.78330,-0.6)
58	K22W (max -dP @ t, d-ang)	0.2@(1.15000,-0.3)	22.5@(1.75000,7.0)	28.6@(1.77500,9.0)	37.0@(1.80833,11.9)
59	K22W (max d-ang @ t, dP)	-0.4@(0.94166,0.1)	12.3@(1.17500,-14.5)	14.3@(1.20000,-16.9)	17.9@(1.24166,-22.2)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	220% / 348%	190% / 298%	192% / 301%	183% / 284%
63	82R at Rugby/L20D at Drayton	999% / 941%	999% / 815%	999% / 813%	999% / 812%
64	R50M / F3M	780% / 999%	669% / 999%	665% / 999%	632% / 999%
65	B10T	347%	255%	248%	239%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-fbs	R39-so15aa.withCMVPP1c1r0-01s	R39-so15aa.withCMVPP1c1r0-02s	R39-so15aa.withCMVPP1c1r0-03s
Disturbance	fbs	01s	02s	03s
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	29	30	31	32
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-04s	R39-so15aa.withCMVPP1c1r0-j03	R39-so15aa.withCMVPP1c1r0-j13	R39-so15aa.withCMVPP1c1r0-j23
3	**Disturbance**	04s	j03	j13	j23
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 09 2012 17:03	FEB 09 2012 17:09	FEB 09 2012 17:14	FEB 09 2012 17:18
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
35	Boise 115	1.01 | 1.03	1.01 | 1.02	1.01 | 1.03	1.00 | 1.04
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05	1.03 | 1.05
37	Forbes 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
38	Riverton 230	1.01 | 1.03	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.05	1.03 | 1.04	1.03 | 1.04	1.02 | 1.04
40	Jamestown 345	0.95 | 0.97	0.96 | 0.96	0.96 | 0.97	0.94 | 0.97
41	Drayton 230	1.01 | 1.03	1.02 | 1.03	1.02 | 1.03	1.01 | 1.03
42	Groton 345	1.00 | 1.01	1.01 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.02 | 1.05	1.03 | 1.05	1.03 | 1.04	1.01 | 1.05
44	Wahpeton 115	1.02 | 1.04	1.02 | 1.03	1.02 | 1.03	1.01 | 1.03
45	Watertown 345	1.01 | 1.02	1.02 | 1.02	1.02 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	STANT4 / 77.77%	STANT4 / 76.16%	ANTEL3 / 26.08%	MNTCE3 / 75.35%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	432%	472%	438%	415%
57	K22W (max +dP @ t, d-ang)	7.2@(2.49999,0.0)	3.2@(2.46666,0.2)	0.5@(0.10833,0.1)	8.3@(2.69165,1.5)
58	K22W (max -dP @ t, d-ang)	11.7@(1.71666,2.5)	5.4@(0.75833,2.1)	15.4@(1.79166,4.7)	23.3@(1.75833,7.5)
59	K22W (max d-ang @ t, dP)	6.2@(1.07500,-7.7)	2.9@(1.04166,-3.4)	6.0@(1.17500,-7.3)	12.6@(1.19166,-15.5)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	206% / 324%	215% / 339%	217% / 342%	188% / 294%
63	82R at Rugby/L20D at Drayton	999% / 860%	999% / 897%	999% / 902%	999% / 819%
64	R50M / F3M	721% / 999%	753% / 999%	748% / 999%	665% / 999%
65	B10T	299%	315%	312%	258%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-04s	R39-so15aa.withCMVPP1c1r0-j03	R39-so15aa.withCMVPP1c1r0-j13	R39-so15aa.withCMVPP1c1r0-j23
Disturbance	04s	j03	j13	j23
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

Schuster Exhibit ___ (PJS-1), Schedule 1

1	**Case No.**	33	34	35	36
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-j33	R39-so15aa.withCMVPP1c1r0-ljs	R39-so15aa.withCMVPP1c1r0-j0s	R39-so15aa.withCMVPP1c1r0-08s
3	**Disturbance**	j33	ljs	j0s	08s
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 09 2012 17:23	FEB 09 2012 17:28	FEB 10 2012 11:41	FEB 10 2012 11:46
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	1.00 | 1.03	1.00 | 1.03	0.98 | 1.04	0.99 | 1.02
35	Boise 115	1.00 | 1.04	1.01 | 1.02	1.01 | 1.05	1.00 | 1.04
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.03 | 1.06	1.04 | 1.06
37	Forbes 230	1.00 | 1.02	1.00 | 1.01	1.00 | 1.03	1.00 | 1.02
38	Riverton 230	1.01 | 1.02	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.01 | 1.05	1.02 | 1.04	1.02 | 1.04
40	Jamestown 345	0.94 | 0.97	0.94 | 0.96	0.94 | 0.98	0.95 | 0.97
41	Drayton 230	1.01 | 1.03	1.01 | 1.02	1.01 | 1.04	1.01 | 1.04
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.02	1.00 | 1.02
43	Minong 161	1.01 | 1.05	1.03 | 1.06	0.99 | 1.07	1.00 | 1.04
44	Wahpeton 115	1.01 | 1.03	1.01 | 1.02	1.01 | 1.03	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	SHERC3 / 79.05%	SHERC3 / 74.35%	SHERC3 / 34.29%	ANTEL3 / 62.56%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	412%	472%	278%	394%
57	K22W (max +dP @ t, d-ang)	11.5@(2.63332,0.4)	11.5@(3.29164,-3.8)	4.5@(4.21663,2.9)	1.1@(3.85830,2.3)
58	K22W (max -dP @ t, d-ang)	19.5@(0.81666,7.6)	8.4@(0.92500,3.8)	51.4@(1.95000,18.7)	29.4@(1.86666,9.0)
59	K22W (max d-ang @ t, dP)	11.0@(1.15000,-12.9)	4.2@(1.10833,-6.8)	21.5@(1.42500,-31.2)	14.2@(1.26666,-17.1)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	189% / 296%	201% / 316%	193% / 301%	193% / 303%
63	82R at Rugby/L20D at Drayton	999% / 812%	999% / 910%	999% / 875%	999% / 822%
64	R50M / F3M	671% / 999%	724% / 335%	644% / 999%	668% / 999%
65	B10T	254%	322%	266%	250%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-j33	R39-so15aa.withCMVPP1c1r0-ljs	R39-so15aa.withCMVPP1c1r0-j0s	R39-so15aa.withCMVPP1c1r0-08s
Disturbance	j33	ljs	j0s	08s
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	37	38	39	40
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-07s	R39-so15aa.withCMVPP1c1r0-06s	R39-so15aa.withCMVPP1c1r0-j1s	R39-so15aa.withCMVPP1c1r0-j2s
3	**Disturbance**	07s	06s	j1s	j2s
4	**Prior Outage**	None	None	None	None
5	**Date/Time**	FEB 09 2012 17:33	FEB 09 2012 17:39	FEB 10 2012 11:51	FEB 10 2012 11:56
6	**Comments**				
7					
8	**Steady State Flows**				
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199	-199
22	**Steady State Vltgs**				
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**				
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%	225% / 355%
30	82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%	347%
33	**Min/MaxTransientVltg**				
34	Arrowhd 230	0.98 | 1.05	1.01 | 1.02	1.02 | 1.02	1.01 | 1.02
35	Boise 115	1.00 | 1.05	1.01 | 1.02	1.01 | 1.02	1.02 | 1.03
36	Dorsey 230	1.03 | 1.06	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	0.99 | 1.03	1.01 | 1.02	1.01 | 1.01	1.01 | 1.02
38	Riverton 230	0.99 | 1.03	1.01 | 1.02	1.02 | 1.02	1.02 | 1.02
39	Coal Creek 230	1.00 | 1.05	1.03 | 1.04	1.03 | 1.04	1.03 | 1.04
40	Jamestown 345	0.93 | 0.97	0.95 | 0.96	0.96 | 0.96	0.96 | 0.97
41	Drayton 230	1.00 | 1.04	1.02 | 1.02	1.02 | 1.03	1.02 | 1.03
42	Groton 345	0.98 | 1.02	1.00 | 1.01	1.01 | 1.01	1.01 | 1.01
43	Minong 161	0.97 | 1.08	1.04 | 1.05	1.04 | 1.04	1.03 | 1.04
44	Wahpeton 115	1.00 | 1.03	1.02 | 1.02	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.00 | 1.02	1.01 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	Worst Case Angle Damping	ANTEL3 / 38.77%	KING 3 / 70.29%	STANT4 / 71.42%	SHERC3 / 14.33%
55	Dorsey SUVP / UdHold				
56	Forbes DC Red (DCAR)	185%	499%	486%	444%
57	K22W (max +dP @ t, d-ang)	15.8@(4.08330,-0.3)	6.5@(3.34998,-2.2)	1.6@(2.49999,0.4)	0.2@(0.10833,0.0)
58	K22W (max -dP @ t, d-ang)	66.1@(1.96666,24.1)	3.2@(0.35833,0.5)	3.6@(0.80000,1.4)	13.2@(1.85000,4.3)
59	K22W (max d-ang @ t, dP)	28.9@(1.43333,-40.7)	-2.3@(3.70830,4.4)	1.9@(1.09166,-2.1)	4.9@(2.26666,-8.3)
60	**OS Rel Trip / Marg**				
61	MH - OH				
62	D602F at Forbes/Dorsey	179% / 277%	212% / 334%	218% / 344%	222% / 351%
63	82R at Rugby/L20D at Drayton	999% / 815%	999% / 944%	999% / 913%	999% / 923%
64	R50M / F3M	594% / 999%	753% / 999%	766% / 999%	765% / 999%
65	B10T	229%	337%	325%	325%
66	**FSCAPS (SS/Unav/Final)**				
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) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-07s	R39-so15aa.withCMVPP1c1r0-06s	R39-so15aa.withCMVPP1c1r0-j1s	R39-so15aa.withCMVPP1c1r0-j2s
Disturbance	07s	06s	j1s	j2s
System Response	OK	OK	OK	OK
70% or 120% Violations				
ORWG Criteria Violations				
Line Tripping				

R39 POWER FLOW AND STABILITY SUMMARY TABLE

1	**Case No.**	41	42	43
2	**Case Name**	R39-so15aa.withCMVPP1c1r0-j3s	R39-so15aa.withCMVPP1c1r0-09s	R39-so15aa.withCMVPP1c1r0-lns
3	**Disturbance**	j3s	09s	lns
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 10 2012 12:01	FEB 10 2012 12:06	FEB 09 2012 17:44
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2273 / 386	2273 / 386	2273 / 386
10	MHEX / L20D	2174 / 222	2174 / 222	2174 / 222
11	ECL-ARP / PRI-BYN	793 / 298	793 / 298	793 / 298
12	MWEX / AHD-SLK	1636 / 698	1636 / 698	1636 / 698
13	D602F / F601C	1822 / 1525	1822 / 1525	1822 / 1525
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	161 / -196	161 / -196	161 / -196
16	R50M / OH>MP	158 / 135	158 / 135	158 / 135
17	G82R	-27	-27	-27
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	747 / 11	747 / 11	747 / 11
20	Forbes SVC / MSC	-17 / 600	-17 / 600	-17 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.004	1.015 / 1.004	1.015 / 1.004
25	Chisago 500/EauClaire 345	1.005 / 0.969	1.005 / 0.969	1.005 / 0.969
26	Int Falls 115/Badoura 115	1.018 / 1.024	1.018 / 1.024	1.018 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.009	1.023 / 1.009	1.023 / 1.009
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 355%	225% / 355%	225% / 355%
30	G82R at Rugby/L20D at Drayton	999% / 944%	999% / 944%	999% / 944%
31	R50M/F3M	790% / 999%	790% / 999%	790% / 999%
32	B10T	347%	347%	347%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	0.99 | 1.02	1.00 | 1.03	1.01 | 1.02
35	Boise 115	1.00 | 1.04	1.00 | 1.03	1.01 | 1.02
36	Dorsey 230	1.03 | 1.06	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.00 | 1.03	1.00 | 1.02	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.03 | 1.04	1.03 | 1.04
40	Jamestown 345	0.95 | 0.97	0.95 | 0.97	0.95 | 0.96
41	Drayton 230	1.01 | 1.04	1.01 | 1.03	1.02 | 1.03
42	Groton 345	1.00 | 1.02	1.00 | 1.02	1.00 | 1.01
43	Minong 161	1.00 | 1.04	1.02 | 1.05	1.03 | 1.05
44	Wahpeton 115	1.01 | 1.03	1.02 | 1.03	1.02 | 1.02
45	Watertown 345	1.01 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	ANTEL3 / 63.63%	SHERC3 / 78.81%	KING 3 / 72.42%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	379%	417%	484%
57	K22W (max +dP @ t, d-ang)	2.0@(2.70832,5.3)	12.5@(2.66665,-0.6)	2.4@(2.59165,-0.1)
58	K22W (max -dP @ t, d-ang)	29.7@(1.88333,9.0)	16.7@(0.85833,6.3)	4.9@(0.92500,2.3)
59	K22W (max d-ang @ t, dP)	14.7@(1.28333,-17.7)	9.2@(1.19166,-10.2)	2.6@(1.12500,-3.9)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	190% / 297%	191% / 300%	213% / 337%
63	G82R at Rugby/L20D at Drayton	999% / 810%	999% / 806%	999% / 922%
64	R50M / F3M	659% / 999%	680% / 999%	755% / 999%
65	B10T	247%	248%	329%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0-j3s	R39-so15aa.withCMVPP1c1r0-09s	R39-so15aa.withCMVPP1c1r0-lns
Disturbance	j3s	09s	lns
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

Final Report

Appendix

F

Sensitivity Analysis Results for MVP Projects

F.1 Stability Analysis Results in MVP Scenario 1

This Appendix summarizes the dynamic performance of the R39 study model in MVP Scenario 1.

Table F-1: Power Flow and Stability Summary Table in MVP Scenario 1

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

Case No.	1	2	3
Case Name	R39-so15aa.withCMVPP1c1r0Sens1-zss	R39-so15aa.withCMVPP1c1r0Sens1-ei2	R39-so15aa.withCMVPP1c1r0Sens1-mts
Disturbance	zss	ei2	mts
Prior Outage	None	None	None
Date/Time	FEB 24 2012 18:19	FEB 24 2012 18:25	FEB 24 2012 18:32
Comments			
Steady State Flows			
NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
B10T / MH>SPC	165 / 61	165 / 61	165 / 61
OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
R50M / OH>MP	156 / 137	156 / 137	156 / 137
G82R	-25	-25	-25
Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
RCDC	-199	-199	-199
Steady State Vltgs			
Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
SS OS Relay Margins			
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
G82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
R50M/F3M	798% / 999%	798% / 999%	798% / 999%
B10T	346%	346%	346%
Min/MaxTransientVltg			
Arrowhd 230	1.01 | 1.01	0.96 | 1.06	0.96 | 1.04
Boise 115	1.02 | 1.02	0.97 | 1.04	1.01 | 1.06
Dorsey 230	1.04 | 1.04	1.03 | 1.06	1.03 | 1.06
Forbes 230	1.01 | 1.01	0.96 | 1.03	0.99 | 1.03
Riverton 230	1.02 | 1.02	0.91 | 1.07	0.97 | 1.05
Coal Creek 230	1.03 | 1.03	0.98 | 1.14	0.95 | 1.07
Jamestown 345	0.96 | 0.96	0.73 | 1.06	0.89 | 1.02
Drayton 230	1.02 | 1.02	0.91 | 1.11	1.00 | 1.05
Groton 345	1.01 | 1.01	0.86 | 1.09	0.94 | 1.03
Minong 161	1.03 | 1.03	1.00 | 1.09	0.97 | 1.08
Wahpeton 115	1.03 | 1.03	0.85 | 1.11	0.98 | 1.07
Watertown 345	1.02 | 1.02	0.92 | 1.07	0.97 | 1.03
Dynamic Voltage Warnings			
	none		none
Worst Case Angle Damping	STANT4 / -451.23%	SHERC3 / 31.30%	SHERC3 / 77.79%
Dorsey SUVP / UdHold			
Forbes DC Red (DCAR)	506%	507%	272%
K22W (max +dP @ t, d-ang)	0.0@(7.04992,0.1)	72.8@(2.64999,-31.8)	22.5@(2.62499,-2.7)
K22W (max -dP @ t, d-ang)	0.1@(9.99988,0.1)	9.3@(0.60000,1.7)	35.9@(0.67500,12.8)
K22W (max d-ang @ t, dP)	0.1@(9.99988,-0.1)	-50.6@(10.00821,34.7)	20.1@(1.09166,-34.3)
OS Rel Trip / Marg			
MH - OH			
D602F at Forbes/Dorsey	225% / 356%	139% / 214%	179% / 277%
G82R at Rugby/L20D at Drayton	999% / 932%	999% / 519%	999% / 695%
R50M / F3M	798% / 999%	592% / 223%	627% / 311%
B10T	346%	70%	168%
FSCAPS (SS/Unav/Final)			
Balta 230	(0 | 0 | 0)	(0 | 1 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 1) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 9 | 0) / (0 | 3 | 0)	(0 | 1 | 0) / (0 | 2 | 1)
Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 2 | 0) / (0 | 1 | 0)	(0 | 1 | 0) / (0 | 0 | 0)
Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 2 | 2) / (1 | 5 | 0)	(1 | 2 | 2) / (1 | 4 | 2)
Damping Performance	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-zss	R39-so15aa.withCMVPP1c1r0Sens1-ei2	R39-so15aa.withCMVPP1c1r0Sens1-mts
Disturbance	zss	ei2	mts
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	4	5	6
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-wls	R39-so15aa.withCMVPP1c1r0Sens1-nmz	R39-so15aa.withCMVPP1c1r0Sens1-nad
3	**Disturbance**	wls	nmz	nad
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 18:37	FEB 24 2012 18:42	FEB 24 2012 18:48
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	G82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	0.98 | 1.03	0.94 | 1.08	1.00 | 1.07
35	Boise 115	1.00 | 1.03	0.93 | 1.03	0.91 | 1.04
36	Dorsey 230	1.04 | 1.06	1.04 | 1.17	1.04 | 1.14
37	Forbes 230	0.99 | 1.03	0.98 | 1.03	0.99 | 1.03
38	Riverton 230	0.96 | 1.04	0.89 | 1.05	0.96 | 1.06
39	Coal Creek 230	0.93 | 1.07	0.93 | 1.08	0.98 | 1.09
40	Jamestown 345	0.84 | 1.01	0.77 | 1.02	0.85 | 1.02
41	Drayton 230	0.96 | 1.07	0.97 | 1.07	0.96 | 1.08
42	Groton 345	0.94 | 1.03	0.88 | 1.05	0.94 | 1.04
43	Minong 161	0.99 | 1.04	0.98 | 1.12	1.04 | 1.09
44	Wahpeton 115	0.94 | 1.06	0.87 | 1.08	0.93 | 1.08
45	Watertown 345	0.97 | 1.02	0.92 | 1.04	0.97 | 1.04
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	SHERC3 / 72.50%	KING 3 / 20.53%	KING 3 / 29.70%
55	Dorsey SUVP / UdHold		/ 0.133	/ 0.133
56	Forbes DC Red (DCAR)	431%	507%	507%
57	K22W (max +dP @ t, d-ang)	9.7@(3.57497,-0.4)	111.4@(2.58332,-52.9)	116.1@(1.96666,-49.9)
58	K22W (max -dP @ t, d-ang)	17.8@(1.89166,3.2)	86.2@(0.23333,7.1)	111.5@(0.25833,11.5)
59	K22W (max d-ang @ t, dP)	8.0@(1.19166,-12.9)	-73.6@(10.00821,43.8)	-81.4@(10.00821,46.5)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	196% / 310%	0.18333 sec / 0.18333 sec	0.16667 sec / 0.16667 sec
63	G82R at Rugby/L20D at Drayton	999% / 808%	999% / 435%	999% / 409%
64	R50M / F3M	711% / 331%	332% / 174%	272% / 140%
65	B10T	258%	67%	131%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 1 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 0) / (3 | 3 | 3)	(3 | 3 | 1) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 3 | 0) / (0 | 1 | 1)	(0 | 5 | 0) / (0 | 3 | 0)	(0 | 5 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 1 | 0) / (0 | 0 | 0)	(0 | 1 | 0) / (0 | 1 | 0)	(0 | 1 | 0) / (0 | 2 | 1)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 4 | 4)	(1 | 4 | 2) / (1 | 5 | 3)	(1 | 5 | 3) / (1 | 5 | 3)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-wls	R39-so15aa.withCMVPP1c1r0Sens1-nmz	R39-so15aa.withCMVPP1c1r0Sens1-nad
Disturbance	wls	nmz	nad
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping		(5T)(6T)	(5T)(6T)

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	7	8	9
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-pas	R39-so15aa.withCMVPP1c1r0Sens1-pcs	R39-so15aa.withCMVPP1c1r0Sens1-pys
3	**Disturbance**	pas	pcs	pys
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 18:53	FEB 24 2012 18:58	FEB 24 2012 19:03
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.01 | 1.07	0.91 | 0.98	1.00 | 1.04
35	Boise 115	0.95 | 1.03	1.01 | 1.04	1.00 | 1.04
36	Dorsey 230	1.04 | 1.18	1.04 | 1.06	1.03 | 1.07
37	Forbes 230	0.98 | 1.05	0.99 | 1.04	1.00 | 1.05
38	Riverton 230	0.96 | 1.05	1.01 | 1.03	1.01 | 1.04
39	Coal Creek 230	0.98 | 1.08	0.98 | 1.08	0.98 | 1.07
40	Jamestown 345	0.85 | 1.00	0.92 | 0.99	0.91 | 1.01
41	Drayton 230	0.98 | 1.06	1.01 | 1.05	1.01 | 1.04
42	Groton 345	0.95 | 1.03	0.98 | 1.02	0.98 | 1.03
43	Minong 161	1.04 | 1.10	0.86 | 0.99	1.00 | 1.07
44	Wahpeton 115	0.93 | 1.06	1.01 | 1.05	1.00 | 1.06
45	Watertown 345	0.97 | 1.04	1.01 | 1.03	1.01 | 1.03
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	KING 3 / 32.86%	KING 3 / 40.26%	KING 3 / 74.38%
55	Dorsey SUVP / UdHold	/ 0.150		
56	Forbes DC Red (DCAR)	507%	179%	272%
57	K22W (max +dP @ t, d-ang)	99.5@(1.98333,-47.3)	0.3@(3.56664,6.5)	17.3@(2.51666,-1.4)
58	K22W (max -dP @ t, d-ang)	88.7@(0.27500,7.6)	59.7@(1.73333,22.6)	26.7@(0.64166,9.9)
59	K22W (max d-ang @ t, dP)	-78.1@(10.00821,48.8)	23.8@(1.22500,-43.2)	15.7@(1.04166,-23.5)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	0.38333 sec / 0.18333 sec	219% / 348%	188% / 293%
63	82R at Rugby/L20D at Drayton	999% / 465%	999% / 717%	999% / 719%
64	R50M / F3M	325% / 188%	680% / 999%	651% / 328%
65	B10T	144%	249%	199%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 1) / (3 | 3 | 3)	(3 | 4 | 3) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 2 | 1) / (0 | 1 | 0)	(0 | 0 | 0) / (0 | 1 | 1)	(0 | 0 | 0) / (0 | 2 | 0)
70	Roseau 230 / Running 230	(0 | 1 | 0) / (0 | 1 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 3 | 2) / (1 | 5 | 4)	(1 | 1 | 1) / (1 | 2 | 2)	(1 | 1 | 1) / (1 | 3 | 3)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-pas	R39-so15aa.withCMVPP1c1r0Sens1-pcs	R39-so15aa.withCMVPP1c1r0Sens1-pys
Disturbance	pas	pcs	pys
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping	(5T)(6T)		

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	10	11	12
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-ya3	R39-so15aa.withCMVPP1c1r0Sens1-yas	R39-so15aa.withCMVPP1c1r0Sens1-swz
3	**Disturbance**	ya3	yas	swz
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 19:08	FEB 24 2012 19:13	FEB 24 2012 19:18
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.05 | 1.07	1.00 | 1.02	1.00 | 1.02
35	Boise 115	1.02 | 1.04	1.02 | 1.04	1.01 | 1.03
36	Dorsey 230	1.04 | 1.05	1.04 | 1.07	1.04 | 1.05
37	Forbes 230	1.01 | 1.03	1.00 | 1.04	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.02 | 1.04	1.01 | 1.05
40	Jamestown 345	0.96 | 0.98	0.95 | 0.98	0.94 | 0.97
41	Drayton 230	1.02 | 1.04	1.02 | 1.04	1.01 | 1.03
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.02
43	Minong 161	1.04 | 1.06	0.98 | 1.03	1.00 | 1.05
44	Wahpeton 115	1.02 | 1.04	1.02 | 1.04	1.01 | 1.03
45	Watertown 345	1.02 | 1.02	1.02 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	SHERC3 / 29.76%	SHERC3 / 42.40%	STANT4 / 75.31%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	305%	382%	434%
57	K22W (max +dP @ t, d-ang)	1.6@(0.10833,0.7)	1.3@(0.10833,0.3)	6.6@(3.44164,-0.5)
58	K22W (max -dP @ t, d-ang)	32.5@(1.70000,14.5)	26.0@(1.67500,11.2)	16.7@(1.71666,3.7)
59	K22W (max d-ang @ t, dP)	15.5@(2.04166,-30.0)	11.7@(1.94166,-22.6)	7.7@(1.05833,-9.5)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	224% / 355%	220% / 349%	201% / 316%
63	82R at Rugby/L20D at Drayton	999% / 835%	999% / 840%	999% / 853%
64	R50M / F3M	798% / 999%	798% / 999%	708% / 334%
65	B10T	293%	293%	294%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-ya3	R39-so15aa.withCMVPP1c1r0Sens1-yas	R39-so15aa.withCMVPP1c1r0Sens1-swz
Disturbance	ya3	yas	swz
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	13	14	15
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-wss	R39-so15aa.withCMVPP1c1r0Sens1-snz	R39-so15aa.withCMVPP1c1r0Sens1-sns
3	**Disturbance**	wss	snz	sns
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 19:23	FEB 24 2012 19:28	FEB 24 2012 19:33
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.00 | 1.02	1.00 | 1.02	1.01 | 1.01
35	Boise 115	1.00 | 1.03	1.01 | 1.03	1.01 | 1.03
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.05	1.02 | 1.05	1.02 | 1.04
40	Jamestown 345	0.95 | 0.97	0.95 | 0.97	0.95 | 0.97
41	Drayton 230	1.01 | 1.03	1.01 | 1.03	1.02 | 1.03
42	Groton 345	1.00 | 1.02	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.00 | 1.05	1.01 | 1.03	1.01 | 1.02
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	STANT4 / 77.97%	STANT4 / 78.10%	STANT4 / 66.18%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	438%	447%	459%
57	K22W (max +dP @ t, d-ang)	8.6@(2.49999,0.3)	6.9@(2.46666,0.4)	1.9@(2.45832,1.9)
58	K22W (max -dP @ t, d-ang)	13.9@(0.75833,4.8)	11.7@(1.70000,2.5)	10.3@(1.79166,2.1)
59	K22W (max d-ang @ t, dP)	7.3@(1.08333,-8.2)	6.1@(1.05833,-7.1)	4.8@(1.10833,-5.4)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	198% / 310%	207% / 325%	210% / 330%
63	82R at Rugby/L20D at Drayton	999% / 833%	999% / 850%	999% / 872%
64	R50M / F3M	702% / 331%	728% / 999%	741% / 999%
65	B10T	277%	297%	307%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-wss	R39-so15aa.withCMVPP1c1r0Sens1-snz	R39-so15aa.withCMVPP1c1r0Sens1-sns
Disturbance	wss	snz	sns
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	16	17	18
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-nns	R39-so15aa.withCMVPP1c1r0Sens1-ssz	R39-so15aa.withCMVPP1c1r0Sens1-sss
3	**Disturbance**	nns	ssz	sss
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 19:39	FEB 24 2012 19:44	FEB 24 2012 19:49
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.01 | 1.02	1.00 | 1.02	1.01 | 1.01
35	Boise 115	1.01 | 1.02	1.01 | 1.03	1.01 | 1.03
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.02 | 1.05	1.02 | 1.04
40	Jamestown 345	0.95 | 0.97	0.95 | 0.97	0.95 | 0.97
41	Drayton 230	1.02 | 1.03	1.01 | 1.03	1.02 | 1.03
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.01 | 1.03	1.00 | 1.05	1.01 | 1.03
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	SHERC3 / 81.45%	STANT4 / 76.83%	STANT4 / 70.84%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	463%	439%	460%
57	K22W (max +dP @ t, d-ang)	6.2@(2.42499,-0.2)	5.7@(2.46666,1.2)	2.2@(2.44166,1.7)
58	K22W (max -dP @ t, d-ang)	7.2@(0.71666,2.4)	14.7@(1.71666,3.3)	10.0@(1.76666,2.0)
59	K22W (max d-ang @ t, dP)	3.6@(1.04166,-3.8)	7.1@(1.07500,-8.5)	4.6@(1.08333,-5.2)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	211% / 332%	203% / 318%	211% / 332%
63	82R at Rugby/L20D at Drayton	999% / 858%	999% / 855%	999% / 874%
64	R50M / F3M	747% / 999%	713% / 999%	744% / 999%
65	B10T	296%	297%	305%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-nns	R39-so15aa.withCMVPP1c1r0Sens1-ssz	R39-so15aa.withCMVPP1c1r0Sens1-sss
Disturbance	nns	ssz	sss
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	19	20	21
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-nlz	R39-so15aa.withCMVPP1c1r0Sens1-nls	R39-so15aa.withCMVPP1c1r0Sens1-vts
3	**Disturbance**	nlz	nls	vts
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 19:54	FEB 24 2012 19:59	FEB 24 2012 20:04
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.00 | 1.01	1.01 | 1.01	1.00 | 1.02
35	Boise 115	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.01	1.01 | 1.01	1.00 | 1.01
38	Riverton 230	1.01 | 1.02	1.01 | 1.02	1.00 | 1.02
39	Coal Creek 230	1.02 | 1.04	1.03 | 1.04	1.02 | 1.04
40	Jamestown 345	0.95 | 0.96	0.95 | 0.96	0.94 | 0.96
41	Drayton 230	1.01 | 1.03	1.02 | 1.02	1.01 | 1.02
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.01 | 1.03	1.02 | 1.03	1.01 | 1.04
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.02	1.01 | 1.02
45	Watertown 345	1.01 | 1.02	1.02 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	STANT4 / 72.63%	STANT4 / 49.07%	SHERC3 / 73.35%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	477%	498%	491%
57	K22W (max +dP @ t, d-ang)	3.6@(3.42497,-0.5)	0.2@(0.10833,0.0)	12.3@(3.15831,-4.1)
58	K22W (max -dP @ t, d-ang)	10.4@(1.73333,2.8)	5.4@(1.80833,1.5)	5.1@(0.98333,2.1)
59	K22W (max d-ang @ t, dP)	5.0@(1.11666,-6.7)	2.2@(1.18333,-3.2)	-4.4@(3.55831,9.6)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	208% / 327%	216% / 341%	203% / 320%
63	82R at Rugby/L20D at Drayton	999% / 895%	999% / 929%	999% / 910%
64	R50M / F3M	739% / 999%	768% / 999%	742% / 327%
65	B10T	321%	340%	326%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-nlz	R39-so15aa.withCMVPP1c1r0Sens1-nls	R39-so15aa.withCMVPP1c1r0Sens1-vts
Disturbance	nlz	nls	vts
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	22	23	24
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-wds	R39-so15aa.withCMVPP1c1r0Sens1-wts	R39-so15aa.withCMVPP1c1r0Sens1-lgs
3	**Disturbance**	wds	wts	lgs
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 20:09	FEB 24 2012 20:15	FEB 24 2012 20:20
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	G82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.00 | 1.03	1.00 | 1.03	1.00 | 1.02
35	Boise 115	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
36	Dorsey 230	1.04 | 1.05	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
38	Riverton 230	1.00 | 1.02	1.00 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.02 | 1.05	1.02 | 1.05	1.02 | 1.04
40	Jamestown 345	0.94 | 0.96	0.94 | 0.96	0.94 | 0.96
41	Drayton 230	1.01 | 1.02	1.01 | 1.02	1.01 | 1.03
42	Groton 345	0.99 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.01 | 1.05	1.01 | 1.05	1.01 | 1.03
44	Wahpeton 115	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.01 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	KING 3 / 54.30%	KING 3 / 43.70%	KING 3 / 76.83%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	507%	507%	467%
57	K22W (max +dP @ t, d-ang)	26.0@(2.57499,-10.9)	24.1@(2.61665,-11.3)	7.4@(3.34998,-2.2)
58	K22W (max -dP @ t, d-ang)	7.6@(0.23333,0.9)	5.9@(0.30833,0.8)	9.6@(0.89166,4.5)
59	K22W (max d-ang @ t, dP)	-15.1@(9.95821,10.3)	-15.9@(9.99988,11.0)	5.0@(1.10000,-7.8)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	189% / 296%	195% / 306%	203% / 320%
63	G82R at Rugby/L20D at Drayton	999% / 827%	999% / 848%	999% / 892%
64	R50M / F3M	709% / 304%	717% / 306%	733% / 336%
65	B10T	271%	279%	319%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 1 | 1)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-wds	R39-so15aa.withCMVPP1c1r0Sens1-wts	R39-so15aa.withCMVPP1c1r0Sens1-lgs
Disturbance	wds	wts	lgs
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	25	26	27
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-fbs	R39-so15aa.withCMVPP1c1r0Sens1-01s	R39-so15aa.withCMVPP1c1r0Sens1-k2s
3	**Disturbance**	fbs	01s	k2s
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 20:25	FEB 24 2012 21:58	FEB 24 2012 22:04
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.01 | 1.01	1.00 | 1.03	1.00 | 1.03
35	Boise 115	1.01 | 1.02	1.00 | 1.04	1.00 | 1.04
36	Dorsey 230	1.04 | 1.04	1.04 | 1.05	1.03 | 1.05
37	Forbes 230	1.01 | 1.01	1.00 | 1.03	1.00 | 1.02
38	Riverton 230	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.03 | 1.03	1.02 | 1.04	1.02 | 1.04
40	Jamestown 345	0.96 | 0.96	0.95 | 0.97	0.95 | 0.97
41	Drayton 230	1.02 | 1.02	1.01 | 1.04	1.01 | 1.03
42	Groton 345	1.01 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.03 | 1.03	1.00 | 1.06	1.00 | 1.06
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.02 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	ANTEL3 / -32.06%	SHERC3 / 78.88%	SHERC3 / 78.42%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	504%	391%	397%
57	K22W (max +dP @ t, d-ang)	1.2@(2.94998,-0.4)	13.3@(2.61665,0.0)	14.7@(2.61665,-0.8)
58	K22W (max -dP @ t, d-ang)	0.0@(-0.01667,0.0)	20.3@(0.81666,7.8)	19.4@(0.80833,7.4)
59	K22W (max d-ang @ t, dP)	-0.4@(2.32499,0.4)	11.4@(1.15000,-13.3)	10.8@(1.14166,-12.3)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	221% / 350%	190% / 297%	189% / 296%
63	82R at Rugby/L20D at Drayton	999% / 928%	999% / 800%	999% / 790%
64	R50M / F3M	789% / 999%	674% / 330%	674% / 329%
65	B10T	346%	251%	246%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-fbs	R39-so15aa.withCMVPP1c1r0Sens1-01s	R39-so15aa.withCMVPP1c1r0Sens1-k2s
Disturbance	fbs	01s	k2s
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	28	29	30
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-03s	R39-so15aa.withCMVPP1c1r0Sens1-k4s	R39-so15aa.withCMVPP1c1r0Sens1-k03
3	**Disturbance**	03s	k4s	k03
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 22:10	FEB 24 2012 22:15	FEB 24 2012 22:21
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	0.99 | 1.03	1.00 | 1.03	1.01 | 1.02
35	Boise 115	1.00 | 1.04	1.01 | 1.03	1.01 | 1.02
36	Dorsey 230	1.03 | 1.06	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.00 | 1.03	1.01 | 1.02	1.01 | 1.02
38	Riverton 230	1.01 | 1.02	1.01 | 1.03	1.02 | 1.02
39	Coal Creek 230	1.02 | 1.05	1.02 | 1.05	1.03 | 1.04
40	Jamestown 345	0.94 | 0.97	0.95 | 0.97	0.96 | 0.97
41	Drayton 230	1.00 | 1.04	1.01 | 1.03	1.02 | 1.03
42	Groton 345	1.00 | 1.02	1.00 | 1.01	1.00 | 1.01
43	Minong 161	0.99 | 1.05	1.00 | 1.05	1.01 | 1.03
44	Wahpeton 115	1.01 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.01 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	SHERC3 / 70.11%	SHERC3 / 77.69%	STANT4 / 79.28%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	348%	426%	463%
57	K22W (max +dP @ t, d-ang)	6.5@(3.72497,0.2)	10.4@(2.49999,-1.1)	4.6@(2.49999,0.1)
58	K22W (max -dP @ t, d-ang)	31.9@(1.79166,10.0)	12.3@(0.80833,5.3)	7.4@(0.77500,3.0)
59	K22W (max d-ang @ t, dP)	15.8@(1.21666,-19.3)	6.8@(1.06666,-8.6)	4.0@(1.06666,-4.7)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	188% / 293%	203% / 318%	212% / 334%
63	82R at Rugby/L20D at Drayton	999% / 805%	999% / 840%	999% / 876%
64	R50M / F3M	656% / 999%	715% / 332%	750% / 999%
65	B10T	243%	288%	306%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-03s	R39-so15aa.withCMVPP1c1r0Sens1-k4s	R39-so15aa.withCMVPP1c1r0Sens1-k03
Disturbance	03s	k4s	k03
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	31	32	33
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-k13	R39-so15aa.withCMVPP1c1r0Sens1-j23	R39-so15aa.withCMVPP1c1r0Sens1-j33
3	**Disturbance**	k13	j23	j33
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 22:26	FEB 24 2012 22:31	FEB 24 2012 22:36
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	G82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.01 | 1.02	1.00 | 1.03	1.00 | 1.03
35	Boise 115	1.01 | 1.03	1.00 | 1.03	1.00 | 1.03
36	Dorsey 230	1.04 | 1.05	1.03 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.02	1.00 | 1.02	1.00 | 1.02
38	Riverton 230	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.03 | 1.04	1.02 | 1.04	1.02 | 1.04
40	Jamestown 345	0.96 | 0.97	0.95 | 0.96	0.95 | 0.97
41	Drayton 230	1.02 | 1.03	1.01 | 1.03	1.01 | 1.03
42	Groton 345	1.00 | 1.01	1.00 | 1.01	1.00 | 1.01
43	Minong 161	1.01 | 1.03	1.00 | 1.06	1.00 | 1.06
44	Wahpeton 115	1.02 | 1.03	1.01 | 1.03	1.02 | 1.03
45	Watertown 345	1.02 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	STANT4 / 74.17%	SHERC3 / 77.84%	SHERC3 / 78.04%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	456%	410%	407%
57	K22W (max +dP @ t, d-ang)	3.9@(2.49999,0.6)	14.8@(2.63332,-1.3)	14.6@(2.63332,-1.2)
58	K22W (max -dP @ t, d-ang)	8.3@(1.71666,1.9)	18.8@(0.81666,7.3)	18.5@(0.80833,7.1)
59	K22W (max d-ang @ t, dP)	4.4@(1.07500,-5.2)	10.4@(1.14166,-12.3)	10.2@(1.13333,-11.9)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	213% / 335%	188% / 294%	188% / 295%
63	G82R at Rugby/L20D at Drayton	999% / 874%	999% / 798%	999% / 797%
64	R50M / F3M	750% / 999%	674% / 329%	675% / 329%
65	B10T	304%	252%	251%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-k13	R39-so15aa.withCMVPP1c1r0Sens1-j23	R39-so15aa.withCMVPP1c1r0Sens1-j33
Disturbance	k13	j23	j33
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

Case No.	34	35	36
Case Name	R39-so15aa.withCMVPP1c1r0Sens1-ljs	R39-so15aa.withCMVPP1c1r0Sens1-j0s	R39-so15aa.withCMVPP1c1r0Sens1-k8s
Disturbance	ljs	j0s	k8s
Prior Outage	None	None	None
Date/Time	FEB 24 2012 22:41	FEB 24 2012 22:46	FEB 24 2012 22:51
Comments			
Steady State Flows			
NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
B10T / MH>SPC	165 / 61	165 / 61	165 / 61
OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
R50M / OH>MP	156 / 137	156 / 137	156 / 137
G82R	-25	-25	-25
Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
RCDC	-199	-199	-199
Steady State Vltgs			
Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
SS OS Relay Margins			
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
G82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
R50M/F3M	798% / 999%	798% / 999%	798% / 999%
B10T	346%	346%	346%
Min/MaxTransientVltg			
Arrowhd 230	1.00 | 1.02	0.99 | 1.03	1.00 | 1.03
Boise 115	1.01 | 1.03	1.00 | 1.04	1.00 | 1.03
Dorsey 230	1.04 | 1.05	1.03 | 1.06	1.04 | 1.05
Forbes 230	1.00 | 1.02	1.00 | 1.03	1.00 | 1.02
Riverton 230	1.01 | 1.02	1.01 | 1.03	1.01 | 1.02
Coal Creek 230	1.02 | 1.05	1.02 | 1.04	1.02 | 1.04
Jamestown 345	0.94 | 0.96	0.95 | 0.98	0.95 | 0.97
Drayton 230	1.01 | 1.03	1.01 | 1.04	1.01 | 1.03
Groton 345	1.00 | 1.01	1.00 | 1.02	1.00 | 1.01
Minong 161	1.00 | 1.03	0.99 | 1.05	1.00 | 1.05
Wahpeton 115	1.01 | 1.02	1.01 | 1.03	1.02 | 1.03
Watertown 345	1.01 | 1.02	1.01 | 1.02	1.02 | 1.02
Dynamic Voltage Warnings			
	none	none	none
Worst Case Angle Damping	MNTCE3 / 77.12%	ANTEL3 / 50.36%	STANT4 / 79.77%
Dorsey SUVP / UdHold			
Forbes DC Red (DCAR)	459%	311%	410%
K22W (max +dP @ t, d-ang)	8.7@(2.63332,-1.2)	3.0@(3.94997,2.6)	13.7@(2.64999,-0.9)
K22W (max -dP @ t, d-ang)	11.8@(0.89166,5.3)	39.2@(1.90833,13.2)	17.5@(0.85000,6.3)
K22W (max d-ang @ t, dP)	6.2@(1.13333,-9.1)	17.6@(1.35000,-23.0)	9.5@(1.19166,-10.5)
OS Rel Trip / Marg			
MH - OH			
D602F at Forbes/Dorsey	199% / 313%	193% / 301%	190% / 298%
G82R at Rugby/L20D at Drayton	999% / 877%	999% / 838%	999% / 793%
R50M / F3M	718% / 332%	660% / 999%	680% / 330%
B10T	313%	254%	248%
FSCAPS (SS/Unav/Final)			
Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
Damping Performance	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-ljs	R39-so15aa.withCMVPP1c1r0Sens1-j0s	R39-so15aa.withCMVPP1c1r0Sens1-k8s
Disturbance	ljs	j0s	k8s
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	37	38	39
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-07s	R39-so15aa.withCMVPP1c1r0Sens1-k6s	R39-so15aa.withCMVPP1c1r0Sens1-h1s
3	**Disturbance**	07s	k6s	h1s
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 22:56	FEB 24 2012 23:02	FEB 24 2012 23:07
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	0.99 | 1.04	1.01 | 1.02	1.01 | 1.01
35	Boise 115	1.00 | 1.05	1.01 | 1.02	1.01 | 1.02
36	Dorsey 230	1.03 | 1.06	1.04 | 1.05	1.04 | 1.05
37	Forbes 230	1.00 | 1.03	1.01 | 1.02	1.01 | 1.01
38	Riverton 230	1.00 | 1.03	1.01 | 1.02	1.02 | 1.02
39	Coal Creek 230	1.01 | 1.05	1.03 | 1.04	1.03 | 1.04
40	Jamestown 345	0.94 | 0.97	0.95 | 0.96	0.96 | 0.96
41	Drayton 230	1.00 | 1.04	1.02 | 1.02	1.02 | 1.03
42	Groton 345	0.99 | 1.02	1.00 | 1.01	1.01 | 1.01
43	Minong 161	0.97 | 1.07	1.02 | 1.03	1.02 | 1.03
44	Wahpeton 115	1.01 | 1.03	1.02 | 1.02	1.02 | 1.03
45	Watertown 345	1.01 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	ANTEL3 / 62.35%	KING 3 / 76.89%	STANT4 / 76.60%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	223%	495%	479%
57	K22W (max +dP @ t, d-ang)	11.0@(3.79997,-0.3)	5.6@(3.29164,-1.9)	2.2@(2.54165,0.3)
58	K22W (max -dP @ t, d-ang)	46.6@(1.90833,15.0)	3.2@(0.65833,1.3)	4.5@(0.80000,1.7)
59	K22W (max d-ang @ t, dP)	22.1@(1.33333,-27.7)	-2.0@(2.94998,4.6)	2.4@(1.09166,-2.8)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	179% / 278%	214% / 338%	217% / 342%
63	82R at Rugby/L20D at Drayton	999% / 779%	999% / 920%	999% / 897%
64	R50M / F3M	613% / 334%	764% / 999%	768% / 999%
65	B10T	218%	327%	319%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 4 | 4) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-07s	R39-so15aa.withCMVPP1c1r0Sens1-k6s	R39-so15aa.withCMVPP1c1r0Sens1-h1s
Disturbance	07s	k6s	h1s
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	40	41	42
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-h2s	R39-so15aa.withCMVPP1c1r0Sens1-h3s	R39-so15aa.withCMVPP1c1r0Sens1-09s
3	**Disturbance**	h2s	h3s	09s
4	**Prior Outage**	None	None	None
5	**Date/Time**	FEB 24 2012 23:12	FEB 24 2012 23:16	FEB 24 2012 23:21
6	**Comments**			
7				
8	**Steady State Flows**			
9	NDEX / EAST BIAS	2278 / 382	2278 / 382	2278 / 382
10	MHEX / L20D	2174 / 224	2174 / 224	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240	784 / 240	784 / 240
12	MWEX / AHD-SLK	1600 / 675	1600 / 675	1600 / 675
13	D602F / F601C	1819 / 1533	1819 / 1533	1819 / 1533
14	B10T / MH>SPC	165 / 61	165 / 61	165 / 61
15	OH E-W / OH>MH	163 / -196	163 / -196	163 / -196
16	R50M / OH>MP	156 / 137	156 / 137	156 / 137
17	G82R	-25	-25	-25
18	Dorsey bipole / CU bipole	2578 / 1147	2578 / 1147	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9	748 / 9	748 / 9
20	Forbes SVC / MSC	-16 / 600	-16 / 600	-16 / 600
21	RCDC	-199	-199	-199
22	**Steady State Vltgs**			
23	Dorsey 500/Dorsey 230	1.036 / 1.045	1.036 / 1.045	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003	1.015 / 1.003	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971	1.004 / 0.971	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024	1.017 / 1.024	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008	1.023 / 1.008	1.023 / 1.008
28	**SS OS Relay Margins**			
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%	999% / 932%	999% / 932%
31	R50M/F3M	798% / 999%	798% / 999%	798% / 999%
32	B10T	346%	346%	346%
33	**Min/MaxTransientVltg**			
34	Arrowhd 230	1.01 | 1.01	1.00 | 1.03	1.00 | 1.03
35	Boise 115	1.01 | 1.02	1.00 | 1.03	1.00 | 1.03
36	Dorsey 230	1.04 | 1.05	1.03 | 1.05	1.04 | 1.05
37	Forbes 230	1.01 | 1.01	1.00 | 1.02	1.00 | 1.02
38	Riverton 230	1.02 | 1.02	1.01 | 1.02	1.01 | 1.02
39	Coal Creek 230	1.03 | 1.04	1.02 | 1.04	1.03 | 1.04
40	Jamestown 345	0.96 | 0.97	0.95 | 0.97	0.95 | 0.97
41	Drayton 230	1.02 | 1.03	1.01 | 1.03	1.01 | 1.03
42	Groton 345	1.01 | 1.01	1.00 | 1.01	1.00 | 1.02
43	Minong 161	1.02 | 1.03	1.00 | 1.05	1.00 | 1.06
44	Wahpeton 115	1.02 | 1.03	1.02 | 1.03	1.02 | 1.03
45	Watertown 345	1.02 | 1.02	1.02 | 1.02	1.02 | 1.02
46	**Dynamic Voltage Warnings**			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	Worst Case Angle Damping	STANT4 / 64.80%	SHERC3 / 79.07%	SHERC3 / 75.99%
55	Dorsey SUVP / UdHold			
56	Forbes DC Red (DCAR)	472%	404%	416%
57	K22W (max +dP @ t, d-ang)	1.2@(2.49999,0.8)	14.8@(2.66665,-1.2)	15.2@(2.64999,-2.0)
58	K22W (max -dP @ t, d-ang)	5.3@(1.74166,1.2)	18.0@(0.86666,6.7)	15.7@(0.84166,5.7)
59	K22W (max d-ang @ t, dP)	2.6@(1.09166,-3.0)	9.8@(1.19166,-11.1)	8.4@(1.16666,-9.4)
60	**OS Rel Trip / Marg**			
61	MH - OH			
62	D602F at Forbes/Dorsey	219% / 345%	189% / 295%	191% / 298%
63	82R at Rugby/L20D at Drayton	999% / 899%	999% / 786%	999% / 795%
64	R50M / F3M	771% / 999%	676% / 328%	684% / 326%
65	B10T	320%	246%	247%
66	**FSCAPS (SS/Unav/Final)**			
67	Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A	N/A	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-h2s	R39-so15aa.withCMVPP1c1r0Sens1-h3s	R39-so15aa.withCMVPP1c1r0Sens1-09s
Disturbance	h2s	h3s	09s
System Response	OK	OK	OK
70% or 120% Violations			
ORWG Criteria Violations			
Line Tripping			

POWER FLOW AND STABILITY SUMMARY TABLE in MVP Scenario 1

1	**Case No.**	43
2	**Case Name**	R39-so15aa.withCMVPP1c1r0Sens1-Ins
3	**Disturbance**	Ins
4	**Prior Outage**	None
5	**Date/Time**	FEB 24 2012 23:27
6	**Comments**	
7		
8	**Steady State Flows**	
9	NDEX / EAST BIAS	2278 / 382
10	MHEX / L20D	2174 / 224
11	ECL-ARP / PRI-BYN	784 / 240
12	MWEX / AHD-SLK	1600 / 675
13	D602F / F601C	1819 / 1533
14	B10T / MH>SPC	165 / 61
15	OH E-W / OH>MH	163 / -196
16	R50M / OH>MP	156 / 137
17	G82R	-25
18	Dorsey bipole / CU bipole	2578 / 1147
19	Dorsey Reserve / Wtrtn SVC	748 / 9
20	Forbes SVC / MSC	-16 / 600
21	RCDC	-199
22	**Steady State Vltgs**	
23	Dorsey 500/Dorsey 230	1.036 / 1.045
24	Roseau 500/Forbes 500	1.015 / 1.003
25	Chisago 500/EauClaire 345	1.004 / 0.971
26	Int Falls 115/Badoura 115	1.017 / 1.024
27	Drayton 230/Groton 345	1.023 / 1.008
28	**SS OS Relay Margins**	
29	D602F at Forbes/Dorsey	225% / 356%
30	82R at Rugby/L20D at Drayton	999% / 932%
31	R50M/F3M	798% / 999%
32	B10T	346%
33	**Min/MaxTransientVltg**	
34	Arrowhd 230	1.01 | 1.01
35	Boise 115	1.01 | 1.02
36	Dorsey 230	1.04 | 1.05
37	Forbes 230	1.01 | 1.01
38	Riverton 230	1.01 | 1.02
39	Coal Creek 230	1.03 | 1.04
40	Jamestown 345	0.95 | 0.96
41	Drayton 230	1.02 | 1.02
42	Groton 345	1.00 | 1.01
43	Minong 161	1.02 | 1.03
44	Wahpeton 115	1.02 | 1.02
45	Watertown 345	1.02 | 1.02
46	**Dynamic Voltage Warnings**	
47		none
48		
49		
50		
51		
52		
53		
54	Worst Case Angle Damping	KING 3 / 68.17%
55	Dorsey SUVP / UdHold	
56	Forbes DC Red (DCAR)	489%
57	K22W (max +dP @ t, d-ang)	1.5@(2.64999,0.5)
58	K22W (max -dP @ t, d-ang)	6.1@(1.75833,1.7)
59	K22W (max d-ang @ t, dP)	3.1@(1.16666,-4.7)
60	**OS Rel Trip / Marg**	
61	MH - OH	
62	D602F at Forbes/Dorsey	212% / 334%
63	82R at Rugby/L20D at Drayton	999% / 913%
64	R50M / F3M	757% / 999%
65	B10T	327%
66	**FSCAPS (SS/Unav/Final)**	
67	Balta 230	(0 | 0 | 0)
68	Eau Cl 345 / Park Lk 115	(3 | 3 | 3) / (3 | 3 | 3)
69	Prairie 115 / Ramsey 230	(0 | 0 | 0) / (0 | 0 | 0)
70	Roseau 230 / Running 230	(0 | 0 | 0) / (0 | 0 | 0)
71	Shey 115 / Split Rock 115	(1 | 1 | 1) / (1 | 1 | 1)
72	**Damping Performance**	N/A

Case	R39-so15aa.withCMVPP1c1r0Sens1-Ins
Disturbance	Ins
System Response	OK
70% or 120% Violations	
ORWG Criteria Violations	
Line Tripping	