Enclosure 8

To

Letter from Mark A. Schimmel (NSPM)
To

Document Control Desk (NRC)

ESC Report No. 2005-11125-2.R02, “Generation Interconnection Study – Projects # G433 and G434; 38 MW Expansion of Prairie Island Units 1 and 2”, Dated March 24, 2006

And

Delyn Electrical Engineering, LLC, “G433-G434 Transient Stability Study – Supplement”, Dated November 13, 2009

And

Xcel letter documenting Midwest ISO acceptance of PINGP 38 MW Increase from Randall Oye to Jim Hill dated November 13, 2009

51 pages follow

Final Report

Generation Interconnection Study - Projects # G433 and G434
38 MW Expansion of Prairie Island Units 1 and 2

March 24, 2006

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Midwest ISO

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ESC Report No. 2005-11125-2.R02

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Executive Summary

The main objective of this study is to evaluate the collective impact of generation interconnection requests G433 and G434 on transmission system performance. Together, these projects have requested a combined output of 38 MW (Gross). Project G433 is a 19 MW expansion to Prairie Island #1 and Project G434 is a 19 MW expansion to Prairie Island #2. At MISO's request, both projects were studied together as one single interconnection request. This study evaluates the collective impact of the proposed projects on the transmission system and included system performance evaluation based on steady-state and stability analysis.

MISO has indicated that the scope of the generator interconnection studies is limited to identifying and resolving possible criteria violations that may limit the ability of the proposed projects to interconnect, and that the results of the studies do not, in any way, imply ability to deliver the power. MISO addresses delivery related issues through separate delivery studies, should the proposed projects request a delivery service.

The following is a summary of study results.

<u>Steady-State Analysis</u>:
The interconnection of the proposed projects impacted several transmission facilities and resulted in steady-state criteria violations for system intact and N-1 contingency conditions. These violations are remote from the Prairie Island substation. Also, the transmission lines out of the Prairie Island substation are not overloaded. Based on information provided by the study ad hoc group, these remote violations should not limit the ability of the proposed projects to interconnect as Energy Resource.

The violations reported in this study could potentially limit the ability of the projects to deliver power into the transmission system. MISO has indicated that these overloads can not be classified as injection issues and therefore they need not to be mitigated for Energy Resource Interconnection Service.

<u>Transfer Capability Analysis</u>
The purpose of the transfer capability analysis was to determine the incremental transfer capability out of the Prairie Island 345 kV substation, prior to the addition of projects G433 and

G434. Results suggest that the full 38 MW of requested output can be accommodated by the transmission system without resulting in transmission limitations at the point of interconnection.

Constrained Interface Analysis:
The study also evaluated the impact of the proposed projects on constrained interfaces in the MAPP system. The results of the analysis are for informational purposes only to identify potential third party flowgate issues for the requested delivery component of the transmission. Results suggest that the proposed projects adversely impact several constrained interfaces. See Section 3.6 for details. Mitigation may be required if it is determined that there is insufficient or no available transfer capability (ATC) on the affected MAPP constrained interfaces. This is an issue that should be addressed with the system impact study for delivery service should the proposed projects proceed with such a request.

Stability Analysis:
Stability analysis was performed to evaluate the impact of the proposed projects on the system stability. No stability criteria violations were observed for the simulated faults. Results indicate that the interconnection of the proposed projects would not adversely impact transmission system stability.

The results of this study are based on available data and assumptions made at the time of conducting this study. In particular, it should be noted that the results depend on delivery assumptions of prior-queued generator interconnections. If the delivery assumptions of the prior-queued generators change and/or if the prior-queued units drop out of the generator interconnection queue, additional studies may be required to determine possible criteria violations that may limit the ability of the project to inject and/or deliver power into the transmission system. Any additional studies are considered outside of the scope of the system impact studies. The results provided in this report may not apply if any of the data and/or assumptions made in developing the study models change.

LEGAL NOTICE

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1. INTRODUCTION

Midwest ISO (MISO) commissioned ABB Inc., to perform a generation interconnection study to evaluate the collective impact of projects G433 and G434 on transmission system performance. Together, these projects have requested a combined output of 38 MW (Gross). Project G433 is a 19 MW expansion to Prairie Island #1 and Project G434 is a 19 MW expansion to Prairie Island #2. At MISO's request, both projects were studied together as one single interconnection request. This study evaluates the collective impact of the proposed projects on the transmission system and included system performance evaluation based on steady-state and stability analysis. Figure 1.1 shows a schematic diagram of the Prairie Island substation.

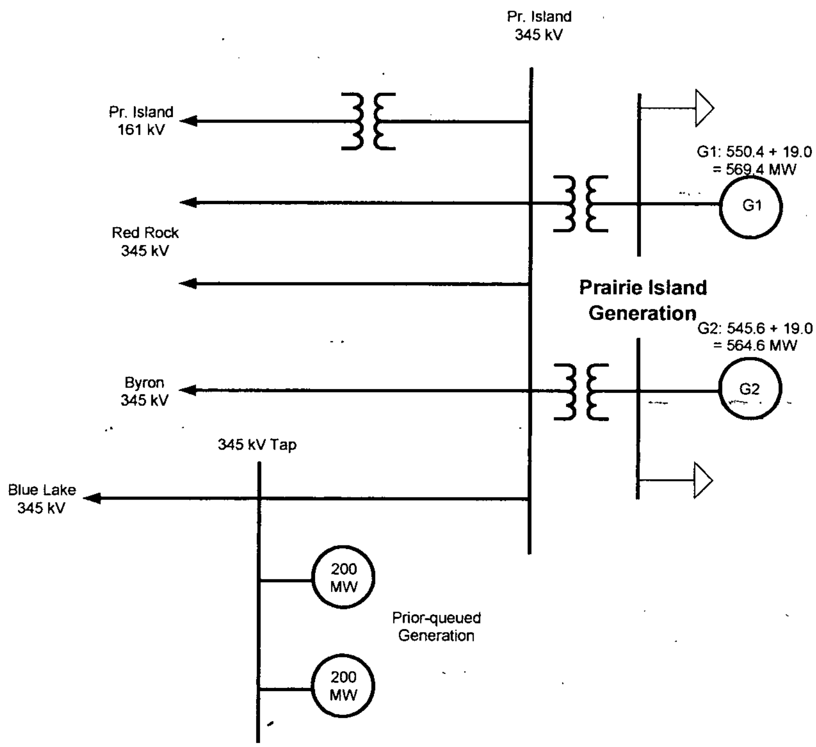

Figure 1.1: Schematic Diagram of Prairie Island Substation

Section 2 describes the study methodology and criteria used for analyses. The results of the steady-state analysis are presented in Section 3. The impact of the proposed projects on MAPP constrained interfaces is also presented in this section. Section 4 presents the results of the stability analysis.

2. STUDY METHODOLOGY

2.1 Steady-State Analysis

The purpose of steady-state analysis is to analyze the collective impact of the proposed projects on transmission system facilities under steady-state conditions. It involves two distinct analyses: thermal analysis and voltage analysis.

2.1.1 Thermal Analysis

System Intact Analysis:

The incremental impact of projects G433 and G434 on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows with and without the proposed projects. For this purpose, full ac power flow solutions were used.

Power flows and voltages were checked on facilities rated 69 kV and above in the XEL system (and also in the facilities of adjoining areas of ALTW, GRE, MEC, OTP and SMMPA) to assess the impact of adding the proposed G433 and G434 projects. The criteria used for flagging thermal overloads is the Rate A data (from the powerflow cases).

MAPP DRS Guidelines[1] were used to identify Significantly Affected Facilities (SAF). According to these guidelines, all overloaded facilities that have a TDF (Transfer Distribution Factor) greater than 2% of the generation addition and an increase in flow of at least 1 MW (without plant vs. with plant) are to be flagged as significantly affected facilities.

N-1 Contingency Analysis:

N-1 contingency analyses include single branch and selected multi-element contingencies both with and without the proposed projects. Single branch contingencies (rated 69 kV and above) were considered in the XEL, ALTW, GRE, OTP and SMMPA systems[2]. Also multi-element contingencies were considered in the XEL and ALTW system based on information provided by the transmission owners. All facilities rated 69 kV and above were monitored in XEL, ALTW, GRE, OTP and SMMPA. All facilities 100 kV and above were monitored in the MEC and MP areas.

As in the system intact analysis, MAPP DRS Guidelines were used to identify Significantly Affected Facilities (SAF). Facilities with a TDF greater than 2% were included in the SAF list.

[1] Steady-State Facility & Constrained Path Impact Determination Requirements & Screening Guidelines for Study Submissions, Prepared by MAPP Design Review Subcommittee (DRS). Oct 28, 2003.

[2] Certain contingencies were excluded from the contingency list. These included contingencies involving the loss of 500 kV lines connecting Manitoba Hydro with the XEL system (these contingencies involve DC runbacks and were not simulated). Also other 345 kV and 230 kV line contingencies were excluded. See Appendix C for a list of contingencies that were excluded.

Contingency analysis was performed using activity ACCC of PSS/E. The contingencies were solved with phase shifters and transformer taps enabled. Non-convergent contingencies from these analyses (primarily due to switching back and forth of transformer taps and switched shunts) were solved manually and their violations were appended to the ACCC results. Facility loadings with and without the proposed projects were tabulated and compared. The following criteria were used as per MISO request:

Report all overloaded facilities with a TDF > 2%

Overloaded = flow> 100% Rate C (Rate B in ALTW) in contingency conditions

Note: The following rating changes were made to the powerflow cases in order to facilitate the use of Rate C in contingency analysis for all monitored facilities regardless of whether the facilities are within or outside of ALTW. For ALTW branches rated 69 kV and above (including tie-lines to neighboring systems), the following rules were adopted:

If Rate C = 0, set Rate C = Rate B.
If Rate C ≠ 0 AND Rate C > Rate B, set Rate C = Rate B (i.e., use the more conservative rating for Rate C)
If Rate C ≠ 0 AND Rate C < Rate B, do not change Rate C (i.e., use the more conservative rating for Rate C)

Appendix C summarizes the corresponding .sub, .mon, and .con files utilized in the studies.

N-2 Contingency Analysis:

The purpose of N-2 contingency analysis is to determine transmission system thermal overloads following simultaneous outages of any two-transmission system branches in the vicinity of the proposed projects.

For the purposes of this analysis, a subsystem was defined consisting of buses (100 kV and above) in the vicinity of the Prairie Island substation. Buses up to five levels away from the Prairie Island substation were included in this subsystem. See Appendix K contains a list of buses comprising the subsystem. The MUST program was then used to generate all combinations of N-2 contingencies (i.e., two simultaneous single contingencies) for all branches within the subsystem and tie-lines out of the subsystem. All facilities rated 69 kV and above were monitored in XEL, ALTW, GRE, OTP and SMMPA. All facilities 100 kV and above were monitored in the MEC and MP areas.

DC contingency analysis was performed using the MUST program and post-contingency power flows in excess of 100% of the Rate C data and with a TDF greater than 2% were recorded. Post-contingency overloads with and without the proposed G433 and G434 projects were tabulated and compared.

2.1.2 Voltage Analysis

For system intact conditions, monitored bus voltages that fall outside the band 0.95 pu – 1.05 pu are flagged as violations. For N-1 contingency conditions, monitored bus voltages outside the range 0.92 pu – 1.10 pu are flagged as violations. In accordance with MAPP DRS Guidelines, those buses that have a voltage change of more than 0.01 p.u. (without plant vs. with plant) are included in the SAF list.

2.2 Transfer Capability Analysis

The purpose of the transfer capability analysis is to determine the incremental transfer capability out of the Prairie Island 345 kV substation, prior to the addition of projects G433 and G434. This analysis determined the first contingency incremental transfer capability (FCITC) and was performed using dc power flow techniques based on the MUST program.

The same sub, mon and con files that were used in the N-1 contingency analysis portion of this study (See Appendix C) were used for this analysis as well. The violation criteria used for this analysis was a 100% of the Rate A rating (for system intact conditions) and 100% of the Rate C rating (for N-1 contingency conditions) and a TDF of 2% or greater.

2.3 Constrained Interface Analysis

The purpose of the constrained interface analysis is to calculate the impact of the proposed projects on specified constrained interfaces in the MAPP transmission system. The MAPP DFCALC constrained interface analysis program is used for this purpose.

2.4 Stability Analysis

The purpose of these analyses was to determine whether the MAPP system would meet stability criteria following commissioning of the proposed projects. To that end, selected contingencies were simulated under summer off-peak conditions with maximum simultaneous transfer levels across the major interfaces. The studies were conducted utilizing the April 2004 MS Windows Version of the NMORWG Stability Package.

First, a stability model was developed to represent system conditions before the addition of the proposed projects (i.e., a pre-project model was developed). Next, the proposed projects were added to the pre-project stability model in order to create the post-project stability model. Stability analysis was performed on the post-project model to determine the stability of the new and existing units when the system is subjected to faults in the local area, as well as critical faults in the region.

3. STEADY-STATE ANALYSIS

3.1 Base Case Development

Two pre-project base cases were developed as part of this study. These cases represent the system without the proposed projects and model i) 2007 summer peak load conditions and ii) 2007 summer off-peak load conditions (with maximum simultaneous exports across the major interfaces).

The pre-project cases were developed from a set of base cases provided by MISO i.e., Cannon Falls (G405) base cases. The G405 cases are based on the MAPP 2002 series 2007 summer peak and summer off-peak cases, with prior-queued generation projects included. Several transmission and generation changes were made to the base cases in order to develop the pre-project cases. Details pertaining to the development of the pre-project cases are provided in Appendix A.

After establishing the pre-project power flow cases, the corresponding post-project power flow cases were developed by increasing the Gross MW outputs of Prairie Island generating units 1 and 2 by 19 MW each. Generators in the MISO footprint[3] were scaled down in order to account for the 38 MW increase in generation. This resulted in two post-project power flow cases, one representing 2007 summer peak load conditions and the other representing 2007 summer off-peak load conditions.

Gross generation and load levels at Prairie Island in the pre- and post-project powerflow cases are shown below. These values were established based on consultation with XEL and MISO.

Prairie Island Unit 1:
Gross MW Output = 550.4 MW (pre-project) and 569.4 MW (post-project)
Station Service Load = 32.2 MW

Prairie Island Unit 2:
Gross MW Output = 545.6 MW (pre-project) and 564.6 MW (post-project)
Station Service Load = 32.7MW

Table 3.1 summarizes the point of interconnection and sink data.

Table 3.2 lists the export levels for the summer off-peak power flow conditions, to reflect a heavily stressed system scenario.

[3] MISO Footprint was defined as generation in the following areas: Area 356: Ameren, Area 359: Cilco, Area 208: Cinergy, Area 360: CWLP, and Area 211: LGEE, Area 650: Lincoln Electric System, Area 218: CONS, Area 361: SIPC, Area 202: FE, Area 217: NIPS.

Table 3.1: G433-434 Project Details

Project	MW	Location	Point of Interconnection		Sink
			Bus Name	Bus #	
G433-434	38	Pr. Island	Pr. Island 345 kV	60105	MISO footprint

Table 3.2: Export Levels for Summer Off-peak Power Flow Case

System Condition	Export Level (MW)		
	NDEX	MHEX_S	MWSI
Summer off-peak	1,949	2,176	1,476

3.2 System Intact Analysis

Power flows and voltages were checked on facilities rated 69 kV and above in the XEL system and also on facilities of adjoining areas like ALTW, GRE, MEC, MP, OTP, and WAPA to assess the impact of adding the proposed G433 and G434 projects. The criteria used for flagging thermal overloads is the Rate A data (from the powerflow cases). Bus voltages that fall outside the band of 0.95 pu - 1.05 pu were flagged as violations.

Figures 3.1 - 3.4 show the power flow diagrams of the area in the vicinity of the proposed projects for 2007 summer peak and summer off-peak load conditions, both with and without the proposed projects.

<u>Impact of Proposed Projects on Facility Loadings</u>

Thermal overloads were observed on several transmission facilities, both with and without the proposed projects (see Appendix B). The impact of these projects on the facility loading under system intact conditions is negligible, both for summer peak and summer off-peak load conditions. No new thermal violations were observed.

<u>Impact of Proposed Projects on Bus Voltages</u>

Voltage criteria violations were observed at several remote buses, both with and without the proposed projects (see Appendix B).The impact of the proposed projects on bus voltages under system intact conditions is negligible, both for summer peak and summer off-peak load conditions. No new voltage violations were observed.

ABB

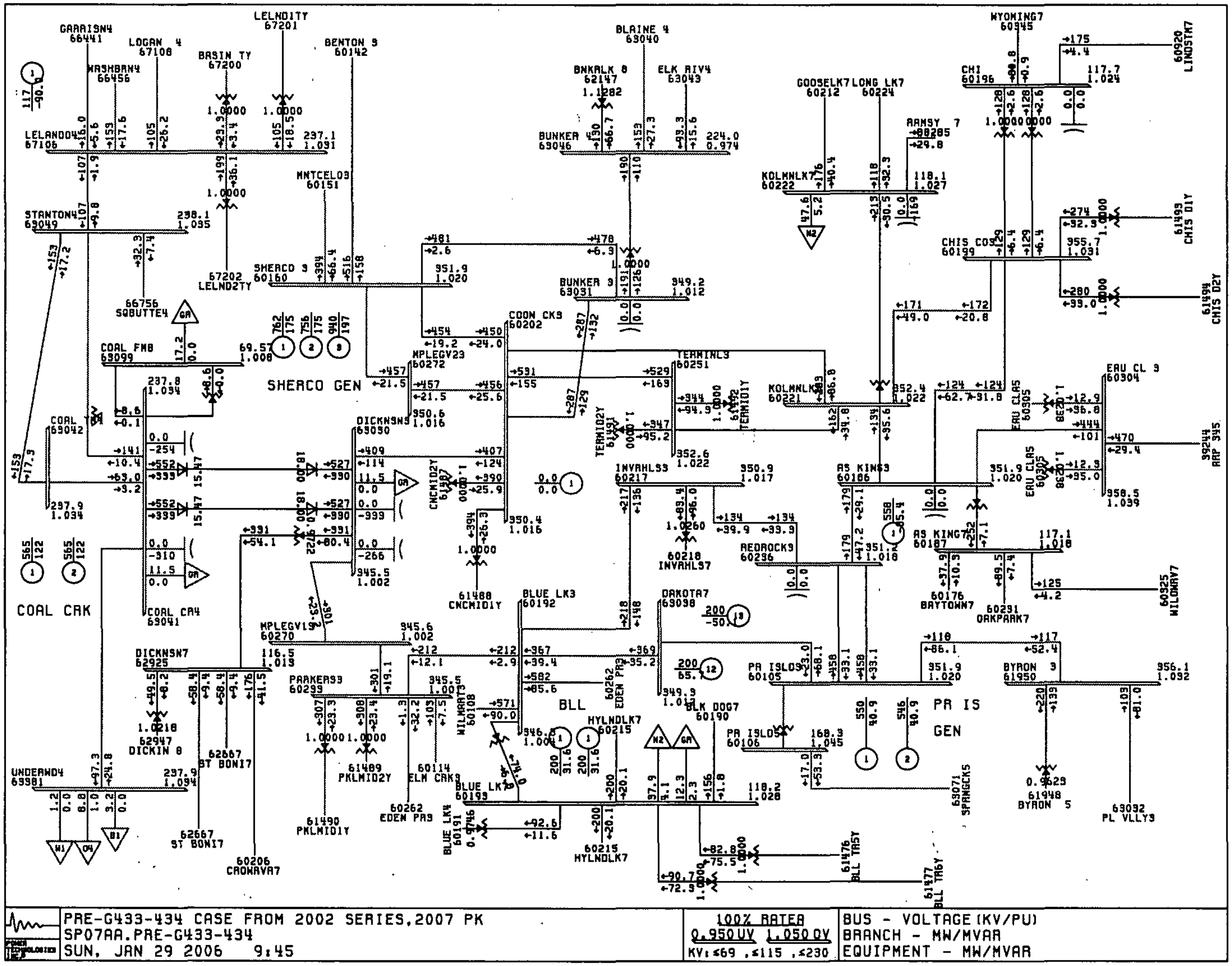

Figure 3.1: Power Flow Diagram for 2007 Summer Peak Load Conditions (Without G433-434)

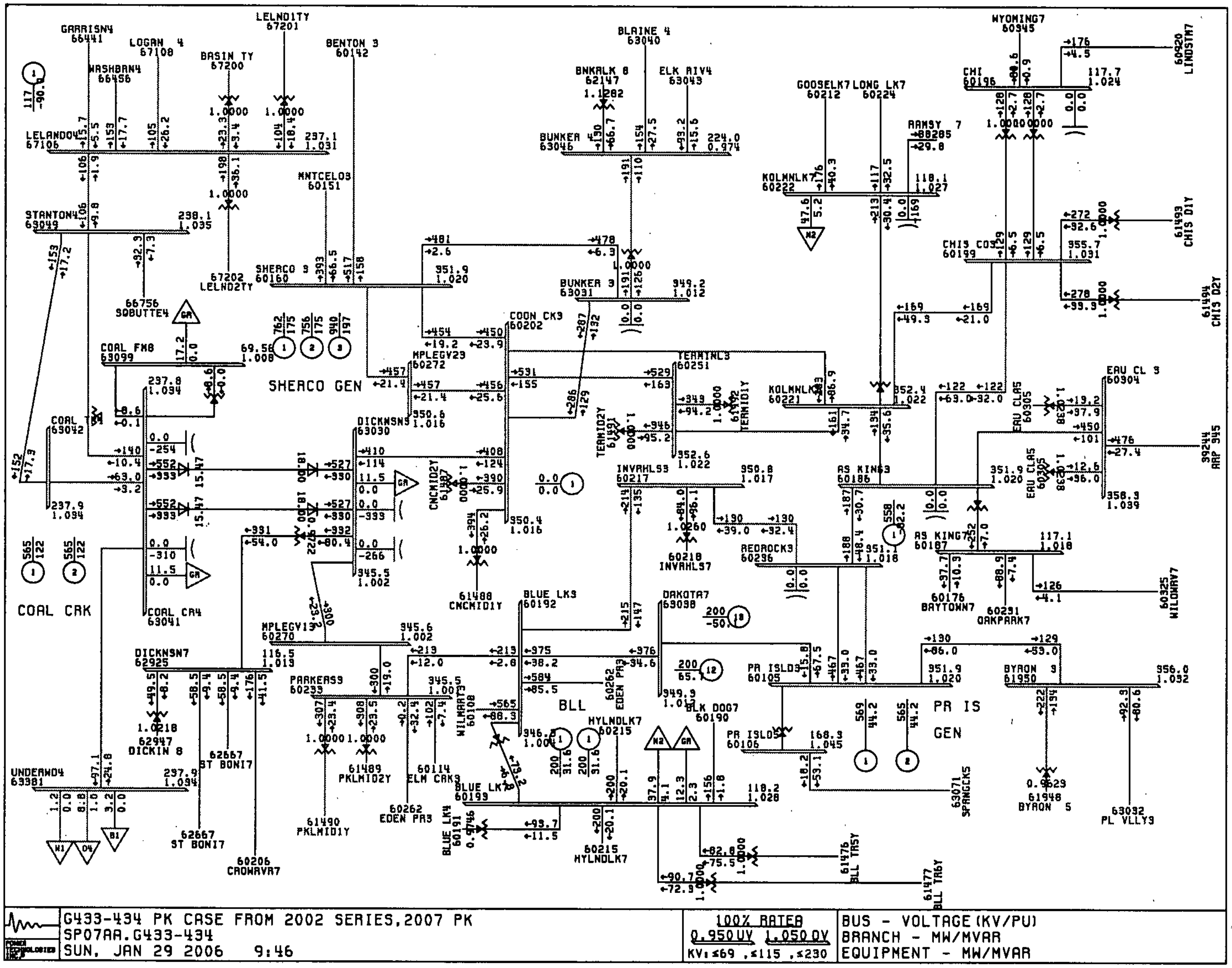

Figure 3.2: Power Flow Diagram for 2007 Summer Peak Load Conditions (With G433-434)

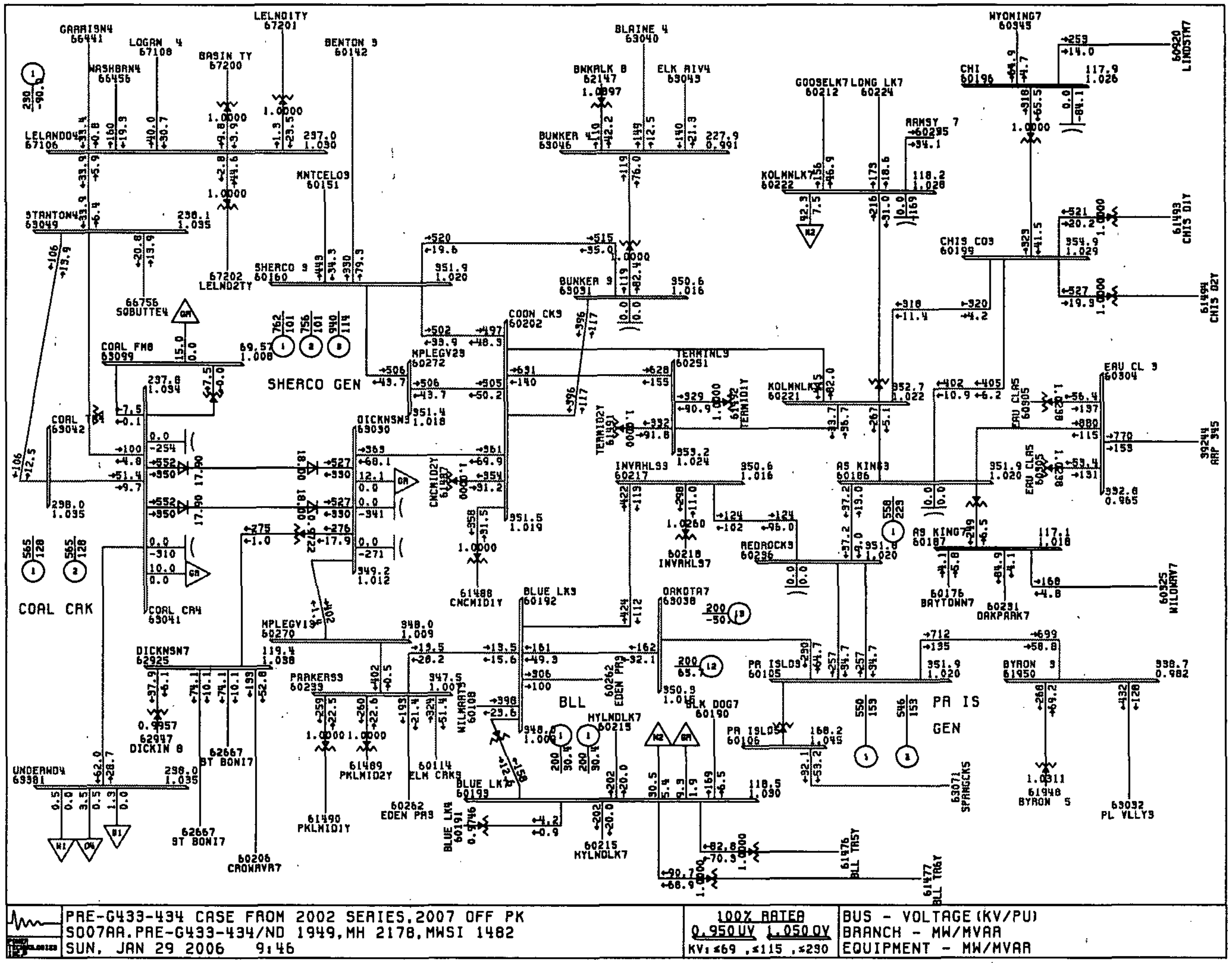

Figure 3.3: Power Flow Diagram for 2007 Summer Off-Peak Load Conditions (Without G433-434)

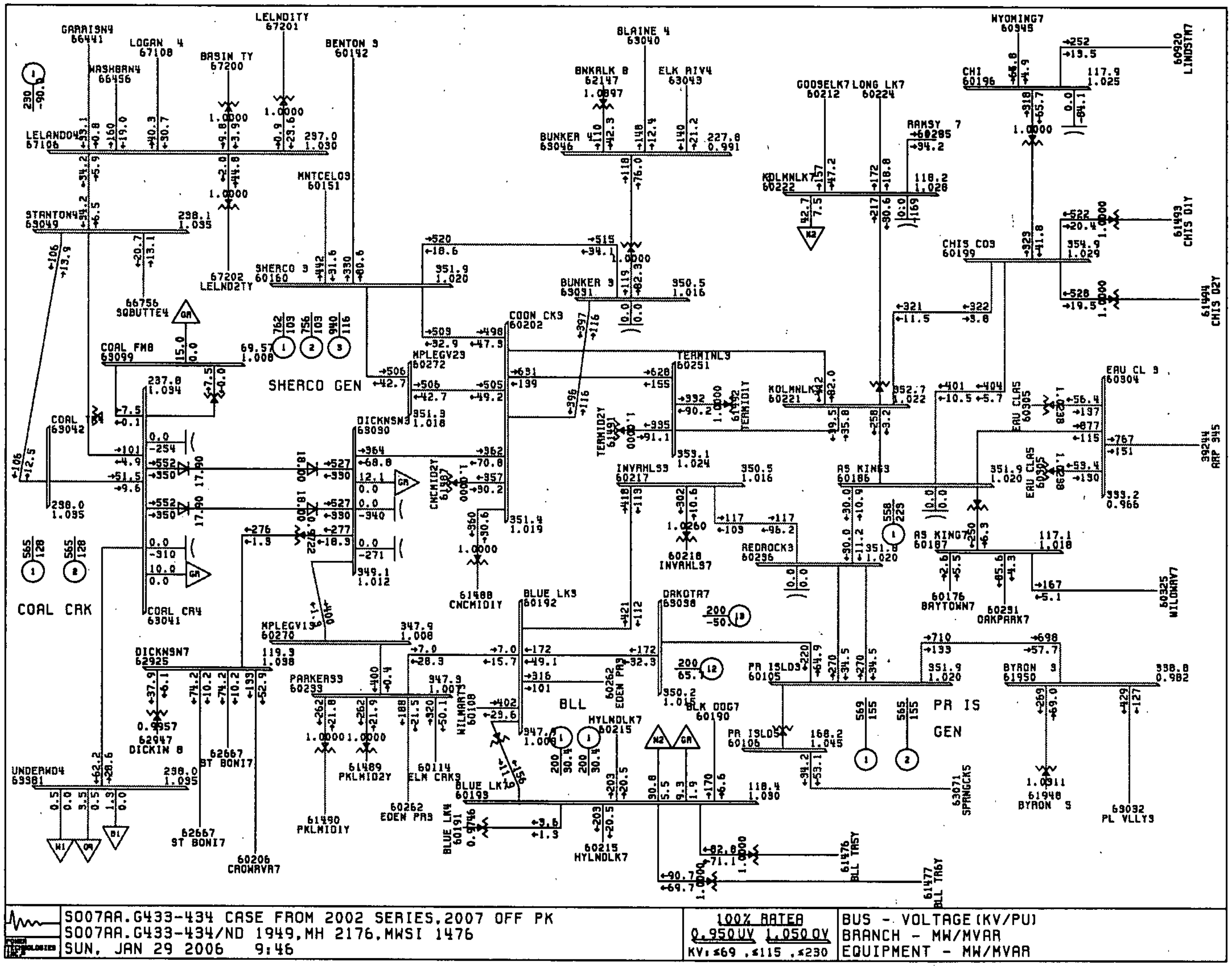

Figure 3.4: Power Flow Diagram for 2007 Summer Off-Peak Load Conditions (With G433-434)

3.3 N-1 Contingency Analysis

After establishing the system intact violations, transmission system steady-state performance was compared by performing N-1 contingency analyses on the summer peak and summer off-peak cases, both with and without the proposed projects. The analyses were conducted using the activity ACCC of PSS/E.

Thermal violations were flagged based on the facility emergency ratings (Rate C in the powerflow case). As explained in Section 2.2.1, only those facilities that have a TDF greater than 2.0% have been flagged as Significantly Affected Facilities.

Bus voltages outside the range of 0.92-1.10 pu were flagged as criteria violations. In accordance with MAPP DRS Guidelines, those buses that have a voltage change of more than 0.01 pu (without plant vs. with plant) are included in the SAF list.

Tables 3.3 and 3.4 list the limiting elements and associated contingencies that cause overloads, along with a comparison of the facility loadings in percentage with and without the proposed projects. These tables list only the most limiting contingency (one that causes highest overload) for each overloaded facility. Facility overloads were grouped into three categories. The first category consisted of all new overloads (red). The second category consisted of all pre-project overloads that increased loading by ten percent or more (black) and the third category consisted of all pre-project overloads that increased loading by less than ten percent (blue). The limiting elements listed in these tables are segregated based on transmission ownership information as available from PSS/E power flow model and information provided by various transmission owners.

AC contingency analysis results were post-processed to create SCREENACCC reports to compare the results obtained from the pre-project cases vs. those obtained from the post-project cases (see Appendix D). The reports presented in Appendix D contain all facility overloads regardless of distribution factor and should be reviewed by the transmission owners.

3.3.1 Summer Peak Conditions

3.3.1.1 Impact of Proposed Projects on Facility Loadings

Table 3.3 lists those facilities that are significantly affected by the addition of the proposed projects. As these facilities are remote from the point of interconnection, a detailed analysis of the impacts is considered beyond the scope of this study.

3.3.1.2 Impact of Proposed Projects on Bus Voltages

Voltage violations were observed at several remote buses both with and without the proposed project. No new voltage violations were observed, and the impact of the proposed projects on pre-project voltage violations is insignificant.

3.3.2 Summer Off-Peak Conditions

3.3.2.1 Impact of Proposed Projects on Facility Loadings

Table 3.4 lists those facilities that are significantly affected by the addition of the proposed projects. These facilities are away from the point of interconnection. As before, a detailed analysis of these overloads is beyond the scope of this study.

3.3.2.2 Impact of Proposed Projects on Bus Voltages

Voltage violations were observed at several remote buses both with and without the proposed projects. Table 3.5 lists buses with voltage violations where the impact is greater than 0.01 p.u. These buses are all remote from the Prairie Island substation.

Table 3.3: Significantly Affected Facilities under N-1 Contingency Conditions (2007 Summer Peak)

LIMITING ELEMENT	RATING (MVA)			CONTINGENCY	% LOADING (ON RATE C)		CHANGE (%)	TDF
	RATEA	RATEB	RATEC		W/O G433/434	WITH G433/434		
				ALTW				
34020 HAZL S 5 161 34135 DUNDEE 5 161 1	167.0	167.0	167.0	34018 HAZLTON3 345 - 34093 ARNOLD 3 345 ckt 1	122.6	124.2	1.6	0.06842
				GRE				
63043 ELK RIV4 230 62134 ELKR14S8 69 2	95.6	112.0	105.2	62297 BENTON 8 69 - 62300 MINDEN 8 69 ckt 1	125.3	126.0	0.7	0.02105
61910 MILACA 4 230 62301 MILACA 8 69 1	96.0	112.0	105.0	60114 ELM CRK3 345 - 60151 MNTCELO3 345 ckt 1	113.3	113.4	0.1	0.04737
				MEC				
64244 SAC GEN 161 64245 CLIPRG19 34.5 1	100.0	100.0	100.0	63908 SAC 5 161 - 64230 POMEROY5 161 ckt 1	154.0	160.9	6.9	0.03421
34016 EMERY 5 161 64252 FLOYD 5 161 1	238.0	238.0	238.0	34018 HAZLTON3 345 - 60102 ADAMS 3 345 ckt 1	104.4	105.0	0.6	0.03947
64256 UNIONTP5 161 64285 BUTLER 5 161 1	181.0	181.0	181.0	825	120.3	120.8	0.5	0.02632
64239 FRANKLN5 161 64285 BUTLER 5 161 1	181.0	181.0	181.0	825	124.7	125.2	0.5	0.02368
				XEL				
60305 EAU CLA5 161 60317 WHEATON5 161 1	272.0	272.0	300.0	60186 AS KING3 345 - 60304 EAU CL 3 345 ckt 1	120.1	120.6	0.5	0.03947
60152 MNTCELO4 230 63045 BENTON 4 230 1	400.0	448.2	440.0	60142 BENTON 3 345 - 60160 SHERCO 3 345 ckt 1	101.6	101.8	0.2	0.02105
60151 MNTCELO3 345 60152 MNTCELO4 230 1	336.0	336.0	436.0	60142 BENTON 3 345 - 60160 SHERCO 3 345 ckt 1	114.4	114.6	0.2	0.02105
60142 BENTON 3 345 63045 BENTON 4 230 2	**336.0**	**336.0**	**420.0**	**60142 BENTON 3 345 - 63045 BENTON 4 230 ckt 1**	**99.9**	**100.1**	**0.2**	**0.02105**
60142 BENTON 3 345 63045 BENTON 4 230 1	336.0	336.0	420.0	60142 BENTON 3 345 - 63045 BENTON 4 230 ckt 2	101.4	101.6	0.2	0.02105

Table 3.4: Significantly Affected Facilities under N-1 Contingency Conditions (2007 Summer Off-Peak)

LIMITING ELEMENT	RATING (MVA)			CONTINGENCY	% LOADING (ON RATE C)		CHANGE (%)	TDF
	RATEA	RATEB	RATEC		W/O G433/434	WITH G433/434		
ALTW								
34059 BOONE 7 115 34076 BNE JCT7 115 1	60.0	60.0	60.0	34052 AMES 7 115 - 34076 BNE JCT7 115 ckt 1	103.5	105.3	1.8	0.02368
GRE								
63040 BLAINE 4 230 62128 BLAINE 8 69 1	95.6	112.0	105.2	61910 MILACA 4 230 - 63045 BENTON 4 230 ckt 1	102.8	103.8	1.0	0.02632
63048 RUSH CY4 230 62293 RUSH CY8 69 1	84.0	84.0	105.0	62141 ISANTTP8 69 - 62296 INDSTTP8 69 ckt 1	117.4	118.1	0.7	0.02105
MEC								
64203 NW FTDG5 161 64230 POMEROY5 161 1	173.0	173.0	173.0	ASK-RRK/ECL3	104.7	105.3	0.6	0.02105
MP								
62175 DEWING 7 115 61650 LITTLEF7 115 1	90.0	90.0	99.0	BEN-GRC/SCL7	99.1	101.2	2.1	0.02895
62175 DEWING 7 115 61651 MUDLAKE7 115 1	90.0	90.0	99.0	BEN-GRC/SCL7	103.2	105.3	2.1	0.03947
XEL								
60163 WST CLD7 115 60165 MEI INT7 115 1	191.0	194.0	213.0	BEN-GRC/SCL7	138.6	142.5	3.9	0.05000
60154 SAUK RV7 115 60157 STCLOUD7 115 1	139.0	139.0	152.0	BEN-GRC/SCL7	144.7	148.5	3.8	0.04211
60164 XRDS 7 115 60165 MEI INT7 115 1	191.0	194.0	213.0	BEN-GRC/SCL7	125.6	129.1	3.5	0.04211
60153 MNTCELO7 115 60166 SALIDA 7 115 1	140.0	140.0	154.0	BEN-GRC/SCL7	154.9	157.9	3.0	0.09737
60158 STCLTP 7 115 60166 SALIDA 7 115 1	139.0	139.0	152.0	BEN-GRC/SCL7	150.2	153.2	3.0	0.05263
60154 SAUK RV7 115 60163 WST CLD7 115 1	139.0	139.0	152.0	BEN-GRC/SCL7	113.7	116.7	3.0	0.03421
60146 GRANCTY7 115 60164 XRDS 7 115 1	191.0	191.0	210.0	BEN-GRC/SCL7	99.3	102.0	2.7	0.02895
60157 STCLOUD7 115 60159 STCTPW 7 115 1	113.0	113.0	124.0	BEN-GRC/SCL7	102.9	105.6	2.7	0.04474
60157 STCLOUD7 115 60158 STCLTP 7 115 1	139.0	139.0	152.0	BEN-GRC/SCL7	108.3	110.6	2.3	0.03684
60143 BENTON 7 115 60146 GRANCTY7 115 1	239.0	350.0	239.0	60143 BENTON 7 115 - 60348 BENCTP7 115 ckt 1	103.3	104.1	0.8	0.04211
60203 COON CK7 115 60253 TWIN LK7 115 1	371.0	371.0	371.0	022 1	102.2	102.7	0.5	0.05000

Table 3.5: Significantly Affected Bus Voltage Violations for N-1 Contingency Conditions (2007 Summer Off-Peak)

BUS NO	BUS NAME	KV	CONTINGENCY	VOLTAGE (PU) W/O G433/434	VOLTAGE (PU) WITH G433/434	CHANGE (PU)
GRE						
62819	FSCHRHL7	115	BEN-GRC/SCL7	0.7679	0.7564	0.0115
XEL						
60161	STREGIS7	115	BEN-GRC/SCL7	0.6842	0.6701	0.0141
60146	GRANCTY7	115	BEN-GRC/SCL7	0.6972	0.6835	0.0137
60348	BENCTP7	115	BEN-GRC/SCL7	0.6972	0.6835	0.0137
60164	XRDS 7	115	BEN-GRC/SCL7	0.7137	0.7005	0.0132
60165	MEI INT7	115	BEN-GRC/SCL7	0.7216	0.7087	0.0129
60732	WST CLD8	69	BEN-GRC/SCL7	0.8254	0.8129	0.0125
62841	WESTWD 8	69	BEN-GRC/SCL7	0.8246	0.8121	0.0125
62842	LESAUK 8	69	BEN-GRC/SCL7	0.8227	0.8102	0.0125
62843	LSAUKTP8	69	BEN-GRC/SCL7	0.8277	0.8154	0.0123
60163	WST CLD7	115	BEN-GRC/SCL7	0.741	0.7288	0.0122
60759	STJOSPH8	69	BEN-GRC/SCL7	0.8327	0.8206	0.0121
60154	SAUK RV7	115	BEN-GRC/SCL7	0.7492	0.7373	0.0119
61189	WATAB 8	69	BEN-GRC/SCL7	0.8343	0.8224	0.0119
62833	STSTPHN8	69	BEN-GRC/SCL7	0.8199	0.8086	0.0113
62832	BROCKWY8	69	BEN-GRC/SCL7	0.8267	0.8155	0.0112
60758	JOHNS U8	69	BEN-GRC/SCL7	0.8445	0.8334	0.0111
62831	BRCKWTP8	69	BEN-GRC/SCL7	0.8467	0.8358	0.0109
60757	AVON 8	69	BEN-GRC/SCL7	0.8583	0.848	0.0103

3.4 N-2 Contingency Analysis

The purpose of N-2 contingency analysis is to determine transmission system thermal overloads following simultaneous outages of any two-transmission system branches in the vicinity of the proposed projects. The analysis was performed on the Summer Peak powerflow cases described in Section 3.1.

For the purposes of this analysis, a subsystem was defined consisting of buses (100 kV and above) in the vicinity of the Prairie Island substation. Buses up to five levels away from the Prairie Island substation were included in this subsystem. See Appendix K for a list of buses comprising the subsystem. The MUST program was then used to generate all combinations of N-2 contingencies (i.e., two simultaneous single contingencies) for all branches within the subsystem and tie-lines out of the subsystem. All facilities rated 69 kV and above were monitored in XEL, ALTW, GRE, OTP and SMMPA. All facilities 100 kV and above were monitored in the MEC and MP areas.

DC contingency analysis was performed using the MUST program and post-contingency power flows in excess of 100% of the Rate C data and with a TDF greater than 2% were recorded. Post-contingency overloads with and without the proposed G433 and G434 projects were tabulated and compared.

Table 3.6 lists overloaded facilities and associated N-2 contingencies causing the overloads, along with a comparison of the facility loadings in percentage with and without the proposed projects. These tables list only the most limiting contingency (one which causes highest overload with the proposed projects) and the corresponding loading with and without the proposed projects. Results suggest that although the proposed projects incrementally increase the loading on previously overloaded facilities, their impact is largely insignificant.

The study ad hoc group should review the overloads listed in Table 3.6 to determine whether operating procedures might be needed to resolve them.

Table 3.6: N-2 Contingency Analysis Results (2007 Summer Peak)

LIMITING ELEMENT	RATE C (MVA)	CONTINGENCY	% LOADING (ON RATE C) W/O G433/434	% LOADING (ON RATE C) WITH G433/434	CHANGE (%)
34020 HAZL S 5 161 34135 DUNDEE 5 161 1	167.0	D:HAZLTON3-ARNOLD 3 1 +BYRON 3-PL VLLY	136.8	138.0	1.2
61976 LOON LK8 69.0 60264 LOON LK7 115 1	82.0	D:PR ISLD3-BYRON 3 1 +W FARIB7-S FARIB	114.7	115.7	1.0
60305 EAU CLA5 161 60317 WHEATON5 161 1	300.0	D:AS KING3-EAU CL 3 1 +EAU CLA5-JEFRSRD	130.3	131.0	0.7
64239 FRANKLN5 161 64285 BUTLER 5 161 1	181.0	D:HAZLTON3-ADAMS 3 1 +AS KING3-EAU CL	128.9	129.4	0.5
64256 UNIONTP5 161 64285 BUTLER 5 161 1	181.0	D:HAZLTON3-ADAMS 3 1 +AS KING3-EAU CL	120.2	120.7	0.5
34016 EMERY 5 161 64252 FLOYD 5 161 1	238.0	D:HAZLTON3-ADAMS 3 1 +BYRON 3-PL VLLY	113.2	113.7	0.5

3.5 Transfer Capability Analysis

The purpose of the transfer capability analysis is to determine the incremental transfer capability out of the Prairie Island 345 kV substation, prior to the addition of projects G433 and G434. This analysis determined the first contingency incremental transfer capability (FCITC) and was performed using dc power flow techniques based on the MUST program.

The same sub, mon and con files that were used in the N-1 contingency analysis portion of this study (See Appendix C) were used for this analysis as well. The violation criteria used for this analysis was a 100% of the Rate A rating (for system intact conditions) and 100% of the Rate C rating (for N-1 contingency conditions) and a TDF of 2% or greater.

The analysis was performed on the pre-project summer peak and summer off-peak cases described in Section 3.1. In each case, a 200 MW transfer was simulated from the Prairie Island 345 kV substation to the MISO footprint. The FCITC reports are attached in Appendix F. As can be seen from these reports, several remote facilities are overloaded even prior to the simulated transfer. However, there are no limiting elements in the immediate vicinity of the Prairie Island substation for both summer peak and summer off-peak system conditions. These results suggest that the full 38 MW of requested output can be accommodated by the transmission system without resulting in transmission limitations at the point of interconnection.

3.6 Constrained Interface Analysis

The purpose of this task was to determine if the proposed projects would adversely impact the regional constrained interfaces (PTDF and OTDF interfaces) of the MAPP system. The analysis was performed using the NMORWG DFCALC IPLAN program on the pre- and post-project powerflow models described in Section 3.1.

The interface definitions for this analysis were provided by the study ad hoc group and are based on the 3/12/04 postings on the MAPP OASIS. The interface data definition file provided by the study ad hoc group is compatible with the 2003/2004 Series MAPP cases. Minor changes were made to this file for compatibility with the 2002 Series MAPP cases (as noted in Section 3.1, the powerflow models used in this study are based on the 2002 Series MAPP cases).

Table 3.7 and 3.8 show the interface flows for cases with and without the proposed projects, as well as the transfer distribution factor (in percent) for the 38 MW power transfer from the proposed projects to the sink for summer peak and summer off-peak system conditions respectively. Also shown are the total transfer capabilities (TTCs) for the various interfaces for the 2007 Summer timeframe as obtained from the MAPP OASIS[4].

[4] http://toinfo.oasis.mapp.org/documents/atcdir/plan/atccomp.txt

As shown in Table 3.7, the proposed projects adversely impact[5] the following interfaces under summer peak conditions: COOPER_S: 15.4% TDF, ECL-ARP: 16.4%, FTCAL_S: 11.0%, MWSI: 49.1% and PRI-BYN: 32.6%.

The corresponding impacts observed in the summer off-peak cases (see Table 3.8) are: MNTZUMA_W: 6.0% TDF, QUADCITY_W: 6.5%, LACWGRLACSTI: 3.3%, S1226TEKAMAH: 3.4% and SPETRILAKRAU: 4.4%.

The DFCALC output is included in the Appendix F.

[5] As per MAPP Design Review Subcommittee criteria (see MAPP DRS document entitled "*Steady-State Facility & Constrained Path Impact Determination Requirements & Screening Guidelines for Study Submissions*" approved July 18, 2003), the minimum PTDF threshold for MAPP PTDF Interfaces is 5% and the minimum MW impact threshold is 1 MW or 1% of the impacted Path TTC (whichever is smaller). PTDF Interfaces that have PTDFs >= 5% -and- a MW impact >= minimum MW impact threshold are considered significantly impacted.

For OTDF Interfaces, the minimum OTDF threshold is 3% and the minimum impact threshold is 1 MW or 1% of the impacted Path TTC (whichever is smaller). OTDF Interfaces that have OTDFs >= 3% -and- a MW impact >= minimum MW impact threshold are considered significantly impacted.

Table 3.7: Impact of Proposed Projects on MAPP Constrained Interfaces (2007 Summer Peak)

INTERFACE	TTC (MW)	WITHOUT G433/434 (MW)	WITH G433/434 (MW)	CHANGE (MW)	TDF (%)
PTDF INTERFACES					
COOPER S	1190	491.6	497.4	5.9	15.4
ECL-ARP	790	469.6	475.9	6.2	16.4
FTCAL S	776	396.0	400.2	4.2	11.0
GGS	1800	1275.7	1276.2	0.5	1.4
GRIS LNC	960	229.7	230.6	0.2	2.4
LKM-WFB	139	-187.9	-187.3	0.5	1.4
MHEX N+	N/A	-1548.3	-1547.9	0.4	1.0
MHEX S+	N/A	1573.2	1572.8	-0.4	-1.0
MH SPC E+	N/A	-72.3	-72.6	-0.3	-0.8
MH SPC W+	N/A	73.9	74.2	0.3	0.9
MNTZUMA W	587	-348.3	-351.0	-2.6	-7.0
MWSI	1480	587.2	605.9	18.6	49.1
NDDC	428	-105.9	-105.9	0.0	0.0
NDEX	2150	296	296.5	0.6	1.5
PRI-BYN	835	117.6	130.0	12.4	32.6
QUADCITY W	1400	217.7	213.0	-4.7	-12.4
WNE WKS	455	338.2	339.4	1.2	3.2
Y2DC	200	0.3	0.3	0.0	0.0
OTDF INTERFACES					
ARNVINARNHAZ	276	-62.2	-64.2	-2.0	-5.2
DAVCALQUARCK	223	104.7	103.8	-0.9	-2.4
LACWGRLACSTI	1251	865.7	864.1	-1.5	-4.0
LKFFOXLKGWLM	160	44.3	43.4	-0.9	-2.5
LORTRKWEMPAD	200	48.8	47.9	-0.9	-2.5
POWREAMTZBON	195	-101.5	-102.6	-1.1	-2.9
S1226TEKAMAH	256	-22.7	-24.2	-1.5	-4.0
SALXFMWEMPAD	336	149.8	148.3	-1.5	-3.9
SPETRILAKRAU	195	-26.8	-28.6	-1.8	-4.8

Table 3.8: Impact of Proposed Projects on MAPP Constrained Interfaces (2007 Summer Off-peak)

INTERFACE	TTC (MW)	WITHOUT G433/434 (MW)	WITH G433/434 (MW)	CHANGE (MW)	TDF (%)
PTDF INTERFACES					
COOPER S	1190	1035.0	1030.4	-4.7	-12.4
ECL-ARP	790	770.0	766.7	-3.4	-8.9
FTCAL S	776	691.0	687.4	-3.6	-9.5
GGS	1800	1091.4	1090.6	-0.9	-2.3
GRIS LNC	960	393.7	392.7	-1.0	-2.6
LKM-WFB	139	-47.5	-48.2	-0.7	-2.0
MHEX N+	N/A	-2130.7	-2130.8	-0.2	-0.4
MHEX S+	N/A	2176.8	2177.0	0.2	0.5
MH SPC E+	N/A	-66.0	-65.6	0.4	1.1
MH SPC W+	N/A	69.8	69.3	-0.4	-1.1
MNTZUMA W	587	-642.5	-640.2	2.3	6.0
MWSI	1480	1481.7	1476.8	-5.0	-13.1
NDDC	428	-89.5	-89.5	0.0	0.1
NDEX	2150	1916.9	1916.4	-0.5	-1.3
PRI-BYN	835	711.7	710.1	-1.6	-4.2
QUADCITY W	1400	-177.1	-174.6	2.5	6.5
WNE WKS	455	402.9	401.8	-1.1	-2.9
Y2DC	200	0.3	0.3	0.0	0.0
OTDF INTERFACES					
ARNVINARNHAZ	276	-149.9	-148.8	1.1	2.9
DAVCALQUARCK	223	62.2	62.7	0.5	1.3
LACWGRLACSTI	1251	807.6	808.8	1.3	3.3
LKFFOXLKGWLM	160	26.8	27.5	0.7	1.8
LORTRKWEMPAD	200	16.3	17.0	0.7	1.8
POWREAMTZBON	195	-205.7	-204.8	0.9	2.4
S1226TEKAMAH	256	-149.0	-147.8	1.3	3.4
SALXFMWEMPAD	336	74.5	75.2	0.8	2.0
SPETRILAKRAU	195	-103.1	-101.4	1.7	4.4

3.7 Impact of Proposed Projects on Steady-State Performance – Summary

The interconnection of the proposed projects impacted several transmission facilities and resulted in steady-state criteria violations for system intact, N-1 and N-2 contingency conditions. These violations are remote from the Prairie Island substation. Also, the transmission lines out of the Prairie Island substation are not overloaded. Based on information provided by the study ad hoc group, these remote violations should not limit the ability of the proposed projects to interconnect.

The violations reported in this study could potentially limit the ability of the projects to deliver power into the transmission system and should therefore be resolved. MISO has indicated that these overloads can not be classified as injection issues and therefore they need not to be mitigated for Energy Resource Interconnection Service.

4. STABILITY STUDIES

4.1 Introduction

The purpose of this analysis was to determine whether the MAPP system would meet stability criteria following commissioning of the proposed G433 and G434 projects. To that end, local and regional contingencies were simulated under summer off-peak conditions with maximum simultaneous NDEX (≈1950), MHEX (≈2175), and MWSI (≈1480) transfer levels.

The following steps were taken:

1. First, a pre-project stability model was developed to represent system conditions prior to the addition of the proposed G433 and G434 projects. Stability models used in the previously completed G405 (Cannon Falls) System Impact Study were used as a starting point for developing the models for this study. The same set of transmission and generation changes that were made in Section 3.1 were also applied to the G405 stability model in order to derive the pre-project stability model. Details of model development are provided in Appendix G.

2. Next, the proposed projects were added to the pre-project stability model to create the post-project stability model. The proposed projects were redispatched utilizing the same guidelines as in the steady-state analysis. The power flow and stability model representation of the Prairie Island units (with the proposed expansion) is shown in Appendix H.

3. Finally, stability analysis was performed on the post-project stability model to determine the stability of new and existing units for various faults in the local area, as well as for regionally critical faults.

The studies were conducted utilizing the April 2004 MS Windows Version of the NMORWG Stability Package.

4.2 Results of Stability Analysis

The analysis of the impact of the proposed projects on stability focused on the following two issues:

- To determine the stability of the proposed projects for disturbances near the point of interconnection.

- To determine if the proposed projects would adversely impact the stability of nearby generation facilities.

The fault scenarios considered for stability assessment are listed in Table 4.1. With the exception of faults 4b3, 4p3 and pr3, all other faults listed in this table are standard faults from the NMORWG study package. All faults were run for 5 seconds, except for faults pcs, pct, pys, and pyt, which were run to 20 seconds, thus allowing for Prony analyses of any oscillations that might occur.

Table 4.1: List of Disturbances Simulated for Stability Assessment

Fault	Fault Description
agl	4 cy slgf @ l.old 345 on ftthomp line, lo brkr 2692 stk clr @ 11 cy by tripping fltd line
ei2	permanent bipole fault on the cu dc line both coal creek units tripped at 0.28 sec
mss	SLGBF fault at Sherco on Coon Creek #1 line Trip Sherco to Coon Creek 345 kV and Coon Creek 345/115 kV
mts	SLGBF fault at Monticello with 8N6 stuck Trip Monticello to Elm Creek
nbz	4 cycle, three phase fault at chisago county trip f601c cross trip d602f, use new 100% reduction init from chisago
nmz	4 cycle, three phase fault at chisago trip f601c, xtrip d602f use new 100% reduction init from chisago, leave svs on mp sys
pcs	SLG fault at King-Eau Claire line with a breaker failure at king trips King-ECL,ECL-ARP,and ASK-CHI line
pct	trip of ask-ecl-arp without a fault trips ask-ecl-arp 345 kv line
pys	14 cycle slg at at prairie island trip pri-byn line
pyt	trip of pri-byn without a fault trips pri-byn 345 kv line
4b3	5 cycle 3 phase fault at DCG. Trip DCG-Blue Lake 345 kV line
4p3	5 cycle 3 phase fault at Prairie Island. Trip DCG-Prairie Island 345 kV line.
pr3	5 cycle 3 phase fault on Prairie Island end of Prairie Island-Red Rock. Trip Prairie Island-Red Rock 345 kV line Ckt 2

Table 4.2 summarizes the results. Simulation summary tables and plots for selected fault scenarios are presented in Appendix J.

No stability criteria violations were observed for simulated faults after addition of proposed projects. Results suggest that the addition of proposed projects would not adversely impact system stability.

Table 4.2: Results of Stability Analysis

Fault	Fault Description	Without G433/434	With G433/434
ag1	4 cy slgf @ l.old 345 on ftthomp line, lo brkr 2692 stk clr @ 11 cy by tripping fltd line	Not Tested	Stable
ei2	permanent bipole fault on the cu dc line both coal creek units tripped at 0.28 sec	Not Tested	Stable
mss	SLGBF fault at Sherco on Coon Creek #1 line Trip Sherco to Coon Creek 345 kV and Coon Creek 345/115 kV	Not Tested	Stable
mts	SLGBF fault at Monticello with 8N6 stuck Trip Monticello to Elm Creek	Not Tested	Stable
nbz	4 cycle, three phase fault at chisago county trip f601c cross trip d602f, use new 100% reduction init from chisago	Not Tested	Stable
nmz	4 cycle, three phase fault at chisago trip f601c, xtrip d602f use new 100% reduction init from chisago, leave svs on mp sys	Not Tested	Stable
pcs	SLG fault at King-Eau Claire line with a breaker failure at king trips King-ECL,ECL-ARP,and ASK-CHI line	Not Tested	Stable
pct	trip of ask-ecl-arp without a fault trips ask-ecl-arp 345 kv line	Not Tested	Stable
pys	14 cycle slg at at prairie island trip pri-byn line	Not Tested	Stable
pyt	trip of pri-byn without a fault trips pri-byn 345 kv line	Not Tested	Stable
4b3	5 cycle 3 phase fault at DCG. Trip DCG-Blue Lake 345 kV line	Not Tested	Stable
4p3	5 cycle 3 phase fault at Prairie Island. Trip DCG-Prairie Island 345 kV line.	Not Tested	Stable
pr3	5 cycle 3 phase fault on Prairie Island end of Prairie Island-Red Rock. Trip Prairie Island-Red Rock 345 kV line Ckt 2	Not Tested	Stable

5. CONCLUSIONS

The impact of adding 38 MW of generation (projects G433 and G434) at the Prairie Island 345 kV substation was evaluated. At MISO's request, both projects were studied together as one single interconnection request. This study evaluated the collective impact of the proposed projects on the transmission system and included system performance evaluation based on steady-state analysis and stability analysis.

Based on the technical evaluation, the following conclusions can be drawn:

Steady-State Analysis:

The interconnection of the proposed projects impacted several transmission facilities and resulted in steady-state criteria violations for system intact and N-1 contingency conditions. These violations are remote from the Prairie Island substation. Also, the transmission lines out of the Prairie Island substation are not overloaded. Based on information provided by the study ad hoc group, these remote violations should not limit the ability of the proposed projects to interconnect as Energy Resource.

The violations reported in this study could potentially limit the ability of the projects to deliver power into the transmission system. MISO has indicated that these overloads can not be classified as injection issues and therefore they need not to be mitigated for Energy Resource Interconnection Service.

Transfer Capability Analysis

The purpose of the transfer capability analysis was to determine the incremental transfer capability out of the Prairie Island 345 kV substation, prior to the addition of projects G433 and G434. Results suggest that the full 38 MW of requested output can be accommodated by the transmission system without resulting in transmission limitations at the point of interconnection.

Constrained Interface Analysis:

The study also evaluated the impact of the proposed projects on constrained interfaces in the MAPP system. The results of the analysis are for informational purposes only to identify potential third party flowgate issues for the requested delivery component of the transmission. Results suggest that the proposed projects adversely impact several constrained interfaces. See Section 3.6 for details. Mitigation may be required if it is determined that there is insufficient or no available transfer capability (ATC) on the affected MAPP constrained interfaces. This is an issue that should be addressed with the system impact study for delivery service should the proposed projects proceed with such a request.

Stability Analysis:

Stability analysis was performed to evaluate the impact of the proposed projects on the system stability. No stability criteria violations were observed for the simulated faults. Results indicate that the interconnection of the proposed projects would not adversely impact transmission system stability.

The results of this study are based on available data and assumptions made at the time of conducting this study. In particular, it should be noted that the results depend on delivery assumptions of prior-queued generator interconnections. If the delivery assumptions of the prior-queued generators change and/or if the prior-queued units drop out of the generator interconnection queue, additional studies may be required to determine possible criteria violations that may limit the ability of the project to inject and/or deliver power into the transmission system. Any additional studies are considered outside of the scope of the system impact studies. The results provided in this report may not apply if any of the data and/or assumptions made in developing the study models change.

Delyn Electrical Engineering, LLC

G433-G434 Transient Stability Study - Supplement

Prepared for Xcel Energy

Delyn Kilpack, PE
11/13/2009

Table of Contents

1 Introduction

This transient stability study is a supplement to the March 24, 2006, System Impact Study titled: Generation Interconnection Study - Projects # G433 and G434. This study is being performed to confirm the upgrades meet the transmission system study requirements of IEEE 765, IEEE Standard for Preferred Power Supply (PPS) for Nuclear Power Generating Stations (NPGS).

The G433 and G434 generation additions add 38 MW to the existing Prairie Island generation facility. The G433 and G434 projects increased the Prairie Island Unit 1 generation output 19 WM to 569.4 MW gross, and the Unit 2 generation output 19 MW to 564.6 MW gross and will be used as the level of power outputs in this study. The increased output is due to upgrades being done on the units to increase their capability.

A transient stability analysis determines the strength of the transmission system during fault conditions and determines if the generators are able to remain in synchronism with the transmission grid during and immediately following a fault. Transient analysis determines whether oscillations caused by a fault damp out or if the oscillation remains on the transmission grid. This transient analysis also evaluated post-fault voltage levels at the Prairie Island 161 kV and 345 kV buses.

The stability analysis shall examine, at a minimum, the stability of the proposed generator increase and other generators close to the generation addition. The stability analysis shall be based upon dynamic data provided by Xcel Energy owners of the Prairie Island generating stations unit. The generation increase shall conform to the Midwest ISO reliability criteria analysis requirements or those of MAPP, MAIN, ECAR, SPP and the Transmission Owner(s) as applicable.

The relative performance of the Transmission System with the proposed generation increase and appropriate system disturbances shall be analyzed. Siemens/Power Technology Inc. Power System Simulation for Dynamics software is being used to study the Transient Stability of the electric system.

The Northern MAPP stability package was used to perform the stability analysis. The stability package utilizes the Seimens/PTI PSS/E and PSS/D version 29 software. Included in the package are automatic programs for adjusting interfaces (setexports.irf) and other programs for running transient stability analysis. The automatic programs within the Northern MAPP stability package must be used wherever possible in the model development and stability simulations. The stability package is developed and maintained by NMORWG (Northern MAPP Operating Review Working Group).

2 Executive Summary

The G433 and G434 generation additions add 38 MW to the existing Prairie Island generation facility. The G433 and G434 projects increased the Prairie Island Unit 1 generation output 19 WM to 569.4 MW gross, and the Unit 2 generation output 19 MW to 564.6 MW gross and will be used as the level of power outputs in this study. The increased output is due to upgrades being done on the units to increase their capability.

There were no stability analysis criteria violations for the nineteen disturbances that were analyzed in this study of G433 and G434. There were no damping problems for any of the nineteen faults analyzed for the benchmark and generator increase models.

The steady state 161kV and 345 kV voltages at Prairie Island were also analyzed following the nineteen disturbances. The analysis demonstrated that the voltages at Prairie Island 161 and 345 kV buses were within the voltage criteria specified by the interconnection customer (IC) for all the disturbances studied. The disturbances included all the following events:

a) Loss of the nuclear power generating unit
b) Loss of the largest (or most significant) generating unit
c) Loss of the largest (or most significant) transmission circuit or intertie
d) Loss of the largest (or most significant) load

3 Model Development

The starting model and stability package came from the MISO G929 stability study previously performed. The model is an off-peak summer model. The stability snapshot was unchanged from the G929 stability models previously performed.

The model used in the G929 study included the addition of prior-queued regional projects that would likely be in service by June of 2009. The Prairie Island generation and load were modeled as follows:.

Prairie Island Unit 1:
Gross MW Output = 550.4 MW (pre-project) and 569.4 MW (post-project)
Station Service Load = 32.2 MW
Prairie Island Unit 2:
Gross MW Output = 545.6 MW (pre-project) and 564.6 MW (post-project)
Station Service Load = 32.7MW

The MWEX (Minnesota-Wisconsin export) level used in the study was set to the maximum level of 1525 MW. MWEX is adjusted by varying Minnesota load in Area 600 (Xcel Energy) and MAIN generation in areas 365 (WE), 366(WPS), and 367(MGE).

3.1 Simultaneous Interfaces

The simultaneous export levels were set to their simultaneous limits in the model as follows:

- NDEX (North Dakota Export) = 1950 MW
- MHEX (Manitoba Hydro Export) = 2175 MW
- MWEX (Minnesota Wisconsin Export) = 1529 MW
- Flow on new Arrowhead – St Lake = 641.6 MW

MWEX is a new interface that replaces MWSI (Minnesota Wisconsin Stability Interface) and is required after the Arrowhead – Stone Lake 345 kV line went into service. The program within the Northern MAPP stability package called setexports.irf is used to set the simultaneous export levels. However, the package supplied my MISO had MWSI but not the newer MWEX interface. Therefore, setexports.irf was used to set NDEX and MHEX to their simultaneous limits.

MWEX is set by adjusting Twin Cities Load and adjusting ATC and MAIN generation to correspond to the load changes. This method of setting MWEX is similar to the method used in the most recent 2006 Northern MAPP stability package setexports program.

4 Stability Analysis

A transient stability analysis determines the strength of the transmission system during fault conditions and determines if the generators are able to remain in synchronism with the transmission grid during and following a fault. Another transient condition determines whether oscillations caused by a fault damps out or if the oscillation remains on the transmission grid close to the fault long after the fault is cleared.

NERC (National Electric Reliability Council) requires both 3-phase faults without breaker failure and single-line-ground faults with a breaker failure to be studied to determine the adequacy of the reliability of the transmission system. The stability simulation runs steady state for a few cycles, then induces a fault, either 3-phase or single-line- ground fault at a specific location. The simulation runs with the fault applied for the amount of time that it takes relays to sense the fault and open breakers that ultimately clear the fault, plus one cycle. A single-line to ground fault with breaker failure is when a breaker fails to open when directed to by the relay. A relay farther down the transmission grid then senses the fault and sends directions to one or more other breakers to open in order to clear the fault. Disturbances with breaker failure require the short to be applied for a longer time and also open more transmission lines in order to clear the fault. Three-phase faults are typically more severe and most of the time have higher fault currents, but since breaker failures cause more lines to open and the fault remains on the transmission grid for longer time periods, they can also cause instability to the electric system.

The ability of generators to remain in synchronism with the transmission grid during a fault can be determined by running the simulation for 5 seconds after the fault. Oscillations however need to decay to zero within an appropriate time. To determine if oscillations are appropriately damped after a fault requires running the simulation for 25 seconds.

4.1 Criteria

The MAPP Members Reliability Criteria and Study Procedures Manual documents the criteria that the transmission system must operate within in order to maintain reliability of the system. The version of the study manual in place at the time of this study is: MAPP-Memb-Rel-Crit-and-Study-Proc-2004-1119.pdf. The transient or stability criteria is copied in this report and is shown in Appendix A.

4.2 Study Procedures

The stability analysis will use the NMORWG stability package commonly referred to as the user interface package (uip). There are nineteen faults that will be run on the Prairie Island G433 and G434 models. Any violations of the applicable regional reliability criteria and any faults that are not appropriately damped will be reported.

Stability plots of all simulations at critical areas of the Northern MAPP region are provided. There are also reports detailing information about the power flow model and conditions of the transmission system during and after the fault. The stability plots show voltages, and rotor angles of generators at specific locations on the transmission grid. The values are plotted during the fault, during the clearing of the fault for a specified amount of time after the fault is cleared. After faults are cleared, voltages near the fault attempt to recover to 1.0 pu. There are usually oscillations of voltage above and below 1.0 pu until the voltage settles to its new steady state voltage. When there is an oscillation of voltage that does not damp out after 25 seconds, this is considered a transient damping problem that requires mitigation. Faults in Minnesota have historically had damping problems. Therefore, in this study all faults were simulated for 25 seconds to insure that there are no damping problems.

The NMORWG uip contains information about certain faults and clearing times with breaker failures and without breaker failures. For use in the uip, each fault previously identified has a three letter code that contains the information required to simulate the fault including the power flow model bus names, clearing times, fault impedances etc. The stability plots and reports reference this three-letter code defined in the package and not the location and type of fault being simulated. A description of the nineteen faults that were simulated and the corresponding three-letter code in the uip is shown in Table 4-1 below:

Table 4-1

Fault Code	Description
pcs	Single line to ground fault with breaker fail at King with 8P6 stuck. Trip King – Eau Claire - Arpin 345 kV line and King to Chisago County 345 kV line.
mqs	Single line to ground fault with breaker fail at Sherco with 8N28 stuck. Trip Sherco generator 3.
mss	Single line to ground fault with breaker fail at Sherco with 8N32. Trip Sherco to Coon Creek 345 kV line.
mts	Single line to ground fault with breaker fail at Monticello with 8N6 stuck. Trip Monticello to Parkers Lake.
msz	Three-phase fault at Sherco on Sherco-Coon Creek #1 345 kV line
mtz	Three-phase fault at Monticello on Monticello- Elm Creek-Parkers Lake 345 kV line
taz	Three-phase fault at Sherco on Sherco-Coon Creek #2 345 kV line.
tbz	Three-phase fault at Coon Creek on Coon Creek -Dickinson 345 kV line.
tcz	Three-phase fault at Dickenson on Dickenson - Parkers lake 345 kV line.
tkz	Three-phase fault at King on King -Eau Claire - Arpin 345 kV line.
ei2	Permanent bipole fault on the CUDC line. Both Coal Creek units tripped at 0.28 sec.

Fault Code	Description
nbz	4 cycle, three phase fault at Chisago county trip F601C cross trip D602F, use new 100% reduction init from Chisago (Loss of the largest (or most significant) transmission circuit or intertie)
mnt	Trip Monticello generating unit
krs	Trip KOCHREF load (loss of most significant load)
fss	Trip Fifth Street load (loss of second most significant load)
nnt	Trip Sherco #3 (loss of most significant generating unit)
nat	Trip of Prairie Island Unit 1 (New fault file created loss of nuclear power generating unit)
nbt	Trip of Prairie Island Unit 2 (New fault file created loss of nuclear power generating unit)
nct	Trip of both Prairie Island units (New Fault file created loss of nuclear power generating units)

4.2.1 Stability Analysis Results

There were no transient voltage violations in the Prairie Island G433 and G434 models for the nineteen faults analyzed.

A summary of the stability analysis results are shown in Table 4.3 for all nineteen faults. Table 4.3 shows the minimum and maximum transient voltage levels at buses that historically have had transient voltage violations. The stability plots are very large files in excess of 35 MB and are over 400 pages. The stability plots are posted on the consultants web site at: www.delynelectricalengineering.com and can be downloaded. User ID's and passwords to access the stability plots are available from the Midwest ISO.

4.2.2 Steady State Voltage Post Fault

An additional analysis was done on the nineteen disturbances showing the steady state voltages at the Prairie Island 161, and 345 kV buses after the disturbance is applied and the system has reached steady state. The steady state voltage criteria are:

- 345 kV system limit: 336.1 kV to 362.3 kV or 0.9742 pu to 1.05 pu
- 161 kV system limit: 160.2 kV to 169 or 99.5 pu to 1.05 pu

The results of the steady state voltages post fault are shown in Table 4-2 below. As can be seen in Table 4-2 none of the post disturbance steady state voltages violates this criteria.

Table 4-2 Comparison of Steady State Voltages

Fault Code	Description	Generator Increase Prairie Island 161 kV	Generator Increase Prairie Island 345 kV
pcs	Single line to ground fault with breaker fail at King with 8P6 stuck. Trip King – Eau Claire - Arpin 345 kV line and King to Chisago County 345 kV line.	1.008 pu 162.3kV	1.036 pu 357.4 kV
mqs	Single line to ground fault with breaker fail at Sherco with 8N28 stuck. Trip Sherco generator 3.	1.014 pu 163.3 kV	1.042 pu 359.6 kV
mss	Single line to ground fault with breaker fail at Sherco with 8N32. Trip Sherco to Coon Creek 345 kV line.	1.015 pu 163.4 kV	1.042 pu 359.6 kV
mts	Single line to ground fault with breaker fail at Monticello with 8N6 stuck. Trip Monticello to Parkers Lake.	1.015 pu 163.3 kV	1.042 pu 359.6 kV
msz	Three-phase fault at Sherco on Sherco-Coon Creek #1 345 kV line	1.015 pu 163.4 kV	1.042 pu 359.6 kV
mtz	Three-phase fault at Monticello on Monticello- Elm Creek-Parkers Lake 345 kV line	1.015 pu 163.3 kV	1.042 pu 359.6 kV
taz	Three-phase fault at Sherco on Sherco-Coon Creek #2 345 kV line.	1.015 pu 163.3 kV	1.042 pu 359.6 kV
tbz	Three-phase fault at Coon Creek on Coon Creek - Dickinson 345 kV line.	1.015 pu 163.3 kV	1.042 pu 359.6 kV
tcz	Three-phase fault at Dickenson on Dickenson - Parkers lake 345 kV line.	1.015 pu 163.4 kV	1.042 pu 359.6 kV
tkz	Three-phase fault at King on King -Eau Claire - Arpin 345 kV line.	1.015 pu 163.3 kV	1.042 pu 359.6 kV
ei2	Permanent bipole fault on the CUDC line. Both Coal Creek units tripped at 0.28 sec.	1.015 pu 163.4 kV	1.042 pu 359.6 kV
nbz	4 cycle, three phase fault at Chisago county trip F601C cross trip D602F, use new 100% reduction init from Chisago (Loss of the largest (or most significant) transmission circuit or intertie)	1.014 pu 163.3 kV	1.042 pu 359.6 kV
mnt	Trip Monticello generating unit	1.014 pu 163.3 kV	1.042 pu 359.6 kV
krs	Trip KOCHREF load (loss of most significant load)	1.015 pu 163.4 kV	1.042 pu 359.6 kV
fss	Trip Fifth Street load (loss of second most significant load)	1.015 pu 163.4 kV	1.042 pu 359.6 kV
nnt	Trip Sherco #3 (loss of most significant generating unit)	1.014 pu 163.3 kV	1.042 pu 359.6 kV

Fault Code	Description	Generator Increase Prairie Island 161 kV	Generator Increase Prairie Island 345 kV
nat	Trip of Prairie Island Unit 1 (New fault file created) (loss of nuclear power generating unit)	1.009 pu 162.5 kV	1.035 pu 357.2 kV
nbt	Trip of Prairie Island Unit 2 (New fault file created) (loss of nuclear power generating unit)	1.008 pu 162.3 kV	1.033 pu 356.4 kV
nct	Trip of both Prairie Island units (New Fault file created loss of nuclear power generating unit)	1.003 pu 161.4 kV	1.007 pu 347.3 kV

5 Summary

G433 and G434 are upgrades to the existing Prairie Island generators unit #1 and #2. Each Prairie Island unit is being upgraded by 19 MW net output. There were no stability analysis criteria violations for the nineteen disturbances that were analyzed in this study of G433 and G434. There were no damping problems for any of the nineteen faults analyzed for the benchmark nor generator increase models.

A check of steady state voltages at Monticello and Prairie Island for the nineteen disturbances was performed. There were no violations of the Prairie Island 161, and 345 kV steady state voltage criteria for the nineteen faults analyzed. The analysis demonstrated that the voltages at Prairie Island 161 and 345 kV buses were within the voltage criteria specified by the interconnection customer (IC) for all the disturbances studied. The disturbances included all the following events:

a) Loss of the nuclear power generating unit
b) Loss of the largest (or most significant) generating unit
c) Loss of the largest (or most significant) transmission circuit or intertie
d) Loss of the largest (or most significant) load

Table 4.3 Summary of Stability Analysis

Case No.	1	2	3	4
Case Name	433-so08aa-ei2	433-so08aa-fss	433-so08aa-krs	433-so08aa-mnt
Disturbance	ei2	fss	krs	mnt
Prior Outage	None	None	None	None
Date/Time	NOV 13 2009 10:58	NOV 13 2009 11:48	NOV 13 2009 11:36	NOV 13 2009 11:23
Comments				
Steady State Flows				
NDEX / EAST BIAS	1950 / 433	1950 / 433	1950 / 433	1950 / 433
MHEX / L20D	2176 / 207	2176 / 207	2176 / 207	2176 / 207
ECL-ARP / PRI-BYN	626 / 461	626 / 461	626 / 461	626 / 461
MWSI / MNEX	1087 / 313	1087 / 313	1087 / 313	1087 / 313
D602F / F601C	1845 / 1628	1845 / 1628	1845 / 1628	1845 / 1628
B10T / MH>SPC	165 / 74	165 / 74	165 / 74	165 / 74
OH E-W / OH>MH	-28 / -196	-28 / -196	-28 / -196	-28 / -196
R50M / OH>MP	158 / 150	158 / 150	158 / 150	158 / 150
G82R	-34	-34	-34	-34
Dorsey BP1 / BP2	1512 / 1712	1512 / 1712	1512 / 1712	1512 / 1712
Dorsey Reserve / Wtrtn SVC	156 / 2	156 / 2	156 / 2	156 / 2
Forbes SVC / MSC	26 / 600	26 / 600	26 / 600	26 / 600
Steady State Vltgs				
Dorsey 500/Dorsey 230	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045
Roseau 500/Forbes 500	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004
Chisago 500/EauClaire 345	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992
Int Falls 115/Badoura 115	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033
Drayton 230/Groton 345	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027
SS OS Relay Margins				
D602F at Forbes/Dorsey	220% / 349%	220% / 349%	220% / 349%	220% / 349%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M/F3M	847% / 335%	847% / 335%	847% / 335%	847% / 335%
B10T	336%	336%	336%	336%
Min/MaxTransientVltg				
Arrowhd 230	0.94 | 1.03	0.99 | 1.00	0.99 | 0.99	0.99 | 1.02
Boise 115	0.99 | 1.04	1.03 | 1.03	1.03 | 1.03	1.00 | 1.04
Dorsey 230	0.98 | 1.06	1.04 | 1.05	1.04 | 1.05	0.98 | 1.06
Forbes 230	0.95 | 1.02	1.01 | 1.02	1.01 | 1.01	0.99 | 1.03
Riverton 230	0.98 | 1.09	1.06 | 1.07	1.06 | 1.06	1.05 | 1.06
Coal Creek 230	1.01 | 1.13	1.03 | 1.04	1.03 | 1.04	1.01 | 1.04
Dickinson 345	0.99 | 1.05	1.01 | 1.03	1.01 | 1.02	0.99 | 1.02
Drayton 230	0.93 | 1.08	1.01 | 1.02	1.01 | 1.02	0.97 | 1.02
Groton 345	0.93 | 1.08	1.03 | 1.03	1.03 | 1.03	1.02 | 1.03
Tioga 230	1.00 | 1.06	1.03 | 1.03	1.03 | 1.03	1.02 | 1.04
Wahpeton 115	0.89 | 1.08	1.03 | 1.03	1.03 | 1.03	1.00 | 1.02
Watertown 345	0.96 | 1.06	1.03 | 1.03	1.03 | 1.03	1.02 | 1.03
Dynamic Voltage Warnings				
	none	none	none	None
Worst Case Angle Damping	SHERC3 / -22.70%	ANTEL3 / 0.00%	ANTEL3 / 5.54%	SHERC3 / -19.87%
Dorsey SUVP / UdHold	/ 15.713			/ 15.885
Forbes DC Red (DCAR)	507%	425%	466%	507%
K22W (max +dP @ t, d-ang)	74.8@(17.47436,-132.7)	0.3@(0.28892,-0.1)	0.2@(0.30756,-0.1)	61.2@(19.98126,-98.5)
K22W (max -dP @ t, d-ang)	8.4@(0.56386,1.0)	8.4@(2.91248,5.0)	4.1@(2.89384,2.5)	0.0@(-0.00466,0.0)
K22W (max d-ang @ t, dP)	-147.7@(20.00455,63.2)	19.0@(20.00455,-4.4)	9.4@(20.00455,-2.0)	-98.6@(20.00455,61.1)
OS Rel Trip / Marg				
MH - OH				
D602F at Forbes/Dorsey	123% / 186%	220% / 349%	220% / 349%	173% / 269%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M / F3M	590% / 219%	837% / 335%	842% / 335%	726% / 263%
B10T	107%	322%	328%	271%
FSCAPS (SS/Unav/Final)				
Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(2 | 2 | 2) / (3 | 3 | 3)	(2 | 2 | 2) / (3 | 3 | 3)	(2 | 2 | 2) / (3 | 3 | 3)	(2 | 2 | 2) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(1 | 7 | 2) / (0 | 1 | 0)	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 0 | 0)
Roseau 230 / Running 230	(0 | 0 | 0) / (1 | 2 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)
Shey 115 / Split Rock 115	(2 | 5 | 2) / (1 | 2 | 2)	(2 | 2 | 2) / (1 | 1 | 1)	(2 | 2 | 2) / (1 | 1 | 1)	(2 | 2 | 2) / (1 | 1 | 1)

Case No.	5	6	7	8
Case Name	433-so08aa-mqs	433-so08aa-mss	433-so08aa-msz	433-so08aa-mts
Disturbance	mqs	mss	msz	mts
Prior Outage	None	None	None	None
Date/Time	NOV 13 2009 5:28	NOV 13 2009 5:42	NOV 13 2009 6:07	NOV 13 2009 5:55
Comments				
Steady State Flows				
NDEX / EAST BIAS	1950 / 433	1950 / 433	1950 / 433	1950 / 433
MHEX / L20D	2176 / 207	2176 / 207	2176 / 207	2176 / 207
ECL-ARP / PRI-BYN	626 / 461	626 / 461	626 / 461	626 / 461
MWSI / MNEX	1087 / 313	1087 / 313	1087 / 313	1087 / 313
D602F / F601C	1845 / 1628	1845 / 1628	1845 / 1628	1845 / 1628
B10T / MH>SPC	165 / 74	165 / 74	165 / 74	165 / 74
OH E-W / OH>MH	-28 / -196	-28 / -196	-28 / -196	-28 / -196
R50M / OH>MP	158 / 150	158 / 150	158 / 150	158 / 150
G82R	-34	-34	-34	-34
Dorsey BP1 / BP2	1512 / 1712	1512 / 1712	1512 / 1712	1512 / 1712
Dorsey Reserve / Wtrtn SVC	156 / 2	156 / 2	156 / 2	156 / 2
Forbes SVC / MSC	26 / 600	26 / 600	26 / 600	26 / 600
Steady State Vltgs				
Dorsey 500/Dorsey 230	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045
Roseau 500/Forbes 500	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004
Chisago 500/EauClaire 345	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992
Int Falls 115/Badoura 115	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033
Drayton 230/Groton 345	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027
SS OS Relay Margins				
D602F at Forbes/Dorsey	220% / 349%	220% / 349%	220% / 349%	220% / 349%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M/F3M	847% / 335%	847% / 335%	847% / 335%	847% / 335%
B10T	336%	336%	336%	336%
Min/MaxTransientVltg				
Arrowhd 230	0.92 | 1.03	0.92 | 1.01	0.92 | 1.01	0.95 | 1.01
Boise 115	0.98 | 1.05	1.00 | 1.05	1.00 | 1.05	1.01 | 1.05
Dorsey 230	1.00 | 1.06	1.02 | 1.06	1.02 | 1.06	1.02 | 1.06
Forbes 230	0.95 | 1.02	0.99 | 1.04	0.98 | 1.03	0.99 | 1.03
Riverton 230	1.01 | 1.07	1.05 | 1.08	1.05 | 1.08	1.05 | 1.08
Coal Creek 230	0.95 | 1.07	0.95 | 1.07	0.96 | 1.06	0.97 | 1.07
Dickinson 345	0.92 | 1.05	0.91 | 1.03	0.93 | 1.03	0.94 | 1.03
Drayton 230	0.97 | 1.05	1.00 | 1.03	0.99 | 1.03	1.00 | 1.03
Groton 345	0.98 | 1.05	1.00 | 1.04	1.00 | 1.04	1.00 | 1.04
Tioga 230	1.00 | 1.05	1.00 | 1.04	1.00 | 1.04	1.01 | 1.04
Wahpeton 115	0.97 | 1.05	1.01 | 1.04	1.00 | 1.04	1.01 | 1.04
Watertown 345	0.99 | 1.04	1.01 | 1.04	1.01 | 1.04	1.01 | 1.04
Dynamic Voltage Warnings				
	none	none	none	none
Worst Case Angle Damping	G405 1 / 36.82%	G405 1 / 70.35%	SHERC3 / 73.21%	G405 1 / 65.32%
Dorsey SUVP / UdHold			/ 0.135	
Forbes DC Red (DCAR)	507%	300%	264%	349%
K22W (max +dP @ t, d-ang)	69.3@(2.81462,-31.6)	24.3@(3.37381,-6.6)	28.5@(3.28993,-7.7)	16.6@(3.43439,-3.6)
K22W (max -dP @ t, d-ang)	24.3@(0.31688,4.4)	26.8@(1.10442,17.5)	33.4@(1.65430,13.0)	20.1@(1.05316,13.3)
K22W (max d-ang @ t, dP)	-102.1@(20.00455,26.9)	17.6@(1.06248,-26.5)	20.6@(1.03452,-31.4)	13.3@(1.03918,-20.1)
OS Rel Trip / Marg				
MH - OH				
D602F at Forbes/Dorsey	112% / 168%	160% / 246%	151% / 232%	169% / 261%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M / F3M	531% / 237%	635% / 302%	628% / 300%	667% / 301%
B10T	122%	174%	158%	198%
FSCAPS (SS/Unav/Final)				
Balta 230	(0 | 1 | 0)	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(2 | 4 | 3) / (3 | 3 | 3)	(2 | 4 | 4) / (3 | 3 | 3)	(2 | 4 | 4) / (3 | 3 | 3)	(2 | 4 | 4) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(1 | 2 | 2) / (0 | 1 | 1)	(1 | 1 | 1) / (0 | 1 | 1)	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 1 | 1)
Roseau 230 / Running 230	(0 | 1 | 0) / (1 | 2 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)
Shey 115 / Split Rock 115	(2 | 4 | 4) / (1 | 2 | 2)	(2 | 2 | 2) / (1 | 1 | 1)	(2 | 2 | 2) / (1 | 2 | 2)	(2 | 2 | 2) / (1 | 1 | 1)

<table>
<tr><td>Case No.</td><td>9</td><td>10</td><td>11</td><td>12</td></tr>
<tr><td>Case Name</td><td>433-so08aa-nat</td><td>433-so08aa-nbt</td><td>433-so08aa-nbz</td><td>433-so08aa-nct</td></tr>
<tr><td>Disturbance</td><td>nat</td><td>nbt</td><td>nbz</td><td>nct</td></tr>
<tr><td>Prior Outage</td><td>None</td><td>None</td><td>None</td><td>None</td></tr>
<tr><td>Date/Time</td><td>NOV 13 2009 12:16</td><td>NOV 13 2009 12:30</td><td>NOV 13 2009 11:10</td><td>NOV 13 2009 10:32</td></tr>
<tr><td>Comments</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Steady State Flows</td><td></td><td></td><td></td><td></td></tr>
<tr><td>NDEX / EAST BIAS</td><td>1950 / 433</td><td>1950 / 433</td><td>1950 / 433</td><td>1950 / 433</td></tr>
<tr><td>MHEX / L20D</td><td>2176 / 207</td><td>2176 / 207</td><td>2176 / 207</td><td>2176 / 207</td></tr>
<tr><td>ECL-ARP / PRI-BYN</td><td>626 / 461</td><td>626 / 461</td><td>626 / 461</td><td>626 / 461</td></tr>
<tr><td>MWSI / MNEX</td><td>1087 / 313</td><td>1087 / 313</td><td>1087 / 313</td><td>1087 / 313</td></tr>
<tr><td>D602F / F601C</td><td>1845 / 1628</td><td>1845 / 1628</td><td>1845 / 1628</td><td>1845 / 1628</td></tr>
<tr><td>B10T / MH>SPC</td><td>165 / 74</td><td>165 / 74</td><td>165 / 74</td><td>165 / 74</td></tr>
<tr><td>OH E-W / OH>MH</td><td>-28 / -196</td><td>-28 / -196</td><td>-28 / -196</td><td>-28 / -196</td></tr>
<tr><td>R50M / OH>MP</td><td>158 / 150</td><td>158 / 150</td><td>158 / 150</td><td>158 / 150</td></tr>
<tr><td>G82R</td><td>-34</td><td>-34</td><td>-34</td><td>-34</td></tr>
<tr><td>Dorsey BP1 / BP2</td><td>1512 / 1712</td><td>1512 / 1712</td><td>1512 / 1712</td><td>1512 / 1712</td></tr>
<tr><td>Dorsey Reserve / Wtrtn SVC</td><td>156 / 2</td><td>156 / 2</td><td>156 / 2</td><td>156 / 2</td></tr>
<tr><td>Forbes SVC / MSC</td><td>26 / 600</td><td>26 / 600</td><td>26 / 600</td><td>26 / 600</td></tr>
<tr><td>Steady State Vltgs</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Dorsey 500/Dorsey 230</td><td>1.041 / 1.045</td><td>1.041 / 1.045</td><td>1.041 / 1.045</td><td>1.041 / 1.045</td></tr>
<tr><td>Roseau 500/Forbes 500</td><td>1.069 / 1.004</td><td>1.069 / 1.004</td><td>1.069 / 1.004</td><td>1.069 / 1.004</td></tr>
<tr><td>Chisago 500/EauClaire 345</td><td>1.002 / 0.992</td><td>1.002 / 0.992</td><td>1.002 / 0.992</td><td>1.002 / 0.992</td></tr>
<tr><td>Int Falls 115/Badoura 115</td><td>1.029 / 1.033</td><td>1.029 / 1.033</td><td>1.029 / 1.033</td><td>1.029 / 1.033</td></tr>
<tr><td>Drayton 230/Groton 345</td><td>1.014 / 1.027</td><td>1.014 / 1.027</td><td>1.014 / 1.027</td><td>1.014 / 1.027</td></tr>
<tr><td>SS OS Relay Margins</td><td></td><td></td><td></td><td></td></tr>
<tr><td>D602F at Forbes/Dorsey</td><td>220% / 349%</td><td>220% / 349%</td><td>220% / 349%</td><td>220% / 349%</td></tr>
<tr><td>G82R at Rugby/L20D at Drayton</td><td>999% / 999%</td><td>999% / 999%</td><td>999% / 999%</td><td>999% / 999%</td></tr>
<tr><td>R50M/F3M</td><td>847% / 335%</td><td>847% / 335%</td><td>847% / 335%</td><td>847% / 335%</td></tr>
<tr><td>B10T</td><td>336%</td><td>336%</td><td>336%</td><td>336%</td></tr>
<tr><td>Min/MaxTransientVltg</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Arrowhd 230</td><td>0.98 | 1.00</td><td>0.98 | 1.00</td><td>0.88 | 1.08</td><td>0.98 | 1.00</td></tr>
<tr><td>Boise 115</td><td>1.02 | 1.03</td><td>1.02 | 1.03</td><td>0.96 | 1.05</td><td>1.02 | 1.03</td></tr>
<tr><td>Dorsey 230</td><td>1.04 | 1.05</td><td>1.04 | 1.05</td><td>1.04 | 1.18</td><td>1.04 | 1.05</td></tr>
<tr><td>Forbes 230</td><td>1.00 | 1.01</td><td>1.00 | 1.01</td><td>0.94 | 1.08</td><td>1.00 | 1.01</td></tr>
<tr><td>Riverton 230</td><td>1.05 | 1.06</td><td>1.05 | 1.06</td><td>0.97 | 1.10</td><td>1.05 | 1.06</td></tr>
<tr><td>Coal Creek 230</td><td>1.02 | 1.04</td><td>1.02 | 1.04</td><td>0.94 | 1.08</td><td>1.02 | 1.04</td></tr>
<tr><td>Dickinson 345</td><td>0.99 | 1.02</td><td>0.99 | 1.02</td><td>0.94 | 1.06</td><td>0.99 | 1.02</td></tr>
<tr><td>Drayton 230</td><td>1.00 | 1.01</td><td>1.00 | 1.01</td><td>0.98 | 1.07</td><td>1.00 | 1.01</td></tr>
<tr><td>Groton 345</td><td>1.02 | 1.03</td><td>1.02 | 1.03</td><td>0.94 | 1.06</td><td>1.02 | 1.03</td></tr>
<tr><td>Tioga 230</td><td>1.02 | 1.04</td><td>1.02 | 1.04</td><td>1.00 | 1.06</td><td>1.02 | 1.04</td></tr>
<tr><td>Wahpeton 115</td><td>1.01 | 1.02</td><td>1.02 | 1.02</td><td>0.90 | 1.06</td><td>1.02 | 1.02</td></tr>
<tr><td>Watertown 345</td><td>1.03 | 1.03</td><td>1.03 | 1.03</td><td>0.96 | 1.05</td><td>1.03 | 1.03</td></tr>
<tr><td>Dynamic Voltage Warnings</td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>none</td><td>none</td><td>67564 [DORSEY 2] 1.21</td><td>none</td></tr>
<tr><td>Worst Case Angle Damping</td><td>KING 3 / -12.02%</td><td>KING 3 / -11.30%</td><td>KING 3 / -24.68%</td><td>KING 3 / -11.30%</td></tr>
<tr><td>Dorsey SUVP / UdHold</td><td></td><td></td><td>/ 0.135</td><td></td></tr>
<tr><td>Forbes DC Red (DCAR)</td><td>507%</td><td>507%</td><td>507%</td><td>507%</td></tr>
<tr><td>K22W (max +dP @ t, d-ang)</td><td>24.4@(2.20418,-13.3)</td><td>23.7@(2.22282,-12.9)</td><td>135.4@(2.21816,-62.7)</td><td>23.7@(2.22282,-12.9)</td></tr>
<tr><td>K22W (max -dP @ t, d-ang)</td><td>0.0@(-0.00466,0.0)</td><td>0.0@(-0.00466,0.0)</td><td>85.2@(0.24232,7.6)</td><td>0.0@(-0.00466,0.0)</td></tr>
<tr><td>K22W (max d-ang @ t, dP)</td><td>-61.3@(20.00455,14.0)</td><td>-60.0@(20.00455,13.6)</td><td>-227.2@(20.00455,64.6)</td><td>-60.0@(20.00455,13.6)</td></tr>
<tr><td>OS Rel Trip / Marg</td><td></td><td></td><td></td><td></td></tr>
<tr><td>MH - OH</td><td></td><td></td><td></td><td></td></tr>
<tr><td>D602F at Forbes/Dorsey</td><td>190% / 299%</td><td>191% / 301%</td><td>0.18640 sec / 0.18640 sec</td><td>191% / 301%</td></tr>
<tr><td>G82R at Rugby/L20D at Drayton</td><td>999% / 999%</td><td>999% / 999%</td><td>999% / 999%</td><td>999% / 999%</td></tr>
<tr><td>R50M / F3M</td><td>776% / 285%</td><td>778% / 287%</td><td>413% / 151%</td><td>778% / 287%</td></tr>
<tr><td>B10T</td><td>291%</td><td>293%</td><td>133%</td><td>293%</td></tr>
<tr><td>FSCAPS (SS/Unav/Final)</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Balta 230</td><td>(0 | 0 | 0)</td><td>(0 | 0 | 0)</td><td>(0 | 1 | 0)</td><td>(0 | 0 | 0)</td></tr>
<tr><td>Eau Cl 345 / Park Lk 115</td><td>(2 | 2 | 2) / (3 | 3 | 3)</td><td>(2 | 2 | 2) / (3 | 3 | 3)</td><td>(2 | 2 | 1) / (3 | 3 | 3)</td><td>(2 | 2 | 2) / (3 | 3 | 3)</td></tr>
<tr><td>Prairie 115 / Ramsey 230</td><td>(1 | 1 | 1) / (0 | 0 | 0)</td><td>(1 | 1 | 1) / (0 | 0 | 0)</td><td>(1 | 4 | 1) / (0 | 1 | 0)</td><td>(1 | 1 | 1) / (0 | 0 | 0)</td></tr>
<tr><td>Roseau 230 / Running 230</td><td>(0 | 0 | 0) / (1 | 1 | 1)</td><td>(0 | 0 | 0) / (1 | 1 | 1)</td><td>(0 | 0 | 0) / (1 | 2 | 0)</td><td>(0 | 0 | 0) / (1 | 1 | 1)</td></tr>
<tr><td>Shey 115 / Split Rock 115</td><td>(2 | 2 | 2) / (1 | 1 | 1)</td><td>(2 | 2 | 2) / (1 | 1 | 1)</td><td>(2 | 5 | 4) / (1 | 2 | 2)</td><td>(2 | 2 | 2) / (1 | 1 | 1)</td></tr>
</table>

Case No.	13	14	15	16
Case Name	433-so08aa-nnt	433-so08aa-pcs	433-so08aa-taz	433-so08aa-tbz
Disturbance	nnt	pcs	taz	tbz
Prior Outage	None	None	None	None
Date/Time	NOV 13 2009 12:01	NOV 13 2009 4:51	NOV 13 2009 6:32	NOV 13 2009 6:44
Comments				
Steady State Flows				
NDEX / EAST BIAS	1950 / 433	1950 / 433	1950 / 433	1950 / 433
MHEX / L20D	2176 / 207	2176 / 207	2176 / 207	2176 / 207
ECL-ARP / PRI-BYN	626 / 461	626 / 461	626 / 461	626 / 461
MWSI / MNEX	1087 / 313	1087 / 313	1087 / 313	1087 / 313
D602F / F601C	1845 / 1628	1845 / 1628	1845 / 1628	1845 / 1628
B10T / MH>SPC	165 / 74	165 / 74	165 / 74	165 / 74
OH E-W / OH>MH	-28 / -196	-28 / -196	-28 / -196	-28 / -196
R50M / OH>MP	158 / 150	158 / 150	158 / 150	158 / 150
G82R	-34	-34	-34	-34
Dorsey BP1 / BP2	1512 / 1712	1512 / 1712	1512 / 1712	1512 / 1712
Dorsey Reserve / Wtrtn SVC	156 / 2	156 / 2	156 / 2	156 / 2
Forbes SVC / MSC	26 / 600	26 / 600	26 / 600	26 / 600
Steady State Vltgs				
Dorsey 500/Dorsey 230	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045	1.041 / 1.045
Roseau 500/Forbes 500	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004	1.069 / 1.004
Chisago 500/EauClaire 345	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992	1.002 / 0.992
Int Falls 115/Badoura 115	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033	1.029 / 1.033
Drayton 230/Groton 345	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027	1.014 / 1.027
SS OS Relay Margins				
D602F at Forbes/Dorsey	220% / 349%	220% / 349%	220% / 349%	220% / 349%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M/F3M	847% / 335%	847% / 335%	847% / 335%	847% / 335%
B10T	336%	336%	336%	336%
Min/MaxTransientVltg				
Arrowhd 230	0.98 | 1.02	0.86 | 0.94	0.92 | 1.01	0.93 | 1.01
Boise 115	1.00 | 1.04	1.01 | 1.05	1.00 | 1.05	1.00 | 1.04
Dorsey 230	0.98 | 1.06	1.03 | 1.09	1.02 | 1.06	1.02 | 1.05
Forbes 230	0.99 | 1.03	0.99 | 1.05	0.98 | 1.03	0.99 | 1.03
Riverton 230	1.05 | 1.06	1.05 | 1.08	1.05 | 1.08	1.05 | 1.07
Coal Creek 230	1.01 | 1.05	0.99 | 1.07	0.97 | 1.06	0.96 | 1.06
Dickinson 345	0.98 | 1.02	0.98 | 1.05	0.93 | 1.03	0.91 | 1.03
Drayton 230	0.97 | 1.02	0.99 | 1.03	0.99 | 1.03	0.98 | 1.03
Groton 345	1.02 | 1.03	1.00 | 1.03	1.00 | 1.04	1.00 | 1.04
Tioga 230	1.02 | 1.04	1.01 | 1.04	1.00 | 1.04	1.01 | 1.04
Wahpeton 115	1.00 | 1.02	1.01 | 1.04	1.00 | 1.04	1.00 | 1.04
Watertown 345	1.02 | 1.03	1.01 | 1.03	1.01 | 1.04	1.01 | 1.04
Dynamic Voltage Warnings				
	none	61631 [MINONG 5] 0.81	none	none
Worst Case Angle Damping	KING 3 / -11.37%	ANTEL3 / 57.73%	SHERC3 / 73.30%	SHERC3 / 69.25%
Dorsey SUVP / UdHold	/ 15.652		/ 0.135	/ 0.139
Forbes DC Red (DCAR)	507%	229%	264%	303%
K22W (max +dP @ t, d-ang)	64.3@(18.62996,-105.9)	0.6@(0.10252,0.5)	28.5@(3.29925,-7.7)	27.0@(3.11286,-8.3)
K22W (max -dP @ t, d-ang)	0.0@(-0.00466,0.0)	50.4@(1.73818,24.7)	33.9@(1.65430,13.4)	29.5@(1.07646,16.3)
K22W (max d-ang @ t, dP)	-110.7@(20.00455,54.0)	25.6@(1.46324,-41.6)	20.8@(1.05316,-31.9)	16.5@(0.99724,-28.4)
OS Rel Trip / Marg				
MH - OH				
D602F at Forbes/Dorsey	166% / 258%	197% / 310%	150% / 231%	163% / 252%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%	999% / 999%	999% / 999%
R50M / F3M	709% / 255%	672% / 335%	626% / 300%	645% / 303%
B10T	265%	206%	158%	175%
FSCAPS (SS/Unav/Final)				
Balta 230	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(2 | 2 | 2) / (3 | 3 | 3)	(2 | 4 | 3) / (3 | 3 | 3)	(2 | 4 | 4) / (3 | 3 | 3)	(2 | 4 | 4) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 1 | 1)
Roseau 230 / Running 230	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)
Shey 115 / Split Rock 115	(2 | 2 | 2) / (1 | 1 | 1)	(2 | 2 | 2) / (1 | 1 | 1)	(2 | 2 | 2) / (1 | 2 | 2)	(2 | 2 | 2) / (1 | 2 | 2)

Case No.	17	18
Case Name	433-so08aa-tcz	433-so08aa-tkz
Disturbance	tcz	tkz
Prior Outage	None	None
Date/Time	NOV 13 2009 6:57	NOV 13 2009 10:46
Comments		
Steady State Flows		
NDEX / EAST BIAS	1950 / 433	1950 / 433
MHEX / L20D	2176 / 207	2176 / 207
ECL-ARP / PRI-BYN	626 / 461	626 / 461
MWSI / MNEX	1087 / 313	1087 / 313
D602F / F601C	1845 / 1628	1845 / 1628
B10T / MH>SPC	165 / 74	165 / 74
OH E-W / OH>MH	-28 / -196	-28 / -196
R50M / OH>MP	158 / 150	158 / 150
G82R	-34	-34
Dorsey BP1 / BP2	1512 / 1712	1512 / 1712
Dorsey Reserve / Wrtn SVC	156 / 2	156 / 2
Forbes SVC / MSC	26 / 600	26 / 600
Steady State Vltgs		
Dorsey 500/Dorsey 230	1.041 / 1.045	1.041 / 1.045
Roseau 500/Forbes 500	1.069 / 1.004	1.069 / 1.004
Chisago 500/EauClaire 345	1.002 / 0.992	1.002 / 0.992
Int Falls 115/Badoura 115	1.029 / 1.033	1.029 / 1.033
Drayton 230/Groton 345	1.014 / 1.027	1.014 / 1.027
SS OS Relay Margins		
D602F at Forbes/Dorsey	220% / 349%	220% / 349%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%
R50M/F3M	847% / 335%	847% / 335%
B10T	336%	336%
Min/MaxTransientVltg		
Arrowhd 230	0.96 | 1.00	0.87 | 0.95
Boise 115	1.01 | 1.04	1.01 | 1.05
Dorsey 230	1.03 | 1.05	1.03 | 1.06
Forbes 230	1.00 | 1.02	0.99 | 1.02
Riverton 230	1.05 | 1.07	1.05 | 1.07
Coal Creek 230	0.99 | 1.06	0.99 | 1.07
Dickinson 345	0.98 | 1.05	0.98 | 1.05
Drayton 230	0.99 | 1.03	0.99 | 1.03
Groton 345	1.00 | 1.04	1.01 | 1.04
Tioga 230	1.01 | 1.04	1.01 | 1.04
Wahpeton 115	1.00 | 1.04	1.02 | 1.04
Watertown 345	1.01 | 1.04	1.02 | 1.04
Dynamic Voltage Warnings		
	none	..none
Worst Case Angle Damping	SHERC3 / 63.19%	SHERC3 / 60.99%
Dorsey SUVP / UdHold		/ 0.135
Forbes DC Red (DCAR)	373%	231%
K22W (max +dP @ t, d-ang)	13.1@(3.27129,-3.5)	3.0@(3.65341,3.2)
K22W (max -dP @ t, d-ang)	18.6@(1.00190,10.6)	44.1@(1.62634,22.5)
K22W (max d-ang @ t, dP)	10.6@(0.98792,-18.5)	23.4@(1.41198,-38.0)
OS Rel Trip / Marg		
MH - OH		
D602F at Forbes/Dorsey	181% / 282%	188% / 294%
G82R at Rugby/L20D at Drayton	999% / 999%	999% / 999%
R50M / F3M	705% / 315%	676% / 335%
B10T	203%	221%
FSCAPS (SS/Unav/Final)		
Balta 230	(0 | 0 | 0)	(0 | 0 | 0)
Eau Cl 345 / Park Lk 115	(2 | 3 | 3) / (3 | 3 | 3)	(2 | 4 | 3) / (3 | 3 | 3)
Prairie 115 / Ramsey 230	(1 | 1 | 1) / (0 | 0 | 0)	(1 | 1 | 1) / (0 | 0 | 0)
Roseau 230 / Running 230	(0 | 0 | 0) / (1 | 1 | 1)	(0 | 0 | 0) / (1 | 1 | 1)
Shey 115 / Split Rock 115	(2 | 2 | 2) / (1 | 2 | 2)	(2 | 2 | 2) / (1 | 2 | 2)

Appendix A Transient Stability Criteria

1. Transient Voltage Criteria

The transient voltage criteria is detailed on page 3 and 4 of the Study Manual. Some of the criteria is shown below:

SYSTEM	FACILITY	Maximum kV/p.u.	Minimum kV/p.u.
MAPP	Default for all buses	1.20 p.u.	0.70 p.u.
ALTW	Duane Arnold Energy Center (DAEC) nuclear plant		0.95 for 8 seconds
GRE	Load Serving Buses	1.2	0.70
	Remaining Buses	1.2	0.70
MP	230 kV buses	276/1.20	189/0.70
	138 kV buses	166/1.20	113/0.82
	115 kV	138/1.20	94.5/0.82
XEL	Fast switched capacitor buses		0.5 for 5 cycles 0.70
	Prairie Island 4 kV buses		0.78 for 60 cycles

The Jamestown 345 kV voltage is allowed to decrease to 0.68 p.u. for any Center faults. The default voltage limit is utilized for all other faults.

The bus voltages in the northern MAPP area (NMORG members) are allowed to increase up to 1.3 p.u. for a duration up to 200 msec., unless otherwise noted.

The Miles City East and West 230 kV bus voltages are allowed to increase up to 1.3 p.u. for a duration up to 270 msec. during Miles City Converter Station block/bypass operation.

The Dorsey 230 KV bus voltage is allowed to increased up to 1.3 p.u. for a duration up to 200 msec. during events which involve temporary or permanent blocking of Dorsey HVdc.

Following fault clearing, the swings in voltages are not allowed to go higher than the maximum transient criteria or lower than the minimum transient criteria documented above. Usually the most severe swings occur during the first cycle immediately following the fault.

In addition to the region and control area transient voltage criterion, there are also separate criteria for specific buses.

Transient Voltage Limitations for SPECIFIC BUSES.

System	Facility	Maximum kV/p.u.	MinimumkV/p.u.
GRE	Balta 230 kV	1.65 p.u. for 5 cycles #	161/0.70
	Coal Creek 230 kV[5]	271/1.18 #	161/0.70
	Dickinson 345 kV	403/1.17	242/0.70
	Hubbard 230 kV	276/1.20	172.5/0.75
	Ramsey 230 kV	1.65 p.u. for 5 cycles #	161/0.70
	MDU Tioga 230 kV	265/1.15	184/0.80
MH	Dorsey 230 kV	1.30 p.u. for 12 cycles	161/0.70
MP	Arrowhead 230 kV	265/1.15	189/0.82
	Boise 115 kV	132/1.15	94.5/0.82
	Forbes 230 kV	265/1.15	189/0.82
	Little Fork 115 kV	138/1.20	81/0.70
	Riverton 230 kV	265/1.15	189/0.82
	Running 230 kV	276/1.20	161/0.70
	Running SWCAP 230 kV[6]	276/1.20	161/0.70
MPC	Drayton 230 kV	265/1.15	184/0.80
OTP	Wahpeton 115 kV	136/1.18	92/0.80
WAPA	Watertown 345 kV	407/1.18	259/0.75

Buses in the northern MAPP area are allowed to operate up to 1.3 p.u. for a duration up to 200 msec.

2. Pre Contingency Voltage Limitations

There is steady state voltage limitations both before and after a contingency or fault. The following is a list of pre-contingent voltage criteria.

System	Facility	Maximum kV/p.u.	Minimum kV/p.u.
MAPP	Default for all buses	1.05 p.u.	0.95 p.u.
DPC	>100 kV buses	1.05	0.90
GRE	Hubbard 230 kV	242/1.05	230/1.00
	Ramsey 230 kV	242/1.05	219/0.95
	Balta 230 kV	242/1.05	219/0.95
	Coal Creek 230 kV	242/1.05	219/0.95
	Dickinson 345 kV	362/1.05	328/0.95
	Load Serving Buses	1.05	0.95
	Remaining Buses	1.05	0.95
MEC	Generation buses	1.05	1.00
	345 kV buses	362/1.05	331/0.96
	161 kV buses	169/1.05	153/0.95
MH	110 kV buses, except	121/1.10	109/0.99
	- Whiteshell 110 kV	119/1.08	116/1.05
	- Ross Lake 110 kV	110/1.00	106/0.96
	121 kV buses	133/1.10	115/0.95
	138 kV buses	145/1.05	138/1.00
	220 kV buses	242/1.10	219/0.99
	230 kV buses, except	242/1.05	223/0.97
	- Grand Rapids 230 kV	242/1.05	230/1.00
	- William River 230 kV	242/1.05	230/1.0
	- Ponton 230 kV	245/1.07	235/1.02
	- Dorsey 230 kV	242/1.05	235/1.02
	- Reston 230 kV	248/1.08	223/0.97
	- Roblin 230 kV	248/1.08	223/0.97
	- Ralls Island 230 kV	248/1.08	223/0.97
	500 kV buses	535/1.07	520/1.04

MP	230 kV buses	242/1.05	230/1.00
	161 kV buses	169/1.05	161/1.00
	138 kV buses	145/1.05	138/1.00
	115 kV buses	121/1.05	115/1.00
Western Division buses exception[1]			
	1.05 p.u. 0.96 p.u.		
OTP	345/230 kV buses	242/1.05	224/0.97
	115 kV buses	123/1.07	112/0.97
SP	110 kV buses	121/1.10	109/0.99
	138 kV buses	146/1.058	117.3/0.85
	230 kV buses	252/1.09	219/0.95
WAPA	Philip 230 kV bus	244/1.06	219/0.95
	Philip 230 kV tap	244/1.06	219/0.95
XEL	Load serving buses[2]		
	- Twin Cities metro area[3]	1.10	0.92
	- Outside TC metro area	1.10	0.90
	Generator buses	1.10	0.95
	Other buses	1.10	none
	Wind farm collector points		
	- Buffalo Ridge	1.10	0.90
	- Chanarambie	1.10	0.90
	Fast switched capacitor buses		
	- Prairie 115 kV main bus	1.09	none
	- Prairie 115 kV cap bus	1.15	none
	- Roseau 500kV bus	1.10	none
	- Sheyenne 115 kV cap bus	1.15	none
	- Running 230 kV cap bus	1.10	none

3. Post Contingency Voltage Limitations

There is also steady state voltage criteria after a contingency or fault. The following are post contingent steady state voltage limitations.

System	Facility	Maximum kV/p.u.	Minimum kV/p.u.
MAPP	Default for all buses	1.10 p.u.	0.90 p.u.
DPC	>100 kV buses	1.05 p.u.	0.90 p.u.
GRE	Hubbard 230 kV	242/1.05	219/0.95
	Ramsey 230 kV	253/1.10	207/0.90
	Balta 230 kV	253/1.10	207/0.90
	Coal Creek 230kV	253/1.10	207/0.90
	Dickinson 345kV	379.5/1.10	310.5/0.90
	Load Serving Buses	1.10	0.92
	Remaining Buses	1.10	0.90
MEC	Generation Buses	1.05	1.00
	345 kV buses	362/1.05	311/0.94
	161 kV buses	169/1.05	145/0.93
MH	110 kV buses	126/1.15	104/0.95
	138 kV buses	152/1.10	130/0.94
	220 kV buses	253/1.15	207/0.95
	230 kV buses	242/1.05	219/0.95
	- Grand Rapids 230 kV	242/1.05	223/0.97

	- William River 230 kV	242/1.05	223/0.97
	- Ponton 230 kV	242/1.05	223/0.97
	- Dorsey 230 kV	242/1.05	235/1.02
	- Reston 230 kV	253/1.10	219/0.95
	- Roblin 230 kV	253/1.10	219/0.95
	- Ralls Island 230 kV	253/1.10	219/0.95
	500 kV buses	535/1.07	500/1.00
MP	230 kV buses	242/1.05	219/0.95
	161 kV buses	169/1.05	153/0.95
	138 kV buses	145/1.05	131/0.95
	115 kV buses	121/1.05	110/0.95
	Western Division buses exception[7]	1.05 p.u.	0.92 p.u.
OTP	230 kV buses	253/1.10	212/0.92
	115 kV buses	126/1.10	106/0.92
SP	110 kV buses	127/1.15	103/0.94
	138 kV buses	152/1.10	117/0.85
	230 kV buses	253/1.10	196/0.85
XEL	Load serving buses[8]	244/1.06	219/0.95
	- Twin Cities metro area[9]	1.10	0.92
	- Outside TC metro area	1.10	0.90
	Generator buses[10]	1.10	0.95
	Wind farm collector points		
	- Buffalo Ridge	1.10	0.90
	- Chanarambie	1.10	0.90
	Other buses	1.10	none
	Roseau 500 kV buses	1.15	none
	Fast switched capacitor buses		
	- Prairie 115 kV main bus	1.09	none
	- Prairie 115 kV cap bus	1.15	none
	- Sheyenne 115 kV cap bus	1.15	none
	- Running 230 kV cap bus	1.10	none
	- Roseau 230 kV cap bus	1.10	none

Xcel Energy

414 Nicollet Mall, MP-7
Minneapolis, Minnesota 55401

Jim Hill
Prairie Island Nuclear Generating Station
1717 Wakonade Drive East
Welch, MN 55089

November 13, 2009

The Midwest ISO accepted the Prairie Island Nuclear Generating Station 38 MW MUR large generator interconnection application on June 25, 2004 and assigned project numbers G433 and G434. The results of the Midwest ISO studies associated with projects G433 and G434 validate that the Prairie Island Nuclear Generating Station MUR expansion will meet all regional requirements for transmission grid stability, following completion of the proposed 38 MW expansion. In addition, the studies confirm the Prairie Island upgrades satisfy the transmission system study requirements of IEEE 765, IEEE Standard for Preferred Power Supply (PPS) for Nuclear Power Generating Stations (NPGS).

The following Midwest ISO studies were performed in support of the 38 MW expansion of Prairie Island Units 1 and 2 and provide the basis for meeting the regional stability and IEEE 765 requirements:

- Final Report, Generation Interconnection Study - Projects # G433 and G434, 38 MW Expansion of Prairie Island Units 1 and 2, dated March 24, 2006.
- G433-G434 Transient Stability Study – Supplement dated November 13, 2009.

Randall L. Oye

Randall L. Oye
Transmission Access Analyst
Xcel Energy Services Inc.
414 Nicollet Mall, MP-7
Minneapolis, MN 55401

Enclosure 9

To

Letter from Mark A. Schimmel (NSPM)
To

Document Control Desk (NRC)

Facility Operating License, TS Pages Marked-up to Show the Proposed Changes

6 pages follow

(4) Pursuant to the Act and 10 CFR Parts 30, 40, and 70, NSPM to receive, possess and use in amounts as required any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis or instrument and equipment calibration or associated with radioactive apparatus or components;

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, NSPM to possess but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility;

(6) Pursuant to the Act and 10 CFR Parts 30 and 70, NSPM to transfer byproduct materials from other job sites owned by NSPM for the purpose of volume reduction and decontamination.

C. This amended license shall be deemed to contain and is subject to the conditions specified in the following Commission regulations in 10 CFR Chapter I: Part 20, Section 30.34 of Part 30, Sections 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70; is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect; and is subject to the additional conditions specified or incorporated below:

(1) Maximum Power Level

NSPM is authorized to operate the facility at steady state reactor core power levels not in excess of 16~~77~~~~50~~ megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. ~~193~~, are hereby incorporated in the license. NSPM shall operate the facility in accordance with the Technical Specifications.

(3) Physical Protection

NSPM shall fully implement and maintain in effect all provisions of the Commission-approved physical security, guard training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: "Prairie Island Nuclear Generating Plant Security Plan, Training and Qualification Plan, Safeguards Contingency Plan, and Independent Spent Fuel Storage Installation Security Program," Revision 1, submitted by letters dated October 18, 2006, and January 10, 2007.

(5) Pursuant to the Act and 10 CFR Parts 30 and 70, NSPM to possess but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility;

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(1) Maximum Power Level

NSPM is authorized to operate the facility at steady state reactor core power levels not in excess of 1677~~50~~ megawatts thermal.

(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. ~~182~~, are hereby incorporated in the license. NSPM shall operate the facility in accordance with the Technical Specifications.

(3) Physical Protection

NSPM shall fully implement and maintain in effect all provisions of the Commission-approved physical security, guard training and qualification, and safeguards contingency plans including amendments made pursuant to provisions of the Miscellaneous Amendments and Search Requirements revisions to 10 CFR 73.55 (51 FR 27817 and 27822) and to the authority of 10 CFR 50.90 and 10 CFR 50.54(p). The combined set of plans, which contains Safeguards Information protected under 10 CFR 73.21, is entitled: 'Prairie Island Nuclear Generating Plant Security Plan, Training and Qualification Plan, Safeguards Contingency Plan, and Independent Spent Fuel Storage Installation Security Program," Revision 1, submitted by letters dated October 18, 2006 and January 10, 2007.

1.1 Definitions (continued)

PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)	The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates, and the OPPS arming temperature for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 5.6.6. Plant operation within these operating limits is addressed in LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits," LCO 3.4.12, "Low Temperature Overpressure Protection (LTOP) –Reactor Coolant System Cold Leg Temperature (RCSCLT) > Safety Injection (SI) Pump Disable Temperature," and LCO 3.4.13, "Low Temperature Overpressure Protection (LTOP) - Reactor Coolant System Cold Leg Temperature (RCSCLT) ≤ Safety Injection (SI) Pump Disable Temperature."
QUADRANT POWER TILT RATIO (QPTR)	QPTR shall be the ratio of the maximum upper excore detector calibrated output to the average of the upper excore detector calibrated outputs, or the ratio of the maximum lower excore detector calibrated output to the average of the lower excore detector calibrated outputs, whichever is greater.
RATED THERMAL POWER (RTP)	RTP shall be a total reactor core heat transfer rate to the reactor coolant of 1677~~50~~ MWt.
REACTOR TRIP SYSTEM (RTS) RESPONSE TIME	The RTS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RTS trip setpoint at the channel sensor output until opening of a reactor trip breaker. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured.

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

18. WCAP-7908-A, "FACTRAN – A FORTRAN IV Code for Thermal Transients in a UO_2 Fuel Rod";

19. WCAP-7907-P-A, "LOFTRAN Code Description";

20. WCAP-7979-P-A, "TWINKLE – A Multidimensional Neutron Kinetics Computer Code";

21. WCAP-10965-P-A, "ANC: A Westinghouse Advanced Nodal Computer Code";

22. WCAP-11394-P-A, "Methodology for the Analysis of the Dropped Rod Event";

23. WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores";

24. WCAP-12910 Rev. 1-A, "Pressurizer Safety Valve Set Pressure Shift";

25. WCAP-14565-P-A, "VIPRE-01 Modeling and Qualification for pressurized Water Reactor Non-LOCA Thermal-Hydraulic Safety Analysis";

26. WCAP-14882-P-A, "RETRAN-02 Modeling and Qualification for Westinghouse Pressurized Water Reactor Non-LOCA Safety Analyses"; ~~and~~

27. WCAP-16009-P-A, "Realistic Large Break LOCA Evaluation Methodology Using Automated Statistical Treatment of Uncertainty Method (ASTRUM)".;

28. Caldon Engineering Report ER-80P, "Improving Thermal Power Accuracy and Plant Safety While Increasing Operating Power Level Using the LEFM System"; and

5.6 Reporting Requirements

5.6.5 CORE OPERATING LIMITS REPORT (COLR) (continued)

29. Caldon Engineering Report ER0157P, "Supplement to Topical Report ER-80P: Basis for a Power Uprate with the LEFM or LEFM CheckPlus System".

c. The core operating limits shall be determined such that all applicable limits (e.g., fuel thermal-mechanical limits, core thermal-hydraulic limits, Emergency Core Cooling Systems (ECCS) limits, nuclear limits such as SDM, transient analysis limits, and accident analysis limits) of the safety analysis are met.

d. The COLR, including any midcycle revisions or supplements, shall be provided upon issuance for each reload cycle to the NRC.

5.6.6 Reactor Coolant System (RCS) PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)

a. RCS pressure and temperature limits for heat-up, cooldown, low temperature operation, criticality, and hydrostatic testing, OPPS arming, PORV lift settings and Safety Injection Pump Disable Temperature as well as heatup and cooldown rates shall be established and documented in the PTLR for the following:

LCO 3.4.3, "RCS Pressure and Temperature (P/T) Limits";
LCO 3.4.6, "RCS Loops - MODE 4";
LCO 3.4.7, "RCS Loops - MODE 5, Loops Filled";
LCO 3.4.10, "Pressurizer Safety Valves";
LCO 3.4.12, "Low Temperature Overpressure Protection (LTOP) – Reactor Coolant System Cold Leg Temperature (RCSCLT) > Safety Injection (SI) Pump Disable Temperature";
LCO 3.4.13, "Low Temperature Overpressure Protection (LTOP) – Reactor Coolant System Cold Leg Temperature (RCSCLT) ≤ Safety Injection (SI) Pump Disable Temperature"; and
LCO 3.5.3, "ECCS - Shutdown".

5.6 Reporting Requirements

5.6.6 Reactor Coolant System (RCS) PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR) (continued)

b. The analytical methods used to determine the RCS pressure and temperature limits and Cold Overpressure Mitigation System setpoints shall be those previously reviewed and approved by the NRC, specifically those described in the following document:

WCAP-14040-NP-A, Revision 4~~2~~, "Methodology Used to Develop Cold Overpressure Mitigating System Setpoints and RCS Heatup and Cooldown Limit Curves" (includes any exemption granted by NRC to ASME Code Case N-514).

c. The PTLR shall be provided to the NRC upon issuance for each reactor vessel fluence period and for any revision or supplement thereto. Changes to the curves, setpoints, or parameters in the PTLR resulting from new or additional analysis of beltline material properties shall be submitted to the NRC prior to issuance of an updated PTLR.

5.6.7 Steam Generator Tube Inspection Report

a. A report shall be submitted within 180 days after the initial entry into MODE 4 following completion of an inspection performed in accordance with the Specification 5.5.8, Steam Generator (SG) Program. The report shall include:

1. The scope of inspections performed on each SG,

2. Active degradation mechanisms found,

3. Nondestructive examination techniques utilized for each degradation mechanism,

4. Location, orientation (if linear), and measured sizes (if available) of service induced indications,

Enclosure 10

To

Letter from Mark A. Schimmel (NSPM)
To

Document Control Desk (NRC)

Revised (clean) Facility Operating License and TS Pages

6 pages follow

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   1. The scope of inspections performed on each SG,

   2. Active degradation mechanisms found,

   3. Nondestructive examination techniques utilized for each degradation mechanism,

   4. Location, orientation (if linear), and measured sizes (if available) of service induced indications,

Enclosure 11

To

Letter from Mark A. Schimmel (NSPM)

To

Document Control Desk (NRC)

List of Regulatory Commitments Associated With This Proposed Amendment

2 pages follow

Enclosure 11

The following list identifies those actions committed to by NSPM in this LAR. Any other actions discussed in the submittal represent intended or planned actions described for information only and should not be regarded as regulatory commitments.

LAR Commitments			
Commitment Number	**Commitment**	**LAR Section**	**Implementation Schedule**
1	The PINGP Technical Requirements Manual (TRM) will be revised to include LEFM administrative controls.	Enclosure 2, Sections I.1.C, I.1.G, I.1.H	Prior to operating above 1650 MWt
2	Revise ERCS Alarm Response Procedure to reflect any changes in LEFM status such as outage time and power limits	Enclosure 2, Sections I.1.G, I.1.H, VII.2.A, VII.3.ii	Prior to operating above 1650 MWt
3	Revise CHECWORKS models to incorporate flow and process system conditions that are determined for the MUR PU conditions	Enclosure 2, Section IV.1.E	Prior to operating above 1650 MWt
4	Revise Emergency and Abnormal Operating Procedures that are power dependent.	Enclosure 2, Section VII.2.A;	Prior to operating above 1650 MWt
5	Recalibrate BOP system alarms due to small process condition changes.	Enclosure 2, Section VII.2.B	Prior to operating above 1650 MWt
6	Revise ERCS and Simulator Calorimetric and TPM programs with new administrative power limits based on LEFM status. Other core power dependent ERCS and Simulator programs such as Xenon, NIS Power, and Boron Concentration will be revised to reflect a core power of 1677 MWt.	Enclosure 2, Sections VII.2.C, VII.3.iv	Prior to operating above 1650 MWt

LAR Commitments			
Commitment Number	**Commitment**	**LAR Section**	**Implementation Schedule**
7	Revise Operator Training Program to include changes to plant procedures and alarm responses in addition to Operator Training regarding the implementation of the allowable at-power administrative limits and new TRM governing LEFM out-of-service time.	Enclosure 2, Sections VII.2.D, VII.3.v, VII.3.vi	Prior to operating above 1650 MWt
8	Re-scale applicable control and protection instrumentation consistent with the increase in 100% nominal core power from 1650 MWt to 1677 MWt.	Enclosure 2, Section VII.3.i	Prior to operating above 1650 MWt
9	Revise ERCS TPM and CALM Programs to adjust the allowable licensed thermal power values used in these programs. Alarms will require evaluation and re-calibration, as required, to reflect small process changes in certain BOP systems. Other core power dependent ERCS programs such as Xenon, NIS Power, and Boron Concentration will be revised to reflect a core power of 1677 MWt.	Enclosure 2, Section VII.3.iii	Prior to operating above 1650 MWt
10	As part of the ERCS TPM program changes, the time greater than 100% power incremental monitoring levels will be reduced with a maximum power based on a power measurement uncertainty of 0.36%.	Enclosure 2, Section VII.4	Prior to operating above 1650 MWt

Enclosure 12

To

Letter from Mark A. Schimmel (NSPM)
To

Document Control Desk (NRC)

Bases Page Provided for Information

1 page follows

B 3.7 PLANT SYSTEMS

B 3.7.1 Main Steam Safety Valves (MSSVs)

BASES

BACKGROUND	The primary purpose of the MSSVs is to provide overpressure protection for the secondary system. The MSSVs also provide protection against overpressurizing the reactor coolant pressure boundary (RCPB) by providing a heat sink for the removal of energy from the Reactor Coolant System (RCS) if the preferred heat sink, provided by the Condenser and Circulating Water System, is not available. Five MSSVs are located on each main steam header, outside containment, upstream of the main steam isolation valves, as described in the USAR (Ref. 1). The MSSVs must have sufficient capacity to limit the secondary system pressure to ≤ 110% of the steam generator design pressure in order to meet the requirements of the ASME Code, Section III (Ref. 2). The MSSV design includes staggered setpoints, according to Table 3.7.1-1 in the accompanying LCO, so that only the needed valves will actuate. Staggered setpoints reduce the potential for valve chattering that is due to steam pressure insufficient to fully open all valves following a turbine reactor trip. Normal functioning of a MSSV is expected to involve some "simmering" which does not make the valve inoperable.
APPLICABLE SAFETY ANALYSES	The design basis for the MSSVs comes from Reference 2 and its purpose is to limit the secondary system pressure to ≤ 110% of design pressure for any anticipated operational occurrence (AOO) or accident considered in the Design Basis Accident (DBA) and transient analysis. The accident analysis requires five MSSVs per steam generator to provide overpressure protection for design basis transients occurring at 100.36~~102~~% RTP.

Enclosure 13

To

Letter from Mark A. Schimmel (NSPM)
To

Document Control Desk (NRC)

Dated

December 28, 2009

PTLR Page Provided for Information

1 page follows

5.0 References

5.1 WCAP-14040-NP-A, Methodology Used to Develop Cold Overpressure Mitigation, Revision ~~2, January 1996.~~ 4, May 2004.

5.2 WCAP-14779, Analysis of Capsule S from the Northern States Power Company Prairie Island Unit 1 Reactor Vessel Radiation Surveillance Program, Revision 2, February 1998.

5.3 WCAP-14780, Prairie Island Unit 1 Heatup and Cooldown Limit Curves Normal Operation, Revision 3, February 1998.

5.4 WCAP-14781, Evaluation of Pressurized Thermal Shock for Prairie Island Unit 1, Revision 3, February 1998.

5.5 WCAP-14613, Analysis of Capsule P from the Northern States Power Company Prairie Island Unit 2 Reactor Vessel Radiation Surveillance Program, Revision 2, February 1998.

5.6 WCAP-14637, Prairie Island Unit 2 Heatup and Cooldown Limit Curves Normal Operation, Revision 3, December 1999.

5.7 WCAP-14638, Evaluation of Pressurized Thermal Shock for Prairie Island Unit 2, Revision 3, December 1999.

5.8 Westinghouse Letter NSP-98-0120, "Prairie Island Units 1 and 2 COMS Setpoint Analysis," Revision 2, February 1998.

5.9 USAR Section 4.7.2, "Reactor Vessel Material Surveillance Program"

5.10 NSP Calculation No. SPCRC002, "Unit 1 Reactor Coolant Hot Leg Pressure Control Room Indication at 1PR-420 (0-750 psig scale) with 2 RC Pumps Running," Revision 0.

5.11 NSP Calculation No. SPCRC003, "Unit 1 Wide Range RCS Cold Leg Temperature Control Room Indication Loop 1T-450B Uncertainty with Streaming Effects," Revision 0.