System Impact Study

Wessington Springs Project

Generation Interconnection GI-0602

100 MW Generation Addition
near Wessington Springs, South Dakota

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Prepared by:

Western Area Power Administration
Upper Great Plains Region
Transmission System Planning
Billings, MT

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1 Executive Summary

The purpose of this study is to evaluate the system impacts of a proposed 100 MW generation addition near Wessington Springs, South Dakota. The Customer requested generation interconnection only study of a new 100 MW generation facility that will interconnect with the Fort Thompson-Storla 230 kV line September of 2008. The customer has indicated that 51 MW of the request will be utilized as network generation resource; however Western did not received a Transmission Service Request in time to include in this study.

Study results indicate the requested generation interconnection can be accommodated with facility improvements, and if the transmission customer addresses potential 3rd party facility overloads that first appear in the 2016 case. The out of queue order nature of this study demands that the request be restudied when the assumptions used in this study change significantly, or this project is at the top of the queue order. Intermediate study results may result in the customer being required to install or participate in additional facilities, on the IS system or third party.

The actual transmission service start date will be dependent upon the final determination of 3rd party impacts to be resolved, and the time required to install the required IS facility improvements to accommodate the generation interconnection, however the customer has indicated that a September 2008 in service date is required. The potential third party overload issues must be resolved with the third party due to loss of the facilities that lead to the overload. Neither overload issue shows in study work until the 2016 model year.

Potential third party overloads requiring line upgrades				
overloaded facilities	upon outage of	peak cases impacted		
		2008 summer	2011 winter	2016 summer
Bloomfield-Gavins Point 115 kV line	Battle Creek-Norfolk 115 kV line	no	no	yes
Redfield-Btap 115 kV line section	Groton-Aberdeen 115 kV line	no	no	yes

North Dakota export transient stability performance and minimum transient voltages are maintained for NDEX at 2080, with the addition of a 30 MVAR capacitor addition near Jamestown 345 kV bus. No new constrained interfaces are required to accommodate the proposed project near Wessington Springs, SD for system intact conditions. Continued operation of the generation with prior outage of Fort Thompson-Wessington Springs will require installation of 20 MVAR of capacitance at Wessington Spring to maintain bus voltages, or adherence to an operational guide.

Informational casework with the NORDAG Study models indicate that requirements for capacitor additions change over time, study work at NDEX=2530 for the 2009 year model indicates 10 MVAR at Wessington Springs plus 20 MVAR at Buffalo 345 kV bus plus 40 at Hilltop 230 kV bus. NDEX=2860 for the 2015 model year requires 10 MVAR at Jamestown 345 kV bus, 40 MVAR at Huron 230 kV bus, and 70 MVAR at Hanlon 230 kV bus. These results emphasize that restudy will be required over time.

Short circuit analysis indicates change in fault current of more than 100 amps at the Fort Thompson 230, Storla 230 and Storla 115 kV buses.

Used as a 51 MW network resource dispatched to AVS or Oahe generation, with the remainder dispatched to Sherco, Wessington Springs had no transient voltage MAPP criteria violations.

Summary of facilities requirements for GI-0602 for 09/08 in-service date			
year 2008 ER	NDEX 2080	Steady State	none
		Dynamic	30 MVAR near Jamestown 345 kV bus
		n-1	Installation of 20 MVAR capacitor at Wessington Springs **or** op guide for reduced output upon outage of Fort Thompson-Wessington springs 230 kV line
year 2008 NR	NDEX 2080	Steady State	none
		Dynamic	none
		n-1	Installation of 20 MVAR capacitor at Wessington Springs **or** op guide for reduced output upon outage of Fort Thompson-Wessington springs 230 kV line

2 Purpose

2.1 Introduction

The Upper Great Plans Region (UGPR) of the Western Area Power Administration (Western) has received a completed application for a new 100 MW generation interconnection near Wessington Springs, South Dakota. The purpose of this study is to evaluate the system impacts of this generation interconnection request. The customer has indicated that a proposed 100 MW generation addition will be connected approximately 21 miles from Basin Electric Power Cooperative's Storla Substation on the Fort Thompson – Storla 230 kV line.

2.2 Background

Western (UGPR) received an interconnection only request from the customer for up to 100 MW. Western (UGPR) provides administration of the IS Tariff on behalf of the other IS parties Basin Electric Power Cooperative (BEPC) and Heartland Consumers Power District (HCPD). Western and the other parties in the IS are all members of the Mid-Continent Area Power Pool (MAPP), and are required to observe MAPP policies and procedures when selling transmission services. The 100 MW request includes a corresponding Transmission Service Request for 51 MW of Network Service (NR) while the remaining 49 MW of the request is to be utilized as an energy resource (ER). The TSR delivery has not been analyzed at this time.

2.3 Previous Studies

Western does <u>not</u> have any current existing studies that could be utilized to determine if this Request could be accommodated. This is an out of queue order study, that will need to be restudied, perhaps several times, as various prior queued projects are either installed or abandoned. Studies will need to be specifically run to evaluate this transmission service request.

3 Study Model Development

Standard MAPP models were modified as detailed below to accommodate this study.

3.1 Steady State

MAPP 2006 series models as posted on the MAPP ftp site. The power flow analysis was done to evaluate the ability of the IS transmission to accommodate the 100 MW scheduled to the model system swing bus and to the Twin Cities area generation. Both gen to gen and gen to load cases were developed with Wessington Springs generation on line, to be compared with the base case with Wessington Springs modeled off line. The study cases were developed from the summer peak 2008, winter peak 2011 and summer peak 2016 cases.

Additional sensitivities were done on these cases, using the same base cases, for 51 MW of the Wessington Springs generation to be used as Network Resource. Each model year was modeled with 51 MW dispatch of the Wessington Springs generation displacing generation at Oahe and AVS and the remainder to Sherco. Because this is an out of queue study and there is great uncertainty in the 2011-2016 case years, these results are of limited value.

3.2 Near term Transient Stability

The standard NMORWG 2006 study package was used to perform the associated transient stability analysis. Near term work was done for NDEX set for 2080. The base model used was the b00-s709aa.xzqV424.sav case from the Belfield GI-0217 study. The base case made the following modifications to the NMORWG study package case[1]:

- North Dakota generation modeled at URGE
- Series compensation Modeled on the LGS-Wilmarth 345 kV line
- SW MN wind at ~825 MW with associated transmission upgrades
- Belfield and Leland Olds III were not modeled

Cases were developed as follows:

Table 3.2 – Dynamic Stability case development existing system NDEX @ 2080		
case	**source**	**change comments**
b02	b00	Add Wessington Springs, model off line
b03	b02	Turn on Wessington Springs at 100 MW, dispatch to Sherco
b04	b02	add 30 MVAR at Jamestown 345
b05	b02	Dispatched 51 MW to AVS, 49 to Sherco
b06	b02	Dispatched 51 MW to Oahe, 49 to Sherco

3.3 Outyear Transient Stability

NORDAG Study models were used to test sensitivity of the proposed additions in out year cases. It is realized that these are “best estimate” cases, and that as NDEX increases, or

[1] Customers in service date for Wessington Springs (GI-0602) is 09/2008. Scheduled in service dates for Coyote (G607) is 10/2008, and none of the increase will cross NDEX. In service date for Stanton (G531) is 04/2009, and it will increase NDEX by 68MW.

projects are either committed or cancelled, that the models and assumptions associated with those models will change, requiring restudy of GI-0602. MAPP interfaces in the NORDAG Study has MHEX_S set to 2175 MW, NDEX set to 2530 MW in the 2009 NORDAG study model, and NDEX set to 2860 for 2015 NORDAG study case.

Export levels for MWSI was set to 1480 MW (the current limit) by the *setexport*s routine in the NORDAG study with Arrowhead-Gardner Park 345 kV line open, and then the Arrowhead-Gardner Park 345 kV line was closed and the interface flow allowed to settle. The resulting flow shows 1215 MW on the MWSI interface, so this level was maintained for this informational portion of the study.

The base case 2009[2] NORDAGS model started with case s709aa.uyqV24V-rev2.sav with:

- North Dakota generation modeled at URGE
- Series compensation Modeled on the LGS-Wilmarth 345 kV line
- SW MN wind at ~825 MW with associated transmission upgrades
- Big Stone II (600 MW) along with local reinforcements
- Mesaba (600 MW) along with Riverton reinforcements
- Belfield and Leland Olds III were not modeled
- Stanton (84 MW) and Coyote (25 MW) were added

Since only some of this generation was dispatched inside NDEX the case resulted in NDEX=2530 MW.

The Wessington Springs generation was modeled based upon information supplied by the generation interconnection requestor by use of an iplan downloaded from the Siemens PTI web site. Several IPLAN routines were used as supplied by the turbine manufacturer to utilize the standard wind generator and exciter models. These routines were used to create a model for the proposed Wessington Springs generating units.

Table 3.3a --2009 dynamic stability -- case development

case	source	change comments
2009 NORDAGs cases without prior queued projects		
7ha	NORDAG	base case
w04	7ha	Wess, dispatch to Sherco
w05	w04	Add 20 MVAR at Buffalo 345

The w04 and w05 cases were developed from the original 7ha NORDAGs case. No additional prior queued projects beyond what NORDAG study initially added were placed into these models. The 7ha case produced a set of disturbances with criteria violations limited to the mat, nbz and yas disturbances. w04 has Wessington Springs generation placed on-line, and resulted in a lower criteria violations on nbz and yas, and added disturbance fd4. W05 has facilities additions to produce cleaner runs equivalent to the 7ha case.

Model year 2015 stability cases were developed from the NORDAGs 8h3 case. The base case NORDAGs model year 2015 case has the addition of the following items as compared to the NORDAG Study model year 2009 case:

[2] The NORDAG Study built the 2015 year case first, then backed Young 3 out of the case to derive the 2009 case.

- Young III (630 MW) with 330 MW dispatched through NDEX

This case resulted in NDEX=2860 MW.

3.4 Short-Circuit Analysis

The purpose of the short-circuit analysis is to identify breakers in the transmission system that will not be able to handle the increased fault current due to the addition of the proposed GI-0602 project. Three-phase and single-line-to-ground faults were simulated and the impact of the proposed project to the fault currents was determined.

4 Study Criteria

The proposed generation addition is located in central South Dakota. The generation is sunk to Sherco for the peak load studies. The heavy transfer and urge dynamic studies adjusted the loads behind interfaces in accordance to the NMORWG 2006 study package in order to adjust flows across the interfaces to desired levels. The resulting study data is examined in accordance to MAPP Design Review Subcommittee (DRS), and improvements required to keep the system within criteria are proposed.

4.1 Steady-State (Powerflow) Criteria

Western has performed the studies of this proposed 100 MW of generation to provide sufficient feedback concerning the limitations in terms of voltage and overloads, and the improvements required for providing the requested generation interconnection. The First Contingency analysis for this study was performed with the PSS/E Rev 30 program utilizing activities DIFF and ACCC, along with a reporting utility in rev 30 to provide a comparative report on up to nine cases at once.

For the ACCC outputs included in this report, the following areas were monitored, and the following contingencies were simulated:

ACCC Areas Monitored (All 69kV and greater facilities in the Area):
ALTW, MP, SMMPA, GRE, OTP, MPW, MEC, NPPD, OPPD, LES, WAPA, MH, SPC, DPC, SJLP and non-metro NSP areas

Voltage Limits: Minimum=0.90 p.u., Maximum=1.10 p.u.
Facility Loading Limits: RATE C Emergency Rating

ACCC Contingencies Simulated:
All Single contingencies with one bus >=110kV in AREAS:
ALTW, MP, SMMPA, GRE, OTP, MPW, MEC, NPPD, OPPD, LES, WAPA, MH, SPC, DPC, SJLP and non-metro NSP areas
Plus all valid multiple contingencies within these areas.

The ACCC request impact comparison listings detail voltage impacts equal to or greater than 0.01 p.u. due to the transfer. These ACCC comparisons also include loading increases equal to or greater than 1 MW and 3% load increase for contingent loading, or

5% load increase for system intact loading. Loading increases greater than or equal to 1 MW on facilities less than 100 kV facilities are included for informational purposes only.

4.2 Analysis for transient stability

Transient analysis baselines were developed to provide a study baseline using the models as described above. Then, the same case work was simulated on the change (Wessington Springs generation on-line) cases. Finally the cases were subjected to system facility additions to clear criteria violations that surfaced when Wessington Springs was placed in service. These data sets were compared and were used to determine impacts to the MAPP system. This case work demonstrated that the proposed system additions along with the 100 MW generation request had no system degradation and provided similar system response as the base line case. It should be noted at this point that this generation interconnection request is out of normal queue order, and that the study results are subject to change as prior queued projects are either executed as planned, or cancelled or reduced. Ultimately these study results may need to be confirmed several times as Wessington Springs generation moves through the queue.

5 Study Results

5.1 ACCC Thermal Analysis

To analyze the steady state impacts of the 100 MW request from a new generating unit near Wessington Springs, South Dakota, powerflow models were created as described in Section 3 above for two summer peak and a winter peak case.

5.1.1 Area local to Wessington Springs

For purposes of this study, the local Wessington Springs area saw no system intact impacts of 5% or greater (see Exhibit 2). Following are details of injection related thermal impacts over 3% for first contingency outages impacted by Wessington Springs (see Exhibit 3). It should be noted that since this study is out of queue order, as projects are either executed or cancelled, restudies will be required to determine if this issue is actual, or an artifact of how the generation was modeled or sunk, or an artifact due to prior queued projects.

5.1.1.1 Bloomfield-Gavins Point 115 kV line

The Bloomfield-Gavins Point 115 kV line was identified as a potential loading impact due to an outage of the Battle Creek-Norfolk 115 kV line. From this table, it is seen that the overloads shown in the base cases are exacerbated by the addition of Wessington Springs in these cases.

Table 5.1.2a – Rate C Overload summary for Bloomfield-Gavins Point 115 kV line

case	Base Case	Gen-Gen	Gen-Load
summer peak 2008			
winter peak 2011			
summer peak 2016	150.5% 114 MVA	153.8% 115 MVA	153.9% 115 MVA

This overload did not occur in the analysis where 51 MW of Wessington Springs is used as a network resource, and the remaining 49 MW is not on line.

5.1.1.2 Aberdeen Junction-Aberdeen

The Aberdeen Junction-Aberdeen 115 kV line was identified as a potential loading impact due to an outage of the Heskett-Wishek 230 kV line. From this table, it is seen that the overloads shown in the base cases are exacerbated by the addition of Wessington Springs in these cases. The ratings in the model are not correct, and the new rating on this line is 120 MVA continuous, therefore this is not an issue.

Table 5.1.2a – Rate C Overload summary for Aberdeen Junction-Aberdeen 115 kV line			
case	Base Case	Gen-Gen	Gen-Load
summer peak 2008	97.7% 85 MVA	101.0% 88 MVA	100.2% 88 MVA
winter peak 2011	<95.0%	98.2% 84 MVA	97.4% 83 MVA
summer peak 2016	110.3% 95 MVA	114.8% 98 MVA	113.9% 98 MVA

5.1.1.3 Redfield-Btap Section of Huron-Redfield-Huron NW Park 115 kV line

The Redfield-B tap section of the Huron-Redfield-Huron NW Park 115 kV line was identified as a potential loading impact due to an outage of the Groton-Aberdeen 115 kV line. From this table, it is seen that the overloads shown in the base cases are exacerbated by the addition of Wessington Springs in these cases.

Table 5.1.2a – Rate C Overload summary for Redfield-Huron West Park 115 kV line			
case	Base Case	Gen-Gen	Gen-Load
summer peak 2008			
winter peak 2011			
summer peak 2016	96.6% 76 MVA	101.8% 80 MVA	101.0% 79 MVA

This overload did not occur in the analysis where 51 MW of Wessington Springs is used as a network resource, and the remaining 49 MW is not on line.

Exhibits 4 thru 9 show potential impacts that are under the DRS criteria reporting threshold and are presented for informational purposes.

5.1.2 Network analysis

Sensitivity analysis was done to determine impacts due to using 51 MW of Wessington Springs generation as network resource. No thermal impacts were found in the system intact cases. First Contingency Outages were run, and for the 2008 year model an impact on the Oahe 230/115 kV transformer was found. That impact was shown in a case that has the entire amount of generation dispatched at the Oahe generator hanging on the 115 kV bus. Case work done dispatching the Wessington Springs unit to an Oahe generator off the 230 kV bus showed no impact to the Oahe 230/115 kV bus. Therefore, this impact was due to the sink chosen not due to the interconnection of the Wessington Springs unit. The 2016 year shows no impacts.

5.2 ATC Evaluation

Table 5.2 shows all the Calculated DFs with impacts greater than criteria for information. Mitigation may be required for the TSR 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 will be addressed with the SIS for delivery service should the proposed GI-0602 project go forward.

Table 5.2a – Calculated PTDFs > 5% based upon a 100 MW transaction			
Interface	2008 gen to gen	2008 gen to load	ATC
FORCHS_PTDF	32.7%	25.4%	available
MNTZUMA_W	17.1%	10.0%	not adequate
QUADCITY_W	32.4%	21.9%	not adequate

Table 5.2b– Calculated OTDFs > 3% based upon a 100 MW transaction			
Interface	2008 gen to gen	2008 gen to load	ATC
ARNVINARNHAZ	21.3%	15.3%	not adequate
DAVCALQUARCK	9.6%	6.9%	not adequate
HLSXFMTIFARN	18.1%	13.1%	available
LKFFOXLKGWLM	13.7%	10.9%	not adequate
LORTRKWEMPAD	9.5%	7.0%	not adequate
S1226TEKAMAH	16.4%	11.1%	not adequate
SALXFMQUADAV	15.0%	10.8%	not adequate
SALXFMWEMPAD	14.0%	10.1%	not adequate
SPETRILAKRAU	19.5%	14.5%	not adequate

5.3 Stability Analysis

The faults listed in Exhibit A were run on the stability cases developed for the study of the 100 MW generation request from the customer. All critical North Dakota faults and local 230 kV generation delivery faults were run.

- Near term dynamic studies were preformed using an updated NMORWG 2006 study package model as described above. Additional stability work was run using the proposed near-term NORDAG model also described above to show the potential impacts of adding the Big Stone 2 unit which is a large prior queued project in South Dakota on the Wessington Springs request. This analysis was done to provide information only on potential impacts.

5.3.1 nbz and nmz

The cases with NDEX set at 2080 had no nbz or nmz violations. Casework done with the NORDAG Study cases show issues for this disturbance, and potential facilities improvements may be required of the customer.

5.3.2 mat High voltage violation

The cases with NDEX set at 2080 had no mat violations. Casework done with the NORDAG Study cases show issues for this disturbance, and potential facilities improvements may be required of the customer.

5.3.3 fd1, fd3, fd4, fdl and fdk disturbances

The pre-Wessington Springs cases with NDEX set at 2080 had a voltage violation at the Jamestown 345 kV bus. The change case voltage minimum was reduced as compared to the base case, and an IS fix of a 95 MVAR capacitor addition at Wessington Springs brought the voltage minimum back up to the base case level. A 30 MVAR capacitor installed on the Jamestown 345 kV bus also brings the voltage minimum at Jamestown back up to base case levels. Cases were created with 51 MW of the generation dispatched to either Oahe or AVS, and sensitivities to the fd1, fd3, fd4, fdk and fdl disturbances tested. Both of these network resource cases result in improved system performance from the pre-Wessington Springs base case.

fd3 voltage violation for NDEX=2080	
case	Jamestown
base (b02)	0.69233
change (b03)	0.68639
IS fix (b04)	0.69256
JT 345 fix	0.69230
nr Oahe (b05)	Okay
nr AVS (b06)	0.69494

5.3.4 ef3

All the cases testing for network resource and with NDEX set at 2080 had no ef3 violations. Informational casework done with the NORDAG Study cases show issues for this disturbance, and potential facilities improvements may be required of the customer.

5.4 Local response

Local system response to dynamic and prior outage voltage response was analyzed in the following section.

5.4.1 Local Dynamic response

Local transient stability disturbances av1, av3, bv1, bv3, cv1c cv3, dv1 and dv3 had no MAPP criteria violations in any of the casework.

5.4.2 Local prior outage voltage response

Various prior outages in the local area were set up, and the system examined for overloads and voltage criteria violations. No local overloads were found for single element outage in the local Wessington Springs area.

A prior outage of the proposed Wessington Springs-Fort Thompson 230 kV line leads to low voltages at Wessington Springs, Storla and Woonsocket. A capacitor of 20 MVAR located at the proposed Wessington Springs 230 kV substation is required to maintain voltage of near unity at the buses mentioned above. The capacitor would be required only if the customer wishes to maintain generation during an outage of the Fort Thompson-Wessington Springs 230 kV line. An operational guide can be developed in lieu of capacitor additions at Wessington Springs.

No other prior outage voltage issues were found, however these results would need to be reviewed when Wessington Springs generation interconnection comes up on the queue list for study.

5.5 Short-Circuit Calculations

Short-circuit calculations were performed to determine the impact of the proposed project on substation fault current levels. Three-phase and single-line-to-ground (SLG)

symmetrical fault current levels were calculated at the local area buses, both without and with the proposed project. In order to calculate fault current levels, classical fault assumptions were used with a pre-fault voltage of 1.0 p.u.

Table 5.5 lists the three-phase and SLG fault current impacts at the local area buses. The comparison showed that the calculated fault current levels were impacted by more than 100 amps at the Fort Thompson 230 (240 amps), Storla 230 (233 amps) and Storla 115 kV (107 amps) buses.

Table 5.5: Fault Currents Without and With Proposed GI-0602 Plant

BUS			WITHOUT GI-0602		WITH GI-0602	
NO.	NAME	kV	FAULT CURRENT (AMP)		FAULT CURRENT (AMP)	
			3-PH	SLG	3-PH	SLG
66507	Fort Thompston	230	15877	16117	16064	16254
67122	Storla	230	4740	4079	4973	4198
67123	Storla	115	6078	6374	6185	6460
66528	Woonsocket	115	5026	4043	5077	4071
66518	Mt Vernon	115	4009	3708	4047	3734

6 Conclusions

The summary of system impacts for the Wessington Springs generation addition is shown below.

6.1 Summary of Impacts from Steady State Analysis

These potential 3rd party facility overloads need to be reviewed with the appropriate owners and addressed, after a transmission Service Request is made, and the customer's project get to the top of the queue.

Table 6.1 (Developed from ACCC Screening Analysis)
Potential Limiting Facility due to Wessington Springs (GI-0602)
Bloomfield-Gavins Point 115 kV line may require customer to participate in upgrade. Restudy after project in queue order or for transmission service request.
Redfield-B tap section of the Huron-Redfield-Huron NW Park 115 kV line may require customer to participate in upgrade. Restudy after project in queue order or for transmission service request.

No local overloads occur in the analysis where 51 MW of Wessington Springs is used as a network resource.

6.2 ATC Evaluation

No mitigation is required until the TSR is studied. Information on ATCs was provided for information only.

6.3 Transient Stability Analysis

System improvements required to maintain system response to disturbances applied while the Wessington Springs generation is in service at 100 MW is the addition of a switched 30 MVAR capacitor in the area around Jamestown 345 kV bus. Some method of keeping the generation online for at least the duration of a fault before a generator trip signal is given may be required.

Table 6.3 (Developed from Transient stability Analysis)	
disturbance	**facility additions required**
nmz	The NDEX=2080 cases and network generation resource cases show no impact. Informational casework shows potential impacts were a pre-existing problem. Will need restudy to confirm as projects assumed in study are dropped, or NDEX increases from the 2080 MW.
mat	The NDEX=2080 case shows no impact. Informational casework shows potential impacts were a pre-existing problem. Will need restudy to confirm as projects assumed in study are dropped, or NDEX increases from the 2080 MW.
fd3	The NDEX=2080 case shows an impact that can be mitigated with addition of a 30 MVAR capacitor at Jamestown 345. Informational casework shows potential impacts exacerbates existing problem. May need to participate in fixing voltage dip at Jamestown 345 kV bus. The customer may need restudy after project is queued up. Capacitive additions for the 2009 model year of 40 MVAR static, **or** 15 MVAR dynamic be required, depending upon what exists in the area by the time queue is attained. Additions required seem to decrease in time, but the effect still is present indicating the need for restudy when queue order is reached. Network resource cases show no impact for NR dispatch of Wessington Springs.
ef3	The NDEX=2080 case shows no impact. Network resource cases show no impact. Informational casework shows potential 10 MVAR capacitor addition at Wessington Springs for 2009 NORDAG model year. NORDAG model year 2015 show increasing effect, indicating that the customer may need more mitigation for this disturbance as time goes on. Out year models indicate requirement for 40 MVAR capacitor at Huron 230 kV, and 70 MVAR capacitor at Hanlon 230 kV and 10 MVAR in Jamestown 345 kV area.

6.4 Prior Outage Analysis

IS improvements required to keep Wessington Springs generation on line at 100 MW for prior outage of Wessington Springs-Fort Thompson is the addition of 20 MVAR capacitor at Wessington Springs 230 kV bus or adherence to an Operational Guide for the outage of Fort Thompson-Wessington Springs 230 kV line.

6.5 Short-Circuit Calculations

Short-circuit calculations show that the calculated fault current levels were impacted by more than 100 amps at the Fort Thompson 230, Storla 230 and Storla 115 kV buses.

7 Listing of Exhibits

Exhibits used for this study report, attached at the end of this report. Additional data is available upon request via cd.

7.1 Exhibit A – List of disturbances used in dynamics cases.

7.2 Exhibit 1 – Capacitor additions in the NORDAG study cases.

7.3 Exhibit 2 – Rate A system intact overloads.

7.4 Exhibit 3 – Rate C First Contingency overloads.

7.5 Exhibit 4 – Rate C First Contingency overloads low voltage facilities for information.

7.6 Exhibit 5 – System Intact Overvoltage violations.

7.7 Exhibit 6 – System Intact Undervoltage violations for Informational purposes.

7.8 Exhibit 7 – First Contingency Overvoltage violations for Informational purposes.

7.9 Exhibit 8 – First Contingency Undervoltage violations.

7.10 Exhibit 9 – First Contingency Undervoltage violations for Informational purposes.

7.11 Exhibit 10 – Rate A system intact overloads for information.

Exhibit A – List of disturbances used in dynamics cases.

Transient Disturbances preformed on cases		
code	Brief description of disturbance	area tested
ac1	4 cy slgf @ avs 345 on broadland line, avs brkr 4596 stk, clr @ 10 cy by tripping fltd line & oliver-mercer load	N Dak
ac3	4 cycle 3 phase fault at antelope valley 345, clear the antelope valley-broadland 345 kv line	N Dak
ah1	4 cycle slgf @ Leland Olds 345 on Groton line, Leland Olds breaker 2396 stuck. Clear @ 11 cycles by tripping faulted line & Leland Olds #1 transformer.	N Dak
ah3	4 cycle 3 phase fault at Leland Olds 345. Clear the Leland Olds-Groton 345 kV line.	N Dak
ag1	4 cycle slgf @ Leland Olds 345 on Fort Thompson line, Leland Olds breaker 2692 stuck. Clear @ 11 cycles by tripping faulted line.	N Dak
ag3	4 cycle 3 phase fault at Leland Olds 345. Clear the Leland Olds-Fort Thompson 345 kV line.	N Dak
am1	5 cy slgf @ l.old 230 on wsh-bis line, lo brkr 682 stk, clr @ 14 cy by tripping l.old 230 bus	N Dak
am3	5 cycle 3 phase fault at leland olds 230, clear the leland olds-washburn-bismarck 230 kv line	N Dak
av1	5 cy slgf @ Fort Thompson 230 on Wess Springs line, delayed trip at F T, cleared by tripping line	local
av3	5 cycle 3 phase fault at Wessington Springs, clear the Wessington Springs-ft thompson 230 kv line	local
bv1	5 cy slgf @ Fort Thompson 230 on Wess Springs line, delayed trip at Wess Springs cleared by tripping line	local
bv3	5 cycle 3 phase fault at Fort Thompson, clear the ft thompson-Wessington Springs 230 kv line	local
cv1	5 cy slgf @ VT Hanlon 230 on Wess Springs line, delayed trip at VT Hanlon cleared by tripping line	local
cv3	6 cycle 3 phase fault at V T Hanlon, clear the Wessington Springs-V T Hanlon 230 kv line	local
dv1	5 cy slgf @ VT Hanlon 230 on Wess Springs line, delayed trip at Wess Springs cleared by tripping line	local
dv3	6 cycle 3 phase fault at V T Hanlon, clear the V T Hanlon-Wessington Springs 230 kv line	local
ec1	5 cy slgf @ cen-hes, brkr 86 stk, sbbp blk @ 1 cy, clr @ 12 cy by tripping cen-hesk, ramp sbdc back @ 17 cy	N Dak
ef1	5 cy slgf @ stanton 230 on cc-mchenry line, brkr 31rb8 stk, clr @ 12.5 cy by tripping fltd line & sq butte line	N Dak
ef3	5 cycle 3 phase fault at stanton 230, clear the stanton-coal creek-mchenry 230 kv line	N Dak
ef4	5 cy slgf @ stanton 230 on cc-mchenry line, brkr 31rb7 stk, clr @ 15.5 cy by tripping fltd line & stanton 230 bus 1	N Dak
ef9	4 cycle 3 phase fault at stanton 230, clear the stanton-coal creek-mchenry 230 kv line	N Dak
ei2	Permanent bipole fault on the CUDC line. Both Coal Creek units tripped at 0.28 sec.	N Dak
eq1	4.5 cycle slgf @ Coal Creek on pole 1, breaker 61rb1 stuck. Clear @ 11.5 cycles by tripping faulted pole & bus 1, cross trip Coal Creek Station 2.	N Dak
evk	5 cy slgf @ sqbt230p1,brkr 15 stk, sbbp blk @ 1 cy, clr @ 12cy,trp sqbt-cen,trp Yng 2,ramp sbdc p2 > 275 @ 17 cy	N Dak
evl	5 cy slgf @ sqbt230p1,brkr 14 stk, sbbp blk @ 1 cy, clr @ 12 cy by tripping bus, ramp sbdc p2 > 275 @ 17 cy	N Dak
ewl	5 cy slgf @ sqbt230p2,brkr 19 stk, sbbp blk @ 1 cy, clr @ 12cy,trp sqbt-cen,trp Yng 2,ramp sbdc p1 > 275 @ 17 cy	N Dak
fd1	5 cy slgf @ sqbt-stn, brkr 18 stk, sbbp blk @ 1 cy, clr @ 11 cy by tripping sqbt-stn, ramp sbdc p1 > 275 @ 17 cy	N Dak
fd3	5.0 cy 3 ph flt @ square butte 230 on stanton line, clr square butte-stanton 230 kv line	N Dak
fd4	5 cy slgf @ sqbt-stn, brkr 17 stk, sbbp blk @ 1 cy, clr @ 12 cy by tripping sqbt-stn, ramp sbdc back @ 17 cy	N Dak
fd9	4.0 cy 3 ph flt @ square butte 230 on stanton line, clr square butte-stanton 230 kv line	N Dak
fdk	5 cy slgf @ sqbt-stn, brkr 18 stk, sbbp blk @ 1 cy, clr @ 11 cy,trip sqbt-stn & Yng2, ramp sbdc p1 > 275 @ 17 cy	N Dak
fdl	5 cy slgf @ sqbt-stn, brkr 17 stk, sbbp blk @ 1 cy, clr @ 12 cy,trip sqbt-stn & Yng2, ramp sbdc back @ 17 cy	N Dak
mad	4 cycle 3 phase fault at Dorsey 500 kV. Clear the Dorsey-Forbes 500 kV line.	500
mts	Three-phase fault at Monticello on Monticello-Parkers Lake 345 kV line.	Cities
nad	4 cycle 3 phase fault on the Dorsey to Forbes 500 kV line D602F at Forbes.	500
nbz	3.5 cycle 3 phase fault on the Chisago County to Forbes 500 kV line D601C at Chisago County.	500
nmz	4 cycle, three phase fault at chisago trip f601c, xtrip d602f, use new 100% reduction init from chisago, leave svs on mp sys	neb
oas	Single line to ground fault with breaker fail at Dorsey 602L stuck.	500
pas	Single line to ground fault with breaker failure at Forbes with 602L stuck. Trip D602F.	500
ya3	4 cycle 3 phase fault at Arrowhead 345 kV, clear the Arrowhead - Gardner park 345 kv line	Cities
yas	4 CY SLG fault at Arrowhead 230 on AHD-GDP ckt #1, AHD brkr stk, clear at 17 cycles by tripping AHD-GDP bus section	Cities

Exhibit 1 -- Capacitor additions in the NORDAG study cases.

		capactor additions										
		7ha	w02	w42	w43	w44	w45	w46	w50	w51	w52	w53
starting case		na	7ha-w00	w02	w42	w43	w44	w45	7ha	w50	w51	w52
		initial case	add priors	add facilities for clean runs	add wess >swing	clean	add wess >mpls	clean	initial case	add facilities	Wess to swing	add facilities
66550	Granite Falls		200	200	200	200	200	200		200	200	200
63054	Panther		250	100	100	100	100	**140**		150*	150*	150*
67160	Groton		75	75	75	75	75	75		75	75	75
67105	Lee Olds		200	200	200	200	200	200		200	200	200
63229	Whapaton		60*	60*	60*	60*	60*	60*		60*	60*	60*
66523	Sioux Falls		250	100	100	100	100	100		100	100	100
67101	AVS		250	250	250	250	250	250		250	250	250
66564	Sioux City		300	100	100	100	100	100		100	100	100
66565	Sioux City 230		250	150	150	150	150	150		150	150	150
60189	Blue Lake		200	200	200	200	200	200		200	200	200
66537	White		200	100	100	100	100	100		100	100	100
66507	Fort Thompson		300	150	150	150	150	150		150	150	150
61612	Riverton		50	50	50	50	50	50		50	50	50
60356	Paynes									50	50	50
63050	Willmar		60	60	60	60	60	60		60	60	60
61954	Redwood Falls		25	25	25	25	25	25		25	25	25
61624	Forbes 230			150	150	150	150	150				
61614	98L Tap			350	350	350	350	350				
61638	Brchklt		25	25	25	25	25	25		50	50	50
67233	DGC			28	28	28	28	28		30	30	30
61616	Hilltop									150*	150*	150*
63369	Jamestown			70*	70*	70*	70*	70*		70*	70*	70*
66792												
61637	plattrv											40
63358	Buffalo					**20**		**20**				
		generation dispatch change from 7ha case										
60002	Sherco				-100							
99616	Wess Springs				100						100	
66519	Oahe		325	325	325				325			
66507	Ft Thompson		325	325	325				325			
66538	White		200	200	200				200			
67349	Belfield		500	500	500							

Exhibit 2 – Rate A system intact overloads.

Base case rate A overloads of 5% increase from base case to change case or more and more than 1 MW.

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.....................................................................................................................
.                                PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E   THU, JUL 26 2007  15:08                        PAGE 8 .
.                                                                                                                                .
.                                     AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS                                .
.                                                                                                                                .
.                            BASE CASE MONITORED BRANCHES LOADED ABOVE  95.0% OF RATING SET A - ALL VIOLATIONS                    .
.....................................................................................................................
                            | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl | ../lf/wl |
                            | f08base. | f08gen-g | f08gen-l | f11base. | f11gen-g | f11gen-l | f16base. | f16gen-g | f16gen-l |
X--- MONITORED ELEMENT ----X | sav      | en.sav   | oad.sav  | sav      | en.sav   | oad.sav  | sav      | en.sav   | oad.sav  |
-----------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
 None
```

Exhibit 3 – Rate C First Contingency overloads.

Potential contingency case rate C overloads of 3% increase from base case to change case and more than 1 MW.

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AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS

CONTINGENCY CASE MONITORED BRANCHES LOADED ABOVE 95.0% OF RATING SET C - WORST CASE VIOLATIONS
THRESHOLD FOR THE COUNT OF CONTINGENCIES CAUSING OVERLOADING IS 100.0% OF RATING SET C
MINIMUM DEVIATION FROM BASE CASE LOADING = 1.0 MVA (MW FOR INTERFACES)
MINIMUM INCREASE IN LOADING FROM BASE CASE = 1.0 PERCENT OF RATING SET C

X--- MONITORED ELEMENT ----X	X---LABEL--X	../lf/wl f08base.sav	../lf/wl f08gen-gen.sav	../lf/wl f08gen-load.sav	../lf/wl f11base.sav	../lf/wl f11gen-gen.sav	../lf/wl f11gen-load.sav	../lf/wl f16base.sav	../lf/wl f16gen-gen.sav	../lf/wl f16gen-load.sav
60133 SHEYNNE4 230.00 66435 FARGO 4 230.00 1	SINGL1 903							111.6% 432MVA (4x)	115.6% 443MVA (4x)	114.8% 441MVA (4x)
60138 SOURIS 7 115.00 60139 MALLARD7 115.00 1	180 2				110.7% 131MVA (1x)			99.0% 121MVA (0x)	102.3% 125MVA (1x)	101.7% 124MVA (1x)
60139 MALLARD7 115.00 67155 LOGAN 7 115.00 1	SINGL1 1638					104.0% 166MVA (2x)	103.6% 165MVA (2x)			
60139 MALLARD7 115.00 67155 LOGAN 7 115.00 1	180 2				128.7% 197MVA (2x)			117.8% 187MVA (1x)	122.0% 194MVA (1x)	121.2% 193MVA (1x)
60140 MCHENRY7 115.00 63044 MCHENRY4 230.00 1	180 2		100.7% 106MVA (1x)	100.1% 105MVA (1x)	129.3% 136MVA (1x)			108.3% 114MVA (1x)	114.3% 120MVA (1x)	113.7% 119MVA (1x)
60148 MINVALY7 115.00 60357 MAYNARD7 115.00 1	SINGL1 744	95.4% 83MVA (0x)	112% 90MVA Locked cap	100.6% 88MVA (1x)	98.9% 87MVA (0x)	105.6% 92MVA (1x)	104.4% 91MVA (1x)	115.0% 95MVA (1x)	120.9% 100MVA (2x)	119.5% 99MVA (2x)
60175 ROSEAU 4 230.00 67576 RICHER 4 230.00 1	SINGL7 161							118.5% 321MVA (3x)		121.7% 329MVA (3x)
60215 HYLNDLK7 115.00 60261 DEANLAK7 115.00 1	SINGL1 202	96.3% 209MVA (0x)								
60215 HYLNDLK7 115.00 60261 DEANLAK7 115.00 1	705 1		101.8% 221MVA (1x)	100.6% 218MVA (1x)				105.6% 227MVA (1x)	111.1% 239MVA (1x)	109.9% 236MVA (1x)
60357 MAYNARD7 115.00 62005 KERKHOT7 115.00 1	SINGL1 744	97.9% 83MVA (0x)	116% 89MVA Locked cap	103.7% 87MVA (1x)	106.2% 90MVA (1x)	113.5% 96MVA (1x)	112.1% 95MVA (1x)	118.4% 98MVA (1x)	125.0% 104MVA (2x)	123.4% 102MVA (2x)
62003 JOHNJCT7 115.00 66555 MORRIS 7 115.00 1	510				136.6% 132MVA (3x)	140.3% 135MVA (3x)	139.4% 135MVA (3x)			
62005 KERKHOT7 115.00 62006 KERKHO 7 115.00 1	510							115.4% 51MVA (2x)	122.6% 54MVA (2x)	121.8% 53MVA (2x)

63219 GRANTCO7	115.00	866							96.6%		
63220 ELBOWLK7	115.00 1								154MVA		
									(0x)		
63219 GRANTCO7	115.00	SINGL4 916								100.5%	99.8%
63220 ELBOWLK7	115.00 1									159MVA	158MVA
										(2x)	(0x)
63219 GRANTCO7	115.00	610 1				131.2%	137.7%	136.5%	130.0%	139.2%	138.1%
66555 MORRIS 7	115.00 1					140MVA	147MVA	146MVA	140MVA	150MVA	148MVA
						(47x)	(170x)	(173x)	(24x)	(60x)	(45x)
63245 WILTON 7	115.00	540							121.0%	124.0%	123.4%
63246 BEMIDJI7	115.00 1								161MVA	164MVA	164MVA
									(107x)	(94x)	(98x)
64751 BLMFLD 7	115.00	SINGL1 1145							150.5%	153.8%	153.9%
66511 GAVINS 7	115.00 1								114MVA	115MVA	115MVA
									(7x)	(7x)	(7x)
66417 DICKNSN4	230.00	107 1				108.0%	111.8%	111.2%	113.6%	117.5%	116.9%
66425 BELFELD4	230.00 1					291MVA	302MVA	300MVA	306MVA	316MVA	314MVA
						(1x)	(1x)	(1x)	(1x)	(1x)	(1x)
66554 MORRIS 4	230.00	610 1							155.2%	164.2%	162.7%
66555 MORRIS 7	115.00 1								194MVA	205MVA	203MVA
									(136x)	(150x)	(144x)
66554 MORRIS 4	230.00	SINGL4 689				111.6%	115.5%	114.8%			
66555 MORRIS 7	115.00 1					139MVA	144MVA	143MVA			
						(2x)	(2x)	(2x)			
67101 ANTELOP3	345.00	107 1	114.5%	117.8%	117.2%						
67183 CHAR.CK3	345.00 1		419MVA	431MVA	429MVA						
			(1x)	(1x)	(1x)						
67105 LELANDO3	345.00	SINGL1 1847	116.1%	123.1%	121.9%	146.7%	153.6%	152.4%	153.9%	161.3%	160.1%
67201 LELND1TY	345.00 1		348MVA	369MVA	366MVA	440MVA	461MVA	457MVA	462MVA	484MVA	480MVA
			(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)
67106 LELANDO4	230.00	SINGL1 1847	116.1%	123.1%	121.9%	146.7%	153.6%	152.4%	153.9%	161.3%	160.1%
67201 LELND1TY	345.00 1		348MVA	369MVA	366MVA	440MVA	461MVA	457MVA	462MVA	484MVA	480MVA
			(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)	(2x)
67401 ABDNJCT7	115.00	SINGL1 1945	97.0%	101.0%	100.2%		98.2%	97.4%	110.3%	114.8%	113.9%
67402 ABDNSBT7	115.00 1		85MVA	88MVA	88MVA		84MVA	83MVA	95MVA	98MVA	98MVA
			(0x)	(1x)	(1x)		(0x)	(0x)	(2x)	(3x)	(3x)
67403 REDFLD 7	115.00	SINGL1 1732							96.6%	101.8%	101.0%
67411 BTAP WP7	115.00 1								76MVA	80MVA	79MVA
									(0x)	(1x)	(1x)

CONTINGENCY LEGEND:

```
X--LABEL---X  EVENTS
SINGL1 202  : OPEN LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60193 [BLUE LK7    115.00] CKT 9
SINGL1 744  : OPEN LINE FROM BUS 63050 [WILLMAR4    230.00] TO BUS 66550 [GRANITF4    230.00] CKT 1
SINGL1 903  : OPEN LINE FROM BUS 63369 [JAMESTN3    345.00] TO BUS 66791 [CENTER 3    345.00] CKT 1
SINGL1 1145 : OPEN LINE FROM BUS 64739 [BATTLCR7    115.00] TO BUS 64918 [NORFK.N7    115.00] CKT 1
SINGL1 1638 : OPEN LINE FROM BUS 66442 [GARRISN7    115.00] TO BUS 66449 [MAX    7    115.00] CKT 1
SINGL1 1732 : OPEN LINE FROM BUS 66512 [GROTON 7    115.00] TO BUS 67402 [ABDNSBT7    115.00] CKT 1
SINGL1 1847 : OPEN LINE FROM BUS 67105 [LELANDO3    345.00] TO BUS 67202 [LELND2TY    345.00] CKT 1
SINGL1 1945 : OPEN LINE FROM BUS 67342 [HESKETT4    230.00] TO BUS 67394 [WISHEK 4    230.00] CKT 1
107     1   : OPEN LINE FROM BUS 67201 [LELND1TY    345.00] TO BUS 67105 [LELANDO3    345.00] CKT 1
              OPEN LINE FROM BUS 67201 [LELND1TY    345.00] TO BUS 67106 [LELANDO4    230.00] CKT 1
              OPEN LINE FROM BUS 67202 [LELND2TY    345.00] TO BUS 67105 [LELANDO3    345.00] CKT 1
              OPEN LINE FROM BUS 67202 [LELND2TY    345.00] TO BUS 67106 [LELANDO4    230.00] CKT 1
180      2  : TRIP LINE FROM BUS 63041 [COAL CR4    230.00] TO BUS 63042 [COAL TP4    230.00] CKT 1
              TRIP LINE FROM BUS 63042 [COAL TP4    230.00] TO BUS 63049 [STANTON4    230.00] CKT 1
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             TRIP LINE FROM BUS 63042 [COAL TP4    230.00] TO BUS 63044 [MCHENRY4    230.00] CKT 1
             TRIP LINE FROM BUS 63041 [COAL CR4    230.00] TO BUS 63049 [STANTON4    230.00] CKT 1
510        : TRIP LINE FROM BUS 66550 [GRANITF4    230.00] TO BUS 66554 [MORRIS 4    230.00] CKT 1
             TRIP LINE FROM BUS 66554 [MORRIS 4    230.00] TO BUS 66555 [MORRIS 7    115.00] CKT 1
             TRIP LINE FROM BUS 66553 [MOORHED4    230.00] TO BUS 66554 [MORRIS 4    230.00] CKT 1
540        : TRIP LINE FROM BUS 63336 [AUDUBON4    230.00] TO BUS 63053 [HUBBARD4    230.00] CKT 1
             TRIP LINE FROM BUS 63053 [HUBBARD4    230.00] TO BUS 61641 [HUBBARD7    115.00] CKT 1
610   1    : TRIP LINE FROM BUS 63331 [FERGSFL4    230.00] TO BUS 63329 [WAHPETN4    230.00] CKT 1
             TRIP LINE FROM BUS 66754 [MAPLE R4    230.00] TO BUS 63329 [WAHPETN4    230.00] CKT 1
             TRIP LINE FROM BUS 63329 [WAHPETN4    230.00] TO BUS 63191 [WAHPET1Y    230.00] CKT 1
             TRIP LINE FROM BUS 63191 [WAHPET1Y    230.00] TO BUS 63229 [WAHPETN7    115.00] CKT 1
             TRIP LINE FROM BUS 63191 [WAHPET1Y    230.00] TO BUS 63129 [WAHPETN9    41.600] CKT 1
705       1 : TRIP LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60233 [PARKERS3    345.00] CKT 1
             TRIP LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60262 [EDEN PR3    345.00] CKT 1
             TRIP LINE FROM BUS 60262 [EDEN PR3    345.00] TO BUS 60263 [EDEN PR7    115.00] CKT 9
866        : TRIP LINE FROM BUS 63052 [INMAN  4    230.00] TO BUS 61611 [WINGRIV4    230.00] CKT 1
             TRIP LINE FROM BUS 63052 [INMAN  4    230.00] TO BUS 63051 [HENNING4    230.00] CKT 1
             TRIP LINE FROM BUS 63052 [INMAN  4    230.00] TO BUS 62531 [INMAN  7    115.00] CKT 1
SINGL4 689 : OPEN LINE FROM BUS 62003 [JOHNJCT7    115.00] TO BUS 63364 [JOHNJCT4    230.00] CKT P1
SINGL4 916 : OPEN LINE FROM BUS 63331 [FERGSFL4    230.00] TO BUS 63366 [SILVRLK4    230.00] CKT 1
SINGL7 161 : OPEN LINE FROM BUS 60173 [ROSEAUN2    500.00] TO BUS 67621 [RIEL   2    500.00] CKT 1
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Exhibit 4 – Rate C First Contingency overloads low voltage facilities for information.

Contingency case buses with Rate C overloads. For informational purposes.

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AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS

CONTINGENCY CASE MONITORED BRANCHES LOADED ABOVE 95.0% OF RATING SET C - WORST CASE VIOLATIONS
THRESHOLD FOR THE COUNT OF CONTINGENCIES CAUSING OVERLOADING IS 100.0% OF RATING SET C
MINIMUM DEVIATION FROM BASE CASE LOADING = 1.0 MVA (MW FOR INTERFACES)
MINIMUM INCREASE IN LOADING FROM BASE CASE = 1.0 PERCENT OF RATING SET C

X--- MONITORED ELEMENT ----X	X---LABEL--X	../lf/wl f08base. sav	../lf/wl f08gen-g en.sav	../lf/wl f08gen-l oad.sav	../lf/wl f11base. sav	../lf/wl f11gen-g en.sav	../lf/wl f11gen-l oad.sav	../lf/wl f16base. sav	../lf/wl f16gen-g en.sav	../lf/wl f16gen-l oad.sav
60027 BLL 74G 13.800 61477 BLL TR6Y 90.000 6	SINGL1 2462							102.2% 61MVA (1x)	106.3% 64MVA (2x)	105.4% 63MVA (2x)
60058 ANS C74G 13.800 60129 SPLT RK7 115.00 P4	NSP - 1	183.8% 417MVA (30x)	183.8% 417MVA (32x)	183.8% 417MVA (31x)	136.3% 309MVA (16x)	142.7% 324MVA (21x)	142.0% 322MVA (21x)			
60107 W FARIB7 115.00 60792 WFARBLT8 69.000 2	SINGL1 2417	130.8% 43MVA (1x)	132.1% 43MVA (1x)	131.8% 43MVA (1x)	105.9% 34MVA (1x)	106.3% 35MVA (1x)	106.6% 35MVA (1x)	105.8% 34MVA (1x)	107.5% 35MVA (1x)	107.2% 35MVA (1x)
60107 W FARIB7 115.00 60792 WFARBLT8 69.000 3	SINGL1 2417	132.1% 43MVA (1x)	133.4% 43MVA (1x)	133.1% 43MVA (1x)	106.9% 35MVA (1x)	107.3% 35MVA (1x)	107.6% 35MVA (1x)	106.8% 35MVA (1x)	108.6% 35MVA (1x)	108.3% 35MVA (1x)
60110 WILMART7 115.00 60650 WILMART8 69.000 2	SINGL1 2420	130.7% 119MVA (5x)	131.8% 120MVA (2x)	131.6% 120MVA (2x)	105.9% 96MVA (2x)	106.8% 97MVA (2x)	106.1% 97MVA (2x)	117.0% 106MVA (3x)	118.1% 107MVA (3x)	117.8% 107MVA (3x)
60156 PYNSVIL7 115.00 60760 PAYNES 8 69.000 1	SINGL1 2443		95.6% 58MVA (0x)			98.1% 60MVA (0x)	97.3% 59MVA (0x)	115.0% 70MVA (1x)	119.5% 73MVA (1x)	118.6% 72MVA (1x)
60315 T-CRNRS7 115.00 60666 T CORNE8 69.000 1	SINGL1 2521		95.4% 77MVA (0x)					109.1% 88MVA (1x)	113.1% 92MVA (1x)	112.0% 91MVA (1x)
60650 WILMART8 69.000 62336 JHNSNTP8 69.000 1	SINGL1 22					97.1% 73MVA (0x)	95.5% 71MVA (0x)	120.4% 90MVA (1x)	128.0% 96MVA (1x)	126.2% 94MVA (1x)
60719 LAFAYET8 69.000 62079 LAFAYTT8 69.000 1	SINGL1 22				98.8% 41MVA (0x)	107.1% 44MVA (1x)	105.3% 43MVA (1x)	100.6% 41MVA (1x)	109.4% 44MVA (1x)	107.4% 44MVA (1x)
60730 ARLNGTN8 69.000 60731 GRENISL8 69.000 1	SINGL1 22							102.3% 51MVA (1x)	119.4% 59MVA (1x)	115.3% 57MVA (1x)
60731 GRENISL8 69.000 60931 CARVRCO8 69.000 1	SINGL1 22							101.1% 51MVA (1x)	118.1% 60MVA (1x)	114.0% 57MVA (1x)
60805 WATRVIL8 69.000 62679 ELYSNTP8 69.000 1	SINGL1 22							96.9% 40MVA (0x)	108.7% 45MVA (1x)	106.3% 44MVA (1x)
60808 EAGLELK8 69.000	SINGL1 22							99.4%	106.8%	105.1%

62347 EAGLELK8 69.000 1									80MVA (0x)	86MVA (1x)	85MVA (1x)
60825 WABASHA8 69.000	SINGL1 11								110.5%	117.8%	115.9%
61960 LAKECITY 69.000 1									42MVA (3x)	45MVA (11x)	44MVA (8x)
60826 TRAVRSE8 69.000	SINGL1 22				120.9%	131.0%	128.7%	161.9%	172.6%	170.1%	
62323 PNLPNTP8 69.000 1					64MVA (1x)	69MVA (1x)	68MVA (1x)	84MVA (54x)	90MVA (56x)	88MVA (54x)	
60826 TRAVRSE8 69.000	NSP	134.5%									
62323 PNLPNTP8 69.000 1		71MVA (27x)									
60826 TRAVRSE8 69.000	705 1		111.3%	110.0%							
62323 PNLPNTP8 69.000 1			59MVA (44x)	58MVA (43x)							
60826 TRAVRSE8 69.000	SINGL1 22					101.4%	98.2%	135.6%	148.5%	145.5%	
62350 TRAVERS8 69.000 1						53MVA (1x)	51MVA (0x)	70MVA (1x)	76MVA (3x)	74MVA (3x)	
60831 EASTWD28 69.000	SINGL1 22							104.4%	111.8%	110.2%	
62347 EAGLELK8 69.000 1								84MVA (1x)	90MVA (1x)	89MVA (1x)	
60868 LESR TP8 69.000	SINGL1 22							117.5%	130.4%	127.4%	
62349 RUSHRVR8 69.000 1								58MVA (1x)	64MVA (1x)	62MVA (1x)	
60938 FTRIDGL8 69.000	SINGL1 22				107.5%	115.8%	114.0%	112.1%	121.0%	118.9%	
62077 SCHLTP 8 69.000 1					45MVA (1x)	49MVA (1x)	48MVA (1x)	47MVA (1x)	51MVA (1x)	50MVA (1x)	
60967 COULEE 8 69.000	875 1	163.8%	170.5%	168.8%	153.2%	159.8%	158.1%	115.8%	123.1%	121.1%	
60968 SW CRK 8 69.000 1		115MVA (1x)	120MVA (1x)	118MVA (1x)	111MVA (1x)	116MVA (1x)	114MVA (1x)	85MVA (1x)	90MVA (1x)	88MVA (1x)	
60968 SW CRK 8 69.000	875 1	133.0%	139.7%	137.9%	127.9%	134.5%	132.8%				
60973 LAX 8 69.000 1		92MVA (1x)	96MVA (1x)	95MVA (1x)	92MVA (1x)	96MVA (1x)	95MVA (1x)				
62077 SCHLTP 8 69.000	SINGL1 22				102.8%	111.1%	109.3%	105.3%	114.1%	112.1%	
62079 LAFAYTT8 69.000 1					43MVA (1x)	47MVA (1x)	46MVA (1x)	44MVA (1x)	48MVA (1x)	47MVA (1x)	
62106 FOREST 8 69.000	SINGL1 2685							103.5%	105.1%	104.7%	
62140 MARTNTP8 69.000 1								47MVA (1x)	48MVA (1x)	48MVA (1x)	
62121 VILGTEN8 69.000	SINGL1 2693							104.2%	105.7%	105.3%	
62132 PRKWOOD8 69.000 1								75MVA (1x)	76MVA (1x)	76MVA (1x)	
62293 RUSH CY8 69.000	SINGL1 2699					95.1%		141.3%	141.9%	141.7%	
62299 ADRIANR8 69.000 1						35MVA (0x)		51MVA (13x)	52MVA (13x)	52MVA (13x)	
62323 PNLPNTP8 69.000	SINGL1 22					102.4%	100.6%	126.5%	134.8%	132.9%	
62342 PENELOP8 69.000 1						69MVA (1x)	68MVA (1x)	85MVA (2x)	90MVA (4x)	89MVA (3x)	
62336 JHNSNTP8 69.000	NSP	139.8%									
62343 PENELTP8 69.000 1		74MVA (51x)									
62341 NWSWDTP8 69.000	SINGL1 22							124.9%	137.7%	134.8%	
62349 RUSHRVR8 69.000 1								62MVA	68MVA	67MVA	

								(1x)	(1x)	(1x)
62341 NWSWDTP8 69.000	SINGL1 22					98.1%		131.1%	144.0%	141.0%
62350 TRAVERS8 69.000 1						51MVA		66MVA	72MVA	71MVA
						(0x)		(1x)	(1x)	(1x)
62342 PENELOP8 69.000	SINGL1 22				98.6%	106.5%	104.7%	132.0%	140.4%	138.4%
62343 PENELTP8 69.000 1					67MVA	72MVA	71MVA	89MVA	94MVA	93MVA
					(0x)	(1x)	(1x)	(18x)	(56x)	(52x)
62427 WILLMAR8 69.000	SINGL1 678							104.8%		105.7%
63050 WILLMAR4 230.00 1								97MVA		98MVA
								(4x)		(4x)
62427 WILLMAR8 69.000	690				96.5%	98.2%	97.9%		106.7%	
63050 WILLMAR4 230.00 1					89MVA	91MVA	90MVA		99MVA	
					(0x)	(0x)	(0x)		(4x)	
63000 COAL 41G 22.000	SINGL1 2687		107.7%	107.6%	109.1%	109.1%	109.1%	109.1%	109.1%	109.1%
63041 COAL CR4 230.00 1			609MVA	609MVA	618MVA	618MVA	618MVA	618MVA	618MVA	618MVA
			(1x)	(1x)	(1x)	(1x)	(1x)	(3x)	(1x)	(2x)
63001 COAL 42G 22.000	SINGL1 2686		103.5%	104.6%	104.6%	104.7%	104.7%	104.6%	104.6%	104.6%
63041 COAL CR4 230.00 1			631MVA	638MVA	638MVA	638MVA	638MVA	638MVA	638MVA	638MVA
			(1x)	(1x)	(1x)	(1x)	(1x)	(2x)	(1x)	(1x)
63823 AVOCA 5 161.00	SINGL1 2779		95.9%					113.2%	116.8%	115.6%
63824 AVOCA 8 69.000 2			48MVA					57MVA	58MVA	58MVA
			(0x)					(1x)	(1x)	(1x)
64418 E MOLINE 161.00	SINGL1 2870							100.3%	100.5%	100.5%
64468 SB 39 8 69.000 1								152MVA	153MVA	153MVA
								(1x)	(1x)	(1x)
64909 N.PLATT4 230.00	SINGL1 1315							102.3%	102.5%	102.5%
3WNDTR N.PLT T8 WND 2 1								239MVA	240MVA	240MVA
								(1x)	(1x)	(1x)
65509 S909 8 69.000	SINGL1 1396		95.6%	95.2%				112.2%	113.3%	112.9%
65537 S937 8 69.000 1			61MVA	60MVA				70MVA	71MVA	71MVA
			(0x)	(0x)				(2x)	(2x)	(2x)
65517 S917 8 69.000	SINGL1 1394	103.0%	103.5%	103.4%				118.5%	119.1%	118.8%
65518 S918 8 69.000 1		68MVA	69MVA	68MVA				78MVA	78MVA	78MVA
		(2x)	(2x)	(2x)				(2x)	(2x)	(2x)
65538 S938 8 69.000	SINGL1 1393	102.9%	103.3%	103.2%				118.2%	118.6%	118.4%
65601 S906 S 8 69.000 1		53MVA	53MVA	53MVA				60MVA	61MVA	61MVA
		(2x)	(2x)	(2x)				(2x)	(2x)	(2x)
65563 S963 8 69.000	SINGL1 1277				120.8%	122.3%	121.8%	114.5%	116.1%	115.6%
65627 W BROCK8 69.000 1					70MVA	71MVA	71MVA	67MVA	68MVA	68MVA
					(2x)	(2x)	(2x)	(2x)	(2x)	(2x)
67315 COYOTE1G 24.000	009				101.8%			103.5%	104.3%	104.2%
67316 COYOTE 3 345.00 1					436MVA			443MVA	447MVA	446MVA
					(2x)			(6x)	(5x)	(5x)
67550 MC.PHIL8 63.500	SINGL1 3448	168.1%	168.1%	168.1%	156.9%	156.9%	156.9%	156.0%	156.1%	156.1%
67757 MCPHL-P7 110.00 1		134MVA	135MVA	135MVA	126MVA	126MVA	126MVA	125MVA	125MVA	125MVA
		(3x)	(3x)	(3x)	(1x)	(1x)	(1x)	(1x)	(1x)	(1x)
68737 T BRN 69.000	SINGL1 3551							98.4%	101.4%	100.8%
68810 GENOA 69.000 1								28MVA	29MVA	29MVA
								(0x)	(1x)	(1x)
68737 T BRN 69.000	875 1	104.8%	110.0%	108.6%	103.3%	108.5%	107.1%			
68810 GENOA 69.000 1		30MVA	31MVA	31MVA	30MVA	31MVA	31MVA			
		(2x)	(2x)	(2x)	(2x)	(2x)	(2x)			

68757 ETHANOL 69.000 69000 MT VALLE 69.000 1	961								104.0% 29MVA (5x)	110.6% 30MVA (38x)	108.9% 30MVA (26x)
68761 HARRISON 69.000 68767 KAISER 69.000 1	960				108.3% 30MVA (3x)	116.4% 32MVA (3x)	114.3% 32MVA (3x)	114.7% 32MVA (2x)	123.1% 34MVA (2x)	120.9% 33MVA (2x)
68761 HARRISON 69.000 68770 LANCASTE 69.000 1	960				104.3% 29MVA (2x)	112.4% 31MVA (3x)	110.3% 31MVA (2x)	110.4% 31MVA (2x)	118.8% 33MVA (2x)	116.6% 32MVA (2x)
68766 MENOMINE 69.000 68768 T KIELER 69.000 1	SINGL1 3534	121.5% 34MVA (4x)	127.2% 36MVA (5x)	125.7% 35MVA (5x)						
68766 MENOMINE 69.000 68768 T KIELER 69.000 1	960				140.6% 40MVA (11x)	148.8% 42MVA (33x)	146.6% 41MVA (22x)	152.9% 43MVA (16x)	161.3% 45MVA (46x)	159.1% 45MVA (44x)
68767 KAISER 69.000 68768 T KIELER 69.000 1	SINGL1 3534	99.0% 27MVA (0x)		103.2% 28MVA (1x)						
68767 KAISER 69.000 68768 T KIELER 69.000 1	960		102.3% 29MVA (2x)		120.8% 34MVA (3x)	129.0% 36MVA (4x)	126.8% 35MVA (3x)	126.8% 35MVA (2x)	135.1% 37MVA (2x)	132.9% 37MVA (2x)
68770 LANCASTE 69.000 68779 HURICAN 69.000 1	SINGL1 2397	108.3% 30MVA (1x)	113.0% 32MVA (1x)	111.8% 31MVA (1x)	115.3% 32MVA (1x)	118.6% 33MVA (1x)	117.7% 33MVA (1x)	123.2% 34MVA (2x)	126.0% 35MVA (2x)	125.2% 34MVA (2x)
68775 BELLCNTR 69.000 68784 T SG 69.000 1	SINGL1 2399	111.3% 47MVA (2x)	112.4% 48MVA (2x)	112.2% 48MVA (2x)	134.5% 57MVA (2x)	132.8% 56MVA (2x)	133.3% 56MVA (2x)	127.8% 54MVA (2x)	124.1% 52MVA (2x)	125.1% 53MVA (2x)
68779 HURICAN 69.000 69181 MTHOP TP 69.000 1	SINGL1 2397	100.2% 28MVA (1x)	104.9% 29MVA (1x)	103.6% 29MVA (1x)	106.8% 29MVA (1x)	110.1% 30MVA (1x)	109.2% 30MVA (1x)	113.7% 31MVA (1x)	116.5% 31MVA (2x)	115.7% 31MVA (2x)
68784 T SG 69.000 68786 BOAZ 69.000 1	SINGL1 2399	108.4% 45MVA (2x)	109.5% 46MVA (2x)	109.4% 46MVA (2x)	131.0% 54MVA (2x)	129.3% 54MVA (2x)	129.8% 54MVA (2x)	124.5% 51MVA (2x)	120.8% 50MVA (2x)	121.9% 50MVA (2x)
68793 T AR 69.000 68806 RCKBG TP 69.000 1	SINGL1 2399							96.6% 26MVA (0x)	101.8% 28MVA (2x)	100.4% 27MVA (1x)
68867 INDEPNDN 69.000 68906 ELK CRK 69.000 1	SINGL1 2519							101.9% 28MVA (1x)	103.0% 29MVA (1x)	102.8% 29MVA (1x)
68874 ALMA 8 69.000 68879 T GILMN 69.000 1	SINGL1 2403					96.0% 28MVA (0x)		109.0% 32MVA (1x)	117.0% 34MVA (1x)	114.9% 33MVA (1x)
68879 T GILMN 69.000 68883 NELSON 69.000 1	SINGL1 2403					95.8% 27MVA (0x)		108.8% 31MVA (1x)	116.8% 34MVA (1x)	114.8% 33MVA (1x)
68883 NELSON 69.000 68885 ELLA 69.000 1	SINGL1 2403							99.4% 28MVA (0x)	107.4% 30MVA (1x)	105.3% 30MVA (1x)
69165 GALENA8 69.000 69505 GALENA 5 161.00 1	SINGL1 3538							108.2% 80MVA (1x)	110.0% 81MVA (1x)	109.5% 81MVA (1x)

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 CONTINGENCY LEGEND:
 X--LABEL---X  EVENTS
 SINGL1 11   : OPEN LINE FROM BUS 60105 [PR ISLD3    345.00] TO BUS 60106 [PR ISLD5    161.00] CKT 10
 SINGL1 22   : OPEN LINE FROM BUS 60108 [WILMART3    345.00] TO BUS 60192 [BLUE LK3    345.00] CKT 1
 SINGL1 678  : OPEN LINE FROM BUS 62005 [KERKHOT7    115.00] TO BUS 62425 [WILLMAR7    115.00] CKT 1
 SINGL1 1277 : OPEN LINE FROM BUS 64863 [HUMBOLT5    161.00] TO BUS 65391 [S975T4 T    161.00] CKT 1
 SINGL1 1315 : OPEN LINE FROM BUS 64909 [N.PLATT4    230.00] TO BUS 64910 [N.PLATT7    115.00] CKT 2
 SINGL1 1393 : OPEN LINE FROM BUS 65382 [S1206T2T    161.00] TO BUS 65406 [S1206  5    161.00] CKT 1
 SINGL1 1394 : OPEN LINE FROM BUS 65383 [S1209T1T    161.00] TO BUS 65409 [S1209  5    161.00] CKT 1
 SINGL1 1396 : OPEN LINE FROM BUS 65386 [S1214T1T    161.00] TO BUS 65414 [S1214  5    161.00] CKT 1
 SINGL1 2397 : OPEN LINE FROM BUS 69507 [SENECA 5    161.00] TO BUS 69511 [BELLCTR5    161.00] CKT 1
 SINGL1 2399 : OPEN LINE FROM BUS 69511 [BELLCTR5    161.00] TO BUS 69515 [HLSBORO5    161.00] CKT 1
 SINGL1 2403 : OPEN LINE FROM BUS 69543 [ALMA   5    161.00] TO BUS 69545 [RCK ELM5    161.00] CKT 1
 SINGL1 2417 : OPEN LINE FROM BUS 60107 [W FARIB7    115.00] TO BUS 60792 [WFARBLT8    69.000] CKT 1
 SINGL1 2420 : OPEN LINE FROM BUS 60110 [WILMART7    115.00] TO BUS 60650 [WILMART8    69.000] CKT 1
 SINGL1 2443 : OPEN LINE FROM BUS 60156 [PYNSVIL7    115.00] TO BUS 60760 [PAYNES 8    69.000] CKT 2
 SINGL1 2462 : OPEN LINE FROM BUS 60193 [BLUE LK7    115.00] TO BUS 61476 [BLL TR5Y    90.000] CKT 5
 SINGL1 2519 : OPEN LINE FROM BUS 60315 [T-CRNRS7    115.00] TO BUS 39706 [WIEN        115.00] CKT 1
 SINGL1 2521 : OPEN LINE FROM BUS 60315 [T-CRNRS7    115.00] TO BUS 60666 [T CORNE8    69.000] CKT 2
 SINGL1 2685 : OPEN LINE FROM BUS 63040 [BLAINE 4    230.00] TO BUS 62128 [BLAINE 8    69.000] CKT 1
 SINGL1 2686 : OPEN LINE FROM BUS 63041 [COAL CR4    230.00] TO BUS 63000 [COAL 41G    22.000] CKT 1
 SINGL1 2687 : OPEN LINE FROM BUS 63041 [COAL CR4    230.00] TO BUS 63001 [COAL 42G    22.000] CKT 1
 SINGL1 2693 : OPEN LINE FROM BUS 63046 [BUNKER 4    230.00] TO BUS 62147 [BNKRLK 8    69.000] CKT 1
 SINGL1 2699 : OPEN LINE FROM BUS 63055 [BEARCK 4    230.00] TO BUS 62314 [BEAR CK8    69.000] CKT 1
 SINGL1 2779 : OPEN LINE FROM BUS 63823 [AVOCA  5    161.00] TO BUS 63824 [AVOCA  8    69.000] CKT 1
 SINGL1 2870 : OPEN LINE FROM BUS 64415 [SB 18  5    161.00] TO BUS 64461 [SB 18 8     69.000] CKT 3
 SINGL1 3448 : OPEN LINE FROM BUS 67757 [MCPHL-P7    110.00] TO BUS 67550 [MC.PHIL8    63.500] CKT 2
 SINGL1 3534 : OPEN LINE FROM BUS 69503 [CASVILL5    161.00] TO BUS 68701 [STONE       69.000] CKT 1
 SINGL1 3538 : OPEN LINE FROM BUS 69505 [GALENA 5    161.00] TO BUS 69165 [GALENA8     69.000] CKT 2
 SINGL1 3551 : OPEN LINE FROM BUS 69527 [HARMONY5    161.00] TO BUS 68726 [HARMNY      69.000] CKT 1
 009         : TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 60270 [MPLEGV13    345.00] CKT 1
               TRIP LINE FROM BUS 60270 [MPLEGV13    345.00] TO BUS 60233 [PARKERS3    345.00] CKT 1
               TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 60202 [COON CK3    345.00] CKT 1
               TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 62925 [DICKNSN7    115.00] CKT 1
               SET BUS 63030 [DICKNSN3    345.00] LOAD TO 1055.0 MW
               CHANGE BUS 63000 [COAL 41G    22.000] GENERATION BY -581.0 MW
 NSP - 1     : TRIP LINE FROM BUS 60126 [SPLT RK3    345.00] TO BUS 60130 [SPLTRTA3    345.00] CKT 1
               TRIP LINE FROM BUS 60130 [SPLTRTA3    345.00] TO BUS 66537 [WHITE  3    345.00] CKT 1
               TRIP LINE FROM BUS 60126 [SPLT RK3    345.00] TO BUS 60131 [SPLTRTB3    345.00] CKT 1
               TRIP LINE FROM BUS 60131 [SPLTRTB3    345.00] TO BUS 66564 [SIOUXCY3    345.00] CKT 1
 NSP         : TRIP LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60108 [WILMART3    345.00] CKT 1
               TRIP LINE FROM BUS 60215 [HYLNDLK7    115.00] TO BUS 60261 [DEANLAK7    115.00] CKT 1
 690         : TRIP LINE FROM BUS 62425 [WILLMAR7    115.00] TO BUS 62005 [KERKHOT7    115.00] CKT 1
               TRIP LINE FROM BUS 60357 [MAYNARD7    115.00] TO BUS 62005 [KERKHOT7    115.00] CKT 1
               TRIP LINE FROM BUS 62005 [KERKHOT7    115.00] TO BUS 62006 [KERKHO 7    115.00] CKT 1
               TRIP LINE FROM BUS 62006 [KERKHO 7    115.00] TO BUS 62001 [BENSON 7    115.00] CKT 1
 705       1 : TRIP LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60233 [PARKERS3    345.00] CKT 1
               TRIP LINE FROM BUS 60192 [BLUE LK3    345.00] TO BUS 60262 [EDEN PR3    345.00] CKT 1
               TRIP LINE FROM BUS 60262 [EDEN PR3    345.00] TO BUS 60263 [EDEN PR7    115.00] CKT 9
 960         : TRIP LINE FROM BUS 60234 [PARKERS7    115.00] TO BUS 60346 [CEDARLK7    115.00] CKT 1
               TRIP LINE FROM BUS 60234 [PARKERS7    115.00] TO BUS 60259 [BASCRK 7    115.00] CKT 1
 875       1 : TRIP LINE FROM BUS 60302 [COULEE 5    161.00] TO BUS 60308 [LACROSS5    161.00] CKT 1
               TRIP LINE FROM BUS 69523 [GENOA  5    161.00] TO BUS 69535 [LAC TAP5    161.00] CKT 1
               TRIP LINE FROM BUS 60308 [LACROSS5    161.00] TO BUS 69535 [LAC TAP5    161.00] CKT 1
               TRIP LINE FROM BUS 60309 [MRSHLND5    161.00] TO BUS 69535 [LAC TAP5    161.00] CKT 1
 961         : TRIP LINE FROM BUS 34008 [FOX LK 5    161.00] TO BUS 61932 [RUTLAND5    161.00] CKT 1
               TRIP LINE FROM BUS 61932 [RUTLAND5    161.00] TO BUS 34009 [WINBAGO5    161.00] CKT 1
               TRIP LINE FROM BUS 61932 [RUTLAND5    161.00] TO BUS 61934 [RUTLAND     69.000] CKT 1

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Exhibit 5 – System Intact Overvoltage violations.

Base case buses with voltages greater than 1.10 per unit. For informational purposes.

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.                                PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E   FRI, JUL 06 2007   7:28       For Information      PAGE 10 .
.                                                                                                                   .
.                                     AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS                   .
.                                                                                                                   .
.                                     'MAPP        ' BASE CASE BUSES WITH VOLTAGE GREATER  1.1000                   .
.....................................................................................................................
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X--------- BUS ---------X	../lf/wl f08base. sav	../lf/wl f08gen-g en.sav	../lf/wl f08gen-l oad.sav	../lf/wl f11base. sav	../lf/wl f11gen-g en.sav	../lf/wl f11gen-l oad.sav	../lf/wl f16base. sav	../lf/wl f16gen-g en.sav	../lf/wl f16gen-l oad.sav
66539 WATERSVC 20.000					1.12394	1.12011		1.10887	1.10468

Exhibit 6 – System Intact Undervoltage violations for Informational purposes.

Base case buses with voltages less than 0.90 per unit. For informational purposes.

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.                              PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E   FRI, JUL 06 2007   7:28         For information    PAGE 11 .
.                                                                                                                   .
.                                   AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS                     .
.                                                                                                                   .
.                                     'MAPP        ' BASE CASE BUSES WITH VOLTAGE LESS  0.9000                      .
.....................................................................................................................
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X--------- BUS ---------X	../lf/wl f08base. sav	../lf/wl f08gen-g en.sav	../lf/wl f08gen-l oad.sav	../lf/wl f11base. sav	../lf/wl f11gen-g en.sav	../lf/wl f11gen-l oad.sav	../lf/wl f16base. sav	../lf/wl f16gen-g en.sav	../lf/wl f16gen-l oad.sav
60798 DODGCEN8 69.000				0.87346	0.87037	0.87157		0.89936	0.89998
60799 KASSON 8 69.000		0.89922	0.89953	0.84740	0.84464	0.84571	0.89007	0.88739	0.88800
60916 GARWINDG 69.000				0.87346	0.87037	0.87157		0.89936	0.89998
99917 KYPMP 17 4.2000								0.89243	0.89451

Exhibit 7 – First Contingency Overvoltage violations for Informational purposes.

Contingency case buses with voltages greater than 1.10 per unit. For informational purposes.

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.....................................................................................................................
.                                PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E   FRI, JUL 06 2007   7:28           For information PAGE 12 .
.                                                                                                                   .
.                                     AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS                   .
.                                                                                                                   .
.                      'MAPP        ' CONTINGENCY CASE BUSES WITH VOLTAGE GREATER THAN  1.1000 - WORST CASE VIOLATIONS                    .
.....................................................................................................................
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X--------- BUS ---------X	X---LABEL--X	../lf/wl f08base.sav	../lf/wl f08gen-gen.sav	../lf/wl f08gen-load.sav	../lf/wl f11base.sav	../lf/wl f11gen-gen.sav	../lf/wl f11gen-load.sav	../lf/wl f16base.sav	../lf/wl f16gen-gen.sav	../lf/wl f16gen-load.sav
60058 ANS C74G 13.800	SINGL1 60		1.10956 (3x)	1.10892 (3x)						
66539 WATERSVC 20.000	SINGL1 2752		1.13032 (5x)	1.12597 (2x)			1.14711 (3822x)			
66539 WATERSVC 20.000	009				1.13915 (43x)			1.14190 (13x)	1.16891 (342x)	1.16961 (111x)
66539 WATERSVC 20.000	SINGL4 2811					1.14689 (3829x)				

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CONTINGENCY LEGEND:
X--LABEL---X  EVENTS
SINGL1 60   : OPEN LINE FROM BUS 60126 [SPLT RK3    345.00] TO BUS 60130 [SPLTRTA3    345.00] CKT 1
SINGL1 2752 : OPEN LINE FROM BUS 63314 [BIGSTON4    230.00] TO BUS 63315 [BIGSTN1G    24.000] CKT 1
009         : TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 60270 [MPLEGV13    345.00] CKT 1
              TRIP LINE FROM BUS 60270 [MPLEGV13    345.00] TO BUS 60233 [PARKERS3    345.00] CKT 1
              TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 60202 [COON CK3    345.00] CKT 1
              TRIP LINE FROM BUS 63030 [DICKNSN3    345.00] TO BUS 62925 [DICKNSN7    115.00] CKT 1
              SET BUS 63030 [DICKNSN3    345.00] LOAD TO 1055.0 MW
              CHANGE BUS 63000 [COAL 41G    22.000] GENERATION BY -581.0 MW
SINGL4 2811 : OPEN LINE FROM BUS 63314 [BIGSTON4    230.00] TO BUS 63317 [BIGSTN2X    25.000] CKT P1
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Exhibit 8 – First Contingency Undervoltage violations.

Possibly impactive contingency case buses with voltages less than 0.90 per unit.

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AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS

'MAPP ' CONTINGENCY CASE BUSES WITH VOLTAGE LESS THAN 0.9000 - WORST CASE VIOLATIONS

X--------- BUS ---------X	X---LABEL--X	../lf/wl f08base.sav	../lf/wl f08gen-gen.sav	../lf/wl f08gen-load.sav	../lf/wl f11base.sav	../lf/wl f11gen-gen.sav	../lf/wl f11gen-load.sav	../lf/wl f16base.sav	../lf/wl f16gen-gen.sav	../lf/wl f16gen-load.sav
61910 MILACA 4 230.00	SINGL1 660									0.89973 (1x)
62425 WILLMAR7 115.00	SINGL1 744								0.89958 (1x)	
63188 PICKERTY 230.00	SINGLE-034					0.89893 (1x)				
63188 PICKERTY 230.00	SINGL7 161							0.86946 (10x)	0.85889 (14x)	0.86024 (14x)
63196 BEMIDJIY 115.00	SINGL1 834							0.50802 (2x)	0.49740 (2x)	0.49872 (2x)
63197 CASS LKY 115.00	SINGL1 834							0.57282 (3x)	0.56284 (2x)	0.56408 (2x)
63246 BEMIDJI7 115.00	SINGL1 834							0.54939 (2x)	0.53864 (2x)	0.53997 (2x)
63248 CASS N 7 115.00	SINGL1 834							0.55210 (3x)	0.54186 (3x)	0.54313 (3x)
64775 CLRWATR7 115.00	SINGL1 1145								0.71814 (14x)	0.71878 (14x)
64775 CLRWATR7 115.00	SINGL1 1159							0.73366 (14x)		
64776 CO.LINE7 115.00	SINGL1 1145							0.67357 (6x)	0.65359 (6x)	0.65441 (6x)
64780 COLMB.W4 230.00	SINGL1 951								0.89889 (2x)	
64780 COLMB.W4 230.00	SINGL1 2968									0.89929 (1x)
64806 E.COL. 4 230.00	SINGL1 2968									0.89559 (3x)
64812 EMMET 7 115.00	SINGL1 1145							0.87132 (3x)	0.86112 (3x)	0.86139 (3x)
64926 ONEILL 7 115.00	SINGL1 1145							0.85491 (4x)	0.84352 (5x)	0.84377 (5x)
64977 STUART 7 115.00	SINGL1 1145								0.89177 (1x)	0.89206 (1x)

65001 VICTRYH4 230.00	SINGL1 1350								0.79469 (1x)	0.79897 (1x)
66311 DUNLAP 7 115.00	SINGL1 1776								0.89840 (1x)	
66428 CARNGTN7 115.00	250					0.89600 (1x)	0.89946 (1x)			
66708 KARLSTA7 115.00	SINGL7 161								0.89928 (3x)	0.89939 (3x)
66785 KARLSTAT 115.00	SINGL7 161								0.89625 (3x)	0.89682 (3x)
66789 BEMIDJIT 115.00	SINGL1 834							0.52730 (2x)	0.51659 (2x)	0.51792 (2x)
67192 LYNN 7 115.00	SINGL1 1350								0.89953 (1x)	
67236 BOXBUTE7 115.00	SINGL1 1776			0.89679 (1x)				0.86940 (1x)	0.86274 (1x)	0.86493 (1x)
67239 COVALT 7 115.00	SINGL1 1350								0.89589 (2x)	0.89978 (1x)

CONTINGENCY LEGEND:

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X--LABEL---X  EVENTS
SINGL1 660  : OPEN LINE FROM BUS 61910 [MILACA 4    230.00] TO BUS 63045 [BENTON 4    230.00] CKT 1
SINGL1 744  : OPEN LINE FROM BUS 63050 [WILLMAR4    230.00] TO BUS 66550 [GRANITF4    230.00] CKT 1
SINGL1 834  : OPEN LINE FROM BUS 63245 [WILTON 7    115.00] TO BUS 63246 [BEMIDJI7    115.00] CKT 1
SINGL1 951  : OPEN LINE FROM BUS 63875 [RAUN   3    345.00] TO BUS 64858 [HOSKINS3    345.00] CKT 1
SINGL1 1145 : OPEN LINE FROM BUS 64739 [BATTLCR7    115.00] TO BUS 64918 [NORFK.N7    115.00] CKT 1
SINGL1 1159 : OPEN LINE FROM BUS 64751 [BLMFLD 7    115.00] TO BUS 66511 [GAVINS 7    115.00] CKT 1
SINGL1 1350 : OPEN LINE FROM BUS 65001 [VICTRYH4    230.00] TO BUS 66573 [STEGALL4    230.00] CKT 1
SINGL1 1776 : OPEN LINE FROM BUS 66570 [ALIANCE7    115.00] TO BUS 67197 [SNAKECK7    115.00] CKT 1
SINGL1 2968 : OPEN LINE FROM BUS 64858 [HOSKINS3    345.00] TO BUS 64860 [HOSKINS7    115.00] TO BUS 64862 [HOSKNS19    13.800] CKT 1
SINGLE-034  : TRIP LINE FROM BUS 66752 [DRAYTON4    230.00] TO BUS 67557 [LETELER4    230.00] CKT 1
              CHANGE BUS 67503 [DORSEY 4    230.00] SHUNT BY 261.0 MW
              CHANGE BUS 60002 [SHERC33G    26.000] GENERATION BY 100.0 MW
              CHANGE BUS 60001 [SHERC32G    24.000] GENERATION BY 57.0 MW
              CHANGE BUS 60028 [INV  71G    13.800] GENERATION BY 104.0 MW
250         : TRIP LINE FROM BUS 66755 [PRAIRIE4    230.00] TO BUS 63047 [RAMSEY 4    230.00] CKT 1
              TRIP LINE FROM BUS 63056 [BALTA  4    230.00] TO BUS 63047 [RAMSEY 4    230.00] CKT 1
              TRIP LINE FROM BUS 63266 [RAMSEY 7    115.00] TO BUS 63047 [RAMSEY 4    230.00] CKT 1
SINGL7 161  : OPEN LINE FROM BUS 60173 [ROSEAUN2    500.00] TO BUS 67621 [RIEL   2    500.00] CKT 1
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Exhibit 9 – First Contingency Overvoltage violations for Informational purposes.

Contingency case buses with voltages less than 0.90 per unit. For informational purposes.

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AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS

'MAPP ' CONTINGENCY CASE BUSES WITH VOLTAGE LESS THAN 0.9000 - WORST CASE VIOLATIONS

X--------- BUS ---------X	X---LABEL--X	../lf/wl f08base. sav	../lf/wl f08gen-g en.sav	../lf/wl f08gen-l oad.sav	../lf/wl f11base. sav	../lf/wl f11gen-g en.sav	../lf/wl f11gen-l oad.sav	../lf/wl f16base. sav	../lf/wl f16gen-g en.sav	../lf/wl f16gen-l oad.sav
60745 SEDAN 8 69.000	SINGL1 2434								0.89300 (1x)	
60746 GLENWD 8 69.000	SINGL1 2434		0.88597 (1x)						0.83603 (1x)	
60747 VILLARD8 69.000	SINGL1 2434		0.87092 (1x)						0.81932 (1x)	
60748 WESTPRT8 69.000	SINGL1 2434		0.86382 (1x)						0.81158 (1x)	
60749 DGLAS C8 69.000	SINGL1 2434		0.85037 (1x)						0.79904 (1x)	
60750 OSAKIS 8 69.000	SINGL1 2434		0.85159 (1x)						0.80040 (1x)	
60751 SAUKCMU8 69.000	SINGL1 2434		0.88617 (1x)						0.83991 (1x)	
60752 BLCKOAK8 69.000	SINGL1 2434								0.87995 (1x)	
60753 MEIRGRV8 69.000	SINGL1 2434								0.89439 (1x)	
60754 MELRSMU8 69.000	SINGL1 2434								0.88936 (1x)	
62755 OMMEN 8 69.000	SINGL1 2434		0.86301 (1x)						0.81044 (1x)	
62756 LEVEN 8 69.000	SINGL1 2434		0.87889 (1x)						0.82798 (1x)	
60800 PINEISL8 69.000	009							0.87023 (3882x)	0.86095 (3888x)	0.86413 (3881x)
62757 GLENWD 8 69.000	SINGL1 2434		0.89846 (1x)						0.85089 (1x)	
62820 W UNION8 69.000	SINGL1 2434		0.86453 (1x)						0.81481 (1x)	
62821 KANDOTA8 69.000	SINGL1 2434		0.88901 (1x)						0.84300 (1x)	
62822 KANDTTP8 69.000	SINGL1 2434		0.89060 (1x)						0.84525 (1x)	

62847 GROVE 8	69.000	SINGL1 2434								0.87861 (1x)	
63146 BEMIDJI9	41.600	SINGL1 834							0.58431 (2x)	0.57189 (2x)	0.57344 (2x)
63156 KARLSTD9	41.600	SINGL7 161								0.89609 (3x)	0.89667 (3x)
63159 EDGE SS9	41.600	220								0.89568 (3x)	0.89601 (3x)
63167 PICKERT9	41.600	SINGL7 161								0.89312 (3x)	0.89456 (3x)
63346 BEMIDJ19	12.500	SINGL1 834							0.38524 (2x)	0.37410 (2x)	0.37551 (2x)
63347 CASS LK8	69.000	SINGL1 834							0.57353 (2x)	0.56353 (2x)	0.56477 (2x)
63348 NO PIPE9	4.2000	SINGL1 834							0.49504 (3x)	0.48505 (8x)	0.48629 (6x)
63349 CASSPIP9	4.2000	SINGL1 834							0.53477 (3x)	0.52381 (3x)	0.52517 (3x)
63356 DON PIP9	4.2000	SINGL7 161								0.89906 (3x)	0.89858 (3x)
64463 SB 27 8	69.000	SINGL1 2871								0.89972 (1x)	
64740 BATTLCR8	69.000	SINGL1 1145							0.68406 (1x)	0.66018 (1x)	0.66115 (1x)
64885 LOUPCTY9	34.500	SINGL1 1253							0.72285 (2x)	0.71165 (2x)	0.71560 (2x)
64916 NELIGH 8	69.000	SINGL1 1145								0.69591 (7x)	0.69686 (7x)
64916 NELIGH 8	69.000	SINGL1 1159							0.71298 (7x)		
64917 NELIGH 9	34.500	SINGL1 1145								0.70235 (6x)	0.70335 (6x)
64917 NELIGH 9	34.500	SINGL1 1159							0.72056 (6x)		
64928 ONEILL 9	34.500	SINGL1 1145								0.89664 (1x)	0.89694 (1x)
65000 VICTR10G	13.800	SINGL1 1350								0.81507 (1x)	0.81946 (1x)
66314 GR ISL19	13.800	330		0.89904 (1x)	0.89938 (1x)				0.88016 (15x)	0.87895 (18x)	0.87895 (18x)
66316 GR ISL29	13.800	330		0.89900 (1x)	0.89934 (1x)				0.88011 (15x)	0.87890 (18x)	0.87890 (18x)
66923 PICKERT8	69.000	SINGL7 161								0.89990 (3x)	
67015 BEMIDJI8	69.000	SINGL1 834							0.55105 (2x)	0.53987 (2x)	0.54126 (2x)

67241 MORRILL9	34.500	SINGL1 1350								0.89649 (1x)	
63857 PERCIVL8	69.000	SINGL1 934								0.89810 (1x)	0.89807 (1x)
63852 THURMAN8	69.000	SINGL1 934								0.89755 (1x)	0.89783 (1x)
64443 COLONA	69.000	SINGL1 2871								0.89901 (1x)	0.89936 (1x)
99917 KYPMP 17	4.2000	SINGL7 161							0.83899 (106x)	0.82667 (3845x)	0.82822 (3820x)
99927 KYPMPS27	69.000	SINGL7 161							0.88849 (5x)	0.87707 (7x)	0.87852 (7x)
99918 KYPMP 18	4.2000	SINGL1 768				0.82178 (4x)	0.81198 (5x)	0.81391 (4x)	0.86252 (8x)	0.85221 (14x)	0.85407 (13x)
99919 KYPMP 19	4.2000	SINGL1 768				0.78186 (2x)	0.77160 (2x)	0.77365 (2x)	0.84097 (4x)	0.83089 (6x)	0.83271 (6x)

CONTINGENCY LEGEND:
X--LABEL---X EVENTS
SINGL1 834 : OPEN LINE FROM BUS 63245 [WILTON 7 115.00] TO BUS 63246 [BEMIDJI7 115.00] CKT 1
SINGL1 1145 : OPEN LINE FROM BUS 64739 [BATTLCR7 115.00] TO BUS 64918 [NORFK.N7 115.00] CKT 1
SINGL1 1159 : OPEN LINE FROM BUS 64751 [BLMFLD 7 115.00] TO BUS 66511 [GAVINS 7 115.00] CKT 1
SINGL1 1253 : OPEN LINE FROM BUS 64840 [GR ISLD7 115.00] TO BUS 64968 [ST.LIB 7 115.00] CKT 1
SINGL1 1350 : OPEN LINE FROM BUS 65001 [VICTRYH4 230.00] TO BUS 66573 [STEGALL4 230.00] CKT 1
SINGL1 2434 : OPEN LINE FROM BUS 60144 [DGLASCO7 115.00] TO BUS 60749 [DGLAS C8 69.000] CKT 1
SINGL1 2871 : OPEN LINE FROM BUS 64418 [E MOLINE 161.00] TO BUS 64468 [SB 39 8 69.000] CKT 1
009 : TRIP LINE FROM BUS 63030 [DICKNSN3 345.00] TO BUS 60270 [MPLEGV13 345.00] CKT 1
TRIP LINE FROM BUS 60270 [MPLEGV13 345.00] TO BUS 60233 [PARKERS3 345.00] CKT 1
TRIP LINE FROM BUS 63030 [DICKNSN3 345.00] TO BUS 60202 [COON CK3 345.00] CKT 1
TRIP LINE FROM BUS 63030 [DICKNSN3 345.00] TO BUS 62925 [DICKNSN7 115.00] CKT 1
SET BUS 63030 [DICKNSN3 345.00] LOAD TO 1055.0 MW
CHANGE BUS 63000 [COAL 41G 22.000] GENERATION BY -581.0 MW
220 : TRIP LINE FROM BUS 63358 [BUFFALO3 345.00] TO BUS 63369 [JAMESTN3 345.00] CKT 1
TRIP LINE FROM BUS 66792 [MAPLE R3 345.00] TO BUS 63358 [BUFFALO3 345.00] CKT 1
TRIP LINE FROM BUS 63358 [BUFFALO3 345.00] TO BUS 63198 [BUFFALOY 345.00] CKT 1
TRIP LINE FROM BUS 63198 [BUFFALOY 345.00] TO BUS 63258 [BUFFALO7 115.00] CKT 1
TRIP LINE FROM BUS 63198 [BUFFALOY 345.00] TO BUS 63158 [BUFFALO9 41.600] CKT 1
TRIP LINE FROM BUS 66792 [MAPLE R3 345.00] TO BUS 63189 [MAPLER1Y 345.00] CKT 1
TRIP LINE FROM BUS 63189 [MAPLER1Y 345.00] TO BUS 66754 [MAPLE R4 230.00] CKT 1
TRIP LINE FROM BUS 63189 [MAPLER1Y 345.00] TO BUS 63359 [MAPLER19 13.800] CKT 1
TRIP LINE FROM BUS 63190 [MAPLER2Y 345.00] TO BUS 66754 [MAPLE R4 230.00] CKT 1
TRIP LINE FROM BUS 66792 [MAPLE R3 345.00] TO BUS 63190 [MAPLER2Y 345.00] CKT 1
TRIP LINE FROM BUS 63190 [MAPLER2Y 345.00] TO BUS 63360 [MAPLER29 13.800] CKT 1
330 : TRIP LINE FROM BUS 64984 [SWEET W3 345.00] TO BUS 66571 [GR ISLD3 345.00] CKT 1
TRIP LINE FROM BUS 66506 [FTTHOMP3 345.00] TO BUS 66571 [GR ISLD3 345.00] CKT 1
SINGL7 161 : OPEN LINE FROM BUS 60173 [ROSEAUN2 500.00] TO BUS 67621 [RIEL 2 500.00] CKT 1

Exhibit 10 – Rate A system intact overloads for information.

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AC CONTINGENCY REPORT FOR 9 AC CONTINGENCY CALCULATION RUNS

BASE CASE MONITORED BRANCHES LOADED ABOVE 95.0% OF RATING SET A - ALL VIOLATIONS

X--- MONITORED ELEMENT ----X	../lf/wl f08base. sav	../lf/wl f08gen-gen.sav	../lf/wl f08gen-load.sav	../lf/wl f11base. sav	../lf/wl f11gen-gen.sav	../lf/wl f11gen-load.sav	../lf/wl f16base. sav	../lf/wl f16gen-gen.sav	../lf/wl f16gen-load.sav
68757 ETHANOL 69.000		95.6%					120.0%	126.7%	124.8%
34376 HANLNTN8 69.000 1		24MVA					30MVA	31MVA	31MVA
68757 ETHANOL 69.000							99.9%	106.5%	104.7%
69000 MT VALLE 69.000 1							25MVA	26MVA	26MVA
68766 MENOMINE 69.000				101.5%	107.3%	105.8%	104.4%	110.4%	108.8%
68768 T KIELER 69.000 1				26MVA	27MVA	27MVA	26MVA	28MVA	27MVA
68787 DAYTON 69.000				127.0%	120.0%	122.0%	99.9%		
68788 T RC 69.000 1				32MVA	30MVA	30MVA	25MVA		
69007 APLRVR 8 69.000	95.4%	103.4%	101.3%	169.5%	169.3%	169.3%	203.1%	203.3%	203.2%
69011 GARFIELD 69.000 1	24MVA	26MVA	25MVA	43MVA	43MVA	43MVA	51MVA	51MVA	51MVA