Exhibit No. _____ (TR-2)
79 pages

Big Stone II
Generator Interconnection Study

Performed by

Delivery Planning Department

For the

Midwest Independent System Operator

November 2004

Generation Interconnection Request #38020-01 – Project G392

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0.0 Executive Summary

Otter Tail Power Company's Delivery Planning Department has been retained by the Midwest Independent System Operator (hereas referred to as "MISO") to perform a Generator Interconnection Evaluation Study (hereas referred to as "Study" or "Big Stone II Study") for MISO project number G392. Project G392 refers to a potential 600 MW coal-fired base-load generating facility to be located at the existing Big Stone plant site in Grant County, South Dakota. The proposed in-service date for this project is early to mid 2011.

This Study has identified possible impacts that this proposed generator may have on the existing transmission system. The objectives of this Study were to:

- Identify thermal overloads and voltage violations resulting from the interconnection of G392
- Identify unstable conditions that may result from the interconnection of G392
- Identify potentially increased fault duties to existing equipment from the interconnection of G392

In order to meet the objectives of this Study, steady state power flow analysis, transient stability analysis, and short circuit analysis were considered. While performing these different types of analyses, two different transmission alternatives were evaluated independently to determine the impact of the proposed generator interconnection on the existing transmission system. Both of these alternatives have one common aspect, which is the addition of a new 230 kV line from Big Stone to Canby with an uprate of existing 115 kV line from Canby to Granite Falls.

The two alternatives studied for this interconnection request are shown below in Figure 0.

Figure 0 – Interconnection Alternatives for Big Stone II Study

1. New 230 kV line from Big Stone to Ortonville with uprate of Ortonville to Johnson Junction to Morris 115 kV line to 230 kV with new 230 kV line from Big Stone to Canby and an uprate of the Canby to Granite Falls 115 kV line to 230 kV.
2. New 230 kV line from Big Stone to Willmar with new 230 kV line from Big Stone to Canby with an uprate of the Canby to Granite Falls 115 kV line to 230 kV.

Steady state analysis for this Study focused on the 2007 timeframe with analysis focusing on summer peak and summer off-peak conditions. These steady state cases were derived from the 2002 series MAPP models and have been used in several previous studies, including the "Group 1" and "Group 2" MISO/WAPA coordinated interconnection studies for the numerous wind generation requests in the Buffalo Ridge area. The Group 1 and Group 2 interconnection requests are ahead of this project in the MISO interconnection queue. These Group studies analyzed the feasibility of connecting approximately 1750 MW's of wind generation within the Buffalo Ridge area of southwest Minnesota, northwestern Iowa, and southeastern South Dakota. The Group 1 projects totaled approximately 916 MW's while the Group 2 projects totaled about 825 MW's.

Since it is possible that this project and many of the Group 2 requests may use some of the same transmission, the project sponsor (hereas referred to as the "Customer") decided during the kick-

off scoping meeting that they would like this interconnection request studied at three different generation levels of "Group 2" projects, which fall in the interconnection queue just ahead of project G392. The reason for the three generation levels is to give a range of possible transmission upgrade costs from potentially the most expensive alternative (all Group 2 projects) to the least expensive (no Group 2 projects). Not knowing the possible markets that these Group 2 projects have targeted for their power, the Customer also requested that a "half-Group 2" case be analyzed to determine what would be the outcome of the Study if approximately half of the Group 2 projects went forward. For the "half Group 2" cases, those projects that were the closest to this project were included since they could potentially have an impact on the required transmission to connect this project.

Based on the analysis performed, it does not appear that the amount of Group 2 generation included within the Study models has a substantial impact on the loading of the interconnection facilities.

Loading violations encountered during steady state contingency analysis of the 2007 summer off-peak case are shown below in Figure 1. The quantities displayed within Figure 1 represent the percent loading on each facility based on its normal continuous rating. Quantities given in yellow represent facility loadings not exceeding emergency ratings while those in red represent those loadings that did exceed emergency ratings.

Figure 1- Overloaded Elements for Summer Off-peak Conditions

	Summer Off-peak Conditions					
	All Group 2		Half Group 2		No Group 2	
Overloaded Facility	**Alt #1**	**Alt #2**	**Alt #1**	**Alt #2**	**Alt #1**	**Alt #2**
Big Stone 230/115/13.8 kV Transformer	103.5%		101.9%			
Morris 230/115 kV Transformer	155.2%		150.4%		141.5%	
Ortonville - Johnson Jct. 115 kV Line		131.1%		127.1%		119.1%

Summer peak contingency analysis results are summarized below in Figure 2. Once again, the quantities shown represent the percent loading on each facility based on the facility's normal continuous rating. As was shown in Figure 1, quantities given in yellow represent facility loadings not exceeding emergency ratings while those in red represent those loadings that did exceed emergency ratings.

Figure 2- Overloaded Elements for Summer Peak Conditions

	Summer Peak Conditions					
	All Group 2		Half Group 2		No Group 2	
Overloaded Facility	**Alt #1**	**Alt #2**	**Alt #1**	**Alt #2**	**Alt #1**	**Alt #2**
Big Stone 230/115/13.8 kV Transformer	119.2%	111.8%	117.0%	109.2%	115.0%	108.4%
Morris 230/115 kV Transformer	177.0%		172.2%		166.4%	
Ortonville - Johnson Jct. 115 kV Line		141.7%		139.0%		133.8%
Big Stone - Browns Valley 230 kV Line	128.7%	114.1%	124.6%	112.8%	120.9%	112.6%
Big Stone - Highway 12 115 kV Line	112.6%		110.4%		108.3%	
Highway 12 - Ortonville 115 kV Line	106.9%		104.7%		102.6%	
Johnson Jct. - Morris 115 kV Line		118.2%		115.8%		111.2%

Voltage violations identified during contingency analysis of the 2007 summer off-peak case indicated that a decrease in voltage is caused by implementing interconnection alternative 2 with

the proposed interconnection. A summary of the post-contingent voltage levels is given below in Figure 3 in per unit voltage. Quantities shown in red indicate those post-contingent voltage levels that are below post-contingent voltage criteria set by transmission owners in this Region.

Figure 3 – Voltage Violations for Summer Off-peak Conditions

	Summer Off-peak Conditions					
	All Group 2		Half Group 2		No Group 2	
Voltage Violation	Alt #1	Alt #2	Alt #1	Alt #2	Alt #1	Alt #2
Willmar 115 kV Bus		0.88		0.90		0.90
Willmar 230 kV Bus		0.91				

Contingency analysis of the summer peak case has very similar voltage results as that shown for summer off-peak conditions. The Willmar bus voltage problems are evident for interconnection alternative 2 as shown below in Figure 4. Once again, quantities shown in red indicate those post-contingent voltage levels that are below post-contingent voltage criteria set by transmission owners in this Region.

Figure 4 – Voltage Violations for Summer Peak Conditions

	Summer Peak Conditions					
	All Group 2		Half Group 2		No Group 2	
Voltage Violation	Alt #1	Alt #2	Alt #1	Alt #2	Alt #1	Alt #2
Willmar 115 kV Bus		0.90		0.90		0.90
Willmar 230 kV Bus		0.90		0.91		0.91

Based on the overall system performance during steady state conditions, this Study has identified that the following upgrades will be necessary on the existing system for connecting the proposed project with interconnection alternative 1. These upgrades are in addition to the new facilities (described in Figure 0) that are included as part of interconnection alternative 1.

Table 1 – Required Upgrades for Interconnection Alternative 1

1. Increase capacity of Morris 230/115 kV Transformer
2. Increase capacity of Big Stone to Browns Valley 230 kV Line
3. Increase capacity of Big Stone to Highway 12 115 kV Line

Implementing interconnection alternative 2 to connect the proposed project to the system will require the following upgrades (shown in Table 2) to the existing system. These upgrades are in addition to the new facilities (described in Figure 0) that are included as part of interconnection alternative 2.

Table 2 – Required Upgrades for Interconnection Alternative 2

1. Increase capacity of Ortonville to Johnson Jct. 115 kV Line
2. Increase capacity of Johnson Jct. to Morris 115 kV Line
3. Increase capacity of Big Stone to Browns Valley 230 kV Line
4. Install capacitor bank in Willmar area to mitigate low voltages

While performing contingency analysis for interconnection alternatives 1 and 2, a few other facilities overloaded outside the area of immediate interconnection, but are very likely to appear during the delivery service study. The facilities that will likely need to be upgraded during the delivery service study may include the following:

Table 3 – Likely Upgrades Required for Delivery Service Study

1. Grant County to Morris 115 kV Line
2. Hoot Lake to Fergus Falls 115 kV Line
3. Hankinson to Wahpeton 230 kV Line

Other system constraints identified further from the area of interconnection were identified during contingency analysis of the summer peak and summer off-peak cases. These facilities are not as likely to be required for delivery, but may appear depending on the assumptions used in the delivery service study.

Table 4 – Upgrades that may be Required for Delivery Service Study

1. Wahpeton to Fergus Falls 230 kV Line
2. Fergus Falls 230/115/13.2 kV Transformer
3. Edgetown Tap to Pelican Rapids 115 kV Line
4. Sheyenne to Fargo 230 kV Line (Interconnection Alternative 1 only)
5. Grant County to Hoot Lake 115 kV Line (Interconnection Alternative 1 only)
6. Aberdeen Jct. to Aberdeen 115 kV Line (Interconnection Alternative 2 only)

Other studies on-going within this region have identified other numerous facility overloads. These overloads appeared again during this Study. Since the future of many of these line overloads is uncertain, the responsibility of these line upgrades may fall within the realm of this project depending on the assumptions used during the delivery service study and the status of any planned upgrades associated with any of these line sections.

Table 5 – Other Overloaded Facilities Under Suspicion for Delivery Service Study

1. Granite Falls to MN Valley Tap 230 kV Line
2. MN Valley Tap to Panther 230 kV Line
3. Panther to McLeod 230 kV Line
4. Willmar to Granite Falls 230 kV Line
5. MN Valley 230/115 kV Transformer
6. MN Valley to Maynard 115 kV Line
7. Maynard to Kerkhoven 115 kV Line

A brief loss analysis during this Study has indicated that alternative 1 is more effective in delivering the generation to the existing transmission system during summer off-peak conditions while alternative 2 is has more loss savings during summer peak conditions. Changes in losses due to project G392 are shown below in Figure 5 for the 2007 summer peak case for OTP and the adjacent control areas.

Figure 5 – Summary of Losses by Control Area

	Summer Peak Conditions						Summer Off-peak Conditions					
	All Group 2		Half Group 2		No Group 2		All Group 2		Half Group 2		No Group 2	
Control Area	% Chng Alt #1	% Chng Alt #2	% Chng Alt #1	% Chng Alt #2	% Chng Alt #1	% Chng Alt #2	% Chng Alt #1	% Chng Alt #2	% Chng Alt #1	% Chng Alt #2	% Chng Alt #1	% Chng Alt #2
ALTW	5.5	5.3	4.4	4.2	4.1	4.0	3.0	2.9	3.0	2.9	2.9	2.8
XEL	3.0	3.2	4.4	4.6	3.9	4.0	6.7	7.0	4.2	4.5	6.4	6.7
MP	4.7	2.7	4.3	2.4	3.4	1.7	8.2	5.6	7.9	5.4	7.5	5.1
SMMPA	0.0	0.0	-8.3	-8.3	0.0	0.0	6.7	6.7	6.7	6.7	3.4	6.7
GRE	4.9	13.8	4.8	14.0	4.4	13.3	13.5	30.7	13.4	21.8	12.4	29.9
OTP	19.6	18.7	19.5	18.6	19.6	18.7	16.8	12.8	16.7	12.8	16.8	12.7
MPW	7.1	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MEC	1.8	1.7	1.6	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.6	1.6
NPPD	-5.0	-5.2	-5.6	-5.7	-6.0	-6.1	-2.7	-2.9	-3.1	-3.3	-3.5	-3.6
OPPD	2.9	2.9	2.3	2.3	2.0	2.0	4.5	4.7	4.7	4.7	4.8	5.0
LES	0.0	0.0	0.0	0.0	-1.1	-1.1	0.0	0.0	0.0	0.0	0.0	0.0
WAPA	1.0	-2.2	0.8	-2.7	-0.2	-3.9	6.4	2.8	6.7	3.2	6.7	3.0
MH	-0.3	-0.2	-0.4	-0.2	-0.3	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2
DPC	-2.5	-2.3	-2.4	-2.2	-2.3	-2.1	-0.4	-0.1	0.0	0.1	0.0	0.3
TOTAL	**3.1**	**3.3**	**3.2**	**3.4**	**2.8**	**3.0**	**4.9**	**4.7**	**4.2**	**3.7**	**4.7**	**4.5**

Transient stability analysis is part of the interconnection Study, but has not yet been completed. This type of analysis will determine if the proposed project is able to maintain system stability after credible disturbances are applied to the system. An addendum to this report will be issued separately once this analysis is completed.

Short circuit analysis is also part of the interconnection Study. This analysis is also incomplete at this time. This type of analysis will determine if existing equipment on the system will be able to withstand increased fault duties associated with the proposed project. The results of this analysis will be included within the same addendum as the transient stability analysis once it is completed.

Interconnection alternatives 1 and 2 for this proposed project have been evaluated extensively from a steady state standpoint and the results of this analysis have been summarized above with more detailed information being contained within the body of this report to follow.

1.0 Introduction

1.1 Study Scope

The scope of this Generator Interconnection Evaluation Study (hereas referred to as the "Study" or the "Big Stone II Study") is to determine the most efficient method of integrating a second generating plant into the existing system at Big Stone, SD. Through the generation interconnection process at the Midwest ISO (MISO), a potential generation developer, hereas referred to as "the Customer", has submitted a request for a new 600 MW generator at the existing site of the Big Stone generator. The current transmission system is not adequate to support the requested generator. This report outlines the results of the Study that has been completed to determine the necessary transmission additions to accommodate this interconnection request.

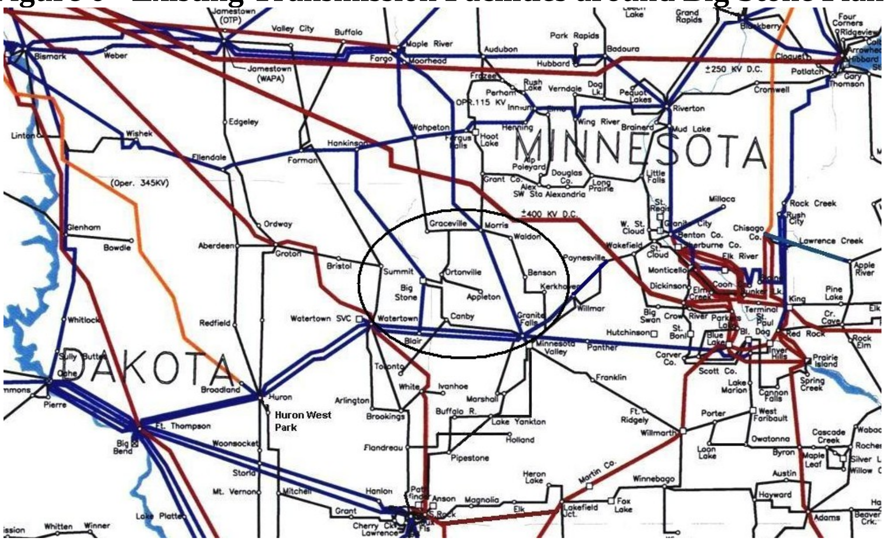
This Study has evaluated two different transmission alternatives to determine the impact of the proposed generator on the existing transmission system. These impacts have been identified by performing steady state power flow analysis for summer peak and summer off-peak conditions. It is anticipated that a subsequent report will be issued describing the results of the transient stability analysis and the short circuit analysis.

1.2 Existing Big Stone Transmission Facilities

The site of the generator interconnection request is at the same location as the existing Big Stone unit in extreme northeastern South Dakota. The existing unit at Big Stone is co-owned by Otter Tail Power Company, Northwestern Energy, and Montana-Dakota Utilities. The unit was initially installed during May of 1975. Over the years, generation equipment within the plant has been upgraded to get its accredited generation level within the MAPP Region to a net output of 470 MW.

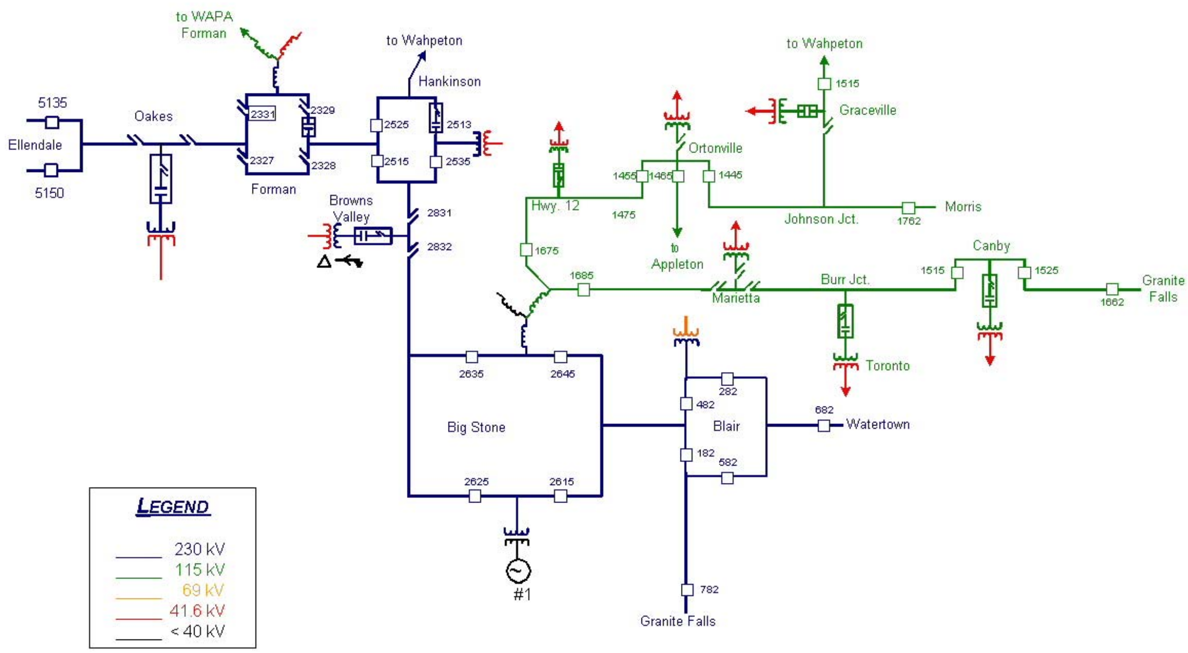
The current transmission system supporting this unit is two 230 kV lines and two 115 kV lines. The 230 kV lines go north and south of the Big Stone site. The north line is from Big Stone to Browns Valley and ultimately terminates at Hankinson, ND. The south line from Big Stone terminates at Blair, SD. The 115 kV lines from the plant also go north and south. The north 115 kV line terminates at the Graceville tap (or Johnson Junction) where it intersects the Graceville – Morris 115 kV line. This line serves loads around Ortonville and Appleton. The south 115 kV line terminates at Granite Falls. This line serves loads around Canby, Marietta, and Toronto. Figure 6 is shown below and illustrates the outlet lines from Big Stone and Big Stone's relative location within the MAPP region.

Figure 6 - Existing Transmission Facilities around Big Stone Plant



A one-line diagram illustrating the current breaker schemes on the existing transmission system is shown below in Figure 7. As shown below, 230 kV ring buses are present at Big Stone, Hankinson, and Blair while dedicated 115 kV line breakers are present at Big Stone, Ortonville, and Canby.

Figure 7 – One-Line Diagram of Existing Transmission System



2.0 Interconnection Alternatives

In order to interconnect the proposed generator without detrimental impacts to the existing transmission system, two separate interconnection alternatives have been analyzed. Both of these alternatives have one common aspect, which is the addition of a new 230 kV line from Big Stone to Canby with an uprate of existing 115 kV line from Canby to Granite Falls.

The two alternatives studied for this interconnection request are shown below in Figure 8. Further explanation of these alternatives can be found in subsequent sections of this report.

Figure 8 – Interconnection Alternatives for Big Stone II Study

3. New 230 kV line from Big Stone to Ortonville with uprate of Ortonville to Johnson Junction to Morris 115 kV line to 230 kV with new 230 kV line from Big Stone to Canby with uprate of the Canby to Granite Falls 115 kV line to 230 kV.
4. New 230 kV line from Big Stone to Willmar with new 230 kV line from Big Stone to Canby with uprate of the Canby to Granite Falls 115 kV line to 230 kV.

2.1 Interconnection Alternative 1

<u>New 230 kV line from Big Stone – Ortonville and from Big Stone to Canby with a 115 kV to 230 kV uprate of Ortonville – Johnson Jct. – Morris line and Canby – Granite Falls line</u>

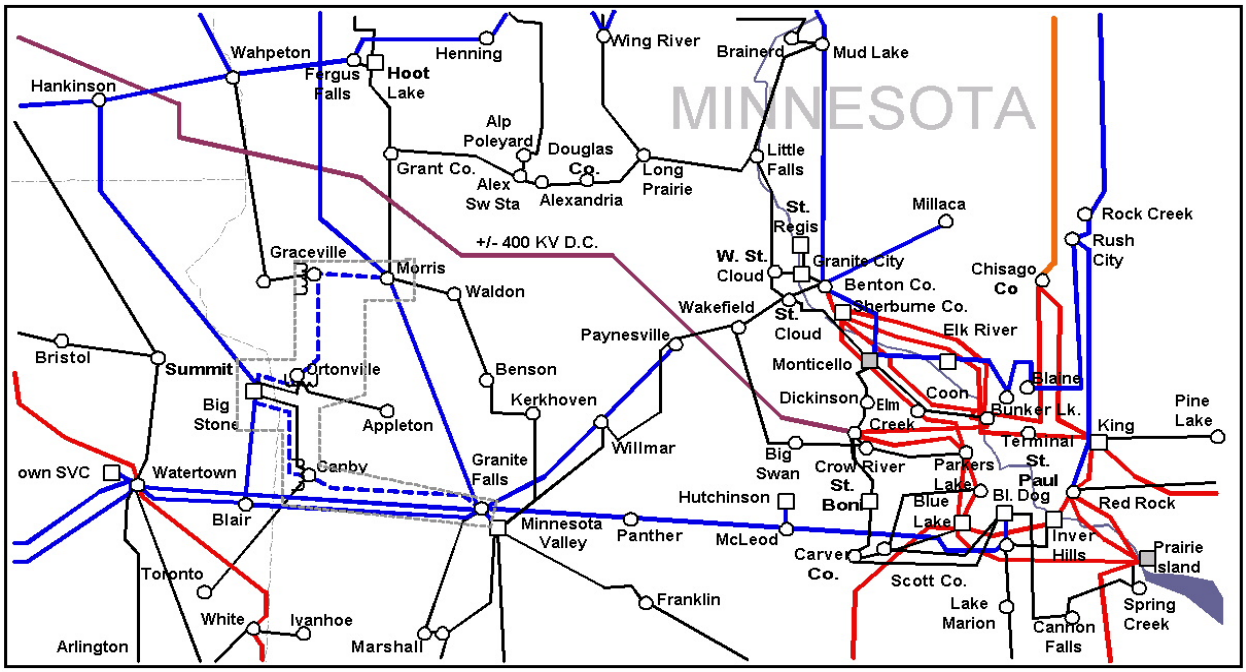
The first interconnection alternative considered for this Study involved utilizing existing 115 kV line routes from the Big Stone plant.

A new 6.5 mile, 230 kV line was considered from Big Stone to Ortonville. At Ortonville, a new 230/115/13.8 kV transformer was added to tie back into the existing 115 kV system feeding the radial line out to Appleton as well as looping back into the Highway 12 substation. From Ortonville, it was assumed that the existing 24.6 mile, 115 kV line was converted to 230 kV into the existing Johnson Junction substation. At Johnson Junction, another 230/115 kV transformer was installed to tie into the existing 115 kV line to Graceville (and eventually to Wahpeton). From Johnson Junction, interconnection alternative 1 included uprating the existing 15.5 mile, 115 kV line to Morris to 230 kV and connecting into the existing 230 kV bus at Morris.

In addition to the "northern" 230 kV line, interconnection alternative 1 also assumed a new 50.5 mile, 230 kV line from Big Stone to Canby with a new 230/115 kV transformer added at Canby to connect back to the existing 115 kV system feeding towards Toronto and Marietta. From Canby, it was assumed that the existing 39.2 mile, 115 kV line to Granite Falls was uprated to 230 kV and terminated into the existing 230 kV bus at Granite Falls.

The following figure illustrates a geographic representation of interconnection alternative 1 that was considered for this Study. Changes or additions to the existing transmission system are shown with dotted lines and circled in gray boxes.

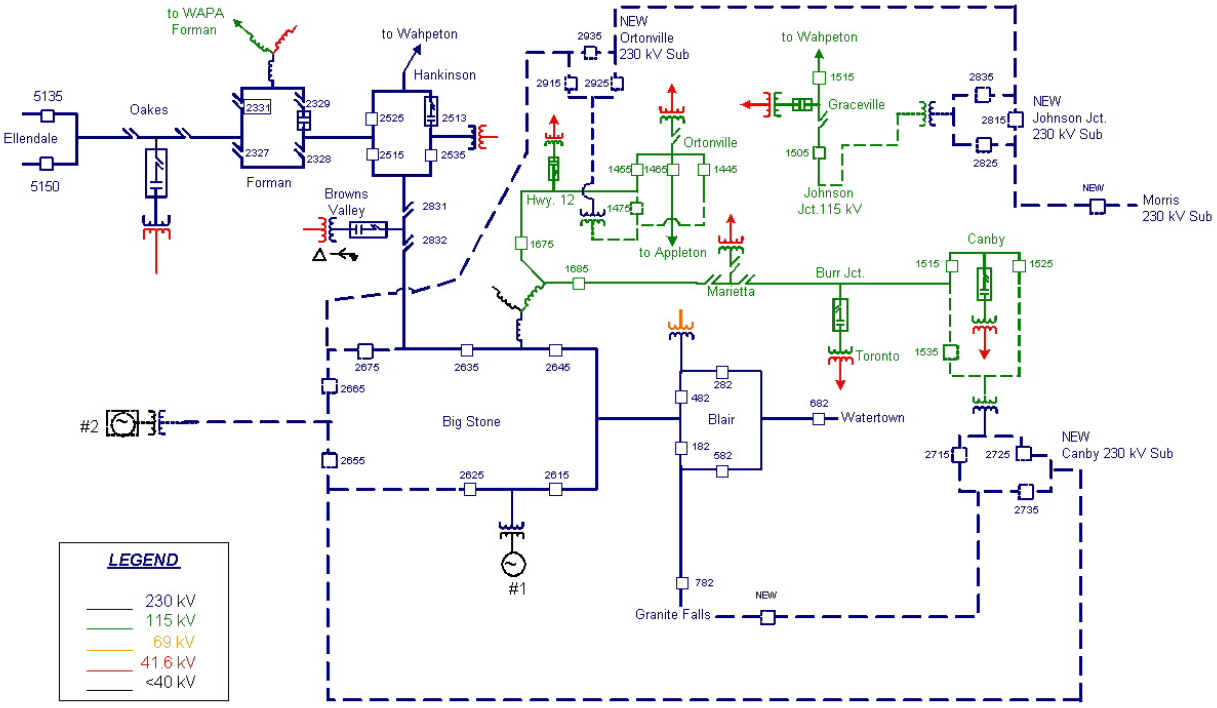
Figure 9 – Geographic Map of Interconnection Alternative 1



Big Stone - Ortonville - Johnson Jct. - Morris 115 kV to 230 kV Uprate with
Big Stone - Canby - Granite Falls 115 kV to 230 kV Uprate

To incorporate interconnection alternative 1 into the existing transmission system, assumptions had to be made as to expected breaker configurations and line arrangements within new or existing substations. Figure 10 is shown below and illustrates the assumptions used in adding the facilities associated with interconnection alternative 1 to the existing transmission system. The existing 230 kV ring bus at Big Stone was expanded to include four more 230 kV breakers to accommodate the new generator and two new 230 kV outlet lines. Along with changes at Big Stone, new 230 kV ring buses were also established at Ortonville, Johnson Junction, and Canby along with 115 kV breaker arrangements being made at Ortonville and Canby. The terminations at Morris and Granite Falls assumed adding new line breakers to match the existing configurations at these substations.

Figure 10 – One-Line Diagram of Interconnection Alternative 1



2.2 Interconnection Alternative 2

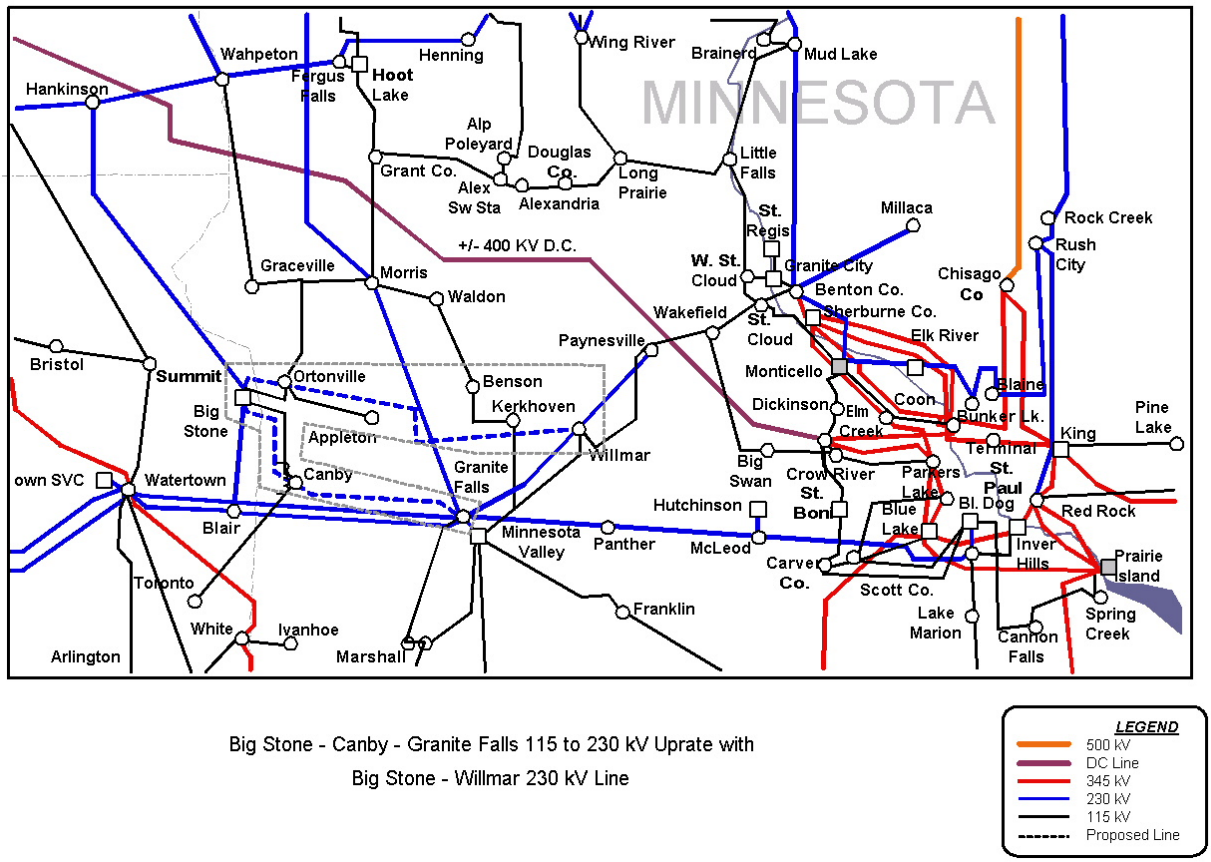
<u>New 230 kV line from Big Stone to Willmar and from Big Stone to Canby with a 115 kV to 230 kV uprate of Canby – Granite Falls line</u>

The second interconnection alternative considered for this Study still uses the "southern" 230 kV line introduced within alternative 1, but includes a new 102 mile, 230 kV line from Big Stone to Willmar instead of taking advantage of the existing 115 kV route from Big Stone to Morris. From Willmar, existing 230 kV lines head northeast towards Paynesville, and southwest towards Granite Falls. This new 230 kV line from Big Stone to Willmar did not require the need for any additional transformers.

As mentioned previously, besides the new line from Big Stone to Willmar, the same Big Stone to Granite Falls 230 kV line configuration, as discussed as part of interconnection alternative 1, was also included as part of alternative 2.

Figure 11 illustrates a geographic representation of interconnection alternative 2 that was studied for this interconnection request. Changes or additions to the existing transmission system are shown with dotted lines and circled in gray boxes.

Figure 11 – Geographic Map of Transmission Alternative 2

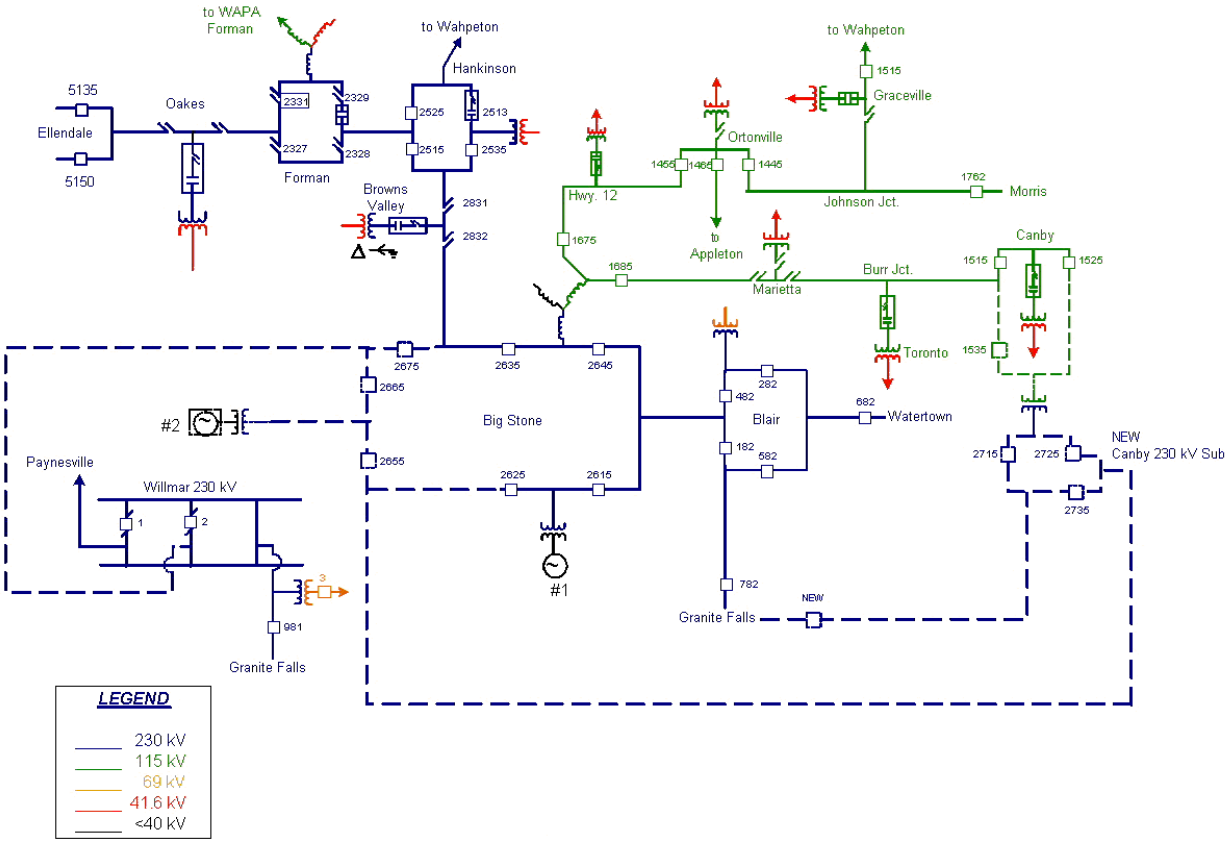


To add interconnection alternative 2 into the existing transmission system, it was assumed that the same 230 kV ring bus expansion as discussed for interconnection alternative 1 was necessary. However, instead of the 230 kV line going from Big Stone to Ortonville, the "northern" 230 kV line for alternative 2 went from Big Stone to Willmar. To terminate into the existing 230 kV bus at Willmar, it was assumed that one new 230 kV line breaker would be necessary on the line to Big Stone. This configuration seemed to match the existing setup of the Willmar 230 kV bus.

Breaker configurations and line arrangements along the "southern" 230 kV line from Big Stone to Granite Falls were assumed to be the same as that mentioned above as part of interconnection alternative 1.

Figure 12 illustrates the assumptions used in adding interconnection alternative 2 into the Study models with dotted lines.

Figure 12 – One-Line Diagram of Interconnection Alternative 2



3.0 Model Development

Steady state analysis for this Study focused on summer peak and summer off-peak conditions for the 2007 timeframe. The Customer does not project an in-service date until 2011 for this generator, but the 2007 cases were most readily available for analysis. These steady state cases were taken from the Group 2 WAPA/MISO coordinated interconnection study. These cases were initially developed from the 2002 series MAPP models for 2007 and then modified by ABB to include the Group 1 interconnection projects from the MISO/WAPA interconnection queues. Upon completion of the Group 1 coordinated study, these models were modified once again to include all of the Group 2 projects. Through the coordinated study process, transmission owners in the northern MAPP region have reviewed the models and submitted numerous updates that ABB has included in the base case models. More documentation about the base case model development for the coordinated studies can be obtained from MISO.

Due to the proximity of the Big Stone site to southwest Minnesota and all the possible wind generation projects occurring in that part of the state, the Customer decided during the April 15, 2004 kick-off meeting that they would like this interconnection request studied at three different generation levels of Group 2 projects. These Group 2 projects refer to seven previously queued wind generation projects in southwestern Minnesota, northeastern South Dakota, and northern Iowa that have been studied together as one interconnection study. Many of these Group 2 projects were studied with the assumption of being delivered to Xcel Energy. A list of these projects that have been studied as part of Group 2 is listed below in Figure 13.

Figure 13 – Group 2 Projects

Project	MW Size	Location	Point of Interconnection	Sink Information
G272	9.9 MW	Murray, MN	Chandler Tap 69 kV	GRE Load
G278	8.0 MW	Pipestone, MN	Pipestone 115 kV	MAIN and ECAR generation
G287	200 MW	Nobles, MN	Nobles 345 kV	MAIN and ECAR generation
GI-0303	200 MW	Brookings, SD	White 115 kV	MAIN and ECAR generation
GI-0304	80 MW	O'Brien, IA	Sioux City - Spencer 115 kV line	MEC
GI-0305	126 MW	Sioux, IA	Eagle 230 kV	MEC
G349	200 MW	Brookings, SD	Yankee 115 kV	MAIN and ECAR generation
Total =	**823.9 MW**			

Due to the low generation level of many of the Xcel Energy peaking facilities in the base case models, the Group 2 generation was sunk further east to the MAIN and ECAR control areas so that Xcel Energy's baseload units would not be backed down.

Since it is possible that this request and many of the Group 2 requests may use some of the same transmission, the Customer prefers to have three generation levels studied in order to give a range of possible interconnection upgrade costs from potentially the most expensive alternative (all Group 2 projects) to the least expensive (no Group 2 projects). Not knowing the possible markets that these Group 2 projects have targeted for their power, the Customer also requested that a half Group 2 case be analyzed to determine what would be the outcome of the Study if approximately half of the Group 2 projects went forward. For the half Group 2 cases, projects G272, GI-0303, and G349 were included in the models since they seemed to be the closest generators that could potentially have an impact on the required transmission for Big Stone II.

In addition to these Group 2 projects, other previously queued generation projects were added to the base case models. These included projects G261, G267, G370, and G380. A description of these projects is listed below in Figure 14.

Figure 14 – Previously Queued Generation Projects Added to Models

Project	MW Size	Location	Point of Interconnection	Sink Information
G261	667.4 MW	Mankato, MN	Wilmarth 345 kV and 115 kV	Xcel Energy
G267	190.5 MW	McLeod, MN	McLeod 230 kV	Xcel Energy
G370	160 MW	Sioux Falls, SD	Anson 115 kV	Xcel Energy
G380	150 MW	Rugby, ND	Rugby 115 kV	Manitoba Hydro

In order to further stress the existing transmission system out of Big Stone and identify all of the potential system constraints during this Study, generation levels at Lake Preston (Toronto), Hoot Lake (Fergus Falls), and the existing Big Stone unit were modeled at their maximum accredited capacity. These generators have the potential for sharing some of the same transmission capacity as the proposed interconnection, therefore having this existing generation on-line further stresses the local transmission outlet out of Big Stone.

After all the previously mentioned base case model alterations were completed, the proposed interconnection of the new Big Stone unit with each associated interconnection alternative was added to the models.

During the kick-off meeting, the Customer stated that the final size and final allocations for this particular project were not definite between the potential partners of the project. However, the Customer brought forward some assumptions in studying this interconnection request of 600 MW. The Customer preferred the following dispatch for this Study.

Sink	***Amount***
Otter Tail Power Company (OTP)	100 MW
Missouri River Energy Services (MRES)	100 MW
Great River Energy (GRE)	100 MW
Minnesota Municipal Power Agency (MMPA)	100 MW
Central Minnesota Municipal Power Agency (CMMPA)	76 MW
Heartland Consumers Power District (HCPD)	74 MW
Hutchinson Utilities Commission (HUC)	50 MW

The final models that were developed for this Study are listed below in Figure 15 and illustrate the following export levels (in MW's) over the known interfaces in the northern MAPP region:

- NDEX: North Dakota Export Interface
- MHEX: Manitoba Hydro Export Interface (Manitoba to US)
- MWSI: Minnesota Wisconsin Stability Interface
- MHOH: Manitoba Hydro/Ontario Hydro Interface
- OHMP: Ontario Hydro/Minnesota Power Interface
- EWTW: Ontario East-West Transfer (East to West)
- BD: Boundary Dam/Tioga 230 kV Line

Figure 15 – 2007 Summer Peak Steady State Analysis Models

2007 Summer Peak Cases - All Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
bas-sp07aa-g392.sav	Base Case Model All prior queued interconnections	0	491.3	1494.9	235.2	0.1	0.4	107.7	0.6
alt1-sp07aa-allgr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	952.8	1505.5	289.7	0.1	0	107.3	0.2
alt2-sp07aa-allgr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	947.2	1502.1	290.9	0.1	0.2	107.5	0.6

2007 Summer Peak Cases - Half Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
bas-sp07aa-halfgr2.sav	Base Case Model All prior queued interconnections	0	502.4	1488.4	171.6	0.1	0.1	107.4	0.2
alt1-sp07aa-halfgr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	965.8	1498.3	229	0.1	0.1	107.4	0.3
alt2-sp07aa-halfgr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	960.2	1495.2	230.4	0.1	0.1	107.3	0.3

2007 Summer Peak Cases - No Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
bas-sp07aa-nogr2.sav	Base Case Model All prior queued interconnections	0	519	1477.8	101.9	0.1	0.1	107.4	0.2
alt1-sp07aa-nogr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	984.4	1487.5	162.6	0.1	0.1	107.4	0.3
alt2-sp07aa-nogr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	979.9	1484.1	164.4	0.1	0.1	107.4	0.3

The base case Group 2 summer off-peak models obtained from MISO included maximum simultaneous export levels over MHEX, NDEX, and MWSI. During development of the summer off-peak cases for this Study, the appropriate changes were made to the source and sinks to modify the level of the Group 2 projects as well as adding all the prior queued generation projects. In the process of making these changes to the base case models, these maximum simultaneous export levels were altered across these critical interfaces. Therefore, in order to obtain the maximum simultaneous transfer levels across NDEX, MHEX, and MWSI, the setexports iplan within the Northern MAPP Operating Review Working Group (NMORWG) stability package was utilized to restore these interfaces back to their base case levels. Once the interface flows were close to the base case level, the proposed interconnection was added to the model. This interconnection did increase the NDEX quantity since alternative #1 included an uprate of an existing 115 kV line to 230 kV (Canby – Granite Falls) and alternative #2 included a new 230 kV line across the existing NDEX interface (Big Stone – Willmar) . The Study models derived for the summer off-peak analysis are listed below and list the new export levels with the proposed interconnection added to the models.

Figure 16 - 2007 Summer Off-peak Steady State Analysis Models

2007 Summer Off-peak Cases - All Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
bas-so07aa.uyv0020.sav	Base Case Model All prior queued interconnections	0	1948.9	2174	1480.9	0.4	0	106.1	0.1
alt1-so07aa-allgr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	2420.4	2183.2	1503.8	0.4	0	106.1	0.1
alt2-so07aa-allgr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	2420.1	2179.9	1508.3	0.4	0	106.1	0

2007 Summer Off-peak Cases - Half Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
bs2-so07aa.uyv0020.sav	Base Case Model All prior queued interconnections	0	1949.3	2174.6	1480.7	0.4	0	106.1	0.1
alt1-so07aa-halfgr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	2421	2183.7	1506	0.3	0	106	-0.1
alt2-so07aa-halfgr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	2421.6	2180.4	1509.9	0.4	0	106.1	-0.1

2007 Summer Off-peak Cases - No Group 2

Case Name	Description	Big Stone II	NDEX	MHEX	MWSI	OHMH	OHMP	EWTW	BD
no2-so07aa.uyv0020.sav	Base Case Model All prior queued interconnections	0	1949.7	2174.4	1480.3	0.3	0	106.1	0
alt1-so07aa-nogr2.sav	Big Stone - Morris 230 kV Big Stone - Granite Falls 230 kV	600	2425.1	2182.2	1509.5	0.3	0	106	-0.1
alt2-so07aa-nogr2.sav	Big Stone - Willmar 230 kV Big Stone - Granite Falls 230 kV	600	2425.5	2179	1513.5	0.4	0	106.1	-0.1

Machine characteristics for modeling the proposed interconnection for steady state analysis were obtained from the Customer. These machine characteristics and the assumptions used for modeling this proposed generator are given in Appendix A in PSS/E format.

4.0 Study Procedure

All aspects of this Study utilized the Power System Simulator for Engineers (PSS/E) software program distributed by Power Technologies Incorporated (PTI). PSS/E version 29.4 on the PC platform has been used during this Study.

Steady state analysis utilized the PSS/E activity ACCC, which simulates branch outages in a user-defined area while monitoring voltage and loading within another user-defined area. For this Study, the following areas had all single contingencies simulated during ACCC analysis:

- Area 331 – Alliant West (ALTW)
- Area 600 – Xcel Energy (XEL)
- Area 608 – Minnesota Power (MP)
- Area 613 – Southern Minnesota Municipal Power Agency (SMMPA)
- Area 618 – Great River Energy (GRE)
- Area 626 – Otter Tail Power Company (OTP)
- Area 635 – Mid-American Energy Council (MEC)
- Area 652 – Western Area Power Administration (WAPA)
- Area 667 – Manitoba Hydro (MH)

In addition, valid multiple contingencies from the 2003 series MAPP contingency file were applied during ACCC analysis. The contingency file used for this Study was the same as that used during the Group 2 MISO/WAPA coordinated study.

In flagging violations during contingency analysis, the following areas were monitored during ACCC analysis:

- Area 331 – Alliant West (ALTW)
- Area 600 – Xcel Energy (XEL)
- Area 608 – Minnesota Power (MP)
- Area 613 – Southern Minnesota Municipal Power Agency (SMMPA)
- Area 618 – Great River Energy (GRE)
- Area 626 – Otter Tail Power Company (OTP)
- Area 635 – Mid-American Energy Council (MEC)
- Area 640 – Nebraska Public Power District (NPPD)
- Area 645 – Omaha Public Power District (OPPD)
- Area 650 – Lincoln Electric System (LES)
- Area 652 – Western Area Power Administration (WAPA)
- Area 667 – Manitoba Hydro (MH)

4.1 Study Criteria

During steady state contingency analysis, branch loadings and bus voltages were monitored. Study criteria for contingency analysis monitored normal branch ratings (Rate A) for system intact conditions and emergency ratings (Rate C) for contingency conditions. Voltage criteria

used during contingency analysis was taken from the latest version of the MAPP Members Reliability Criteria and Study Procedures Manual.

All impacts created or worsened by the addition of the proposed interconnection were flagged. Facility impacts within the following bounds were not considered a violation during contingency analysis:

- A change in voltage of less than +/- 1%
- Any bus voltage higher than 0.92 p.u. during "n-1" conditions
- Any bus voltage lower than 1.10 p.u. during "n-1" conditions
- An increase in loading of less than 2% of the proposed interconnection project size for non-MISO (MAPP member) facilities during "n-1" conditions
- An increase in loading of less than 3% of the proposed interconnection project size for MISO member facilities during "n-1" conditions
- An increase in loading of less than 5% of the proposed interconnection during system intact conditions
- Branch loadings not exceeding emergency ratings (Rate C) during a contingency condition
- Branch loadings not exceeding normal ratings (Rate A) during a system intact condition

Any impacted facilities that were identified during steady state ACCC contingency analysis for 2007 summer peak and 2007 summer off-peak conditions that do not fall within these criteria are discussed in the following sections. In discussing the ACCC analysis results, the primary focus was on those facilities immediately surrounding the point of interconnection.

5.0 Steady State Power Flow Analysis Results

5.1 2007 Summer Off-peak Conditions

5.1.1 All Group 2 Projects from MISO/WAPA Coordinated Study

5.1.1.1 Loading Violations

5.1.1.1.1 Interconnection Alternative 1

During ACCC contingency analysis of the 2007 summer off-peak case with all Group 2 projects modeled from the MISO/WAPA coordinated study, there were two facilities identified as being overloaded for interconnection alternative 1. These facilities included the existing Big Stone 230/115/13.8 kV transformer and the Morris 230/115 kV transformer. The magnitude of the post-contingent loading on these facilities along with the corresponding contingencies is shown below in Figure 17.

Figure 17 – Loading Violations for Alternative 1 During Summer Off-peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
FromBus		kV	ToBus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			239.6	102.8	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			241.2	103.5	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			105.2	105.2	BASE CASE
												NUMEROUS OTHER CONTINGENCIES
										136.8	136.8	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1

The existing Big Stone 230/115/13.8 kV transformer only loads up to 103.5% of the normal rating for loss of the new Big Stone to Ortonville 230 kV line, which is well below the 125% emergency rating of the Big Stone transformer. However, the Morris 230/115 kV transformer overloads for a multitude of system conditions. During summer off-peak, system intact conditions, the transformer exceeds its normal rating of 100 MVA and is only worsened by critical contingencies in the area of interconnection. The magnitude of the loading experienced by the Morris 230/115 kV transformer during summer off-peak conditions will require this interconnection project to upgrade the existing 230/115 kV transformer at Morris for interconnection alternative 1.

As mentioned in section 2.1, interconnection alternative #1 included 230 kV lines from Big Stone to Morris and from Big Stone to Granite Falls. These 230 kV lines were assumed to be composed of 954 ACSR conductor with a thermal rating of 390 MVA. During contingency analysis of interconnection alternative 1 for 2007 summer off-peak conditions will all of the Group 2 projects modeled, it appears that the 390 MVA rating of the new 230 kV lines between Big Stone and Morris will not be adequate in carrying the amount of post-contingent flow possible for loss of adjacent 230 kV outlet lines out of the Big Stone plant. Figure 18 indicates that up to 411 MVA of flow is possible on the Big Stone to Ortonville 230 kV line for loss of the Big Stone to Blair 230 kV line. Likewise, a 125 MVA, 230/115/13.8 kV transformer was added at Ortonville as part of interconnection alternative 1 for modeling purposes. It appears that 125 MVA will not be sufficient in handling the potential for up to 182 MVA during loss of the Big

Stone to Ortonville 230 kV line during summer off-peak conditions. The expected loading on the new interconnection facilities that exceed their assumed capacity can be found below in Figure 18.

Figure 18 – Potential Loading on Interconnection Facilities for 2007 Summer Off-peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
FromBus		kV	ToBus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			411.0	102.2	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			181.4	145.1	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63216	ORTONVL7	115	63321	ORTNVLEY	230	1	125			181.5	145.2	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			408.2	104.5	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1

Contingency analysis for interconnection alternative 1, also indicated that there were other facilities overloaded. Some of these facilities that are closer to the point of interconnection are shown below in Figure 19. Since these facilities are not in the direct area of interconnection, they are not required interconnection upgrades. However, upgrades to these facilities may be required at a later date if some of these same facilities appear in the delivery service study. A full listing of other facility overloads that appeared at locations more remote from the area of interconnection are shown in Appendix B.1.1. The more local facilities exceeding their emergency rating include the 230 kV line from Granite Falls to MN Valley Tap extending to Panther and continuing to McLeod. In addition, the Grant County to Morris 115 kV line, the MN Valley 230/115 kV transformer, and the Maynard to Kerkhoven Tap 115 kV line all exceed their emergency ratings as shown below in Figure 19. According to the following figure, an upgrade of the Fergus Falls to Hoot Lake 115 kV line may also be required during the delivery service study. Study results also indicate that the Wahpeton to Fergus Falls 230 kV also loads up beyond normal ratings, but not above emergency ratings.

Figure 19 - Loading Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
FromBus		kV	ToBus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			355.7	100.7	BASE CASE
										451.8	116.4	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
												NUMEROUS OTHER CONTINGENCIES
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			385.9	126.2	BASE CASE
								365.1	117.0	481.4	157.6	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187	204.5	109.4	250.2	133.8	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60357	MAYNARD7	115	62005	KERKHOT7	115	1	78			77.3	113.3	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			392.4	123	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
												60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
												NUMEROUS OTHER CONTINGENCIES
63050	WILLMAR4	230	66550	GRANITF4	230	1	383			354.6	100.0	60150 MNVLTAP4230.00 63054 PANTHER4230.00 C1
										360.3	101.6	63054 PANTHER4230.00 60742 PANTHER869.000 C1
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			118.5	123.4	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			343.7	109.6	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										338.6	105.8	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
										338.6	105.8	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
										338.6	105.8	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96			96.9	100.7	63219 GRANTCO7115.00 63220 ELBOWLK7115.00 C1
								110.5	113.4	123.4	130.2	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

As mentioned previously, the mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded to handle the post-contingent flow identified in Figure 19.

5.1.1.1.2 Interconnection Alternative 2

Contingency analysis for interconnection alternative 2 during summer off-peak conditions with all of the Group 2 projects within the model has only identified one overloaded facility. This is the Johnson Jct. to Ortonville 115 kV line that overloads for numerous contingencies. The highest post-contingent flow on the line was for loss of the Hankinson to Wahpeton 230 kV line. The following figure illustrates this overload.

Figure 20 - Loading Violations for Alternative 2 During Summer Off-peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6	112.9	109.1	106.7	110.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES

Since the post-contingent flow on this 115 kV line exceeds the emergency limit of 106 MVA, implementation of this interconnection alternative would trigger the need to upgrade this 115 kV line to handle this post-contingent flow.

Contingency analysis for interconnection alternative 2 also identified numerous other lines that were overloaded further away from the point of interconnection. These facility overloads could be a result of the assumed delivery of this generation, therefore these facilities are not required to be upgraded as part of the interconnection process, but may be required during a later stage of the delivery service study. The overloaded facilities that are a bit closer to the point of interconnection are identified below in Figure 21, with a full listing of the contingency results for interconnection alternative 2 being available in Appendix B.1.1 for 2007 summer off-peak conditions with all of the Group 2 projects.

Figure 21 - Loading Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
FromBus		kV	ToBus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			360.2	101.3	BASE CASE
										452.8	116.7	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
												NUMEROUS OTHER CONTINGENCIES
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			392.2	127.1	BASE CASE
								365.1	117.0	429.5	138.7	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187	204.5	109.4	253.7	135.7	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			395.4	123.9	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
												60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			107.9	112.4	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			333.8	105.9	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										330.5	103.3	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
										330.5	103.3	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
										330.3	103.2	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96	110.5	113.4	119.5	125.6	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.1.1.2 Voltage Violations

5.1.1.2.1 Interconnection Alternative 1

Contingency analysis of the 2007 summer off-peak case for all of the Group 2 projects within the model did not identify any voltage violations within the immediate area of interconnection for alternative 1. However, there were a multitude of voltage violations that did occur at locations far from the proposed interconnection. A full listing of these voltage violations can be found within Appendix B.1.2. Some of these voltage violations that occurred at locations a bit closer to the point of interconnection are listed below in Figure 22. These voltage violations are not required to be fixed during the interconnection Study, but may be required if later in the delivery service study these same voltage violations are shown to be further aggravated by the assumed delivery of the proposed interconnection.

Figure 22 – Voltage Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
63054	PANTHER4	230			NEW	BASE CASE AND NUMEROUS OTHERS
60149	MINVALT4	230		0.9118	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230		0.9117	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60189	BLK DOG4	230		0.8856	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8859	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8865	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8917	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
60898	GLENCOE	115		0.8793	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8797	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8810	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8880	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115		0.9194	NEW	62001 BENSON 7115.00 62006 KERKHO 7115.00 C1
				0.9044	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62981	MCLEOD 7	115		0.8858	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8862	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8874	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8945	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62982	HUTCHMN7	115		0.8916	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8920	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8932	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8998	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62983	HUTCH3M7	115		0.8909	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8912	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8924	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8991	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
63219	GRANTCO7	115		0.9026	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9025	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9019	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES
			0.8897	0.8274	-0.0623	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
			0.8939		ELIMINATED	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
				0.8864	NEW	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
				0.9008	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
67452	ALEXSS	115		0.9005	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9004	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.8996	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
67453	ALEXSWM	115		0.9002	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9001	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.8993	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
67454	ALEXPLDM	115		0.8977	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.8976	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.8968	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63220	ELBOWLK7	115		0.898	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.898	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.8974	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1

Figure 22 (continued)

Voltage Violation			Existing System	Int. Alt #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
63221	BRANDN 7	115			NEW	NUMEROUS CONTINGENCIES
63222	ALEXAND7	115		0.9046	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9046	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9037	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
60156	PYNSVIL7	115			NEW	NUMEROUS CONTINGENCIES
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62530	FRAZEE 7	115		0.9186	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9185	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9178	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62752	MLTN TP7	115			NEW	NUMEROUS CONTINGENCIES
62753	MILTONA7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230		0.8989	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.8988	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.898	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63052	INMAN 4	230		0.8983	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.8983	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.8974	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, mitigation of these voltage violations may be required if these same violations appear during the delivery service study.

5.1.1.2.2 Interconnection Alternative 2

Interconnection alternative 2 involved 230 kV lines from Big Stone to Willmar and from Big Stone to Granite Falls. Contingency analysis of the 2007 summer off-peak case with all of the Group 2 projects included in the model has identified some potential voltage violations at both the Willmar 115 kV and 230 kV buses. Since these voltage violations are directly at the point of interconnection, mitigation of the voltage violations at Willmar will be necessary if interconnection alternative 2 goes forward in connecting the proposed generator. Post-contingent voltage levels with the worst-case contingencies are shown below in Figure 23.

Figure 23 – Voltage Violations for Alternative 2 During Summer Off-peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES
			0.8939	0.8848	-0.0091	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
				0.9139	NEW	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
				0.9123	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1

Since the post-contingent voltage at these two buses dropped below GRE's criteria of 0.92 p.u., mitigation of these voltages must be completed if interconnection alternative 2 is implemented when connecting the proposed generator to the system.

Interconnection alternative 2 also had numerous other voltage violations identified during contingency analysis of the 2007 summer off-peak case with all of the Group 2 projects modeled. A complete listing of these voltage violations can be found in Appendix B.1.2. However, a list of those buses closer to the point of interconnection can be found below in Figure 24. Since these voltage violations occur at buses more remote from the point of interconnection, they do not have to be resolved during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 24 – Voltage Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
63054	PANTHER4	230			NEW	BASE CASE AND NUMEROUS OTHERS
60149	MINVALT4	230		0.9169	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230		0.9167	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60189	BLK DOG4	230		0.8867	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60898	GLENCOE	115		0.8840	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.8904	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62982	HUTCHMN7	115		0.8953	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62983	HUTCH3M7	115		0.8947	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63219	GRANTCO7	115		0.9142	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9142	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9143	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
67452	ALEXSS	115		0.9154	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9153	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9154	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
67453	ALEXSWM	115		0.9151	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.915	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9151	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
67454	ALEXPLDM	115		0.9126	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9125	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9126	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63220	ELBOWLK7	115		0.9105	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9105	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9106	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63221	BRANDN 7	115			NEW	NUMEROUS CONTINGENCIES
63222	ALEXAND7	115		0.9194	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9193	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9194	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
60156	PYNSVIL7	115			NEW	NUMEROUS CONTINGENCIES
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62752	MLTN TP7	115			NEW	NUMEROUS CONTINGENCIES
62753	MILTONA7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230		0.9133	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9132	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9133	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63052	INMAN 4	230		0.9128	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9127	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9127	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, mitigation of these low voltages may be required if these same violations appear during the delivery service study.

5.1.2 Half Group 2 Projects from MISO/WAPA Coordinated Study

5.1.2.1 Loading Violations

5.1.2.1.1 Interconnection Alternative 1

The 2007 summer off-peak case with half of the Group 2 projects modeled from the MISO/WAPA coordinated study resulted in two facilities being overloaded for interconnection alternative 1. These two facilities are once again the Morris 230/115 kV transformer and the Big Stone 230/115/13.8 kV transformer, as was shown for interconnection alternative 1 for the scenario with all of the Group 2 projects modeled. These facilities with their corresponding post-contingent flows are shown below in Figure 25.

Figure 25 - Loading Violations for Alternative 1 During Summer Off-peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			130.0	130.0	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			236.2	101.4	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			237.5	101.9	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1

The Morris 230/115 kV transformer is overloaded for numerous different contingencies, of which the highest post-contingent flow was for loss of the Hankinson to Wahpeton 230 kV line. Since the post-contingent flow on this transformer exceeds the emergency rating, the Morris 230/115 kV transformer would have to be upgraded as part of interconnection alternative 1. The Big Stone 230/115/13.8 kV transformer only reaches about 102% of its normal rating, which is below the emergency rating of this transformer, therefore the need to upgrade this transformer is not required for this interconnection alternative.

Overloads on some of the new line sections also appeared during contingency analysis of the half Group 2 summer off-peak cases. These line sections included the Big Stone to Ortonville 230 kV line and the Ortonville to Johnson Jct. 230 kV line. In addition, the 125 MVA, 230/115/13.8 kV transformer placed at Ortonville did not have enough capacity to handle the amount of post-contingent flow experienced for loss of the Big Stone to Ortonville 230 kV line. Figure 26 illustrates the post-contingent flows possible on these line sections for the contingencies shown in the far right-hand column.

Figure 26 - Potential Loading on Interconnection Facilities for 2007 Summer Off-peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			409.8	101.9	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			406.8	103.9	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
63216	ORTONVL7	115	63321	ORTNVLEY	230	1	125			177.8	142.3	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			177.8	142.2	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1

Implementation of interconnection alternative 1 will have to be designed such that the conductor used on the 230 kV line from Big Stone to Johnson Jct. will be able to handle the amount of

post-contingent flow illustrated in Figure 26. Furthermore, the Ortonville 230/115/13.8 kV transformer will have to be able to handle at least 180 MVA of flow as shown in the previous figure.

In addition to these local facility overloads, there were also numerous other overloads shown for interconnection alternative 1 during the summer off-peak half Group 2 case. A full listing of these facility overloads can be found in Appendix B.2.1. Overloaded facilities within the vicinity of the proposed interconnection are shown below in Figure 27. These facilities as well as those shown in Appendix B.2.1 are not directly impacted by the interconnection itself, but could be more related to the delivery of the output from the proposed interconnection. Therefore, the upgrade of these facilities is not required during the interconnection stage of this Study, but may be required later if the delivery service study shows some of these same constraints.

Figure 27 - Loading Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			372.3	120.7	BASE CASE
										472	148.4	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
										395.8	124.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187	193.1	103.2	240.4	128.6	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			436.7	112.6	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96	102.6	106.3	111.5	116.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			355.1	111.3	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96	107.1	109.1	120.0	125.5	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			331.2	105.0	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										322.7	100.8	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
										322.7	100.8	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
										322.6	100.8	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
63194	FERGSFLY	230	63231	FERGSFL7	115	1	112			120.0	107.2	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.1.2.1.2 Interconnection Alternative 2

Similar to section 5.1.1.1.2, the only overloaded facility identified by contingency analysis of the 2007 summer off-peak case with half of the Group 2 projects for interconnection alternative 2 was on the Johnson Jct. to Ortonville 115 kV line. This line overload appeared for a large number of contingencies, but reaches the highest level for loss of the Wahpeton to Hankinson 230 kV line. The post-contingent flow on this line is shown below in Figure 28.

Figure 28 - Loading Violations for Alternative 2 During Summer Off-peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6	108.1	104.3	112.2	116.2	63311 CANBY 4230.00 66550 GRANITF4230.00 C1
												NUMEROUS OTHER CONTINGENCIES

Since the highest amount of flow on this line reaches 116% of its normal rating, it is over the emergency rating of 106 MVA. Therefore, implementation of interconnection alternative 2 would require the upgrade of the Johnson Jct. to Ortonville 115 kV line.

Numerous other overloads in areas remote from the point of interconnection were identified for interconnection alternative 2 during contingency analysis of the 2007 summer off-peak case with half of the Group 2 projects included. These overloads can be found in Appendix B.2.1 with more of the local overloads being shown below in Figure 29. Since these overloads are not in the direct area of interconnection, they are not required upgrades during the interconnection Study process. These overloads are provided for informational purposes and may appear in a delivery service study, which would then require upgrades due to the delivery of the output of the proposed interconnection.

Figure 29 - Loading Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			377.8	121.7	BASE CASE
										397.8	125.1	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187	193.1	103.2	242.4	129.6	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96	102.6	106.3	101.3	105.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96	107.1	109.1	116.2	121.0	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			322.8	101.8	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63194	FERGSFLY	230	63231	FERGSFL7	115	1	112			116.1	103.6	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.1.2.2 Voltage Violations

5.1.2.2.1 Interconnection Alternative 1

With only half of the Group 2 projects modeled from the MISO/WAPA coordinated study during 2007 summer off-peak conditions, the amount of voltage violations seemed to decrease for interconnection alternative 1. Once again, there were no voltage violations encountered in the immediate area of interconnection. However, there were others spread throughout the system. A complete list of voltage violations for interconnection alternative 1 that were evident during 2007 summer off-peak conditions can be found in Appendix B.2.2. Some of the voltage violations

adjacent to the area of interconnection are shown below in Figure 30. These voltage violations could be more related to the assumptions used during the interconnection Study as to where the power from the proposed interconnection is being delivered. Therefore, they are not required to be fixed during the interconnection Study, but may be required if later in the delivery service study these same voltage violations are shown to be further aggravated by the assumed delivery of the proposed interconnection.

Figure 30 - Voltage Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60156	PYNSVIL7	115			NEW	NUMEROUS CONTINGENCIES
60189	BLK DOG4	230		0.8975	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8977	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8984	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9028	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
60898	GLENCOE	115		0.8917	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8921	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8934	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8993	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
60899	GLNCOMU8	69			NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.8981	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8985	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8998	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9057	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62982	HUTCHMN7	115		0.9004	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9008	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9019	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9074	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62983	HUTCH3M7	115		0.9001	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9004	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9016	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9071	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES
			0.9041	0.8719	-0.0322	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
				0.8719	NEW	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
62526	RUSH LK7	115		0.9184	NEW	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
				0.9152	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9152	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9132	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
62527	ELMO 7	115		0.9145	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9144	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9126	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1
62531	INMAN 7	115		0.9122	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9122	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
				0.9103	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, mitigation of these low voltages may be required if these same violations appear during the delivery service study.

5.1.2.2.2 Interconnection Alternative 2

Contingency analysis results for interconnection alternative 2 for 2007 summer off-peak conditions with half of the Group 2 projects modeled had one voltage violation in the immediate area of interconnection. This voltage violation was at the Willmar 115 kV bus and was evident for five different contingencies. Figure 31 is shown below and illustrates the post-contingent voltage levels evident at the 115 kV bus for the corresponding contingencies shown in the far right-hand column.

Figure 31 - Voltage Violations for Alternative 2 During Summer Off-peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62425	WILLMAR7	115	0.9186	0.8927	-0.0259	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
			0.9048	0.8850	-0.0198	62425 WILLMAR7115.00 62005 KERKHOT7115.00 CC1 60357 MAYNARD7115.00 62005 KERKHOT7115.00 C1 62005 KERKHOT7115.00 62006 KERKHO 7115.00 C1 62006 KERKHO 7115.00 62001 BENSON 7115.00 C1
			0.9041	0.8941	-0.0100	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
			0.9172	0.8909	-0.0263	62427 WILLMAR869.000 63050 WILLMAR4230.00 C1

Since the post-contingent voltage at this bus is below the criteria of 0.92 p.u., mitigation of this voltage violation must be completed if interconnection alternative 2 is implemented when connecting the proposed generator to the existing system.

Numerous other voltage violations were identified during contingency analysis of the 2007 summer off-peak case with half of the Group 2 projects modeled for interconnection alternative 2. A full listing of these voltage violations can be found in Appendix B.2.2. A list of those buses closer to the point of interconnection can be found below in Figure 32. Since these voltage violations occur at buses more remote from the point of interconnection, they do not have to be resolved during the interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 32 - Voltage Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60156	PYNSVIL7	115			NEW	NUMEROUS CONTINGENCIES
60189	BLK DOG4	230		0.8987	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
60898	GLENCOE	115		0.896	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60899	GLNCOMU8	69		0.9139	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.9024	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62982	HUTCHMN7	115		0.9036	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62983	HUTCH3M7	115		0.9034	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES
62531	INMAN 7	115		0.9185	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9195	NEW	60101 FORBES 2500.00 60174 ROSEAUS2500.00 C1

The mitigation of these voltage violations is not required as part of this interconnection Study. However, these voltage problems would need to be mitigated if these same violations appear during the delivery service study.

5.1.3 No Group 2 Projects in Southwest Minnesota

5.1.3.1 Loading Violations

5.1.3.1.1 Interconnection Alternative 1

When none of the Group 2 projects from the MISO/WAPA coordinated study were included in the models, only one overloaded facility was evident during contingency analysis of the 2007 summer off-peak case for interconnection alternative 1. This facility was the Morris 230/115 kV transformer. This transformer overload was evident for numerous contingencies, but seemed to have the highest loading for loss of the Hankinson to Wahpeton 230 kV line. The post-contingent flow is shown below in Figure 33.

Figure 33 - Loading Violations for Alternative 1 During Summer Off-peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			122.6	122.6	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES

The emergency rating of the Morris 230/115 kV transformer is 125 MVA. Since the post-contingent loading of this transformer does not exceed this level, it would not be necessary to upgrade this transformer if none of the Group 2 projects go forward.

As seen in previous summer off-peak results for interconnection alternative 1, the new 230 kV line from Big Stone to Ortonville to Johnson Jct. overloaded for loss of he Big Stone to Blair 230 kV line. The assumed line capacity of 390 MVA will not be sufficient if interconnection alternative 1 is selected. In addition, the new Ortonville 230/115/13.8 kV transformer that was

added to the models as part of alternative 1 also overloaded for loss of the Big Stone to Ortonville 230 kV line. Post-contingent flows on these new facilities are shown below in Figure 34.

Figure 34 - Potential Loading on Interconnection Facilities for 2007 Summer Off-peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			407.5	101.3	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			412.4	102.9	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			170.4	136.3	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1

Besides local facility overloads, there were also a lot of other loading violations noticed at areas further away from the point of interconnection. A full list of these overloads can be found in Appendix B.3.1. Some of these overloads that are a bit closer to the point of interconnection are listed below in Figure 35. These overloaded facilities are not required upgrades during this interconnection Study, but may be required at a later date if these same facilities appear during the delivery service study.

Figure 35 - Loading Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			343.4	110.1	BASE CASE
										430.1	138.2	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			217.4	116.3	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			390.7	100.7	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
										390.7	100.7	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
												NUMEROUS OTHER CONTINGENCIES
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			329.0	103.1	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
												60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
												NUMEROUS OTHER CONTINGENCIES
63054	PANTHER4	230	62980	MCLEOD 4	230	1	319					60108 WILMART3345.00 60192 BLUE LK3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			124.6	128.2	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
										98.5	102.6	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										97.7	101.7	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										104.3	108.6	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
										97.4	100.8	63219 GRANTCO7115.00 63223 HOOT LK7115.00 C1
63194	FERGSFLY	230	63231	FERGSFL7	115	1	112			114.5	102.2	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
63194	FERGSFLY	230	63331	FERGSFL4	230	1	112			114.4	102.1	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96	101.3	102.8	114.5	117.6	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.1.3.1.2 Interconnection Alternative 2

Interconnection alternative 2 identified the Johnson Jct. to Ortonville 115 kV line as being overloaded for five separate contingencies. This is the same line section that has been overloaded for the all Group 2 as well as the half Group 2 cases that have been discussed in previous sections. The critical contingencies as well as the resultant post-contingent loading on this 115 kV line can be found below in Figure 36.

Figure 36 - Loading Violations for Alternative 2 During Summer Off-peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6			109.2	105.7	63050 WILLMAR4230.00 63314 BIGSTON4230.00 C1
										116.9	113.3	63311 CANBY 4230.00 66550 GRANITF4230.00 C1
										121.7	117.7	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										120.5	116.6	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										97.8	101.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1

Since some of these contingencies load this line section up beyond the emergency limit, implementation of interconnection alternative 2 will require the upgrade of the existing 115 kV line from Johnson Jct. to Ortonville.

Contingency analysis of interconnection alternative 2 during 2007 summer off-peak conditions with none of the Group 2 projects modeled identified a large number of other facility overloads more remote from the Big Stone area. These overloads can be found in Appendix B.3.1. A listing of some of the closer facility overloads that could be associated with the assumptions for the delivery of the power from the proposed interconnection can be found below in Figure 37. Since these facility overloads are more related to the delivery from the proposed interconnection, they are not required to be upgraded unless they are identified in the delivery service study.

Figure 37 - Loading Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			348.6	110.9	BASE CASE
										379.2	120.4	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			220.2	117.8	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			392.7	101.2	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
										392.7	101.2	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
												NUMEROUS OTHER CONTINGENCIES
63054	PANTHER4	230	62980	MCLEOD 4	230	1	319			296.7	103.9	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			115.4	119.6	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1
63231	FERGSFL7	115	63223	HOOT LK7	115	1	96	101.3	102.8	110.8	113.2	63329 WAHPETN4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.1.3.2 Voltage Violations

5.1.3.2.1 Interconnection Alternative 1

Adding interconnection alternative 1 to the 2007 summer off-peak case with no Group 2 projects modeled from the MISO/WAPA coordinated study did not have any voltage impacts in the immediate area of interconnection. However, there was a multitude of voltage violations noted at other locations more remote from the proposed project. A complete listing of these violations can be found in Appendix B.3.2. Some of these violations that are adjacent to the area of interconnection are shown below in Figure 38. These voltage violations are more remote from the point of interconnection and may be more influenced by the assumptions used in the delivery of the power from the proposed interconnection. Therefore, they are not required to be fixed during the interconnection Study. However, if some of these same voltage violations occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 38 - Voltage Violations on Remote Facilities for Alternative 1 During Summer Off-peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
60189	BLK DOG4	230		0.9117	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9119	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9125	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9163	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
60898	GLENCOE	115		0.9124	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9127	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9139	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9186	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62005	KERKHOT7	115		0.9110	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62981	MCLEOD 7	115		0.9187	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9190	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
62982	HUTCHMN7	115		0.9191	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9193	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
62983	HUTCH3M7	115		0.9190	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9193	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES
62425	WILLMAR7	115	0.9198	0.8918	-0.0280	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
			0.9081	0.8898	-0.0183	62425 WILLMAR7115.00 62005 KERKHOT7115.00 CC1 60357 MAYNARD7115.00 62005 KERKHOT7115.00 C1 62005 KERKHOT7115.00 62006 KERKHO 7115.00 C1 62006 KERKHO 7115.00 62001 BENSON 7115.00 C1
			0.9082	0.8887	-0.0195	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
				0.9006	NEW	62427 WILLMAR869.000 63050 WILLMAR4230.00 C1
			0.9146	0.8697	-0.0449	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
			0.9081	0.8898	-0.0183	62425 WILLMAR7115.00 62005 KERKHOT7115.00 CKT C1 60357 MAYNARD7115.00 62005 KERKHOT7115.00 CKT 1 62005 KERKHOT7115.00 62006 KERKHO 7115.00 CKT 1 62006 KERKHO 7115.00 62001 BENSON 7115.00 CKT 1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, these low voltages would require mitigation if these same violations appear during the delivery service study.

5.1.3.2.2 Interconnection Alternative 2

Contingency analysis results for the 2007 summer off-peak case with none of the Group 2 projects modeled had one voltage violation within the immediate area of interconnection for alternative 2. This voltage violation occurred at the Willmar 115 kV bus and was evident during five separate contingencies. The post-contingent voltage level at this bus for these five contingencies is shown below in Figure 39.

Figure 39 - Voltage Violations for Alternative 2 During Summer Off-peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62425	WILLMAR7	115	0.9198	0.9046	-0.0152	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
			0.9081	0.9001	-0.0080	62425 WILLMAR7115.00 62005 KERKHOT7115.00 CC1 60357 MAYNARD7115.00 62005 KERKHOT7115.00 C1 62005 KERKHOT7115.00 62006 KERKHO 7115.00 C1 62006 KERKHO 7115.00 62001 BENSON 7115.00 C1
			0.9082	0.8997	-0.0085	62005 KERKHOT7115.00 62425 WILLMAR7115.00 CC1
				0.9041	NEW	62427 WILLMAR869.000 63050 WILLMAR4230.00 C1

In the event that interconnection alternative 2 goes forward when connecting the proposed generator to the system, it will be necessary to install system enhancements in order to eliminate this voltage violation that has appeared to be aggravated by the proposed project.

In addition to this voltage violation at Willmar, there was several other voltage violations noted at various other locations outside the area of immediate interconnection. A complete list of these voltage violations can be found in Appendix B.3.2. Some of these violations that are just adjacent to the area of interconnection are noted below in Figure 40. Since these voltage violations may be more related to the delivery of the power from the proposed interconnection, they are not required upgrades during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 40 - Voltage Violations on Remote Facilities for Alternative 2 During Summer Off-peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60189	BLK DOG4	230		0.9126	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
					NEW	NUMEROUS CONTINGENCIES
60898	GLENCOE	115		0.9157	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
					NEW	NUMEROUS CONTINGENCIES
62981	MCLEOD 7	115			NEW	NUMEROUS CONTINGENCIES
62982	HUTCHMN7	115			NEW	NUMEROUS CONTINGENCIES
62983	HUTCH3M7	115			NEW	NUMEROUS CONTINGENCIES
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES

The mitigation of these voltage violations is not required as part of this interconnection Study. However, if these same violations appear during the delivery service study, they would need to be mitigated through the addition of system enhancements.

5.2 2007 Summer Peak Conditions

5.2.1 All Group 2 Projects from the MISO/WAPA Coordinated Study

5.2.1.1 Loading Violations

5.2.1.1.1 Interconnection Alternative 1

Contingency analysis of the 2007 summer peak case with all Group 2 wind projects modeled from the MISO/WAPA coordinated study has indicated that there are five potential overloads for interconnection alternative 1. These overloads appear on the Big Stone 230/115/13.8 kV transformer, the Big Stone to Browns Valley 230 kV line, the Morris 230/115 kV transformer, the Big Stone to Highway 12 115 kV line and the Highway 12 to Ortonville 115 kV line. The post-contingent loadings on these overloaded facilities are shown below in Figure 41.

Figure 41 – Loading Violations for Alternative 1 During Summer Peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			298	102.4	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
										374.6	128.7	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			132.7	132.7	BASE CASE
										177	177	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			277.7	119.2	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			277.7	119.2	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63214	BIGSTON7	115	63215	HIWY12 7	115	1	216			243.3	112.6	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63215	HIWY12 7	115	63216	ORTONVL7	115	1	216			230.8	106.9	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1

According to the figure above, post-contingent flow on the Big Stone to Browns Valley 230 kV line exceeds its emergency limit for outage of the Johnson Jct. to Morris 230 kV line. The

Morris 230/115 kV transformer is overloaded for numerous contingencies with the highest amount of post-contingent loading occurring for outage of the Hankinson to Wahpeton 230 kV line. The corresponding post-contingent flow on this transformer was 177 MVA, which is well above the 125 MVA emergency transformer limit. Flows on the Big Stone 230/115/13.8 kV transformer were over the normal rating of the transformer, but did not exceed the emergency limit. The highest loading experienced on this transformer was 277.7 MVA when the Big Stone to Ortonville 230 kV line was out of service. In addition, the Big Stone to Highway 12 115 kV and the Highway 12 to Ortonville 115 kV line were overloaded for loss of the Big Stone to Ortonville 230 kV line. Facilities with post-contingent loadings above their respective emergency limits would need to be upgraded if interconnection alternative 1 is chosen to connect the proposed generator. These facilities include the Big Stone to Browns Valley 230 kV line, the Morris 230/115 kV transformer, and the Big Stone to Highway 12 115 kV line.

Contingency analysis results from the 2007 summer peak case also indicated that the assumptions used in adding the interconnection facilities to the model were not adequate in handling the amount of post-contingent flow possible on these facilities. Figure 42 is shown below and illustrates the amount of post-contingent flow possible on the new interconnection facilities. If interconnection alternative 1 is implemented to connect the generator, the facilities associated with this interconnection alternative would have to be able to handle the following amount of post-contingent flow.

Figure 42 - Potential Loading on Interconnection Facilities for 2007 Summer Peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			412.2	105.6	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
										431.2	110.4	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										426.5	109.2	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
63216	ORTNVLE4	115	63321	ORTNVLEY	230	1	125			202.8	162.3	63314 BIGSTON4230.00 63320 ORTNVLE4 230.00 C1
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			201.8	161.5	63314 BIGSTON4230.00 63320 ORTNVLE4 230.00 C1
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			418.6	107.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
										438.6	112.3	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										433.5	111	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
63337	JHNSNJT4	230	66554	MORRIS 4	230	1	390.4			427.2	109.4	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										422.1	108.1	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										407.3	104.3	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1

Numerous other overloads were identified for interconnection alternative 1 while performing contingency analysis on the 2007 summer peak case with all of the Group 2 projects. A full listing of these overloads can be found in Appendix C.1.1. A list of those overloads that are near the vicinity of the interconnection are shown below in Figure 43. Since these overloads are a bit more remote from the point of interconnection, they are not required fixes during the interconnection phase of this Study. However, if these facility overloads occur during the delivery service study, they would then be required upgrades.

Figure 43 - Loading Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			345.3	113.9	BASE CASE
								344.4	108.3	450.6	141.7	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			112.8	120.2	BASE CASE & NUMEROUS OTHERS
										161.6	168.4	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			389.4	121.7	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60357	MAYNARD7	115	1	78			93.7	132.4	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			436.8	112.6	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
60357	MAYNARD7	115	62005	KERKHOT7	115	1	78			89.7	137.4	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			360	112.9	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
												60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
60133	SHEYNNE4	230	66435*	FARGO 4	230	1	391			395.2	101.1	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63233	EDGETAP7	115	63223	HOOT LK7	115	1	96			113	120.7	63051 HENNING4230.00 63052 INMAN 4230.00 C1
										114.8	122.2	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
										94	101.4	63219 GRANTCO7115.00 63220 ELBOWLK7115.00 C1
63233	EDGETAP7	115	63234	PEL RPD7	115	1	96			95.1	101.9	63051 HENNING4230.00 63052 INMAN 4230.00 C1
										96.9	103.5	63051 HENNING4230.00 63331 FERGSFL4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.1.1.2 Interconnection Alternative 2

Analysis results from studying interconnection alternative 2 during summer peak conditions with all of the Group 2 projects has identified four facilities that are overloaded. These facilities include the Big Stone 230/115/13.8 kV transformer, the Big Stone to Browns Valley 230 kV line, the Ortonville to Johnson Jct. 115 kV line and the Johnson Jct. to Morris 115 kV line. Post-contingent flows on these overloaded facilities are shown below in Figure 44.

Figure 44 - Loading Violations for Alternative 2 During Summer Peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			259.1	111.2	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										255.7	109.8	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										250.6	107.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			260.5	111.8	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										255.7	109.8	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										250.6	107.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6			126.4	124.3	BASE CASE
										136.8	141.7	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			289.8	100.6	BASE CASE
										326.1	112.1	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
62003*	JOHNJCT7	115	66555	MORRIS 7	115	1	106			125.3	118.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1

The post-contingent flow on the Big Stone 230/115/13.8 kV transformer never exceeds its emergency rating. However, the Ortonville to Johnson Jct. 115 kV line, the Johnson Jct. to Morris 115 kV line and the Big Stone to Browns Valley 230 kV line all exceed their emergency ratings, therefore an upgrade of these lines would be necessary if interconnection alternative 2 is implemented to connect this generator to the system.

There were also numerous other overloads that occurred during contingency analysis of interconnection alternative 2 during summer peak conditions. These overloads were not as close to the point of interconnection as the overloads shown above in Figure 44. A few of these overloads that did occur a bit closer to the point of interconnection are shown below in Figure 45. These overloads are most likely caused by the assumed delivery of the interconnection and are therefore not required upgrades as part of this interconnection Study. The overloads shown below may require system upgrades if these same facilities occur during the delivery service study. A full listing of the overloads encountered during contingency analysis of interconnection alternative 2 for summer peak conditions with all of the Group 2 projects modeled can be found in Appendix C.1.1.

Figure 45 - Loading Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with All Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			349.6	114.7	BASE CASE
								344.4	108.3	450.9	141.8	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			99.1	107.2	BASE CASE
										148.4	154.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			332.7	107.2	BASE CASE
										421.4	131.7	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			225.5	120.6	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			436.9	112.6	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			364	114.1	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
63233	EDGETAP7	115	63223	HOOT LK7	115	1	96			98	108.3	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										110.9	118.4	63051 HENNING4230.00 63052 INMAN 4230.00 C1
										112.7	119.9	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
63233	EDGETAP7	115	63234	PEL RPD7	115	1	96			94.8	101.2	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			306.1	101.3	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
67401	ABDNJCT7	115	67402	ABDNSBT7	115	1	80			78.5	100.3	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										81.4	101.8	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.1.2 Voltage Violations

5.2.1.2.1 Interconnection Alternative 1

Summer peak conditions seemed to cause more voltage violations than summer off-peak conditions. These voltage violations were widespread throughout the system. Analyzing the impacts that interconnection alternative 1 had on the summer peak case with all of the Group 2 projects modeled from the MISO/WAPA coordinated study, has identified that voltages within the area of immediate interconnection were improved by new 230 kV terminations at Morris and Granite Falls. Within the immediate area, voltages below 0.92 p.u. were improved in all contingencies that were studied. The magnitude of this improvement along with the troublesome contingencies that caused these voltage violations is shown below in Figure 46.

Figure 46 - Voltage Violations for Alternative 1 During Summer Peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
66550	GRANITF4	230	0.919	0.9194	0.0004	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
			0.9108	0.9162	0.0054	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
			0.9118	0.9168	0.005	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
			0.9119	0.9175	0.0056	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
			0.8744	0.9156	0.0412	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.8166	0.896	0.0794	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
66554	MORRIS 4	230	0.9057		ELIMINATED	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.8094		ELIMINATED	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
66555	MORRIS 7	115	0.8971		ELIMINATED	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.7689	0.9023	0.1334	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1

Low voltage criteria at these WAPA buses is 0.90 p.u. As can be seen above, interconnection alternative 1 improves voltages to above 0.90 p.u. in nearly all cases.

Besides these voltage violations within the immediate area of interconnection, there was a multitude of other bus voltage violations spread throughout the system. A full list of these voltage violations can be found in Appendix C.1.2. Those voltage violations that were just adjacent to the area of interconnection can be found below in Figure 47. These voltage violations are more remote from the area of interconnection and will not be required fixes during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 47 - Voltage Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60356	PAYNES 4	230		0.9088	NEW	BASE CASE AND NUMEROUS OTHERS
60162	WAKEFLD7	115		0.9157	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9165	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9183	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60189	BLK DOG4	230		0.9095	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9101	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9112	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9168	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
60357	MAYNARD7	115		0.9068	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
60898	GLENCOE	115		0.8682	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8693	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8716	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8784	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62001	BENSON 7	115		0.9198	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115			NEW	NUMEROUS CONTINGENCIES
62616	BIGSWAN7	115		0.9041	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9049	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9065	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9113	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62981	MCLEOD 7	115		0.8747	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8759	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8781	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8848	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62982	HUTCHMN7	115		0.8733	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8744	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8764	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8828	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62983	HUTCH3M7	115		0.8733	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8744	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8765	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8829	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
63054	PANTHER4	230		0.9132	NEW	BASE CASE AND NUMEROUS OTHERS
63219	GRANTCO7	115		0.9073	NEW	BASE CASE AND NUMEROUS OTHERS
63329	WAHPETN4	230			NEW	NUMEROUS CONTINGENCIES
63260	ENDERLN7	115		0.9179	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9175	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
62527	ELMO 7	115		0.9158	NEW	BASE CASE AND NUMEROUS OTHERS
62531	INMAN 7	115		0.9189	NEW	BASE CASE AND NUMEROUS OTHERS
62752	MLTN TP7	115		0.9073	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9073	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115		0.9173	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9018	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9047	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.9021	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.902	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.903	NEW	BASE CASE AND NUMEROUS OTHERS

Figure 47 (continued)

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115			NEW	NUMEROUS CONTINGENCIES
62529	CMRTJCT7	115			NEW	NUMEROUS CONTINGENCIES
62530	FRAZEE 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115		0.9174	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9178	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9184	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
62533	CORMRNT7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230			NEW	NUMEROUS CONTINGENCIES
63052	INMAN 4	230			NEW	NUMEROUS CONTINGENCIES
63231	FERGSFL7	115		0.9178	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9182	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9188	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63232	EDGETWN7	115		0.9174	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9178	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9184	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63233	EDGETAP7	115		0.9192	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9197	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
63234	PEL RPD7	115			NEW	NUMEROUS CONTINGENCIES
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.9198	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9194	NEW	60173 ROSEAUN2500.00 67564 DORSEY 2500.00 C1
63247	CASS LK7	115		0.9198	NEW	63246 BEMIDJI7115.00 66710 NARY 7115.00 C1
63248	CASS N 7	115		0.9195	NEW	63246 BEMIDJI7115.00 66710 NARY 7115.00 C1
63331	FERGSFL4	230			NEW	NUMEROUS CONTINGENCIES
63336	AUDUBON4	230	0.8053	0.9135	0.1082	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
66792	MAPLE R3	345		0.9167	NEW	60133 SHEYNNE4230.00 66435 FARGO 4230.00 C1
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
62425	WILLMAR7	115		0.9115	NEW	BASE CASE AND NUMEROUS OTHERS

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. Mitigation of these may be required if these same violations appear during the delivery service study.

5.2.1.2.2 Interconnection Alternative 2

The implementation of interconnection alternative 2 indicated that two voltage violations are evident within the direct area of this project. These voltage violations are at the Willmar 115 kV and 230 kV buses. The number of contingencies that caused these voltage violations were numerous and are not all going to be shown here within the report, but if further information is desired about the contingencies that caused these voltage violations and the corresponding post-contingent voltage levels, refer to Appendix C.1.2.

Figure 48 – Voltage Violations for Alternative 2 During Summer Peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES

Since the two voltage violations at Willmar are at the point of interconnection for alternative 2, the mitigation of these voltage violations will be required as part of this interconnection Study if alternative 2 is implemented to connect the proposed generator to the system.

Besides these voltage violations at Willmar, numerous other violations were found throughout the system for interconnection alternative 2. Some of these violations that are a bit closer to the area of interconnection are shown below in Figure 49, while a complete listing can be found in Appendix C.1.2. Since these voltage violations are not directly within the area of interconnection, they are not required to be fixed during the interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 49 - Voltage Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with All Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
60356	PAYNES 4	230		0.8819	NEW	BASE CASE AND NUMEROUS OTHERS
60149	MINVALT4	230		0.9111	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230		0.911	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60162	WAKEFLD7	115		0.9162	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60189	BLK DOG4	230		0.9109	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60374	FIBROMN7	115		0.916	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
60898	GLENCOE	115		0.8726	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62002	WALDEN 7	115		0.9122	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115			NEW	NUMEROUS CONTINGENCIES
62616	BIGSWAN7	115		0.906	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.8791	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62982	HUTCHMN7	115		0.877	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62983	HUTCH3M7	115		0.8771	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63054	PANTHER4	230		0.9163	NEW	BASE CASE AND NUMEROUS OTHERS
63219	GRANTCO7	115		0.9071	NEW	BASE CASE AND NUMEROUS OTHERS
63218	MOROTP 7	115		0.9108	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9048	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9097	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63329	WAHPETN4	230			NEW	NUMEROUS CONTINGENCIES
63260	ENDERLN7	115		0.9178	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9149	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9194	NEW	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
62527	ELMO 7	115		0.9175	NEW	BASE CASE AND NUMEROUS OTHERS
62531	INMAN 7	115			NEW	BASE CASE AND NUMEROUS OTHERS
62752	MLTN TP7	115		0.9089	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9089	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115		0.9174	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9022	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.906	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.9035	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.9035	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.9045	NEW	BASE CASE AND NUMEROUS OTHERS
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115			NEW	NUMEROUS CONTINGENCIES
62529	CMRTJCT7	115			NEW	NUMEROUS CONTINGENCIES
62530	FRAZEE 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115		0.9099	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9032	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9084	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
62533	CORMRNT7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230			NEW	NUMEROUS CONTINGENCIES

Figure 49 (continued)

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
63052	INMAN 4	230			NEW	NUMEROUS CONTINGENCIES
63053	HUBBARD4	230		0.9189	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
63231	FERGSFL7	115		0.9105	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9039	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9091	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63232	EDGETWN7	115		0.9099	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9032	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9084	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63233	EDGETAP7	115		0.9118	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9051	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9104	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63234	PEL RPD7	115			NEW	NUMEROUS CONTINGENCIES
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.9056	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9129	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9066	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9115	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
63331	FERGSFL4	230			NEW	NUMEROUS CONTINGENCIES
63336	AUDUBON4	230	0.8053		ELIMINATED	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
66717	ULRICH 7	115		0.9136	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.914	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9189	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
66792	MAPLE R3	345		0.9192	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9145	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9182	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
				0.9072	NEW	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
66550	GRANITF4	230	0.919		ELIMINATED	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
			0.9108	0.9183	0.0075	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
			0.9118	0.9138	0.002	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1

Figure 49 (continued)

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
66550	GRANITF4	230	0.9119	0.9178	0.0059	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
			0.8744		ELIMINATED	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.8166		ELIMINATED	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
66554	MORRIS 4	230	0.9057		ELIMINATED	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.8094		ELIMINATED	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
				0.9198	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
66555	MORRIS 7	115	0.8971		ELIMINATED	60108 WILMART 3345.00 60331 LKFLDXL3345.00 C1
			0.7689		ELIMINATED	60143 BENTON 7115.00 60146 GRANTCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
				0.912	NEW	60192 BLUE LK3345.00 60108 WILMART 3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9059	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9109	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, these voltage violations will need to be mitigated if these same ones appear during the delivery service study.

5.2.2 Half Group 2 Projects from the MISO/WAPA Coordinated Study

5.2.2.1 Loading Violations

5.2.2.1.1 Interconnection Alternative 1

Only including half of the Group 2 projects from the MISO/WAPA coordinated study didn't seem to alleviate any of the loading constraints identified for 2007 summer peak conditions for interconnection alternative 1. Overloads were still noted on the Big Stone 230/115/13.8 kV transformer, the Big Stone to Highway 12 115 kV line, the Highway 12 to Ortonville 115 kV line, the Big Stone to Browns Valley 230 kV line, and the Morris 230/115 kV transformer. Each of these overloads is listed below with their corresponding post-contingent load levels for the critical contingency that overloaded the facility.

Figure 50 – Loading Violations for Alternative 1 During Summer Peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			272.7	117.0	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			272.7	117.0	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63214	BIGSTON7	115	63215	HIWY12 7	115	1	216			238.5	110.4	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63215	HIWY12 7	115	63216	ORTONVL7	115	1	216			226.1	104.7	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			130.6	130.6	BASE CASE
										172.2	172.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			360.0	126.7	63320 ORTNVLE4230.00 63337 JHNSNJT4230.00 C1
												NUMEROUS OTHER CONTINGENCIES

As shown above in Figure 50, the Big Stone to Ortonville 230 kV line is a critical contingency that will require the upgrade of the Big Stone to Highway 12 115 kV line. Other contingencies simulated have shown that the Morris 230/115 kV transformer as well as the Big Stone to Browns Valley 230 kV line will need to be upgraded in order to handle post-contingent flows higher than they are currently capable of. The Big Stone 230/115/13.8 kV transformer and the Highway 12 to Ortonville 115 kV line is overloaded for outage of the Big Stone to Ortonville 230 kV line, but loading does not exceed emergency ratings on these facilities.

As shown previously in section 5.2.1.1.1, many of the interconnection facilities associated with alternative 1 are not adequate in handling the amount of post-contingent flow possible on them with the proposed project connected at Big Stone. This Study assumed 954 ACSR conductor along the new 230 kV lines out of the site, however it appears that this conductor will not be capable of handling the amount of flow expected on these lines. The following figure illustrates the interconnection facilities that exceeded their assumed 390 MVA capacity for this ACSR conductor.

Figure 51 - Potential Loading on Interconnection Facilities for 2007 Summer Peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63216	ORTONVL7	115	63321	ORTNVLEY	230	1	125			210.7	168.6	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			210.6	168.5	63314 BIGSTON4230.00 63320 ORTNVLE4230.00 C1
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			428.5	107.3	63195 BIGSTONY230.00 63214 BIGSTON7115.00 C1
										428.5	107.3	63195 BIGSTONY230.00 63314 BIGSTON4230.00 C1
										404.4	101.3	63214 BIGSTON7115.00 63215 HIWY12 7115.00 C1
										421.5	105.5	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
										418.9	104.9	63311 CANBY 4230.00 66550 GRANITF4230.00 C1
										421.9	108.1	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										417	106.8	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										403.2	103.3	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
										425.3	106.5	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
										408.5	102.3	66503 BLAIR 4230.00 66550 GRANITF4230.00 C1
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			401.0	103.4	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
										422.4	109.3	63311 CANBY 4230.00 66550 GRANITF4230.00 C1
										427.2	109.4	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										422.3	108.2	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										408.2	104.6	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
										414.7	107.0	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
										396.9	102.5	66503 BLAIR 4230.00 66550 GRANITF4230.00 C1
63337	JHNSNJT4	230	66554*	MORRIS 4	230	1	390.4			415.8	106.5	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										410.9	105.3	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										396.9	101.7	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1

The contingency analysis results from the 2007 summer peak case with half of the Group 2 projects modeled also identified numerous other overloads that were not as close to the point of interconnection as those shown in previous sections. A list of these overloads can be found in Appendix C.2.1. However, some of these facilities that are a bit closer to the point of interconnection are shown below in Figure 52. Since these overloads could be more related to the delivery of the power from this project, they are not required upgrades at this time. However, if the delivery service study for this interconnection identifies some of these same facility overloads, it would be during that study that these facilities would need to be upgraded.

Figure 52 – Loading Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			336.3	110.2	BASE CASE
								319.2	100.4	446.1	140.3	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			110.5	117.1	BASE CASE
								124.2	133.2	155.8	162.3	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			395.5	123.6	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			216.3	115.7	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60148	MINVALY7	115	60357	MAYNARD7	115	1	78			74.7	102.6	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
										74.8	101.1	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			431.0	111.1	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
60357	MAYNARD7	115	62005	KERKHOT7	115	1	78			70.2	102.2	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1
												63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
										74.4	100.5	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			337.8	105.9	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
63219	GRANTCO7	115	63223	HOOT LK7	115	1	96			87	100.7	63219 GRANTCO7115.00 66555 MORRIS 7115.00 C1
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			307.4	101.1	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										337.1	105.3	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.2.1.2 Interconnection Alternative #2

Interconnection alternative 2 had slightly more favorable results over interconnection alternative 1 during contingency analysis of the 2007 summer peak case with half of the Group 2 projects modeled. Alternative 2 indicated that the Big Stone 230/115/13.8 kV transformer, the Ortonville to Johnson Jct. to Morris 115 kV line as well as the Big Stone to Browns Valley 230 kV line were overloaded. The magnitude of these overloads along with their corresponding contingencies is shown below in Figure 53.

Figure 53 - Loading Violations for Alternative 2 During Summer Peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			254.0	109.0	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
										245.2	105.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			254.3	109.2	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
										245.2	105.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6			124.2	121.9	BASE CASE & NUMEROUS OTHERS
										134.2	139	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62003*	JOHNJCT7	115	66555	MORRIS 7	115	1	106			122.8	115.8	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			327.1	112.8	63195 BIGSTONY 230.00 63214 BIGSTON7 115 C1

According to the quantities in Figure 53, the Big Stone 230/115/13.8 kV transformer does not exceed its emergency rating. However, the existing 115 kV line from Ortonville to Johnson Jct. and around to Morris as well as the Big Stone to Browns Valley 230 kV line exceed emergency limits therefore mandating the need for an upgrade of these lines if interconnection alternative 2 is implemented in connecting the proposed generator to the system.

A multitude of other facilities were identified as being overloaded for interconnection alternative 2 during contingency analysis of the 2007 summer peak case. This list of overloads can be found in Appendix C.2.1. Some of the overloads that appear closer to the point of interconnection are shown below in Figure 54. These overloads are not in the direct area of interconnection and could be more related to the assumptions used in delivering this power from the proposed generator. Therefore, it is not necessary to upgrade these facilities during the interconnection phase of this Study. However, if these same facilities appear in the delivery service study, they will then need to be upgraded.

Figure 54 - Loading Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with Half Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			340.5	111	BASE CASE
								319.2	100.4	445.7	140.2	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			97	104.1	BASE CASE & NUMEROUS OTHERS
								124.2	133.2	144.4	150.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			325.9	104.4	BASE CASE
								332.3	105.8	360.1	116.2	63195 BIGSTONY230.00 63214 BIGSTON7115.00 C1
								332.3	105.8	360.1	116.2	63195 BIGSTONY230.00 63314 BIGSTON4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			218.1	116.7	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			431.1	111.1	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
62980	MCLEOD 4	230	63054	PANTHER4	230	1	319			339.3	106.4	60192 BLUE LK3345.00 60108 WILMART3345.00 C1
63329	WAHPETN4	230	63331	FERGSFL4	230	1	320			327.2	102.2	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.2.2 Voltage Violations

5.2.2.2.1 Interconnection Alternative 1

As mentioned previously, the amount of voltage violations identified during summer peak conditions were far more abundant than those identified during summer off-peak conditions. Analysis of interconnection alternative 1 during summer peak conditions with half of the Group 2 projects modeled only revealed one bus voltage that fell below this Study's voltage criteria. This voltage appeared at the Morris 115 kV bus for loss of the Morris 230/115 kV transformer. The post-contingent voltage is noted below in Figure 55.

Figure 55 - Voltage Violations for Alternative 1 During Summer Peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
66555	MORRIS 7	115		0.9046	NEW	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1

This particular bus is owned by WAPA and their low voltage criteria is 0.90 p.u. As can be seen from the previous figure, the bus voltage at the Morris 115 kV bus does not drop below 0.90 p.u. for this contingency.

There were no other bus voltage violations found within the immediate area of interconnection for alternative 1. However, there were numerous other bus voltage violations at locations more remote from the immediate Study area. A complete listing of these voltage violations can be found in Appendix C.2.2. Some of these voltage violations that appeared at locations closer to the immediate area of interconnection are shown below in Figure 56. Since these voltage violations are not directly contained within the immediate Study area, mitigation of them is not required during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 56 – Voltage Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60356	PAYNES 4	230		0.9193	NEW	BASE CASE AND NUMEROUS OTHERS
63219	GRANTCO7	115		0.9167	NEW	BASE CASE AND NUMEROUS OTHERS
60189	BLK DOG4	230		0.9193	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9194	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
60149	MINVALT4	230		0.9183	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230		0.9182	NEW	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60357	MAYNARD7	115		0.915	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
60898	GLENCOE	115		0.8854	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8852	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8864	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.894	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62002	WALDEN 7	115		0.9086	NEW	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115		0.9095	NEW	62001 BENSON 7115.00 62006 KERKHO 7115.00 C1
				0.9166	NEW	62427 WILLMAR869.000 63050 WILLMAR4230.00 C1
			0.9108	0.8728	-0.038	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
				0.9008	NEW	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
				0.9133	NEW	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
62616	BIGSWAN7	115		0.9164	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.916	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9166	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63218	MOROTP 7	115		0.9049	NEW	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
62981	MCLEOD 7	115		0.8918	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8916	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8928	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9003	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62982	HUTCHMN7	115		0.8892	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8889	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8899	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8972	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62983	HUTCH3M7	115		0.8893	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.8891	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.8901	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.8975	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
63054	PANTHER4	230		0.904	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9039	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9053	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9102	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
66555	MORRIS 7	115		0.9046	NEW	66554 MORRIS 4230.00 66555 MORRIS 7115.00 C1
62425	WILLMAR7	115		0.92	NEW	BASE CASE AND NUMEROUS OTHERS
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
62752	MLTN TP7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9114	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9148	NEW	BASE CASE AND NUMEROUS OTHERS

Figure 56 (continued)

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△V	Contingency
67452	ALEXSS	115		0.9122	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.9121	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.913	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62752	MLTN TP7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9114	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9148	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.9122	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.9121	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.913	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115		0.9072	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9193	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62529	CMRTJCT7	115		0.9058	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
62530	FRAZEE 7	115		0.9004	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9173	NEW	62530 FRAZEE 7115.00 63236 AUDUBON7115.00 C1
				0.9128	NEW	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9073	0.8933	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62533	CORMRNT7	115		0.906	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63051	HENNING4	230		0.9191	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63052	INMAN 4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63232	EDGETWN7	115	0.9073	0.8933	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63233	EDGETAP7	115	0.9093	0.8953	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63234	PEL RPD7	115		0.9113	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9097	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.91	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63247	CASS LK7	115		0.909	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
63248	CASS N 7	115		0.9087	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
62752	MLTN TP7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9168	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9114	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9148	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.9122	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.9121	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.913	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115		0.9072	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9193	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1

Figure 56 (continued)

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62529	CMRTJCT7	115		0.9058	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
62530	FRAZEE 7	115		0.9004	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9173	NEW	62530 FRAZEE 7115.00 63236 AUDUBON7115.00 C1
				0.9128	NEW	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9073	0.8933	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62533	CORMRNT7	115		0.906	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63051	HENNING4	230		0.9191	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63052	INMAN 4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63232	EDGETWN7	115	0.9073	0.8933	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63233	EDGETAP7	115	0.9093	0.8953	-0.014	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63234	PEL RPD7	115		0.9113	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9097	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.91	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63247	CASS LK7	115		0.909	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
63248	CASS N 7	115		0.9087	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
66710	NARY 7	115		0.9162	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
66715	LEECHLK7	115		0.9161	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
66716	LAPORTE7	115		0.9163	NEW	63245 WILTON 7115.00 63246 BEMIDJI7115.00 C1
66717	ULRICH 7	115		0.9181	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, if these same violations appear during the delivery service study, they would then need to be mitigated by system additions.

5.2.2.2.2 Interconnection Alternative 2

Voltage performance for interconnection alternative 2 during summer peak conditions with half of the Group 2 projects modeled from the MISO/WAPA coordinated study resulted in a slight voltage decrease at the Willmar 230 kV bus and the Willmar 115 kV bus. This voltage decrease at the 230 kV bus occurred for loss of the Willmar to Granite Falls 230 kV line. The post-contingent voltage at the Willmar 230 kV bus is noted below in Figure 57. The voltage decrease at the 115 kV bus was larger than that noticed on the 230 kV bus and occurred for numerous different contingencies.

Figure 57 - Voltage Violations for Alternative 2 During Summer Peak Conditions with Half Group 2 Projects

Voltage Violations			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
63050	WILLMAR4	230	0.9098	0.9074	-0.0024	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62425	WILLMAR7	115				NUMEROUS CONTINGENCIES

Voltage criteria at these buses is 0.92 p.u. As can be seen in the previous figure, the bus voltage within the existing system was below this criteria and interconnection alternative 2 further depressed it. Since the change in bus voltage on the 230 kV bus is less than 0.01 p.u., this

voltage violation is dismissed for this interconnection Study. However, the voltage violations witnessed at the 115 kV bus will need to be mitigated as part of this interconnection Study if alternative 2 is implemented in connecting the proposed generator to the system. Other than these two voltage violations at Willmar, there were no other voltage violations evident within the immediate area of interconnection.

Even though this was the only voltage violation within the immediate area of interconnection, there were several other voltage violations evident for interconnection alternative 2 during summer peak conditions with half of the Group 2 projects modeled. A complete listing of these voltage violations can be found in Appendix C.2.2. Since these voltage violations are not within the area of interconnection, they are not required to be fixed during the interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project. Some of these more remote voltage violations that are adjacent to the Study area are shown below in Figure 58.

Figure 58 - Voltage Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with Half Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60356	PAYNES 4	230			NEW	BASE CASE AND NUMEROUS OTHERS
63219	GRANTCO7	115		0.9171	NEW	BASE CASE AND NUMEROUS OTHERS
60189	BLK DOG4	230		0.9175	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60898	GLENCOE	115		0.8832	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115	0.9108		ELIMINATED	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
62616	BIGSWAN7	115		0.9137	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.8896	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62982	HUTCHMN7	115		0.8868	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62983	HUTCH3M7	115		0.887	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62752	MLTN TP7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9124	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9165	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.9149	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62752	MLTN TP7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS
62753	MILTONA7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9124	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9165	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.9149	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115		0.9056	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9199	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62529	CMRTJCT7	115		0.9037	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
62530	FRAZEE 7	115		0.8983	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9194	NEW	62530 FRAZEE 7115.00 63236 AUDUBON7115.00 C1
				0.9163	NEW	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9073	0.894	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62533	CORMRNT7	115		0.9039	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63051	HENNING4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63052	INMAN 4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63232	EDGETWN7	115	0.9073	0.894	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63233	EDGETAP7	115	0.9093	0.896	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63234	PEL RPD7	115		0.9102	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9104	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.9071	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
62752	MLTN TP7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS

Figure 58 (continued)

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62753	MILTONA7	115		0.9188	NEW	BASE CASE AND NUMEROUS OTHERS
63220	ELBOWLK7	115		0.9124	NEW	BASE CASE AND NUMEROUS OTHERS
63222	ALEXAND7	115		0.9165	NEW	BASE CASE AND NUMEROUS OTHERS
67452	ALEXSS	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67453	ALEXSWM	115		0.914	NEW	BASE CASE AND NUMEROUS OTHERS
67454	ALEXPLDM	115		0.9149	NEW	BASE CASE AND NUMEROUS OTHERS
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115		0.9056	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9199	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62529	CMRTJCT7	115		0.9037	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
62530	FRAZEE 7	115		0.8983	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9194	NEW	62530 FRAZEE 7115.00 63236 AUDUBON7115.00 C1
				0.9163	NEW	63051 HENNING4230.00 63331 FERGSFL4230.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9073	0.894	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62533	CORMRNT7	115		0.9039	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63051	HENNING4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63052	INMAN 4	230		0.9192	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
63232	EDGETWN7	115	0.9073	0.894	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63233	EDGETAP7	115	0.9093	0.896	-0.0133	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63234	PEL RPD7	115		0.9102	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.9104	NEW	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.9071	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
66553	MOORHED4	230		0.9184	NEW	66435 FARGO 4230.00 66553 MOORHED4230.00 C1
66717	ULRICH 7	115		0.9145	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. If these same violations appear during the delivery service study, they would then need to be mitigated.

5.2.3 No Group 2 Projects from MISO/WAPA Coordinated Study

5.2.3.1 Loading Violations

5.2.3.1.1 Interconnection Alternative 1

Eliminating all of the Group 2 projects from MISO/WAPA coordinated study during 2007 summer peak conditions did not seem to have a large impact on the overloaded facilities that have been shown in previous sections for interconnection alternative 1. The Big Stone 230/115/13.8 kV transformer, the Big Stone to Browns Valley 230 kV line, the Big Stone to Highway 12 115 kV line, the Highway 12 to Ortonville 115 kV line, as well as the Morris 230/115 kV transformer all appeared as being overloaded. Figure 59 illustrates the amount of post-contingent flow possible on these facilities for the critical contingencies shown in the far right-hand column.

Figure 59 - Loading Violations for Alternative 1 During Summer Peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
FromBus		kV	ToBus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			347.9	121.5	63320 ORTNVLE4230.00 63337 JHNSNJT4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			267.9	115	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			267.9	115	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63214	BIGSTON7	115	63215	HIWY12 7	115	1	216			233.9	108.3	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63215	HIWY12 7	115	63216	ORTONVL7	115	1	216			221.6	102.6	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
66554	MORRIS 4	230	66555	MORRIS 7	115	1	100			126.7	126.7	BASE CASE
										166.4	166.4	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES

The Big Stone 230/115/13.8 kV transformer, The Big Stone to Highway 12 115 kV line and the Highway 12 to Ortonville 115 kV line do not exceed emergency limits and therefore are not a required upgrades for this scenario. However, the overloads present on the Big Stone to Browns Valley 230 kV line and the Morris 230/115 kV transformer are beyond their emergency limits and will be required upgrades if interconnection alternative 1 is chosen to connect the proposed generator.

As seen in previous sections, a few of the lines associated with the interconnection alternative itself were not assumed to have adequate capacity during this Study. The new 230 kV lines out of Big Stone were assumed to be composed of 954 ACSR with a summer capacity of 390 MVA. This rating is not sufficient in meeting the amount of post-contingent flow possible on these facilities. In addition, the new Ortonville 230/115/13.8 kV transformer added to the models as part of interconnection alternative 1 will need to have a capacity much greater than 125 MVA in order to handle the amount of post-contingent flow possible on this transformer. Figure 60 is shown below and illustrates the amount of flow possible on some of the interconnection facilities associated with alternative 1.

Figure 60 – Potential Loading on Interconnection Facilities for 2007 Summer Peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63320	ORTNVLE4	230	63321	ORTNVLEY	230	1	125			202.2	159	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63216	ORTONVL7	115	63321	ORTNVLEY	230	1	125			202.2	159	63314 BIGSTON4 230.00 63320 ORTNVLE4 230.00 C1
63314	BIGSTON4	230	63320	ORTNVLE4	230	1	390.4			413	105.8	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										408.4	104.6	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										394.6	101.1	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
63320	ORTNVLE4	230	63337	JHNSNJT4	230	1	390.4			392.1	100.6	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
										416.5	106.7	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										412.8	106.1	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1
										411.4	105.4	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
										397.2	101.7	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63337	JHNSNJT4	230	66554	MORRIS 4	230	1	390.4			405.1	103.8	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
										400.1	102.5	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1

Numerous other overloaded facilities were present during contingency analysis of the 2007 summer peak case for interconnection alternative 1 with none of the Group 2 projects modeled. A full listing of these overloaded elements can be found in Appendix C.3.1. Some of these overloads that were somewhat closer to the point of interconnection are shown below in Figure 61. These overloads may not be directly associated with the interconnection of this proposed generator, but could be more related to the assumed delivery of its power. Since the constraints are further from the immediate point of interconnection, the upgrade of these facilities is not required during this Study, but may be required later if these same facilities appear during the delivery service study.

Figure 61 – Loading Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #1		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			316.3	102.4	BASE CASE
										419.5	131.9	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96			105.6	111.1	BASE CASE
								117.7	124.9	149.3	155.5	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
60148	MINVALY7	115	60357	MAYNARD7	115	1	78			89.7	123.1	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			403.6	104.0	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
										392.8	101.2	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
60357	MAYNARD7	115	62005	KERKHOT7	115	1	78			85.8	126.5	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			380.2	118.8	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
										362.9	113.4	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63233	EDGETAP7	115	63223	HOOT LK7	115	1	96			97.6	105.9	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
										108.8	113.6	63051 HENNING4230.00 63052 INMAN 4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.3.1.2 Interconnection Alternative 2

Interconnection alternative 2 identified many of the same constraints during 2007 summer peak conditions as were shown previously with all and half of the Group 2 projects modeled. Once again, the Big Stone 230/115/13.2 kV transformer, the Ortonville to Johnson Jct. 115 kV line and the Johnson Jct. to Morris 115 kV line were all identified as being overloaded. The post-contingent loading levels with their corresponding contingencies can be found below in Figure 62.

Figure 62 – Loading Violations for Alternative 2 During Summer Peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
63195	BIGSTONY	230	63214	BIGSTON7	115	1	233			249.6	107.1	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
								236.2	101.4	249.3	107.0	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
63195	BIGSTONY	230	63314	BIGSTON4	230	1	233			249.6	107.1	63311 CANBY 4230.00 63314 BIGSTON4230.00 C1
								240.4	103.2	252.6	108.4	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
								236.2	101.4	249.8	107.2	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
62003	JOHNJCT7	115	63216	ORTONVL7	115	1	96.6			119.8	117.3	BASE CASE
								138.5	135.5	129.2	133.8	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
												NUMEROUS OTHER CONTINGENCIES
62003*	JOHNJCT7	115	66555	MORRIS 7	115	1	106			117.9	111.2	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
63314	BIGSTON4	230	63325	BROWNSV4	230	1	291			326.5	112.6	63314 BIGSTON4230.00 66503 BLAIR 4230.00 C1

Since the two 115 kV line sections between Ortonville and Morris exceed the short-term emergency rating of the conductor, it will be necessary to upgrade these two line sections. In addition, the loading on the Big Stone to Browns Valley 230 kV line is above its emergency limit. However, the loading on the Big Stone 230/115/13.8 kV transformer is below 125% of the normal rating, therefore it does not exceed its emergency limit and will not be a required upgrade if alternative 2 is implemented in connecting the proposed generator to the system for this scenario.

In addition to these overloaded facilities in the immediate vicinity of the interconnection, there were also a multitude of overloads shown for a variety of other contingencies. These overloads can be found in Appendix C.3.1. A few of these overloads that are more immediately located near the proposed interconnection are shown below in Figure 63. These facilities are shown for informational purposes since they could be more related to the delivery of the power from the proposed generator than the actual interconnection. These facilities are not required upgrades during the interconnection Study, but may be required later if these same facilities appear during the delivery service study.

Figure 63 – Loading Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with No Group 2 Projects

Overloaded Branch							Normal	Existing System		Int. Alt. #2		
From Bus		kV	To Bus		kV	ckt	Rating	MVA	% Rate A	MVA	% Rate A	Contingency
60150	MNVLTAP4	230	66550	GRANITF4	230	1	318			319.9	103.1	BASE CASE
										421.1	132.4	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63219	GRANTCO7	115	66555	MORRIS 7	115	1	96	117.7	124.9	137.1	142.8	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
60148	MINVALY7	115	60149	MINVALT4	230	C1	187			201.8	107.9	60150 MNVLTAP4230.00 66550 GRANITF4230.00 C1
60150	MNVLTAP4	230	63054	PANTHER4	230	1	388			404.9	104.4	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
63327	HANKSON4	230	63329	WAHPETN4	230	1	320			391.7	122.4	63369 JAMESTN3345.00 66791 CENTER 3345.00 C1
												NUMEROUS OTHER CONTINGENCIES
63233	EDGETAP7	115	63223	HOOT LK7	115	1	96			106.8	111.1	63051 HENNING4230.00 63052 INMAN 4230.00 C1

The mitigation of these overloaded facilities is not required for this interconnection Study. However, if these facilities appear during the delivery service study, they would need to be upgraded.

5.2.3.2 Voltage Violations

5.2.3.2.1 Interconnection Alternative 1

Contingency analysis of the 2007 summer peak case with none of the Group 2 projects included from the MISO/WAPA coordinated study did not reveal any voltage violations in the immediate area of interconnection for alternative 1. There were however, numerous voltage violations in areas throughout the northern MAPP region. A complete listing of these violations can be found in Appendix C.3.2. A few of the voltage violations that were just adjacent to the area of interconnection are shown below in Figure 64. Since these voltage violations are not in the immediate Study area, mitigation of them is not required during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 64 – Voltage Violations on Remote Facilities for Alternative 1 During Summer Peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
62006	KERKHO 7	115		0.8942	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
				0.9182	NEW	66550 GRANITF4230.00 63050 WILLMAR4230.00 C1 63050 WILLMAR4230.00 62427 WILLMAR869.000 C1
				0.9171	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES
63331	FERGSFL4	230		0.8976	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9057	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
60898	GLENCOE	115		0.8992	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9001	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9016	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9066	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62981	MCLEOD 7	115		0.9055	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9064	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9079	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9128	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62982	HUTCHMN7	115		0.902	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9028	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9041	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.9086	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62983	HUTCH3M7	115		0.9023	NEW	63314 BIGSTON4230.00 63325 BROWNSV4230.00 C1
				0.9031	NEW	63325 BROWNSV4230.00 63327 HANKSON4230.00 C1
				0.9044	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
				0.909	NEW	63337 JHNSNJT4230.00 66554 MORRIS 4230.00 C1
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES
63050	WILLMAR4	230			NEW	NUMEROUS CONTINGENCIES
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62528	TAMARAC7	115		0.9173	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.8878	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9006	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
62529	CMRTJCT7	115		0.9150	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.8872	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9041	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
62530	FRAZEE 7	115		0.9098	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
			0.9128	0.8768	-0.0360	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1

Figure 64 (continued)

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
62530	FRAZEE 7	115		0.8921	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9151	0.9041	-0.0110	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
				0.9117	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9129	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
62533	CORMRNT7	115		0.9153	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.8873	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9035	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
62752	MLTN TP7	115			NEW	NUMEROUS CONTINGENCIES
62753	MILTONA7	115			NEW	NUMEROUS CONTINGENCIES
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230	0.9198	0.8797	-0.0401	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.8821	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63052	INMAN 4	230	0.9195	0.8794	-0.0401	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.8804	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63053	HUBBARD4	230		0.9002	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
63219	GRANTCO7	115			NEW	NUMEROUS CONTINGENCIES
63220	ELBOWLK7	115			NEW	NUMEROUS CONTINGENCIES
63222	ALEXAND7	115			NEW	NUMEROUS CONTINGENCIES
63231	FERGSFL7	115		0.9124	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9146	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63232	EDGETWN7	115	0.9151	0.9041	-0.0110	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
				0.9117	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9129	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63233	EDGETAP7	115	0.9170	0.9061	-0.0109	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
				0.9136	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9148	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1

Figure 64 (continued)

Voltage Violation			Existing System	Int. Alt. #1		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
63234	PEL RPD7	115		0.8904	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9000	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
63236	AUDUBON7	115		0.9180	NEW	60133 SHEYNNE4230.00 63336 AUDUBON4230.00 C1
				0.8943	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
				0.9167	NEW	60143 BENTON 7115.00 60146 GRANCTY7115.00 C1 60143 BENTON 7115.00 60348 BENCTP7 115.00 C1 60348 BENCTP7 115.00 60157 STCLOUD7115.00 C1
63336	AUDUBON4	230		0.9127	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
66717	ULRICH 7	115		0.9000	NEW	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
67452	ALEXSS	115			NEW	NUMEROUS CONTINGENCIES
67453	ALEXSWM	115			NEW	NUMEROUS CONTINGENCIES
67454	ALEXPLDM	115			NEW	NUMEROUS CONTINGENCIES

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study. However, if some of these same violations appear during the delivery service study, they would then need to be mitigated by the addition of system enhancements.

5.2.3.2.2 Interconnection Alternative 2

Analysis of interconnection alternative 2 during summer peak conditions with no Group 2 projects modeled indicated very similar results to previous sections of this report. The same two voltage violations at Willmar were evident for alternative 2. The Willmar 230 kV voltage violation was only evident for about a handful of contingencies; however, the 115 kV voltage violation appeared for numerous contingencies. A summary of the post-contingent voltage levels for these two buses is shown below in Figure 65.

Figure 65 - Voltage Violations for Alternative 2 During Summer Peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	Δ V	Contingency
63050	WILLMAR4	230		0.9194	NEW	63050 WILLMAR4230.00 66550 GRANITF4230.00 C1
				0.9184	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60215 HYLNDLK7115.00 60261 DEANLAK7115.00 C1
				0.9190	NEW	60192 BLUE LK3345.00 60108 WILMART3345.00 C1 60261 DEANLAK7115.00 60244 SCOTTCO7115.00 C1
				0.9195	NEW	60108 WILMART3345.00 60192 BLUE LK3345.00 C1
				0.9145	NEW	60108 WILMART3345.00 60331 LKFLDXL3345.00 C1
62425	WILLMAR7	115			NEW	NUMEROUS CONTINGENCIES

Since the voltages at these two buses are below the criteria of 0.92 p.u. and are slightly aggravated by the proposed interconnection, mitigation of these two voltage violations will be required during this interconnection Study if alternative 2 is implemented when connecting the

proposed generator to the system. Besides these two voltage violations at Willmar, there were no other voltage problems identified within the immediate area of interconnection.

As shown with other sections of this report, interconnection alternative 2 caused a whole bunch of other voltage violations at locations further from the immediate area of interconnection. A list of these voltage violations with their corresponding post-contingent voltage levels can be found in Appendix C.3.2. Some of these voltage violations that were just adjacent to the area of interconnection are shown below in Figure 66. Since these violations are not in the immediate Study area, they are not required to be mitigated during this interconnection Study. However, if some of these same voltage violations would happen to occur during the delivery service study, system upgrades would need to be added to mitigate the voltage violations that are aggravated by this proposed project.

Figure 66 – Voltage Violations on Remote Facilities for Alternative 2 During Summer Peak Conditions with No Group 2 Projects

Voltage Violation			Existing System	Int. Alt. #2		
Bus		kV	V-CONT	V-CONT	△ V	Contingency
60356	PAYNES 4	230			NEW	NUMEROUS CONTINGENCIES
62005	KERKHOT7	115			NEW	NUMEROUS CONTINGENCIES
63054	PANTHER4	230			NEW	NUMEROUS CONTINGENCIES
60898	GLENCOE	115		0.8998	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62981	MCLEOD 7	115		0.9061	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62982	HUTCHMN7	115		0.9019	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62983	HUTCH3M7	115		0.9023	NEW	63327 HANKSON4230.00 63329 WAHPETN4230.00 C1
62526	RUSH LK7	115			NEW	NUMEROUS CONTINGENCIES
62527	ELMO 7	115			NEW	NUMEROUS CONTINGENCIES
62530	FRAZEE 7	115	0.9128		ELIMINATED	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
62531	INMAN 7	115			NEW	NUMEROUS CONTINGENCIES
62532	FERGUS 7	115	0.9151	0.9061	-0.0090	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
62752	MLTN TP7	115			NEW	NUMEROUS CONTINGENCIES
62753	MILTONA7	115			NEW	NUMEROUS CONTINGENCIES
60144	DGLASCO7	115			NEW	NUMEROUS CONTINGENCIES
63051	HENNING4	230	0.9198		ELIMINATED	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
63052	INMAN 4	230	0.9195		ELIMINATED	60173 ROSEAUN2500.00 60174 ROSEAUS2500.00 C1
63219	GRANTCO7	115			NEW	NUMEROUS CONTINGENCIES
63220	ELBOWLK7	115			NEW	NUMEROUS CONTINGENCIES
63222	ALEXAND7	115			NEW	NUMEROUS CONTINGENCIES
63232	EDGETWN7	115	0.9151	0.9061	-0.0090	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63233	EDGETAP7	115	0.9170	0.9081	-0.0089	63233 EDGETAP7115.00 63223 HOOT LK7115.00 C1
63235	PERHAM 7	115			NEW	NUMEROUS CONTINGENCIES
66792	MAPLE R3	345		0.9149	NEW	63358 BUFFALO3345.00 66792 MAPLE R3345.00 C1
67452	ALEXSS	115			NEW	NUMEROUS CONTINGENCIES
67453	ALEXSWM	115			NEW	NUMEROUS CONTINGENCIES
67454	ALEXPLDM	115			NEW	NUMEROUS CONTINGENCIES

As mentioned previously, the mitigation of these voltage violations is not required as part of this interconnection Study, but if these same violations appear during the delivery service study, mitigation of them may be required.

6.0 Loss Analysis

6.1 Introduction

A brief loss analysis was conducted for this interconnection Study using the steady state power flow models developed for contingency analysis. Areas monitored for the loss analysis focused on those control areas within the immediate Study area and those just adjacent of it.

6.2 Summer Off-peak Conditions

Figure 67 is shown below and illustrates the loss characteristics of each interconnection alternative for the three different summer off-peak scenarios studied for this proposed interconnection.

Figure 67 – Loss Analysis Results by Control Area for Summer Off-peak Conditions

	Summer Off-peak Conditions														
Control	All Group 2					Half Group 2					No Group 2				
Area	Base	Alt #1	△ MW	Alt #2	△ MW	Base	Alt #1	△ MW	Alt #2	△ MW	Base	Alt #1	△ MW	Alt #2	△ MW
ALTW	181.0	186.6	5.6	186.4	5.4	162.0	167.0	5.0	166.9	4.9	149.3	153.7	4.4	153.6	4.3
XEL	592.3	634.9	42.6	637.0	44.7	565.4	590.0	24.6	592.1	26.7	525.6	561.6	36.0	563.2	37.6
MP	91.5	99.7	8.2	96.9	5.4	88.7	96.3	7.6	93.8	5.1	84.4	91.2	6.8	88.9	4.5
SMMPA	2.8	3.0	0.2	3.0	0.2	2.8	3.0	0.2	3.0	0.2	2.8	2.9	0.1	3.0	0.2
GRE	48.7	56.3	7.6	70.3	21.6	46.6	53.8	7.2	59.6	13.0	43.1	49.2	6.1	61.5	18.4
OTP	93.8	112.7	18.9	107.6	13.8	90.0	108.1	18.1	103.2	13.2	84.3	101.3	17.0	96.6	12.3
MPW	1.6	1.6	0.0	1.6	0.0	1.4	1.4	0.0	1.4	0.0	1.3	1.3	0.0	1.3	0.0
MEC	328.6	333.6	5.0	333.5	4.9	297.3	301.8	4.5	301.8	4.5	279.4	283.9	4.5	283.9	4.5
NPPD	88.4	86.1	-2.3	85.9	-2.5	84.2	81.7	-2.5	81.5	-2.7	80.5	77.8	-2.7	77.7	-2.8
OPPD	48.7	51.0	2.3	51.1	2.4	44.2	46.4	2.2	46.4	2.2	41.6	43.7	2.1	43.8	2.2
LES	4.6	4.6	0.0	4.6	0.0	4.6	4.6	0.0	4.6	0.0	4.6	4.6	0.0	4.6	0.0
WAPA	298.0	318.4	20.4	306.7	8.7	288.9	309.6	20.7	298.5	9.6	253.3	271.6	18.3	261.2	7.9
MH	241.4	240.9	-0.5	241.1	-0.3	242.6	242.1	-0.5	242.2	-0.4	246.1	245.5	-0.6	245.7	-0.4
DPC	79.2	78.9	-0.3	79.1	-0.1	75.8	75.8	0.0	75.9	0.1	75.4	75.4	0.0	75.6	0.2
Total =	**2100.6**	**2208.3**	**107.7**	**2204.8**	**104.2**	**1994.5**	**2081.6**	**87.1**	**2070.9**	**76.4**	**1871.7**	**1963.7**	**92.0**	**1960.6**	**88.9**

As can be seen from the previous figure, interconnection alternative 2 was most effective in reducing system losses when the proposed generator was added to the summer off-peak models.

6.3 Summer Peak Conditions

This same type of analysis was performed for summer peak conditions. The following figure illustrates the loss characteristics of each interconnection alternative for the three different summer peak scenarios.

Figure 68 – Loss Analysis Results by Control Area for Summer Peak Conditions

	Summer Peak Conditions														
Control	All Group 2					Half Group 2					No Group 2				
Area	Base	Alt #1	△ MW	Alt #2	△ MW	Base	Alt #1	△ MW	Alt #2	△ MW	Base	Alt #1	△ MW	Alt #2	△ MW
ALTW	120.6	127.6	7.0	127.4	6.8	85.3	89.2	3.9	89.0	3.7	77.7	81.0	3.3	80.9	3.2
XEL	489.9	504.9	15.0	506.1	16.2	406.4	425.1	18.7	425.9	19.5	380.3	395.9	15.6	396.3	16.0
MP	69.7	73.1	3.4	71.6	1.9	66.4	69.4	3.0	68.0	1.6	65.0	67.3	2.3	66.1	1.1
SMMPA	1.3	1.3	0.0	1.3	0.0	1.3	1.2	-0.1	1.2	-0.1	1.2	1.2	0.0	1.2	0.0
GRE	118.7	124.8	6.1	137.7	19.0	110.9	116.5	5.6	128.9	18.0	108.1	113.1	5.0	124.7	16.6
OTP	104.8	130.3	25.5	128.9	24.1	101.5	126.1	24.6	124.7	23.2	95.8	119.2	23.4	117.8	22.0
MPW	1.3	1.4	0.1	1.4	0.1	1.2	1.2	0.0	1.2	0.0	1.2	1.2	0.0	1.2	0.0
MEC	198.8	202.5	3.7	202.2	3.4	158.9	161.5	2.6	161.3	2.4	146.7	149.1	2.4	148.9	2.2
NPPD	95.8	91.2	-4.6	91.1	-4.7	94.6	89.6	-5.0	89.5	-5.1	94.1	88.8	-5.3	88.7	-5.4
OPPD	36.5	37.6	1.1	37.6	1.1	34.7	35.5	0.8	35.5	0.8	33.8	34.5	0.7	34.5	0.7
LES	9.5	9.5	0.0	9.5	0.0	9.5	9.5	0.0	9.5	0.0	9.6	9.5	-0.1	9.5	-0.1
WAPA	233.2	235.5	2.3	228.1	-5.1	211.4	213.1	1.7	205.9	-5.5	187.4	187.0	-0.4	180.3	-7.1
MH	258.6	257.8	-0.8	258.1	-0.5	252.3	251.4	-0.9	251.8	-0.5	258.9	258.0	-0.9	258.4	-0.5
DPC	65.9	64.3	-1.6	64.4	-1.5	64.1	62.6	-1.5	62.7	-1.4	63.0	61.6	-1.4	61.7	-1.3
Total =	**1804.6**	**1861.8**	**57.2**	**1865.4**	**60.8**	**1598.5**	**1651.9**	**53.4**	**1655.1**	**56.6**	**1522.8**	**1567.4**	**44.6**	**1570.2**	**47.4**

As can be seen from the previous figure, interconnection alternative 1 was most effective in reducing system losses when the proposed generator was added to the summer peak models.

6.4 Conclusion

Loss performance is very similar between the two interconnection alternatives, however interconnection alternative 1 reduces losses more during summer peak conditions when power pool prices are typically higher than those in the off-peak times.

7.0 Constrained Interface Analysis

Favorable results from a generator interconnection study do not guarantee delivery of the power to a specific market. Interconnection studies performed within MISO typically include a high level constrained interface analysis section to indicate to the Customer any potential constrained interfaces that may be encountered during a subsequent delivery service study.

This particular interconnection Study did not include constrained interface analysis. This is in part due to the changing nature of this interconnection request. During the April 15, 2004 interconnection Study kick-off meeting, assumptions were brought forward to model the delivery of this proposed interconnection. However, since this kick-off meeting, the same parties are not all involved in this project any more. In fact, additional parties that did not originally attend the kick-off meeting are now potentially involved in this project.

Due to the sole dependency of delivery on constrained interface analysis results and the changing nature of this interconnection project, there is not going to be constrained interface analysis performed as part of this interconnection Study unless the Customer comes forward with new assumptions for the delivery of this project. Constrained interface analysis performed during the delivery service study will ultimately determine the liabilities that this project will have for fixing any constrained interfaces in the MAPP and MISO footprints.

8.0 Transient Stability Analysis

As part of this interconnection Study, transient stability analysis is required to evaluate the stability constraints that may be introduced by this new generator. This analysis has not yet been completed. It is expected that work on stability analysis will commence immediately following the publication of this Study report. An addendum to this report will be issued with the transient stability analysis results included within it.

The current Northern MAPP Operating Review Working Group (NMORWG) stability package published on March 11, 2004 is planning to be utilized to perform this analysis. This analysis will build off the models that have been utilized by the Group 2 MISO/WAPA coordinated study. Analysis results from steady state contingency analysis or input from the Customer after review of this report may influence the transient stability analysis process and the amount of cases that will be studied.

If transient stability analysis results indicate any system violations either local to the generator or regional on the MAPP or MISO system, they will be required to be fixed as part of the interconnection process.

9.0 Short Circuit Analysis

Short circuit analysis evaluates the capability of existing equipment on the system to determine if fault duties and system protection schemes are adequate for new interconnection requests. This type of analysis is also part of the interconnection Study and is not yet complete at this time. It is anticipated that transient stability analysis and short circuit analysis will be performed together and included within the same addendum to this report.

Any short circuit associated constraints identified during evaluation of this project will also require system upgrades during the interconnection Study.

10.0 Conclusion

This report has documented the steady state contingency analysis results and the loss characteristics of two interconnection alternatives when connecting a new 600 MW coal-fired generator in northeastern South Dakota at the existing Big Stone site in Grant County.

These two transmission alternatives included two different 230 kV outlet lines out of the existing Big Stone site. These were:

Alternative #1: Uprate existing 115 kV lines to 230 kV along following routes:

a. Big Stone to Ortonville
b. Ortonville to Johnson Jct.
c. Johnson Jct. to Morris
d. Big Stone to Canby
e. Canby to Granite Falls

Alternative #2: New 230 kV line from

a. Big Stone to Willmar

With an up-rate of existing 115 kV lines to 230 kV along following routes:

a. Big Stone to Canby
b. Canby to Granite Falls

Contingency analysis results have indicated that the amount of Group 2 generation included from the latest MISO/WAPA coordinated study does not have a huge impact on the overloaded facilities associated with the interconnection of project G392.

Based on the overall system performance during steady state conditions, this Study has identified that the following upgrades will be necessary for connecting the proposed project with interconnection alternative 1.

Table 6 – Required Upgrades for Interconnection Alternative 1

1. Increase capacity of Morris 230/115 kV Transformer
2. Increase capacity of Big Stone to Browns Valley 230 kV Line
3. Increase capacity of Big Stone to Highway 12 115 kV Line
4. Increase capacity of Highway 12 to Ortonville 230 kV Line

Implementing interconnection alternative 2 to connect the proposed project to the existing system will require the following upgrades:

Table 7 – Required Upgrades for Interconnection Alternative 2

1. Increase capacity of Ortonville to Johnson Jct. 115 kV Line
2. Increase capacity of Johnson Jct. to Morris 115 kV Line
3. Increase capacity of Big Stone to Browns Valley 230 kV Line
4. Install capacitor bank in Willmar area to mitigate low voltages

While performing contingency analysis for interconnection alternatives 1 and 2, a few other facilities were overloaded outside the area of immediate interconnection, but are very likely to

appear during the delivery service study. The facilities that will likely need to be upgraded during the delivery service study may include the following:

Table 8 – Likely Upgrades Required for Delivery Service Study

1. Grant County to Morris 115 kV Line
2. Hoot Lake to Fergus Falls 115 kV Line
3. Hankinson to Wahpeton 230 kV Line

Other system constraints identified further from the area of interconnection were identified during contingency analysis of the summer peak and summer off-peak cases. These facilities are not as likely to be required for delivery, but may appear depending on the assumptions used in the delivery service study.

Table 9 – Upgrades that may be Required for Delivery Service Study

1. Wahpeton to Fergus Falls 230 kV Line
2. Fergus Falls 230/115/13.2 kV Transformer
3. Edgetown Tap to Pelican Rapids 115 kV Line
4. Sheyenne to Fargo 230 kV Line (Interconnection Alternative 1 only)
5. Grant County to Hoot Lake 115 kV Line (Interconnection Alternative 1 only)
6. Aberdeen Jct. to Aberdeen 115 kV Line (Interconnection Alternative 2 only)

Other studies on-going within this region have identified other numerous facility overloads. These overloads appeared again during this Study. Since the future of many of these line overloads is uncertain, the responsibility of these line upgrades may fall within the realm of this project depending on the assumptions used during the delivery service study and the status of any planned upgrades associated with any of these line sections.

Table 10 – Other Overloaded Facilities Under Suspicion for Delivery Service Study

1. Granite Falls to MN Valley Tap 230 kV Line
2. MN Valley Tap to Panther 230 kV Line
3. Panther to McLeod 230 kV Line
4. Willmar to Granite Falls 230 kV Line
5. MN Valley 230/115 kV Transformer
6. MN Valley to Maynard 115 kV Line
7. Maynard to Kerkhoven 115 kV Line

A brief loss analysis during this Study has indicated that alternative 1 is more effective in delivering the generation to the existing transmission system during summer off-peak conditions while alternative 2 is has more loss savings during summer peak conditions with the proposed interconnection added to the models.

Transient stability analysis is part of the interconnection Study, but has not yet been completed. This type of analysis will determine if the proposed project is able to maintain system stability both locally and regionally after credible disturbances are applied to the system. An addendum to this report will be issued separately once this analysis is completed.

Short circuit analysis is also part of the interconnection Study. This analysis is also incomplete at this time. This type of analysis will determine if existing equipment and protection schemes

on the system will be able to withstand increased fault duties and power flows associated with the proposed project. The results of this analysis will be included within the same addendum as the transient stability analysis once it is completed.

Based on the results of this interconnection Study, it appears that either alternative used to connect this generator to the system will work from a steady state contingency analysis standpoint given that the proper system enhancements are made within the direct area of interconnection.