BASIN ELECTRIC POWER COOPERATIVE

GI-0704 & GI-0716
Out of Queue System Impact Study

CEII Removed - Critical Energy Infrastructure Information

Project Name: Deercreek Generation Station
Interconnection Queue # : GI-0704 & GI-0716
Queue Date: March 16th, 2007 & July 6th, 2007
Fuel Type : Natural Gas
Turbine Type : GE
Generation Amount : 300 MW
Point of Interconnection : White, SD
Requested Service : Network Resource
In Service Date: Fall 2012

Prepared by:
Basin Electric Power Cooperative
Transmission Services Division
Bismarck, ND
May, 2010

Executive Summary

The Upper Great Plains Region (UGPR) of the Western Area Power Administration (Western) has received two completed applications for interconnection requests of 240 MW and 60 MW of generation located near the Western Area Power Administration's White 345 kV Substation. The total of the request would be a 300 MW generating facility to be connected to the Western/Heartland Consumers Power District/Basin Electric Power Cooperative Integrated System (IS) at the White 345 kV substation via a 0.2 mile 345 kV line. This request is identified as request numbers GI-0704 and GI-0716 on Western's Generation Interconnection Queue posted on its Open Access Same-Time Information System (OASIS).

The interconnection customer has submitted two Transmission Service Requests (TSR), which are labeled #71283528 and #71487605, in Western's OASIS Queue. The delivery of this generator was evaluated as a network resource and sunk to generation or load as designated in the request.

The scope of this out of queue system impact study is to identify and resolve possible criteria violations that may limit the ability of the generator to interconnect. In accordance with WAPA system impact study practices, an interconnection request is required to mitigate stability impacts, short-circuit impacts and injection related steady state impacts (local area thermal and voltage impacts under system intact and contingency conditions). Several prior queued projects including GI-0108, GI-0303, GI-0619, GI-0703, and GI-0707a have been excluded from this analysis as it is unknown whether they will proceed or not. Future studies will be performed as these projects proceed.

The following is a summary of study results:

Stability Analysis:

The impact of the proposed generator on local area and regional stability performance was evaluated. Results indicate that the proposed project would not adversely impact local or regional area stability.

Steady-State Analysis:

The interconnection of the proposed generator does negatively impact some of the interconnecting transmission facilities. The steady state analysis was performed for both near-term cases (2010 timeframe) and an out-year cases (2020 timeframe) for both peak and off peak scenarios. The following conclusions are drawn:

- One system intact violation was introduced by this project.

CIRCUIT/WINDING CKT #	NAME	#	TO NAME	#		RATE MVA	Precase MVA	Postcase MVA	**Diff MVA**	**DF %**
601007	SPLTRTA3	345.0	652537 WHITE 3	345.0	1	717.0	624.1	780.6	156.5	52.17%

- Post-contingency overloads were observed on the following:

CIRCUIT/WINDING CKT #	NAME	#	TO NAME	#		RATE MVA	Precase MVA	Postcase MVA	**Diff MVA**	**DF %**
601007	SPLTRTA3	345.0	652537 WHITE 3	345.0	1	717.0	692.6	854.98	162.38	54.13%
652529	WATERTN3	345.0	WATERTN4	230.00	230/1 1	400.0	370.3	497.88	127.58	42.53%
652504	BROOKNG7	115.0	652538 WHITE 7	115.0	1	160.0	132.5	165.99	33.49	11.16%
652474	AURORA 7	115.0	652505 FLANDRU7	115.0	1	120.0	114.2	139.9	25.7	8.57%
652474	AURORA 7	115.0	652504 BROOKNG7	115.0	1	120.0	125	143.68	18.68	6.23%

- The Watertown 345 kV transformer and the Brookings – White 115 kV line overloads are below their emergency ratings therefore this generator may be able to reduce its output in order to clear those violations.

- The Split Rock-White overload is based on terminal equipment ratings (current transformer). The transmission line conductor rating is adequate. A Facility Study will be required to determine if other substation upgrades are necessary.

- The Brookings – Aurora – Flandreau 115kV line overload is caused by the outage of the Spilt Rock – White 345kV line during a summer off peak high SWMN wind condition. A summer peak high wind analysis showed an acceptable loading on the line.

Several additional facilities were flagged for steady-state criteria violations, however those violations were based upon the modeled delivery of the generator's output of 300 MW sunk to either the load or to generation rather than the interconnection of the unit. The TSR study will illustrate any delivery issues from this project.

Constrained Interface Analysis:
The study also evaluated the impact of the proposed project on constrained interfaces in the MAPP system. These results are to identify potential third party flow gate issues for the assumed delivery to Basin generation and Basin load. Results indicate that the proposed project does not adversely impact any third party flowgates.

Short-Circuit Analysis:
The addition of the proposed GI-0704 & GI-0716 project increases fault currents in the study area. Initial analysis of breakers does not show any unacceptable current limitations, however, all breaker ratings were not available for the impacted substations. When this information does become available, the calculated fault currents should be compared against the breaker ratings in order to determine whether existing breakers at these substations could become overstressed and whether breaker replacements may be required.

Injection Related Constraints:
Of the violations listed in this report, there is one facility considered an injection related constraint. This constraint was seen during light load and high wind conditions with the interconnection of this generator which included the following:

- White – Split Rock 345 kV line

This impacted facility can be mitigated by upgrading substation terminal equipment for system intact conditions and a post contingent runbacks of Deer Creek for prior outage conditions.

Study Summary:
These study results indicate the addition of the generator which comprises of requests GI-0704 & GI-0716, will not degrade the reliability of the MAPP system. It does result in some unacceptable loading conditions due to the interconnection of the project, which can be mitigated by terminal upgrades. The generator does not negatively impact the voltage profile in the areas studied and does not negatively impact any the area's stability performance or the performance of stability limited interfaces. The study results demonstrate that the Western Area Power Administration (Western)/ Basin Electric Power Cooperative (Basin)/ Heartland Consumers Power District Integrated System (IS) is capable of accommodating the interconnection request.

Table of Contents

Executive Summary 2
1.0 Introduction 5
2.0 Description of Request 5
2.1 Area Information 6
2.2.1 Existing System 6
2.2.2 Previous studies 7
3.0 Study Methodology and Criteria 8
3.1 Ad Hoc Study Group 8
3.2 Steady-State Analysis Criteria 8
3.2.1 Thermal Analysis Criteria 8
3.2.2 Voltage Analysis Criteria 9
3.3 Constrained Interface Analysis 9
3.4 Computer Programs and Input Files 9
3.5 Model Development 9
3.5.1 GI-0704 & GI-0716 Modeling 9
3.5.2 Prior Queued Projects 10
3.5.3 Steady State Model Cases 11
3.5.4 Transient Stability Model Development 12
3.6 Steady State Power flow Analysis Procedure 13
3.7 Contingency Analysis 13
3.8 Additional Information 13
4.0 Steady State Analysis Results 14
4.1 Near Term Results 14
4.1.1 Near Term - System Intact 14
4.1.2 Near Term – Contingency Conditions 14
4.2 Out Year Results 15
4.3 Prior Outages 15
4.3.1 White – Brookings County 345 kV lines 1 & 2 – (bw) 16
4.3.2 White – Split Rock 345 kV line – (ws) 16
4.4 Constrained Interface Analysis 16
4.5 Steady State Conclusions 21
5.0 Stability Analysis 22
5.1 Computer Programs and Input Files 22
5.2 Model Development 22
5.3 Disturbance Definitions 22
5.4 Performance Criteria 23
5.5 Stability Results 23
5.5.1 Regional Stability Results 24
5.5.2 Local Stability Results 24
5.6 Stability Sensitivity 24
5.7 Prior Outage Stability Analysis 25
5.7.1 Prior Outage of Center – Jamestown 345 kV (eb) 25
5.7.2 Prior Outage of Leland Olds – Ft. Thompson 345 kV (ag) 25
6.0 Short Circuit Analysis 26
6.1 Base Case Development 26
6.2 Short-Circuit Calculations 26
7.0 Conceptual Costs 28
8.0 Conclusion 29
APPENDICIES 31

1.0 Introduction

The purpose of this document is to provide information to the MAPP Design Review Subcommittee (DRS) regarding the addition of a new 300 MW combined cycle unit called the ***Deercreek Station***. This request is labeled GI-0704 and GI-0716 in the Integrated System's (IS) queue. This study examines steady state power flow analysis, dynamic stability analysis, and constrained interface analysis of the 300 MW generator to the bulk electric system.

2.0 Description of Request

The new generator has requested a point of interconnection to be located near White, SD, off of the Western White 345 kV substation. The geographic location of this request can be seen in the following figure 2.1

Figure 2.1 – GI0704 and GI0716 Geographic Location (CEII)

A one-line of the generator interconnection into the bulk system can be seen in Figure 2.2.

Figure 2.2 – One-line of the GI-0704 & GI-0716 and surrounding transmission (CEII)

2.1 Area Information

The following section lays out the facilities in the immediate vicinity of the interconnection request as well as identifies other system studies that have been completed for projects in the region.

2.2.1 Existing System

The system in the vicinity of this project will look at electrically close vicinity of the White 345 kV substation. The generation will be connecting to the 345 kV substation at White which has 5 outlets. The 345 kV line coming from the north is from Watertown which extends to Groton and up to Leland Olds, which is considered the coal field generation area. The 345 kV line extending to the south leads down to the Sioux Falls area, to the Split Rock substation. There are also two 345 kV lines that extend roughly a quarter mile over to Xcel's Brookings County substation. This sub feeds into the Buffalo Ridge area which has approximately 1200 MW's of wind generation capacity. The 115 kV system at White consists of a single 115 kV line that runs back to Brookings substation.

2.2.2 Previous studies

This interconnection request falls in an area where other requests have been studied. Those requests that are prior queued to this and have been studied include the following:

- GI-0108 – 200 MW wind farm interconnecting to the White 345 kV sub
- GI-0303 – 170 MW wind farm interconnecting to the White 115 kV sub
- GI-0316 – 120 MW Gas turbine near Groton, SD
- GI-0608 – 120 MW Gas turbine near Groton, SD
- GI-0616 & GI-0707a – 81 MW and a 286 MW (Total 387 MW) Wind Farm on the Leland Olds – Groton 345 kV line

These studies are posted on the Western OASIS page.

3.0 Study Methodology and Criteria

3.1 Ad Hoc Study Group

An Ad-Hoc study group of surrounding Transmission Owner's (TO's) and Transmission Users (TUM's) was arranged to get input for the study scope and feedback on the report. Members from the following companies were invited to participate in this group.

- Basin Electric
- East River Electric
- Great River Energy
- Manitoba Hydro
- Minnkota Power Cooperative
- MISO
- Missouri River Energy Services
- Montana Dakota Utilities
- Northwestern
- Ottertail Power Company
- WAPA
- XCEL

3.2 Steady-State Analysis Criteria

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

Contingencies were solved using the GRE Contingency iplan. Phase shifters and transformer taps were enabled. Non-convergent contingencies from these analyses (primarily due to switching back and forth of transformer taps and switched shunts) were solved manually and their violations were appended to the results.

Thermal violations were flagged based on continuous facility rating (Rate A in PSS/E). Post-contingency power flows in excess of 100% of the Rate A were recorded. Facility loadings with and without the GI-0704 & GI-0716 generator were tabulated and compared. If several contingencies overload a given transmission facility, only the worst ten contingencies are reported. Overloads on generator step up transformers are not reported.

3.2.1 Thermal Analysis Criteria

The incremental impact of the GI-0704 & GI-0716 unit on thermal loading of transmission facilities was evaluated by comparing transmission system power flows with and without the proposed generator. The criteria for this study is the standard 5% PTDF, 3% OTDF, and 1 MW criteria.

The Contingency analysis was run to flag any loading violations above 100% of Rate A, during system intact and contingency scenarios. Any violations outside these limits were evaluated. A change in loading increase of less than 1 MW is considered a negligible effect.

3.2.2 Voltage Analysis Criteria

The incremental impact of the GI-0704 & GI-0716 unit on voltage performance of the transmission facilities was evaluated by comparing transmission system voltages with and without the proposed generator. The criteria for this study are the standard as seen in Table 3.1 below.

The contingency analysis was run to flag any voltage below 0.97 p.u., and any voltage above 1.05 p.u. during system intact and contingency scenarios. Any violations outside these limits were evaluated. A change in voltage of less than +/- 1% is considered a negligible effect.

System	Base kV	System Intact Conditions		N-1 Contingency Conditions	
		Max (pu)	Min (pu)	Max (pu)	Min (pu)
Northern MAPP	110-500 kV	1.05	0.95	1.10	0.90
MP (Area 608)	110-500 kV	1.05	1.00	1.05	0.95
MP Western Division (Area 610)	115-230 kV	1.05	0.96	1.05	0.92
OTP (Area 626)	230-345 kV	1.05	0.97	1.10	0.92
	115 kV	1.07	0.97	1.10	0.92

Table 3.1 – Voltage Criteria

3.3 Constrained Interface Analysis

The purpose of the constrained interface analysis is to calculate the impact of the proposed project on specified interfaces in the MAPP transmission system. The MAPP DFCALC constrained interface analysis program was used for this purpose. This analysis is used to illustrate the proposed delivery of the project on area interfaces and flowgates.

3.4 Computer Programs and Input Files

The PSS/E Power System Simulator for Engineers was used for this study. PTI PSS/ETM Rev 29.4 and Version 6.6B of the Digital FORTRAN Compiler was utilized to perform all aspects of the stability study work. The NMORWG pkg2010-1-05-2010 was the starting point for the stability analysis in this study. PTI PSS/E Rev 32.0.2 was utilized to perform all aspects of the steady state study work which includes thermal, voltage, short circuit, and constrained interface analysis.

3.5 Model Development

In order to properly study the GI-0704 and GI-0716 interconnections, several models were considered for this project. The dynamic models were derived from the NMORWG package dated 1-05-2010, and the steady state models were developed from the 2009 MNTACT models.

3.5.1 GI-0704 & GI-0716 Modeling

The GI-0704 & GI-0716 requests represent a single generator. This is a 300 MW generator that will be fed via a short 345 kV line in the White 345 kV substation. The generator was modeled on a 13.8 kV bus connected to the Deercreek 345 kV sub, which can be seen in Figure 2.2. One-line diagrams of the area can be seen in Appendix B.

The project was modeled with the following specifications.

- 300 MW Generator
- Reactive capability to control power factor between 95 % supplying vars to 95% consuming vars
- Qmax: 145.5 Mvar
- Qmin: -145.5 Mvar
- Scheduled Voltage set to 1.03 at POI (Deercreek 345 kV)
- Dynamics data can be found in appendix A.3

3.5.2 Prior Queued Projects

Area generation whether existing or a planned project is turned on in the area to demonstrate a worst case scenario. Existing and DRS approved area generation is energized at Pmax. Some previously queued generation was included in the models according to the listed in-service dates, their proximity to the project, and what stage the project was in.

The following Table 3.2 gives a list of projects that are currently in-service and are currently modeled in the cases.

Bus	GI#	QueueDate	Type	Size	Brand
659290	GI 0208	20 Jun 02	Wind	40	GEDFIG
659291	GI 0209	20 Jun 02	Wind	40	GEDFIG
659274	GI 0316	04 Aug 03	Gas	120	
620138	G380	21 Nov 03	Wind	150	Suzlon
608603	G502	14 Mar 05	Wind	50.6	Siemens
608606	GS659	01 Sep 06	Wind	49.5	GEDFIG
615015	G645	26 May 06	Coal	50	
615015	G788	24 Apr 07	Coal	49	
659194	GI 0503	28 Jan 05	Wind	100	GEDFIG
659294	GI 0508	18 Apr 05	Wind	49.5	GEDFIG
662101	GI 0602	31 Mar 06	Wind	100	
659274	GI 0608	14 Jul 06	Gas	120	
659294	GI 0615	18 Oct 06	Wind	49.5	GEDFIG
657703	GM0100	11 Sep 06	Wind	100	GEDFIG
657703	GM0200	13 Nov 06	Wind	60	GEDFIG
661307	G767	20 Mar 07	Wind	19.5	GEDFIG
661999	G132	17 Sep 01	Wind	180	Acciona
600059	G408	02 Mar 04	Wind	12	GEDFIG
657703	GM00300	31 Jul 07	Wind	40.5	GEDFIG
659194	GI 0720	28 Jan 05	Wind	15.5	GEDFIG

Table 3.2 – In-service projects included in the base case

In general all MISO projects that were in the SPA stage of studies were not included in this study because of the unknown transmission updates required for their interconnection. The MISO Group 5 projects or other projects near this have been included in the outyear cases.

Bus	GI#	QueueDate	Type	Size
600099,600077	G176	04-Mar-02	Wind	100
90149,90150	G349	02-Jun-03	Wind	200
99359	G359	27-Mar-04	Wind	150
99555	G555	24-Oct-05	Wind	100
99586	G586	30-Dec-05	Wind	30
99618	G618	11-Apr-06	Wind	138
99621	G621	18-Apr-06	Wind	20
99634	G634	27-Apr-06	Wind	96
99635	G635	27-Apr-06	Wind	101
99636	G636	15-May-06	Wind	18.9
99637	G637	16-May-06	Wind	20
99638	G638	17-May-06	Wind	20

Table 3.3 – Projects added based on MISO recommendation to the base case and modeled at their full output.

The following table shows the request within the Western queue that were considered. Due to the uncertainty of most of the projects within this group it was decided to exclude all projects except for GI-0616 from the analysis.

Bus	GI#	QueueDate	Type	Size
652198	GI-0108	07-Aug-01	Wind	200
652196	GI-0303	10-Mar-03	Wind	170
660616	GI-0616	23-Oct-06	Wind	81
652619	GI-0619	19-Dec-06	Wind	300
652194	GI-0703	23-Feb-07	Wind	200
659285	GI-0704	16-Mar-07	Gas	240
660707	GI-0707a	13-Apr-07	Wind	286
659285	GI-0716	06-Jul-07	Gas	60

Table 3.4 – Integrated System (IS) projects

3.5.3 Steady State Model Cases

Cases for the steady state thermal, voltage and distribution factor analysis are derived from the 2009 MRO Final cases. These cases were further refined by the Minnesota Transmission Assessment and Compliance Team (MNTACT). The five cases chosen for this study include both a near term and out year scenarios. The near term cases reflect 2010 loads and a pre-CAPX environment, while the 2020 cases reflect a post-CAPX environment. This area is not a typical winter peaking area so summer peak and off peak cases are the worst case scenario. The following table shows the base MNTACT cases along with a short description of each model chosen for this study.

	Models Formed form the MRO 2009 Series	Description of Model
Near Term	MRO-COL09-2010SU70-FINAL-MWEX	This is to model 2175 MW on MHEX and 1525 MW on MWEX
	MRO-COL09-2010-11W-FINAL	2010-2011 Winter Peak Load Scenario
	MRO-COL09-2010SUPK-FINAL	2010 Summer Peak Load Scenario
Out Year	MRO-COL09-2020SU70-FINAL-HW	This is to model 2000 MW of generation in SWMN and 700 MW in SEMN (Back dow n the base load generation after turning dow n peakers)
	MRO-COL09-2020SUPK-FINAL	2020Summer Peak Load Scenario

Table 3.5– GI-0704 & GI-0716 base cases.

3.5.4 Transient Stability Model Development

Cases used for dynamic stability analysis are taken again from the January 2010 version of the 2008 NMORWG study package. The off-peak summer high transfer case (urg-so10aa.sav) with North Dakota coalfield generation at URGE output was used as a starting point for this study. From the urg-so10aa case prior queued projects shown in **Table 3.3** were added along with load and topology adjustments to get to a 2015 time frame case.

The following changes were made to the urg-so10aa case to get to a 2015 time frame

- Add Table 3.3 projects
- Turn on White to Brooking County 345 circuit 2 along with Transformer
- Add in Bison Wind 2-8
- Add in Oliver County 4
- Turned on 423 MW to get Square Butte DC carrying 500 MW
- Generation at Fibromn turned on (50 MW)
- Add Center – Prairie 345 kV line
- Add St. Joesephs Wind (300 MW)
- Add Edgeley wind (49.5 MW)
- Add GI-0616 (80.5 MW)
- SWMN at 100 percent
- Riel substation
- Essar MN 230 kV substation
- Added GI-0108 but set to status 0 (0 MW)
- Added GI-0303 but set to Status 0 (0 MW)
- Added GI-0619 but set to status 0 (0 MW)
- Added GI-0703 but set to status 0 (0 MW)
- Turned Groton unit 2 to Status 0 (0 MW) for worst case voltage profile
- 2015 load correcting idevs were executed for OTP, MPC, BEPC, MP

This case includes the transient limited stability interfaces MHEX, NDEX, and MWEX set at their boundary limits of 2175, 2079, and 1525 respectfully.

The following process was used to evaluate the differences of each option:

- Document the transient stability performance of the existing system for the 2015 summer conditions at high simultaneous NDEX/MHEX/MWEX conditions of 2080/2175/1525 respectively.
- Document the stability performance of the resulting system with the generator online. Differences in power interfaces in the system were made to the generators east of the Twin cities.

Four cases were developed for a high transfer scenario with North Dakota coal field generation at Urge. The first case left the generator offline, while the remaining cases turned GI-0704 & GI-0716 generation online and explored different sinking methods as shown in Figure 3.6.

Off-Peak Load Cases	GI0704	NDEX	MHEX	MWEX	Comments
es0-so15aa.sav	0	2081	2175	1523	GI0704 off -- No prior quued requests added
es1-so15aa.sav	300	2079	2176	1524	GI0704 online -- Dispatched to Basin Load outside of NDEX
es2-so15aa.sav	300	2081	2174	1527	GI0704 online -- Dispatched to generation *
es3-so15aa.sav	300	2079	2173	1524	GI0704 online -- Sunk to swing bus

* George Neal (100 MW) , Spirit Mound (100 MW), Duane Arnold (60 MW) , and LRS 1(40 MW)

Figure 3.6– 2015 High Transfer Steady State Models

3.6 Steady State Power flow Analysis Procedure

Steady state analysis was simulated in accordance with the MAPP DRS standards. Both single and multiple contingencies were run. To determine steady state results for each contingency, the contingency program developed by GRE was used as well as the standard PSSE tool ACCC. For the GRE contingency iplan, single and multiple contingencies were created by the iplan for all areas within the MAPP region. Any cases that did not solve using this type of analysis were solved manually.

3.7 Contingency Analysis

Contingency analyses included single branch and selected multi-element contingencies on facilities rated 110 kV and above. Single branches as well as multi-terminal outages in WAPA, GRE, MH, MP, OTP, and XEL within zones 331, 600, 608, 611, 618, 626, 633, 635, 652, 667, and 680 were considered. All facilities rated 70 kV and above were monitored in the WAPA, OTP, GRE, MP, XEL and MH control areas within the zones 331, 600, 608, 611, 618, 626, 633, 635, 652, 667, and 680.

Contingencies were solved using GRE's contingency program. Phase shifters and transformer taps were enabled. Thermal violations were flagged based on 100% of facility ratings (Rate A in PSS/E). Post-contingency power flows in excess of 100% of Rate A were recorded.

If several contingencies overload a given transmission facility, only the worst fifteen contingencies are reported. Overloads on generator step up transformers are not reported.

3.8 Additional Information

This request began as part of a group study effort by the Upper Great Plains Region (UGPR) of the Western Area Power Administration (Western). In this group study effort, four requests that were near each other both geographically on the system and in the OASIS queue were part of a group case building process. This process involves developing a set of cases that can be used as a starting point for each subsequent study. The four requests and locations of these requests for this group effort can be seen in Table 3.6

IS Project Num	Queue Date	Interconnection Location	Type	Max Output (MW)
GI-0619	19-Dec-06	Leland Olds - Groton 345 kV line	Wind	300
GI-0703	23-Feb-07	Summit 115 kV substation	Wind	200
GI-0704	16-Mar-07	White 345 kV substation	Gas	240
GI-0716	06-Jul-07	White 345 kV substation	Gas	60

Table 3.7 – Group Study Projects

Each of these requests were studied sequentially in accordance with the Western tariff.

4.0 Steady State Analysis Results

The incremental impact of the GI-0704 & GI-0716 generator on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows with and without the GI-0704 & GI-0716 project.

4.1 Near Term Results

A complete listing of the near term voltage and loading tables can be seen in Appendix D.

4.1.1 Near Term - System Intact

One facility was significantly affected with system intact and near term conditions. All issues stemmed during the off peak and high wind situations. The peak conditions did not show any issues. The near term bus voltages in the region were not negatively impacted due to the introduction of this unit.

White – Split Rock 345 kV line: This line loaded above its 717 MVA rating as a result of dispatching the GI-0704 & GI-0716 projects. The overload may be addressed by upgrading terminal equipment at White and Split Rock.

4.1.2 Near Term – Contingency Conditions

Appendix D.1 lists the significantly affected facility loadings for contingency conditions with and without the proposed project. The table lists the limiting facilities and associated contingencies that cause overloads, along with a comparison of facility loadings expressed both in MVA and in percent on Rate A without and with the proposed projects.

The violations were then screened to identify injection constraints which are listed in Table 4.1. For the purposes of the screening, overloads on facilities that are in the electrical vicinity of the White 345 kV substation were considered to be injection constraints.

These facilities include the following:

CIRCUIT/WINDING			TO			CKT	RATE	Precase	Postcase	**Diff**	**DF**	CONTINGENCY				
#	NAME	#	NAME			#	MVA	MVA	MVA	**MVA**	**%**	FROM		TO		CKT
601007	SPLTRTA3	345.0	652537	WHITE 3	345.0	1	717.0	692.6	854.98	162.38	54.13%	652503	BLAIR 4	230.0 652550	GRANITF4	230.0 1
652529	WATERTN3	345.0	WATERTN4		230.00	230/1 1	400.0	370.3	497.88	127.58	42.53%	601006	SPLT RK3	345.0 601007	SPLTRTA3	345.0 1
652504	BROOKNG7	115.0	652538	WHITE 7	115.0	1	160.0	132.5	165.99	33.49	11.16%	601006	SPLT RK3	345.0 601007	SPLTRTA3	345.0 1
652474	AURORA 7	115.0	652505	FLANDRU7	115.0	1	120.0	114.2	139.9	25.7	8.57%	601006	SPLT RK3	345.0 601007	SPLTRTA3	345.0 1
652474	AURORA 7	115.0	652504	BROOKNG7	115.0	1	120.0	125	143.68	18.68	6.23%	601006	SPLT RK3	345.0 601007	SPLTRTA3	345.0 1

Table 4.1 – Injection Constraints

White – Split Rock 345 kV line: This line loaded above its 717 MVA rating as a result of dispatching the GI-0704 & GI-0716 projects. The contingency is the loss of the 230 kV lines between Watertown and Granite Falls. The line was overloaded with system intact conditions yet continues to load up with a post contingent overload of 854 MVA. The overload may be addressed by upgrading terminal equipment at White and Split Rock.

White – Brookings 115 kV line: One contingency overloaded this 115 kV line rated at 160 MVA in the post-project case. The contingency is the loss of the 345 kV line between White and Split Rock. Post-contingency loadings are 132.5 MVA (pre-project)

vs. 166 MVA (postproject). The overload is less than the emergency limit of the line of 176 MVA.

Brookings – Aurora – Flandreau – Split Rock 115 kV line: One contingency overloaded this 115 kV line rated at 120 MVA in the post-project summer off peak case. The contingency is the loss of the parallel 345 kV line between White and Split Rock. Post-contingency loadings are 114.2 MVA (pre-project) vs. 144 MVA (postproject). The overload may be addressed by upgrading or reconductoring the transmission line and/or terminal equipment. The overload may also be addressed by having a run back sceme for this unit for this parallel 345 kV outage.

This overload was not observed in the 2010 summer peak case, nor the 2010 summer peak high wind sensitivity. Therefore the loading on this line could be increased by additional non firm transfers that would be present in the urge summer off peak high transfer, high wind scenario. For this reason, it is not considered an injection constraint.

Watertown 345/230 kV transformer: One contingency overloaded this 345/230 kV transformer rated at 400 MVA continuous and 500 MVA emergency in the post-project summer off peak case. The contingency is the loss of the 345 kV line between White and Split Rock. Post-contingency loadings are 370 MVA (pre-project) vs. 497 MVA (postproject). The overload is less than the emergency rating of the transformer.

This overload was not observed in the 2010 summer peak case, nor the 2010 summer peak high wind sensitivity. Therefore the loading on this line could be increased by additional non firm transfers that would be present in the urge summer off peak high transfer, high wind scenario. For this reason, it is not considered an injection constraint.

Overloads were also observed on several other transmission facilities. In the context of this system impact study, these overloads were not considered injection related constraints and therefore will only be addressed if they appear during the transmission service approval process for this project.

- Lake Yankton – Buffalo Ridge 115 kV line
- Buffalo Ridge - Pipestone – Pathfinder 115 kV line
- Groton – Bristol 115 kV line
- Groton – Redfield 115 kV line
- Huron – Redfield 115 kV line
- Utica Jct – Yankton Jct 115 kV line
- Broadland 345/230 kV transformer
- AVS – Broadland 345 kV

4.2 Out Year Results

The out year results did not indicate any new loading or voltage violations that were not addressed in the near term cases. Several of the violations in the near term analysis are reduced due to the addition of the CAPX facilities to the east. The bus voltages in the region were not negatively impacted due to the introduction of this unit in these out year cases as well.

A complete listing of the out year voltage and loading tables can be seen in Appendix D.

4.3 Prior Outages

Prior outages around the White area were analyzed to see if any specific prior outage would affect the operation of the GI-0704 & GI-0716 generator. Analysis of prior outages showed that

the generation will have to have an operating study done to coordinate prior outages in the area. A full comprehensive analysis of prior outage conditions will be studied in an operating study before this unit comes into service.

A complete listing of the prior outage loading tables can be seen in Appendix D.

4.3.1 White – Brookings County 345 kV lines 1 & 2 – (bw)

Analysis was completed by taking a prior outage of both 345 kV ties from the White 345 kV substation to the Brookings County substation. Full contingency analysis was then rerun. No constraints were found from this prior outage as the local system is unloaded due to the prior outage of the connection to the Buffalo Ridge area wind generation.

Loading on the White – Split Rock 345 kV line was reduced as can be seen in the following table.

	White - Split Rock 345 kV Loading	
	Precase	With Deercreek
Base Case - so10aa	658	815
Prior Outages		
A) Brookings County - White	445	691
B) Brookings County - White & Split Rock MISO/IS	392	541

Table 4.3.1 – Prior outage loading on White – Split Rock

As can be seen from the previous table is that the IS system is capable of accommodating the generation interconnection request without any ties to the MISO system at White. The system is unloaded due to the large amount of wind generation on the MISO system coming into the White 345 kV sub.

4.3.2 White – Split Rock 345 kV line – (ws)

Analysis was completed by taking a prior outage of the 345 kV line from the White 345 kV substation to the Split Rock substation. Full contingency analysis was then rerun.

This prior outage puts a large stress on the parallel 115 kV line from White – Split Rock. Loadings are increased to 140% of 160 MVA on the White – Brookings line. Other highly loaded facilities are those in the Buffalo Ridge area as the generation has lost a primary outlet during high wind scenarios. This prior outage would require generation reductions, coordination with other generation in the area, or an uprate of facilities. A full operating study will disclose operating limits for prior outages with the different system conditions.

4.4 Constrained Interface Analysis

Constrained path analysis has been completed to assess the potential issues related to deliverability of the proposed generation. Analysis was completed using the 2010 and 2020 summer peak models that were used for steady state power flow analysis. Both generation and load re-dispatch were considered. The analysis was completed using the DRS established “dfcalc-otdf-6digit.ipl” distribution factor (DF) calculation program, which measures the flows on all constrained interface ties, with and without the new generation. The net differences between the two cases are then compared to determine the total impact on each constrained interface. The net change in power flow across the interface is then divided by the new generation

amount. This quantity equals the distribution factor. A distribution factor above 5% (for PTDF type flowgates) or 3% (for OTDF type flowgates) constitutes an impact on a constrained interface.

For the generation-to-load scenario, Basin load was scaled up by 300 MW's. For the generation-to-generation scenario, the generator was added and Spirit Mound, Neal 4, and the Miles City DC tie were all backed down 100 MW to create a south bias for the generator delivery.

The associated TSR request within the Integrated System Queue will result in a full delivery study and will capture any affected flowgates. The following will give some insight on any impacts that may be caused by this generator.

For the outyear distribution factor analysis, several assumptions were made on flowgates that have changed due to transmission additions in the area. The following line sections and/or flowgates were impacted.

- Prairie Island – Byron - North Rochester now intersects the line
- Duane Arnold – Tiffin - Montezuma now intersects the line
- NDEX - CAPX facilities

	PTDF			
	Summer Peak 2010			
	Load Dispatch		Generation Dispatch	
Constrained Interface	(MW)	%	(MW)	%
WEMPAD__PTDF	-0.50	-0.16%	-1.20	-0.41%
EAUARP__PTDF	1.40	0.48%	3.20	1.05%
ZIOLKVZIOADN	-1.50	-0.49%	-3.70	-1.24%
WEMPLBROE	-0.40	-0.12%	-0.90	-0.31%
MTGSPC__PTDF	-1.40	-0.47%	-1.00	-0.34%
NAPRRN__PTDF	-1.30	-0.44%	-3.60	-1.21%
ZIOARC__PTDF	-0.50	-0.16%	-1.20	-0.41%
ZIOPLP__PTDF	-0.90	-0.30%	-2.30	-0.75%
WEMPADWEMROE	-0.80	-0.28%	-2.20	-0.72%
ARNHAZ__PTDF	-3.10	-1.03%	-5.10	-1.71%
RCKXFM__PTDF	-0.10	-0.03%	-0.10	-0.02%
QUARCK__PTDF	-0.60	-0.20%	-0.80	-0.28%
PPRZIO__PTDF	0.90	0.30%	2.30	0.75%
NDEX	-116.90	-38.98%	-98.10	-32.71%
MHEX_S	0.30	0.11%	0.90	0.31%
MHEX_N	-0.50	-0.18%	-1.00	-0.35%
GGS	-35.20	-11.72%	-4.50	-1.51%
GENTLMREDWIL	-6.70	-2.24%	-2.00	-0.66%
GRIS_LNC	-30.90	-10.29%	0.00	-0.01%
COOPER_S	-1.20	-0.40%	-5.10	-1.69%
PR_ISL_BYRON	2.50	0.85%	7.20	2.40%
FTCAL_S	14.60	4.86%	-6.20	-2.07%
TIFARN__PTDF	-2.80	-0.95%	-4.30	-1.43%
AHDSTL__PTDF	-0.20	-0.07%	2.00	0.68%
MWEX____PTDF	1.40	0.46%	5.90	1.97%

Figure 4.4.1 - 2010 PTDF Constrained Interface Analysis results

	OTDF			
	Summer Peak 2010			
	Load Dispatch		Generation Dispatch	
Constrained Interface	(MW)	%	(MW)	%
LEEBYRNELELC	-0.20	-0.06%	-1.40	-0.47%
CDVNELQUA471	0.10	0.02%	-1.20	-0.41%
QUDCOR471QUD	0.20	0.07%	-0.10	-0.02%
QUDCORNEL471	0.20	0.07%	-0.10	-0.02%
ADNZIOPLPZIO	0.90	0.31%	2.30	0.78%
EAUARPWMPPAD	1.40	0.48%	3.10	1.04%
PADXFMWEMROE	-0.20	-0.06%	-0.40	-0.15%
EAUARPPRIBYR	1.60	0.55%	3.70	1.24%
PADBLKPADTLR	-0.20	-0.07%	-0.50	-0.17%
BLKCORPADTLR	-0.10	-0.03%	-0.20	-0.08%
RSSROEWEMROE	-0.10	-0.02%	-0.20	-0.07%
RRNNPTRRNGPK	0.00	0.01%	-0.10	-0.04%
BLKCRDWEMROE	-0.10	-0.02%	-0.10	-0.05%
PADTLRPADBLK	-0.10	-0.04%	-0.30	-0.10%
ROE_T2ROE_T3	-0.20	-0.05%	-0.40	-0.14%
TCRWIEARPRRN	0.30	0.11%	0.60	0.20%
TCRWIEEARP_G	0.30	0.12%	0.80	0.26%
PADTLRWEMROE	-0.10	-0.03%	-0.30	-0.08%
WTAPEDWERRRN	-0.20	-0.06%	-0.50	-0.18%
MTGSPCCOFPAN	-1.50	-0.49%	-1.10	-0.36%
QUA471CDVNEL	0.10	0.02%	-1.20	-0.41%
QUACDVQUA471	0.20	0.07%	-1.40	-0.48%
WEMPADZIOPLP	-0.60	-0.20%	-1.60	-0.52%
WEMPADCHVSLA	-0.40	-0.14%	-1.20	-0.40%
ZIOPLPZIOARC	-1.20	-0.41%	-3.10	-1.05%
ZIOPLPWEMPAD	-1.00	-0.32%	-2.40	-0.81%
ZIOARCZIOPLP	-0.90	-0.30%	-2.30	-0.76%
CHESILNELELC	0.40	0.12%	0.30	0.11%
NELELCCHESIL	0.40	0.12%	0.10	0.02%
LCONELWEMPAD	0.20	0.08%	1.20	0.40%
ELNHNZNAPRRN	-0.50	-0.18%	-1.60	-0.52%
PLPARCPLRRAC	-0.60	-0.20%	-1.50	-0.51%
PLPARCZIOARC	-0.50	-0.18%	-1.40	-0.47%
PLPZIOCHESIL	0.90	0.31%	2.30	0.77%
PLPZIOZIOARC	1.20	0.41%	3.20	1.05%
PZIOPLPWR_AT	-0.90	-0.31%	-2.30	-0.78%
PLPRACPLPADN	-0.70	-0.23%	-1.80	-0.60%
RRNWESRRNGPK	0.00	0.01%	-0.10	-0.04%
RRNWESRRNGPK	0.00	0.01%	-0.10	-0.04%
ARNHAZWEMPAD	-3.10	-1.04%	-5.20	-1.73%
LORTRKWEMPAD	-0.40	-0.14%	-1.00	-0.32%
LKJFOXARNHAZ	1.20	0.39%	0.60	0.18%
QUARCKCORMOL	-0.60	-0.19%	-0.60	-0.21%
RCKXFMQUADAV	-0.10	-0.02%	0.10	0.03%
SALXFMQUAS91	-0.50	-0.17%	-0.60	-0.21%
SALXFMCORMOL	-0.50	-0.17%	-0.70	-0.23%
SALXFMQUADAV	-0.50	-0.17%	-0.60	-0.21%
TIFARNHILMON	-2.30	-0.78%	-2.90	-0.97%
ARNVINARNHAZ	-0.80	-0.27%	-0.90	-0.30%
DAVCALQUARCK	-0.40	-0.12%	-0.50	-0.17%
LAKFOXLAKLKF	2.70	0.89%	1.00	0.32%
DYSWASARNHAZ	-1.30	-0.45%	-2.20	-0.72%
BONBJCSYCLEH	-0.50	-0.18%	-0.40	-0.12%
BONBJCLEHWBS	-0.70	-0.22%	-1.30	-0.43%
LKJFOXLKJTRI	1.50	0.51%	0.90	0.31%
HAZDUNEAUARP	0.40	0.14%	0.50	0.17%

	OTDF (contd)			
	Summer Peak 2010			
	Load Dispatch		Generation Dispatch	
	(MW)	%	(MW)	%
HILXFMTIFARN	-0.80	-0.27%	-1.20	-0.39%
8STKERWEMPAD	0.00	0.00%	0.00	0.00%
8STKERARNHAZ	0.00	0.00%	0.00	0.00%
LIMEMELEHWEB	0.80	0.28%	1.40	0.48%
LORTRKWPAD_G	-0.40	-0.14%	-1.00	-0.32%
VINDYSARNHAZ	-0.80	-0.27%	-0.90	-0.30%
LIMEMEADAHAZ	1.20	0.41%	2.50	0.83%
SALJCRWEMPAD	-0.40	-0.13%	-0.70	-0.22%
LKFFOXLKFWLM	2.80	0.92%	1.00	0.33%
ARNHAZMTZBON	-2.80	-0.94%	-4.30	-1.42%
SALXFMTIFARN	-0.80	-0.28%	-1.20	-0.41%
SALXFMHL3TIF	-0.70	-0.23%	-1.00	-0.34%
TIFARNMTZBON	-2.50	-0.82%	-3.00	-1.01%
EMELIMEMEFYD	-0.70	-0.25%	-1.70	-0.58%
HAZX21HAZX22	0.00	0.01%	0.60	0.19%
FOXRUTLKGWLM	1.30	0.44%	-2.50	-0.84%
RUTWBOLKFWLM	0.00	0.00%	0.00	0.00%
DUNHAZARNHAZ	-1.00	-0.32%	-1.40	-0.47%
PLPRACADNZIN	-0.70	-0.23%	-1.80	-0.59%
NAPFOXNAPKEW	0.70	0.23%	1.90	0.63%
NPTRKRGDRRKR	0.00	-0.01%	0.10	0.04%
WIAHOVRKRWRW	0.20	0.06%	0.50	0.16%
WRWWRNWRWNA	0.60	0.21%	1.80	0.61%
SJHALKNAIASC	0.00	0.00%	0.00	0.00%
IASCLKNASJHA	0.00	0.00%	0.00	0.00%
GEACOEGEAMRL	-0.20	-0.08%	-0.80	-0.28%
BYRMLFBYRPVV	1.50	0.51%	3.50	1.15%
BYRMLFPVVADM	1.20	0.39%	2.30	0.77%
ALMWABPRISBY	0.60	0.21%	0.40	0.13%
ALMELKKGEUAR	0.20	0.06%	0.00	-0.01%
SUBTEKFTCRAU	-4.00	-1.35%	1.80	0.59%
TEKRAUCOONEB	-3.90	-1.30%	0.60	0.20%
ADMXFMHAZADM	1.40	0.47%	3.20	1.07%
PLYSOURAUSOU	-11.00	-3.65%	-20.20	-6.73%
SONCOCCOCCCT	-0.80	-0.25%	-2.20	-0.72%
SONCCTCOCSON	0.80	0.26%	2.10	0.69%
WABROCPRISBY	0.00	-0.02%	1.10	0.38%
READEMMTZBON	0.80	0.27%	2.20	0.72%
ARNHAZ__SRC3	-3.10	-1.04%	-5.30	-1.77%
QUAD91CORD39	0.40	0.14%	1.90	0.63%
CORS39QUAD91	0.40	0.15%	1.80	0.59%
92HILLOUHILL	-0.20	-0.07%	1.60	0.53%
GENLACGENCOU	-0.30	-0.11%	-1.10	-0.35%
ADARCRADAPVV	-0.40	-0.14%	-2.30	-0.76%
ADARCRBYRBYR	-0.10	-0.04%	-0.80	-0.28%
ADARCRBYRPVV	0.00	0.00%	0.00	0.00%
HAZBAHHAZWAS	0.00	0.00%	0.80	0.27%
LANGENHARGEN	0.10	0.03%	-0.30	-0.11%
BNDSYCGDMSEP	1.50	0.49%	5.10	1.71%
MNTBNDTIFARN	1.00	0.35%	4.40	1.48%
CBLRVBCOOJOE	-0.10	-0.02%	-0.70	-0.24%
ADABEAMCHHAZ	1.40	0.45%	1.80	0.58%
ROCWABJPMALM	0.50	0.17%	0.20	0.05%
ROCWABKNGARP	0.60	0.20%	0.40	0.13%
ADABVRGENOAG	0.90	0.31%	0.90	0.31%
BVRHRMHAZMTC	1.10	0.35%	1.30	0.42%

Figure 4.4.2 - 2010 OTDF Constrained Interface Analysis results

	PTDF			
	Summer Peak 2020			
	Load Dispatch		Generation Dispatch	
Constrained Interface	(MW)	%	(MW)	%
WEMPAD__PTDF	-1.70	-0.55%	-2.10	-0.70%
EAUARP__PTDF	5.20	1.74%	5.90	1.96%
ZIOLKVZIOADN	-5.80	-1.95%	-6.40	-2.13%
WEMPLBROE	-1.30	-0.42%	-1.60	-0.53%
MTGSPC__PTDF	-3.00	-1.02%	-1.80	-0.59%
NAPRRN__PTDF	-5.00	-1.67%	-6.00	-2.01%
ZIOARC__PTDF	-1.90	-0.64%	-2.10	-0.70%
ZIOPLP__PTDF	-3.60	-1.19%	-3.90	-1.30%
WEMPADWEMROE	-2.90	-0.97%	-3.70	-1.24%
ARNHAZ__PTDF	-6.20	-2.08%	-7.70	-2.56%
RCKXFM__PTDF	-0.10	-0.04%	0.00	-0.01%
QUARCK__PTDF	-3.40	-1.13%	-3.00	-1.01%
PPRZIO__PTDF	3.60	1.20%	3.90	1.30%
NDEX	-108.60	-36.21%	-98.40	-32.81%
MHEX_S	1.10	0.38%	1.30	0.44%
MHEX_N	-1.70	-0.58%	-1.70	-0.56%
GGS	-31.50	-10.50%	-4.70	-1.57%
GENTLMREDWIL	-6.40	-2.13%	-2.90	-0.95%
GRIS_LNC	-26.70	-8.90%	-0.90	-0.30%
COOPER_S	-1.10	-0.37%	-8.30	-2.76%
PR_ISL_BYRON	6.00	1.98%	8.50	2.84%
FTCAL_S	11.60	3.86%	-9.50	-3.17%
TIFARN__PTDF	-5.80	-1.92%	-6.40	-2.15%
AHDSTL__PTDF	0.90	0.30%	2.20	0.73%
MWEX____PTDF	5.70	1.88%	8.00	2.65%

Figure 4.4.3 - 2020 PTDF Constrained Interface Analysis results

	OTDF			
	Summer Peak 2020			
	Load Dispatch		Generation Dispatch	
Constrained Interface	(MW)	%	(MW)	%
LEEBYRNELELC	0.20	0.06%	-2.00	-0.68%
CDVNELQUA471	1.30	0.44%	-1.60	-0.54%
QUDCOR471QUD	1.30	0.42%	0.40	0.15%
QUDCORNEL471	1.30	0.42%	0.40	0.15%
ADNZIOPLPZIO	3.60	1.20%	3.90	1.31%
EAUARPWMPPAD	5.20	1.73%	5.80	1.94%
PADXFMWEMROE	-0.60	-0.19%	-0.70	-0.24%
EAUARPPRIBYR	5.40	1.79%	6.10	2.04%
PADBLKPADTLR	-0.60	-0.20%	-0.80	-0.27%
BLKCORPADTLR	-0.30	-0.09%	-0.40	-0.13%
RSSROEWEMROE	-0.30	-0.09%	-0.30	-0.12%
RRNNPTRRNGPK	0.00	0.00%	0.00	0.00%
BLKCRDWEMROE	-0.20	-0.06%	-0.20	-0.08%
PADTLRPADBLK	-0.40	-0.12%	-0.50	-0.16%
ROE_T2ROE_T3	-0.40	-0.13%	-0.50	-0.18%
TCRWIEARPRRN	1.00	0.32%	1.10	0.35%
TCRWIEEARP_G	1.40	0.47%	1.60	0.52%
PADTLRWEMROE	-0.30	-0.11%	-0.40	-0.14%
WTAPEDWERRRN	-0.80	-0.28%	-1.00	-0.33%
MTGSPCCOFPAN	-3.20	-1.07%	-1.90	-0.63%
QUA471CDVNEL	1.30	0.45%	-1.60	-0.53%
QUACDVQUA471	2.40	0.79%	-1.50	-0.51%
WEMPADZIOPLP	-2.20	-0.72%	-2.70	-0.89%
WEMPADCHVSLA	-1.40	-0.47%	-2.00	-0.66%
ZIOPLPZIOARC	-4.90	-1.65%	-5.40	-1.80%
ZIOPLPWEMPAD	-3.80	-1.28%	-4.20	-1.41%
ZIOARCZIOPLP	-3.50	-1.18%	-3.90	-1.29%
CHESILNELELC	1.90	0.63%	0.80	0.27%
NELELCCHESIL	1.90	0.64%	0.40	0.12%
LCONELWEMPAD	0.20	0.08%	1.80	0.60%
ELNHNZNAPRRN	-2.10	-0.70%	-2.60	-0.86%
PLPARCPLRRAC	-2.40	-0.79%	-2.60	-0.88%
PLPARCZIOARC	-2.20	-0.72%	-2.40	-0.81%
PLPZIOCHESIL	3.80	1.27%	4.00	1.34%
PLPZIOZIOARC	5.00	1.66%	5.40	1.82%
PZIOPLPWR_AT	-3.70	-1.24%	-4.10	-1.36%
PLPRACPLPADN	-2.80	-0.94%	-3.10	-1.04%
RRNWESRRNGPK	0.10	0.02%	0.00	-0.01%
RRNWESRRNGPK	0.10	0.02%	0.00	-0.01%
ARNHAZWEMPAD	-6.30	-2.10%	-7.80	-2.58%
LORTRKWEMPAD	-1.10	-0.36%	-1.60	-0.52%
LKJFOXARNHAZ	0.30	0.10%	-0.60	-0.18%
QUARCKCORMOL	-3.20	-1.06%	-2.50	-0.84%
RCKXFMQUADAV	0.00	-0.01%	0.30	0.09%
SALXFMQUAS91	-0.20	-0.08%	-0.20	-0.07%
SALXFMCORMOL	-0.20	-0.08%	-0.20	-0.08%
SALXFMQUADAV	-0.20	-0.08%	-0.20	-0.07%
TIFARNHILMON	-4.60	-1.54%	-4.00	-1.34%
ARNVINARNHAZ	-1.20	-0.39%	-0.80	-0.26%
DAVCALQUARCK	-1.20	-0.40%	-1.20	-0.39%
LAKFOXLAKLKF	-0.20	-0.06%	-2.20	-0.74%
DYSWASARNHAZ	-2.20	-0.73%	-2.70	-0.91%
BONBJCSYCLEH	-0.50	-0.16%	-0.40	-0.12%
BONBJCLEHWBS	-0.70	-0.24%	-1.20	-0.42%
LKJFOXLKJTRI	0.80	0.26%	-0.10	-0.02%
HAZDUNEAUARP	0.70	0.24%	0.60	0.20%
SPETRILAKRAU	0.00	0.00%	0.00	0.00%
SALXFMWEMPAD	-0.30	-0.09%	-0.30	-0.11%

	OTDF (contd)			
	Summer Peak 2020			
	Load Dispatch		Generation Dispatch	
	(MW)	%	(MW)	%
HILXFMTIFARN	-0.50	-0.18%	-0.60	-0.20%
8STKERWEMPAD	0.00	0.00%	0.00	0.00%
8STKERARNHAZ	0.00	0.00%	0.00	0.00%
LIMEMELEHWEB	2.00	0.67%	2.60	0.88%
LORTRKWPAD_G	-1.10	-0.36%	-1.60	-0.52%
VINDYSARNHAZ	-1.20	-0.39%	-0.80	-0.26%
LIMEMEADAHAZ	3.00	1.01%	4.20	1.40%
SALJCRWEMPAD	-0.80	-0.26%	-0.90	-0.30%
LKFFOXLKFWLM	-0.20	-0.08%	-2.20	-0.74%
ARNHAZMTZBON	-5.70	-1.90%	-6.40	-2.12%
SALXFMTIFARN	-0.30	-0.09%	-0.30	-0.10%
SALXFMHL3TIF	-0.30	-0.09%	-0.30	-0.11%
TIFARNMTZBON	0.00	0.00%	0.00	0.00%
EMELIMEMEFYD	-2.00	-0.68%	-3.10	-1.03%
HAZX21HAZX22	0.50	0.16%	1.20	0.40%
FOXRUTLKGWLM	-3.30	-1.09%	-7.50	-2.51%
RUTWBOLKFWLM	0.00	0.00%	0.00	0.00%
DUNHAZARNHAZ	-1.40	-0.47%	-1.40	-0.48%
PLPRACADNZIN	-2.80	-0.93%	-3.10	-1.02%
NAPFOXNAPKEW	2.70	0.89%	3.10	1.04%
NPTRKRGDRRKR	0.00	0.00%	0.00	0.00%
WIAHOVRKRWRW	0.70	0.24%	0.90	0.29%
WRWWRNWRWNA	2.50	0.82%	3.00	1.00%
SJHALKNAIASC	0.00	0.00%	0.00	0.00%
IASCLKNASJHA	0.00	0.00%	0.00	0.00%
GEACOEGEAMRL	-1.60	-0.54%	-2.20	-0.73%
BYRMLFBYRPVV	1.30	0.42%	1.50	0.51%
BYRMLFPVVADM	0.90	0.31%	1.10	0.37%
ALMWABPRISBY	0.40	0.13%	-0.10	-0.04%
ALMELKKGEUAR	0.00	0.00%	0.00	0.00%
SUBTEKFTCRAU	-2.90	-0.98%	3.00	1.01%
TEKRAUCOONEB	-3.10	-1.02%	1.40	0.47%
ADMXFMHAZADM	3.20	1.08%	4.70	1.57%
PLYSOURAUSOU	-6.10	-2.03%	-15.20	-5.08%
SONCOCCOCCCT	-0.60	-0.20%	-2.30	-0.76%
SONCCTCOCSON	0.60	0.21%	2.20	0.73%
WABROCPRISBY	-0.40	-0.12%	0.20	0.06%
READEMMTZBON	1.70	0.58%	3.60	1.21%
ARNHAZ__SRC3	-6.40	-2.13%	-7.90	-2.65%
QUAD91CORD39	1.40	0.48%	4.00	1.34%
CORS39QUAD91	1.40	0.47%	3.70	1.24%
92HILLOUHILL	0.10	0.03%	3.60	1.20%
GENLACGENCOU	-1.90	-0.63%	-2.50	-0.84%
ADARCRADAPVV	-2.40	-0.82%	-3.70	-1.23%
ADARCRBYRBYR	-1.40	-0.47%	-2.10	-0.71%
ADARCRBYRPVV	0.00	0.00%	0.00	0.00%
HAZBAHHAZWAS	0.70	0.23%	1.80	0.59%
LANGENHARGEN	-0.60	-0.20%	-1.10	-0.36%
BNDSYCGDMSEP	3.50	1.17%	8.90	2.97%
MNTBNDTIFARN	2.80	0.92%	8.10	2.71%
CBLRVBCOOJOE	-0.10	-0.04%	-1.10	-0.36%
ADABEAMCHHAZ	1.90	0.63%	1.90	0.64%
ROCWABJPMALM	0.70	0.22%	0.20	0.08%
ROCWABKNGARP	0.80	0.25%	0.40	0.14%
ADABVRGENOAG	0.80	0.28%	0.70	0.22%
BVRHRMHAZMTC	1.40	0.45%	1.30	0.42%
BVRHRMBYRADM	0.80	0.27%	0.50	0.15%
HAZWASHAZBLA	0.80	0.26%	1.70	0.58%

Figure 4.4.4 - 2020 OTDF Constrained Interface Analysis results

4.5 Steady State Conclusions

Steady state analysis of the GI-0704 & GI-0716 project was completed by doing thermal, voltage, and constrained interface analysis. The thermal and voltage results showed several impacted facilities due to the interconnection of this generator. Several facilities outside of the "interconnection" region of this generator are near or over their facility ratings. This may be due to prior queued projects or the delivery of this project. The distribution factor analysis showed no third party flowgates were impacted based on the assumed delivery.

5.0 Stability Analysis

The purpose of the stability analysis is to determine whether the MAPP system would meet stability criteria following commissioning of the proposed GI-0704 & GI-0716 plant. To that end, faults were simulated in Northern MAPP to assess the impact of the proposed project on transmission system stability.

5.1 Computer Programs and Input Files

The NMORWG pkg2010-1-05-2010 was the starting point for this study. All simulations were created using PSS/e Rev 29.4.

5.2 Model Development

The cases used for the stability analysis were the "es0, es1, es2, and es3" cases as discussed in section 3.5.3 Summer Off-peak High Transfer Model Development. The dynamics models used for this generator analysis were the GENROU, ESST4B, and GAST models and the information can be seen in Appendix ?

5.3 Disturbance Definitions

The disturbances used to test the northern MAPP region included the ag1, ei2, and nmz disturbance files as well as the rest of the standard NMORWG disturbance files. These faults are defined as follows:

- **ag1** – Single line to ground fault on the Leland Olds to Fort Thompson 345 kV line with Leland Olds breaker stuck
- **ei2** – Permanent bipole fault on the Coal Creek DC line
- **nmz** – Three phase fault at Chisago, trip F601C, Cross trip D602F

The fault files were used to check the transient response of the system with and without GI0704 online.

In addition to the standard faults within the NMORWG package, additional local faults were studied as shown in **Table 5.1.**

Fault Name	Faulted Bus	Fault Type	Clearing Time (cycles)	Initial Clearing	Backup Clearing (cycles)	Backup Clearing
fbs	Fieldon Bypass		5	Bypass Fieldon capacitor without a fault		
lgs	Lakefield Gen 345 kV	3-phase	4	Lakefield Gen-Lakefield Jct. 345 kV, bypass Fieldon Series Compensator, trip Lakefield Jct.-Nobles 345		
ljs	Lakefield Jct. 345 kV	3-phase	4	Lakefield Gen-Lakefield Jct. 345 kV, bypass Fieldon Series Compensator, trip Lakefield Jct.-Nobles 345		
lns	Lakefield Jct 345 kV	SLGBF	4	Lakefield Jct.-Nobles 345 kV	11	Lakefield Jct. breaker stuck, Lakefield Jct. 345/161 tx
lnz	Lakefield Jct. 345 kV	3-phase	4	Lakefield Jct.-Nobles 345 kV		
na3	Brookings Co. 345 kV	3-phase	6	Brookings Co.-White 345 kV #1		
ne3	Nobles 345 kV	3-phase	6	Nobles-Split Rock 345 kV		
nf3	Nobles Co. 345 kV	3-phase	6	Nobles Co. - Lakefield 345 kV		
nls	Nobles 345 kV	SLGBF	4	Nobles - Lakefield Jct. 345 kV	11	Nobles breaker stuck, trip Nobles 345/115 tx #1
nlz	Nobles 345 kV	3-phase	4	Nobles - Lakefield Jct. 345 kV		
nmz	Chisago 500 kV	3-phase	4	Chisago - Forbes 500 kV		
nns	Split Rock 345 kV	SLGBF	4	Split Rock - Nobles 345 kV	11	Nobles breaker stuck, trip Nobles 345/115 tx #1
np3	Fenton 115 kV	3-phase	6	Fenton - Nobles co. 115 kV #1		
sns	Split Rock 345 kV	SLGBF	4	Split Rock - Nobles 345 kV	11	Split Rock breaker stuck, trip Split Rock-Sioux City
snz	Split Rock 345 kV	3-phase	4	Split Rock - Nobles 345 kV		
sss	Split Rock 345 kV	SLGBF	4	Split Rock - Sioux City 345 kV	11	Split Rock breaker stuck, trip Split Rock-Nobles 345
ssz	Split Rock 345 kV	3-phase	4	Split Rock - Sioux City 345 kV		
swz	White 345 kV	3-phase	4	Split Rock - White 345 kV		
vts	Lakefield Gen 345 kV	3-phase	4	Wilmarth-Fieldon 345 kV, bypass Fieldon Series Cap		
wds	Wilmarth 345 kV	3-phase	4	Wilmarth-Fieldon 345 kV,trip all Lakefield generations, close Fieldon bypass,trip Wilmarth-Lakefield Jct. 345 kV	7	trip Lakefield Jct. Nobles Co. 345
ws3	White 345 kV	3-phase	4	White - Split Rock 345 kV		
wss	Split Rock 345 kV	SLGBF	4	Split Rock - White 345 kV	11	Split Rock breaker stuck, trip Split Rock 345/115 tx
wts	Wilmarth 345 kV	SLGBF	4	Wilmarth-Fieldon 345 kV, breaker 8S32 stuck,trip all Lakefield generations, close Fieldon bypass,trip Wilmarth-Lakefield Jct. 345 kV	7	trip Lakefield Jct. Nobles Co. 345, trip MEC ST at 10
ye3	Leland olds 345 kV	3-phase	4	Leland olds - GI-0616 345 kV		
yf3	GI-0619 345 kV	3-phase	4	GI-0619 - Groton 345 kV		
yg3	White 345 kV	3-phase	4	White - Watertown 345 kV		

Table 5.1 – Area faults

5.4 Performance Criteria

The study criteria and the methodology and procedures as documented in the *"MAPP Operating Study Manual"* are followed in this study.

5.5 Stability Results

The following section lists the results from the regional and local area stability results. For all tables and other stability information please see Appendix C. The cases used for the stability analysis were the "es0, es1, es2, es3" cases which are described in section 3.5.4 under model development. The corresponding stability summary tables for the stability analysis can be found in Appendix C as well.

5.5.1 Regional Stability Results

Three critical buses that have been noted with low voltages in the past are compared. The following Table 5.2 shows that the addition of the generator does not degrade any of the transient voltages at these buses nor other stations below criteria for the regional faults.

The analysis of the stability runs for the “es0 ,es1,es2, es3” cases on the local faults that were studied showed that the addition of the generator for request GI-0704 and GI-0716 does not adversely affect the region or local area. In general, voltage profiles unchanged and faults were well damped.

	Groton 345 kV (PU) Transient Voltage Minimum			Wahpeton 115 kV (PU) Transient Voltage Minimum			Watertown 345 kV (PU) Transient Voltage Minimum		
	Disturbance			Disturbance			Disturbance		
	ag1	ei2	nmz	ag1	ei2	nmz	ag1	ei2	nmz
es0-so15aa Base Case	0.94	0.92	0.94	0.95	0.85	0.86	0.97	0.92	0.94
es1-so15aa GI0704 Added	0.94	0.93	0.94	0.95	0.85	0.86	0.98	0.93	0.94
es2-so15aa GI0704 Added	0.94	0.93	0.94	0.95	0.84	0.86	0.98	0.92	0.94
es3-so15aa GI0704 Added	0.94	0.92	0.94	0.95	0.83	0.85	0.98	0.92	0.93

Figure 5.2 - Transient Voltage dips with high SWMN wind

5.5.2 Local Stability Results

Local stability analysis included faults at the White 345 kV bus. All faults met criteria and were well damped. All stability tables and plots can be seen in Appendix C.

5.6 Stability Sensitivity

Case “ds1-so12aa” was developed to determine if not having the Center – Grand Forks 345 kV line in service would result in unacceptable the stability results. The analysis of the stability runs for the “ds1” case on the local faults and regional faults that were studied showed no stability violations.

5.7 Prior Outage Stability Analysis

Prior outage analysis was done for Center – Jamestown 345 kV line, and for the Leland Olds – Ft. Thompson 345 kV line.

5.7.1 Prior Outage of Center – Jamestown 345 kV (eb)

Stability Analysis for the prior outage eb (Center – Jamestown 345 kV) showed no transient stability issues and all faults were well damped.

	Groton 345 kV (PU)			Wahpeton 115 kV (PU)			Watertown 345 kV (PU)		
	Disturbance			Disturbance			Disturbance		
	ag1	ei2	nmz	ag1	ei2	nmz	ag1	ei2	nmz
es0-so15eb Base Case	0.93	0.90	0.93	0.95	0.83	0.86	0.97	0.92	0.94
es1-so15eb GI0704 Added	0.93	0.91	0.94	0.95	0.84	0.86	0.97	0.92	0.94
Delta Impact	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00

5.7.2 Prior Outage of Leland Olds – Ft. Thompson 345 kV (ag)

Stability Analysis for the prior outage ag (Leland Olds – Ft. Thompson 345 kV) showed no transient stability issues and all faults were well damped.

	Groton 345 kV (PU)			Wahpeton 115 kV (PU)			Watertown 345 kV (PU)		
	Disturbance			Disturbance			Disturbance		
	ag1	ei2	nmz	ag1	ei2	nmz	ag1	ei2	nmz
es0-so15ag Base Case	NA	0.90	0.92	NA	0.83	0.86	NA	0.92	0.94
es1-so15ag GI0704 Added	NA	0.91	0.93	NA	0.84	0.86	NA	0.92	0.94
Delta Impact		0.01	0.01		0.01	0.00		0.00	0.00

Note: Fault ag1 was not simulated as the faulted line was already out of service for the prior outage condition.

6.0 Short Circuit Analysis

The purpose of the short circuit analysis is to determine the impact of the proposed project on station equipment in the region. Breakers are analyzed to see if there is enough breaking capability after the addition of the project. The PSSE tool "ASCC" was used for this purpose.

6.1 Base Case Development

The pre-project model used for this analysis was the short-circuit case "*08sc-102208.sav*" included in the 2010 NMORWG Study Package.

Starting from this case, a post-project case was developed by adding the proposed GI-0704 & GI-0716 project and associated upgrades described in section 3. Suitable assumptions were made for the sequence data required for these additions.

6.2 Short-Circuit Calculations

Short-circuit calculations were performed to determine the impact of the proposed project on substation fault current levels. Three-phase and single-line-to-ground (SLG) symmetrical fault current levels were calculated at all study area buses rated 69 kV and above, both without and with the proposed project and the proposed network upgrades. In order to calculate fault current levels, classical fault assumptions were used with a pre-fault voltage of 1.0 p.u.

Figure 6.1 lists the three-phase and SLG fault current levels at the substations in the vicinity of GI-0704 & GI-0716. The highest of these fault currents was compared against the lowest rated circuit breaker at each of these substations to determine whether or not the circuit breaker may be overstressed. Lowest breaker ratings were not available for all of the area substations.

The comparison showed that the calculated fault current levels increased yet did not exceed the lowest breaker rating substations analyzed. The calculated fault currents should be compared against the corresponding lowest breaker ratings when this information becomes available in order to determine whether existing breakers at these substations could become overstressed and whether mitigation may be required.

BUS		MIN. BREAKER	WITHOUT GI-0704 (1)		WITH GI-0704 (2)		CHANGE (2)-(1)	
NO.	NAME	RATING	FAULT CURRENT (AMP)		FAULT CURRENT (AMP)		AMP	
		AMP	3-PH	SLG	3-PH	SLG	3-PH	SLG
66537	WHITE 3 345		6795.9	5723.9	7954.8	6234.3	1158.9	510.4
60383	BRKNGCO3 345		6771.7	5683.2	7920.5	6185.7	1148.8	502.5
60129	SPLT RK7 115		26742.4	15914.3	27685.1	16132.6	942.7	218.3
60382	BRKNGCO7 115		11970.3	1399.4	12848.6	1406.9	878.3	7.5
60015	ANSON CG 115		23906.1	14371.5	24656.9	14549.3	750.8	177.8
60125	PATHFDR7 115		21852.6	12957.6	22477.9	13101.8	625.3	144.2
60122	LAWRENC7 115		22332.7	15480.2	22951.2	15675.8	618.5	195.6
66524	SIOUXFL7 115		20235.3	16589.7	20716.1	16803.2	480.8	213.5
66529	WATERTN3 345		7053.8	7250.2	7527.1	7576.5	473.3	326.3
60130	SPLTRTA3 345		9013.2	4985.1	9459	5073.4	445.8	88.3
66530	WATERTN4 230		11002.3	11052	11433	11337.9	430.7	285.9
60126	SPLT RK3 345		9759.3	5175.8	10187.2	5254	427.9	78.2
60381	YANKEE 7 115		9403	1528.7	9814.2	1535.6	411.2	6.9
60131	SPLTRTB3 345		9208.5	4904.9	9557.4	4969.5	348.9	64.6
66538	WHITE 7 115		7554.5	8983.1	7865	9273.7	310.5	290.6
66531	WATERTN7 115		11525.9	13243.3	11756.6	13445.1	230.7	201.8
60287	NOBLES 7 115		16849.5	0	17053.4	0	203.9	0
66523	SIOUXFL4 230		10729.8	7818	10910.8	7881.9	181	63.9
60127	SPLT RK4 230		10474.1	7550.6	10651.3	7611.8	177.2	61.2
60279	BUFFRID7 115		8792.5	2072.9	8959.2	2078.9	166.7	6
67451	WTRTNPP 115		9506.8	5547	9658.1	5580.8	151.3	33.8
60121	MINEHAH7 115		10991.9	6847.8	11141.4	6886.1	149.5	38.3
66504	BROOKNG7 115		6482.9	4947.9	6631.7	5005.1	148.8	57.2
66512	GROTON 7 115		14330.2	14968.3	14461.9	15063.8	131.7	95.5
67275	GROTONB7 115		14314.7	15062.1	14445.9	15158.6	131.2	96.5
60286	NOBLES 3 345		7440.8	3708.4	7559.2	3727.8	118.4	19.4
60117	CHERRYC7 115		9176.7	5504.5	9283.5	5529.9	106.8	25.4
66564	SIOUXCY3 345		14865.3	8831.9	14963.6	8855.1	98.3	23.2
60132	WSX FLS7 115		8645	5102.8	8740	5124.7	95	21.9
63875	RAUN 3 345		31981.4	31614.6	32075.2	31675.7	93.8	61.1
60124	LINCNCO7 115		8553.2	5217.9	8644.4	5240.3	91.2	22.4
66503	BLAIR 4 230		7651.2	5947.3	7741.1	5983	89.9	35.7
67160	GROTON 3 345		5075.1	4744.6	5158.1	4792.6	83	48
66514	HURON 4 230		9529	8808.6	9611.3	8855.6	82.3	47
60128	SPLT RK5 161		7049.7	4903.8	7127.5	4928.8	77.8	25
66515	HURON 7 115		13064	14696	13135.5	14756.6	71.5	60.6
67205	BRDLAND4 230		8760.2	7649	8827.5	7683.3	67.3	34.3
66294	IVANHOE7 115		3415.9	2548.3	3478.3	2571.3	62.4	23
66550	GRANITF4 230		7561.9	6062.8	7623	6088.7	61.1	25.9
66507	FTTHOMP4 230		16474.6	16008.8	16534.2	16047.6	59.6	38.8
60123	PIPESTN7 115		6886.6	2132.9	6944.3	2136.5	57.7	3.6
60384	FENTON 7 115		8567.8	0	8623.8	0	56	0
60148	MINVALY7 115		10126.8	8487.8	10181.1	8513	54.3	25.2
66551	GRANITF7 115		9988.8	10576.5	10042.7	10616.4	53.9	39.9
60150	MNVLTAP4 230		7045.4	5482.3	7096.9	5502.8	51.5	20.5
60149	MINVALT4 230		6991.2	5439.3	7041.8	5459.5	50.6	20.2
60147	MINVALY4 230		6749.9	5367.2	6798.5	5387.5	48.6	20.3

Figure 6.1- GI-0704 & GI-0716 Short Circuit comparison

7.0 Conceptual Costs

The costs associated with the interconnection of this project are laid out in this section. These are conceptual costs for any facilities identified in this report which are deemed necessary to interconnect. A corresponding facility study will look at each of the facilities identified in the results section of this report. The facility study will determine a much finer detailed cost to build or uprate those facilities than that which is shown below.

As described in the section 4 of this report the following facilities would be required to be built or uprated for the introduction of this generator.

Uprate Facilities

- White – Split Rock 345 kV line to at least 855 MVA
- Brookings – Aurora – Flandreau 115 kV line to 145 MVA

The preliminary conceptual costs for the addition of project GI-0704 are shown in the following table 7.1. These facilities were identified from the thermal, stability, and short circuit analysis.

Facility Additions (345 kV station @ GI-0704	**Quantity**		**Unit Costs ($$ Million)**	**Total Costs ($$ Million)**
New 345 kV breaker	1		$1,000,000	$1,000,000
Circuit breakers				
Switches				
Buswork, materials, relays, etc				
Construction				
Subtotal of Facility Additions				**$1,000,000**
Uprates to Increase Line Rating Limits				
Uprates to White - Split Rock 345 kV line to 855 MVA	2		$500,000	$1,000,000
Uprates to Increase Line Rating Limits				
Uprates to Brookings - Aurora - Flandreau 115 kV line to 145 MVA	3		$250,000	$750,000
Subtotal of Uprates				**$1,750,000**
Total Project Estimate				**$2,750,000**
Note : The assumption for increasing line ratings was for new terminal equipment per 345 kV substation at $500,000				

Table 7.1 – GI-0704 Conceptual Cost Estimate

8.0 Conclusion

The out of queue study results show that the addition of the 300 MW combined cycle generator, consisting of request GI-0704 & GI-0716, to be fed into the bulk electric system through the White 345 kV substation does not degrade the reliability of the MAPP system.

The following is a summary of study results:

Stability Analysis:
The impact of the proposed generator on local area and regional stability performance was evaluated. Results indicate that the proposed project would not adversely impact local and regional area stability.

Steady-State Analysis:
The interconnection of the proposed generator does impact some of the interconnecting transmission facilities. Some steady-state criteria violations flagged but were based upon the modeled delivery of the generator's output of 300 MW sunk to load or to other generation.

The analysis was performed for both near-term cases (2010 timeframe) and out-year cases (2020 timeframe) for both peak and off peak scenarios. The following conclusions are drawn:

- One system intact violation was introduced by this project.

CIRCUIT/WINDING CKT # NAME #	TO NAME #	RATE MVA	Precase MVA	Postcase MVA	**Diff MVA**	**DF %**
601007 SPLTRTA3 345.0	652537 WHITE 3 345.0 1	717.0	624.1	780.6	156.5	52.17%

- Post-contingency overloads were observed on the following:

CIRCUIT/WINDING CKT # NAME #	TO NAME #	RATE MVA	Precase MVA	Postcase MVA	**Diff MVA**	**DF %**
601007 SPLTRTA3 345.0	652537 WHITE 3 345.0 1	717.0	692.6	854.98	162.38	54.13%
652529 WATERTN3 345.0	WATERTN4 230.00 230/1 1	400.0	370.3	497.88	127.58	42.53%
652504 BROOKNG7 115.0	652538 WHITE 7 115.0 1	160.0	132.5	165.99	33.49	11.16%
652474 AURORA 7 115.0	652505 FLANDRU7 115.0 1	120.0	114.2	139.9	25.7	8.57%
652474 AURORA 7 115.0	652504 BROOKNG7 115.0 1	120.0	125	143.68	18.68	6.23%

The Watertown 230/345 kV transformer and the Brookings – White 115 kV line are below their emergency rating therefore this generator may be able to reduce in order to clear those violations. The Brookings – Aurora – Flandreau 115 kV line is overloaded in the summer off peak high transfer and high wind case, yet it is not overloaded in the summer peak high wind sensitivity, therefore it is not considered an injection constraint.

Constrained Interface Analysis:
The study also evaluated the impact of the proposed project on constrained interfaces in the MAPP system. These results are to identify potential third party flow gate issues for the assumed delivery to Basin generation and Basin load. Results indicate that the proposed project does not adversely impact any third party flowgates.

Short-Circuit Analysis:
The addition of the proposed GI-0704 & GI-0716 project increases fault currents in the study area. Initial analysis of breakers does not show any unacceptable current limitations, however, all breaker ratings were not available for the impacted substations. When this information does

become available, the calculated fault currents should be compared against the breaker ratings in order to determine whether existing breakers at these substations could become overstressed and whether breaker replacements may be required.

Injection Related Constraints:

Of the violations listed in this report, there is one facility considered an injection related constraint. This constraint was seen during light load and high wind conditions with the interconnection of this generator which included the following:

- White – Split Rock 345 kV line

This impacted facility can be mitigated by upgrading substation terminal equipment for system intact conditions and post contingent runbacks of Deer Creek for prior outage conditions.

These study results indicate the addition of the generator which comprises of requests GI-0704 & GI-0716, will not degrade the reliability of the MAPP system. It does result in some unacceptable loading conditions due to the interconnection of the project. The generator does not negatively impact the voltage profile in the areas studied and does not negatively impact any the area's stability performance or stability limited interfaces performance. The study results demonstrate that the Western Area Power Administration (Western)/ Basin Electric Power Cooperative (Basin)/ Heartland Consumers Power District Integrated System (IS) is capable of accommodating the interconnection request.

The results of this study are based on available data and assumptions made at the time of conducting this study. If any of the data and/or assumptions made in developing the study models change, the results provided in this report may not apply.

APPENDICIES

Appendix A – Model Documentation

- Appendix A.1 – Case Naming Convention
- Appendix A.2 – Generator Power flow data
- Appendix A.3 – Generator dynamic data
- Appendix A.4 – Power Flow information files

Appendix B – Power flow summary reports and maps

- Appendix B.1 – GI-0704 & GI-0716 location
- Appendix B.2 – SUOP 2010
- Appendix B.3 – SUPK 2010
- Appendix B.4 – WIPK 2010
- Appendix B.5 – SUPK 2020
- Appendix B.6 – SUOP 2020

Appendix C – Transient Stability Tables

- Appendix C.1 – Table of Faults Ran
- Appendix C.2 – GI-0704 & GI-0716e 2015 Summer Off Peak Stability Tables
- Appendix C.3 – GI-0704 & GI-0716eb 2015 Summer Off Peak Stability Tables
- Appendix C.4 – GI-0704 & GI-0716ag 2015 Summer Off Peak Stability Tables
- Appendix C.5 – GI-0704 & GI-0716e 2015 Summer Off Peak Stability Plots
- Appendix C.6 – GI-0704 & GI-0716eb 2015 Summer Off Peak Stability Plots
- Appendix C.7 – GI-0704 & GI-0716ag 2015 Summer Off Peak Stability Plots

Appendix D – Thermal and Voltage Analysis

- Appendix D.1 – SUOP 2010 – Thermal Analysis
- Appendix D.2 – SUOP 2010 – Voltage Analysis
- Appendix D.3 – SUPK 2010 – Thermal Analysis
- Appendix D.4 – SUPK 2010 – Voltage Analysis
- Appendix D.5 – WIPK 2010 – Thermal Analysis
- Appendix D.6 – WIPK 2010 – Voltage Analysis
- Appendix D.7 – SUPK 2020 – Thermal Analysis
- Appendix D.8 – SUPK 2020 – Voltage Analysis
- Appendix D.9 – SUOP 2020 – Thermal Analysis
- Appendix D.10 – SUOP 2020 – Voltage Analysis

Appendix E – Distribution Factor Analysis

- Appendix E.1 – Summer Peak 2010 gen to gen
- Appendix E.2 – Summer Peak 2010 gen to load
- Appendix E.3 – Summer Peak 2020 gen to gen
- Appendix E.4 – Summer Peak 2020 gen to load

Appendix F – Short Circuit Analysis

- Appendix F.1 – Short Circuit Analysis

Appendix G – Stability Sensitivity

- Appendix G.1 – GI-0704 & GI-0716 2012 Summer Off Peak Stability Tables
- Appendix G.2 – GI-0704 & GI-0716 2012 Summer Off Peak Stability Plots