

# Final Report

System Impact Study - Project # GI-0217  
500 MW Coal Fired Plant in Stark County, ND  
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## Executive Summary

Western Area Power Administration (WAPA) commissioned ABB Inc., to perform a system impact study for the interconnection of Project # GI-0217, a 500 MW (net) coal fired generation plant to be located in Stark County, ND. The proposed plant has requested interconnection in to the Belfield 345 kV substation via a new eight-mile long 345 kV line. This system impact study includes system performance evaluation based on stability, steady-state, and short-circuit analyses.

WAPA has indicated that the scope of the system impact studies is limited to identifying and resolving possible criteria violations that may limit the ability of the generator to interconnect, and that the results of the studies do not, in any way, imply deliverability.

The following is a summary of study results.

### Stability Analysis:

The results of the stability analysis indicate that the addition of the proposed GI-0217 plant would adversely impact both local and regional stability performance.

For local-type contingencies, the dynamic performance following outage of any 345 kV section of the line between Belfield and Antelope Valley is unacceptable. In addition to significant system-wide oscillations, transient voltage violations were observed at several nearby buses following the outage of the Belfield-Charlie Creek 345 kV line, regardless of whether this outage is triggered by a fault. Installation of both a generation tripping scheme (to trip the proposed plant following the loss of the Belfield-Charlie Creek 345 kV line) and a well-tuned PSS at Belfield (to damp oscillations following the loss of the Charlie Creek-Antelope Valley 345 kV line) is recommended to alleviate the local area stability problems.

For regional contingencies, stability criteria violations were observed for the following faults (these faults were simulated with delayed recovery modeled on the Square Butte HVdc line):

- *fd3* – 5 cycle 3-phase fault on Square Butte-Stanton 230 kV line
- *bl3* – 5 cycle 3-phase fault on Stanton-Leland Olds 230 kV line

- *ec3* – 5 cycle 3-phase fault on Center-Heskett 230 kV line
- *ed3* – 5 cycle 3-phase fault on Stanton-Square Butte 230 kV line
- *ef3* – 5 cycle 3-phase fault on Stanton-Coal Creek-McHenry 230 kV line

Particular attention was given to fault *fd3* because this fault resulted in the lowest transient voltages at the Jamestown 345 kV bus. Three options were investigated to alleviate the pre- and post-project *fd3* violations:

Option 1 involves providing reactive support in the form of capacitors and SVCs at the Jamestown 345 kV bus. Results indicate that in addition to the compensation required to address the violations without the GI-0217 plant, an additional 30 to 35 MVAR capacitor and an additional 20 to 30 MVAR SVC mitigate the post-project *fd3* violations.

Option 2 involves adding series compensation on the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines. Considering that the level of series compensation required to mitigate the pre- and post-project *fd3* violations is in the order of 60% to 75%, this solution is not considered viable.

Option 3 involves reducing the *fd3* fault clearing time from the present 5 cycles to 4 cycles. With 4 cycle fault clearing, there are no pre- and post-project criteria violations.

Similarly, the transient voltage violations following faults *b/3*, *ec3* and *ed3* can be mitigated by reducing the corresponding fault clearing times from the existing 5 cycles to 4 cycles. Mitigation of fault *ef3* would require both 4 cycle clearing and a 20 MVAR switched shunt at the Jamestown 345 kV bus.

To achieve the 4 cycle fault clearing time, the feasibility of using faster breakers at the following substations should be investigated:

- Square Butte 230 kV substation on the Square Butte-Stanton 230 kV line. This would resolve both the *fd3* and *ed3* violations.
- Center 230 kV substation on the Center-Heskett 230 kV line (for fault *ec3*).
- Stanton 230 kV substation on the Stanton-Leland Olds 230 kV line (for fault *b/3*) and the Stanton-Coal Creek-McHenry 230 kV line (for fault *ef3*). In addition to the 4 cycle clearing, mitigation of fault *ef3* would require the addition of a 20 MVAR switched shunt at Jamestown 345 kV as described above.

A sensitivity analysis was performed to check post-project stability performance with a new Belfield-Hettinger 230 kV line and a second 345/230 kV transformer at Belfield (these reinforcements are effective in mitigating the injection related steady-state criteria violations, as explained below). As before, faults *fd3*, *b/3*, *ec3* and *ef3* resulted in transient voltage violations in the Jamestown area. Results indicate that these violations are less severe than those previously observed. In other words, the proposed Belfield area reinforcements help improve the transient voltages at Jamestown 345. No transient voltage violations were observed following fault *ed3*. With 4 cycle fault

clearing, there were no criteria violations for faults *fd3*, *bl3*, *ec3* and *ef3*. As before, the feasibility of using faster breakers at the Square Butte, Center and Stanton 230 kV substations should be investigated. Examination of the local area fault results indicate that with the proposed reinforcements, there is no need to trip the proposed GI-0217 plant following the loss of any section of the 345 kV line between Belfield and Antelope Valley. This performance improvement can be attributed to the availability of the new transmission outlet between the Belfield and Hettinger.

#### Steady-State Analysis:

The results of the steady-state analysis indicate that the addition of proposed GI-0217 plant would adversely impact transmission system performance, both under system intact and contingency conditions. Although several transmission facilities were significantly impacted, particular attention was given to the following facilities that became newly overloaded following the addition of the proposed plant. These facilities are at or in the immediate vicinity of the Belfield substation.

- Belfield 345/230 kV transformer
- Dickinson 230/115 kV transformer
- Dickinson – S. New England 115 kV line
- Belfield – Charlie Creek 345 kV line
- Belfield – Dickinson 230 kV line

Results indicate that the above overloads can be mitigated through the following three network reinforcements:

1. Addition of a Belfield-Hettinger 230 kV line.

*Instead of a Belfield-Hettinger 230 kV line, other transmission alternatives can be considered. One such alternative is to add a second 230/115 kV transformer at Dickinson and upgrade / reconductor the Dickinson-Hettinger 115 kV line such that its emergency rating is at least 130 MVA. The feasibility of reconductoring / rebuilding this 115 kV line should be investigated. Furthermore, terminal equipment uprates / replacements will be required on Belfield-Dickinson 230 kV line to mitigate the observed post-contingency overloads.*

2. Change terminal equipment settings on the Belfield – Charlie Creek 345 kV line.
3. Addition of second Belfield 345/230 kV transformer (identical to the first). In addition, any one of the following alternatives should be implemented to avoid overloading each transformer following the loss of the parallel transformer.
  - a. Trip the remaining in-service transformer.
  - b. Optionally, if it is desired to have at least one of the two transformers in-service, the proposed plant should be run back to approx. 170 MW to alleviate the overload.
  - c. Yet another possibility is to replace the existing transformer with a larger unit (say 250 MVA normal / 450 MVA emergency) and size the second

transformer such that it is identical to the replacement. This will eliminate the need to trip the remaining in-service transformer or to run back the proposed plant.

*In lieu of transformer #2 at Belfield, another possibility may be to replace the existing transformer with one rated at least 450 MVA normal / 515 MVA emergency.*

#### Constrained Interface Analysis

The study also evaluated the impact of the proposed project on constrained interfaces in the MAPP system. These results are for informational purposes only to identify potential third party flowgate issues for the requested delivery component of the transmission. Results indicate that the proposed project adversely impacts several MAPP interfaces. See [Section 5](#) of this report. Mitigation may be required if it is determined that there is insufficient or no available transfer capability (ATC) on the affected MAPP constrained interfaces. Such an assessment can be made as part of the delivery studies, if deemed necessary.

#### Short-Circuit Analysis:

The addition of the proposed GI-0217 project increases fault currents in the study area. Pre- and post-project fault currents were compared against the lowest breaker rating at each of the impacted substations to determine whether breakers at these substations could be overdutied.

Not all the impacted stations had the breaker ratings available. At the stations for which breaker ratings were available, the comparison did not indicate fault levels exceeding the respective lowest breaker ratings. For the remaining substations, 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 breaker replacements may be required.

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.

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## 1. INTRODUCTION

Western Area Power Administration (WAPA) commissioned ABB Inc., to perform a System Impact Study for the interconnection of Project # GI-0217, a 500MW (net) coal fired generation project to be located in Stark County, ND. The proposed plant has requested interconnection in to the Belfield 345 kV substation via a new eight-mile long 345 kV line. The projected plant in-service date is April 1, 2013.

Section 2 describes the study methodology and criteria used for the analyses. Results of the stability and steady-state analysis are presented in Sections 3 and 4 respectively. Constrained interface analysis and short-circuit analysis results are presented in Sections 5 and 6 respectively.

## 2. STUDY METHODOLOGY

### 2.1 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-0217 plant. To that end, faults were simulated in Northern MAPP to assess the impact of the proposed project on transmission system stability. Preliminary solutions were identified and tested for faults that resulted in stability criteria violations.

### 2.2 Steady-State Analysis

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

#### 2.2.1 System Intact Analysis

The incremental impact of the GI-0217 project on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows with and without the proposed project. For this purpose, full ac power flow solutions were used.

All transmission facilities rated 110 kV and above were monitored in the WAPA, OTP, GRE, MP, XEL and MH control areas. The criterion used to flag thermal overloads is 100% of continuous facility rating (Rate A in PSS/E). Significantly Affected Facilities (SAF) were identified based on the following criteria: All overloaded facilities that have a TDF (Transfer Distribution Factor) greater than 2% of the generation addition and an increase in flow of at least 1 MW (without plant vs. with plant) are flagged as significantly affected facilities.

Monitored bus voltages that fall outside the band 0.95 pu – 1.05 pu are flagged as violations. Those buses that have a voltage change of more than 0.01 p.u. (without plant vs. with plant) are included in the SAF list.

#### 2.2.2 Contingency Analysis

Contingency analyses include single branch and selected multi-element contingencies on facilities rated 115 kV and above. Single branch as well as multi-terminal outages in WAPA, and single branch contingencies in OTP, GRE, MP and XEL were considered. Select multi-terminal outages were also considered in Northern MN. All facilities rated 110 kV and above were monitored in the WAPA, OTP, GRE, MP, XEL and MH control areas.

Contingency analysis was performed using the GRE Contingency Program “*contingency.irf*”. Contingencies were solved with phase shifters and transformer taps enabled. Thermal violations were flagged based on facility emergency ratings (Rate C in PSS/E). Post-contingency power flows in excess of 90% of the Rate C were recorded. Facility loadings with and without the GI-0217 plant were

tabulated and compared. The criteria used to flag thermal overloads is 100% of Rate C.

For contingency conditions, monitored bus voltages outside the range 0.90 pu – 1.10 pu are flagged as violations (Note: It is our understanding that the overvoltage threshold of 1.10 pu is hardcoded in the GRE contingency program; the user can define only an undervoltage threshold)

Significantly Affected Facilities (SAF) were identified using the same criteria as in the system intact analysis.

### **2.3 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.

### **2.4 Short-Circuit Analysis**

The purpose of the short-circuit analysis is to identify breakers in the transmission system that will not be able to handle the increased fault current due to the addition of the proposed GI-0217 project. Three-phase and single-line-to-ground faults were simulated and the impact of the proposed project the fault currents was determined.

### 3. STABILITY ANALYSIS

#### 3.1 Model Development

Models were developed using the NMORWG 2006 Study Package provided by Minnkota Power. This package utilizes PTI PSS/E™ Rev 29.4 and Version 6.6B of the Digital FORTRAN Compiler.

The starting point for the development of the pre-project model (i.e., without the proposed GI-0217 plant) was case *s709aa.uyqV424-rev2.sav* included in the package. This is a 2009 summer off-peak base case with Northern MAPP load (i.e., North Dakota, Manitoba Hydro and NSP load) at 70% of the corresponding summer peak load. The case already has the Arrowhead-Gardner Park 345 kV line (AHD-GPK) in-service. Several changes were made to this case with input from the study ad hoc group. Some of the more significant changes included the following:

- North Dakota generation modeled at URGE.
- Series compensation modeled on the LGS-Wilmarth 345 kV line.
- With input from Xcel Energy, modeled SW MN Wind at ~ 825 MW along with associated transmission upgrades.
- No CAPX 2020 projects are modeled in the case.

At the request of WAPA, prior-queued wind farm G132 (180 MW wind farm on the Ellendale-Wishek 230 kV line) was not modeled in the preliminary runs. As will be seen later in the study, project G132 improves transient stability performance (a sensitivity analysis was performed later in the study with G132 included). Hence, not modeling G132 in the preliminary runs is considered a conservative assumption for study purposes.

Also, prior-queued project GI-0208 (40 MW wind farm at Edgeley 115 kV) was turned off. WAPA indicated that this project improves transient stability and that turning it off is a conservative assumption for study purposes. Project GI-0209 (40 MW wind farm at Ft. Thompson 69 kV) was, however, included.

Export levels in the pre-project case were set to the following levels using the *setexports* program included in the NMORWG Study Package. MHEX was set to 2175 MW. MWSI was loaded to its existing 1480 MW limit with Arrowhead-Gardner Park 345 kV open and then Arrowhead-Gardner Park was closed. NDEX was set to 2080 MW.

After establishing the pre-project case, the proposed GI-0217 plant was added in order to create the post-project stability case. For the purposes of this analysis, the proposed plant was modeled directly at the Belfield 345 kV substation via a generator step-up transformer. It is important to note that in both cases NDEX levels are on the order of 2080 MW. In other words, the output of the GI-0217 plant was assumed consumed within NDEX

boundaries. This was accomplished by increasing North Dakota loads from 61.8% of 2009 Summer Peak load levels in the pre-project case to 77.1% in the post-project case. The MHEX and MWSI levels were set as described above.

The case titles for the pre- and post-project cases are presented below. Please refer to Appendices [A.1](#) and [A.2](#) for more detailed case summaries.

Pre-project stability case (i.e., without GI-0217):

B00-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
ND=2080,MH=2176,MW=1258,OHMH=-196,OHMP=151,EWTW=98,BD=165

Post-project stability case (i.e., with GI-0217):

B01-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
ND=2080,MH=2175,MW=1237,OHMH=-196,OHMP=151,EWTW=99,BD=165

Corresponding North Dakota Coalfields one-line diagrams without and with the GI-0217 plant are depicted in Figures [3.1\(a\)](#) and [3.1\(b\)](#), respectively.

### 3.2 Baseline Performance (i.e., Without the GI-0217 Plant)

This section summarizes the results from simulations conducted to test Northern MAPP dynamic performance under baseline conditions (i.e., prior-to commissioning of the proposed GI-0217 plant). The analyses was conducted on case *b00-s709aa.xzqV424.sav* (*b00*) described in the previous section.

With guidance from Reference 1, the disturbance scenarios listed in [Table 3.1](#) were examined on the *b00* Case. The results from the studies are summarized in [Appendix A.3](#). The following transient voltage violations are reported in that Appendix:

- Contingency *fd1*: 69% voltages at Jamestown
- Contingency *fd3*: 69% voltages at Jamestown
- Contingency *fd4*: 67% voltages at Jamestown

As mentioned in [1], the violations following *fd1* and *fd4* are not a concern because their *fdk* and *fdl* counterparts with tripping of Young 2 exhibit no violations. The violation for *fd3* on the other hand is indeed a criteria violation, as was the case for simulations with 2080 NDEX reported in [1].

Not indicated in [Appendix A.3](#) is the fact that Contingencies *a11* and *am1*, both leading to the outage of the Leland Olds 230 kV bus, lead to lightly damped oscillations involving the Northern MAPP system; in particular those units and systems that are separated from the Leland Olds and Antelope Valley stations by the outage (i.e., Young, Coyote, Square Butte and Coal Creek, and associated

systems). Excerpts from the simulation plots for these two contingencies are included in Figures 3.2a and 3.2b, respectively.

### 3.3 Performance with the GI-0217 Plant

The same contingencies that were tested in the baseline analyses (Table 3.1) were tested with the GI-0217 Plant in service (Case *b01*). The results are summarized in Appendix A.4. The following transient voltage violations are observed:

- Contingency *fd1*: 65% voltages at Jamestown
- Contingency *fd3*: 66% voltages at Jamestown
- Contingency *fd4*: 64% voltages at Jamestown

Disregarding for the aforementioned reasons the *fd1* and *fd4* results, the one detrimental impact of the GI-0217 plant is observed for contingency *fd3*, which leads to a deterioration in transient voltage violations in the Jamestown area from 69% to 66%.

Also still present are the oscillations for Contingencies *al1* and *am1* observed in the baseline analyses. See Figures 3.3a and 3.3b, respectively.

The above results suggest there is not a significant impact of the GI-0217 plant (other than for contingency *fd3*) on regional-type contingencies. This is probably a direct consequence of the fact that NDEX flow levels were kept at around 2080 MW by increasing North Dakota loads.

The local impact of the GI-0217 plant was examined next. A review of the simulation results suggests that Contingencies *au3*, *au9*, and *ad3*, all of which lead to the outage of the 345 kV connection between the Belfield and Antelope Valley Stations, lead to significant (and unacceptable) lightly damped oscillations throughout the system. See as an example the excerpt from the simulation results of Contingency *au9* in Figure 3.4. Contingency *ax3*, on the other hand, that severs one of the two 230 kV connections between Belfield and the system does not lead to such oscillations.

There are two solutions to the observed oscillations. One is to recognize that, as indicated in the steady-state analyses, the outage of any section of the 345 kV transmission between Belfield and Antelope Valley will lead to significant overloads on the remaining 230 kV system connecting to the GI-0217 plant; including that of the 250 MVA 345/230 kV transformer at Belfield. Consequently, the GI-0217 Plant is likely to be either tripped or rapidly runback after such contingencies. The results for Contingency *auj* suggest that, if the unit is tripped 200 msec after fault inception, a well-damped, stable performance will ensue.

The second solution is to furnish the Belfield unit with a well-tuned Power System Stabilizer (PSS) to damp the oscillations. In order to do so, an accelerating-

power PSS was tuned for the GI-0217 Plant with emphasis on the configuration without the 345 kV connection in service. The following PSS parameters were thus derived:

```

** IEEEST **  BUS X-- NAME --X BASEKV MC      C O N S      S T A T E S      V A R S      I C O N S
                67349      BELF500G 19.000 1  138751-138767  51775-51781  12795-12796  6534-6535

IC  BUS      A1      A2      A3      A4      A5      A6      T1      T2
 4   0      0.0000  0.0000  0.0000  0.0000  0.0000  0.0000  0.5100  3.0000

      T3      T4      T5      T6      KS      LSMAX  LSMIN  VCU      VCL
0.1900  0.3500  0.0000  0.0250  6.340  0.1000 -0.1000  0.000  0.000

```

The simulation results with this assumed PSS in service were very encouraging. See as an example the results for Contingency *au9* but with the PSS in service in [Figure 3.5](#), and compare against the same results but without such PSS in [Figure 3.4](#).

Faults *au3* and *au9* also resulted in transient voltage violations at the several buses in the local area. See simulation summary tables (Appendices [A.3](#) and [A.4](#)).

- Fault *au3*: 66% voltages at Little Miss 115, 69% at Little Miss 230 and at Baker 230
- Fault *au9*: 64% voltages at Little Miss 115, 66% at Little Miss 230, 67% at Baker 230 etc.

These violations are present regardless of whether a PSS is present at the GI-0217 plant (no such violations were noticed in the pre-project case). Results show that if the Belfield unit is tripped 200 msec after fault inception (fault *auj*), there are no transient voltage violations.

A trip of the Belfield-Charlie Creek 345 kV line without a fault also resulted in similar damping and transient voltage violations (the transient voltage violations are less widespread and less severe). See results of fault *aut* in [Appendix A.4](#).

Based on the above results, and assuming no new transmission is built, it is clear that the GI-0217 plant would need to be tripped in order to mitigate the transient voltage violations following the loss of the Belfield-Charlie Creek 345 kV line.

However, even without a fault, the loss of the 345 kV path between Charlie Creek-Antelope Valley would weaken the transmission system making it susceptible to oscillations. Therefore, it is also recommended to have a well-tuned PSS at Belfield in order to damp out oscillations following 345 kV contingencies. Considering the low cost of modern PSSs, and its significant impact on system performance, furnishing such a PSS on the GI-0217 plant is recommended. Thus, installation of both a generation tripping scheme and a well-tuned PSS at Belfield is recommended.



### 3.4 Sensitivity Analysis with AHD-GPK 345 kV Line Outaged

The purpose of this analysis is to check whether the GI-0217 plant would adversely impact regional stability performance prior to commissioning of the Arrowhead-Gardner Park 345 kV line.

Two sensitivity cases were developed starting from the pre- and post-Belfield cases described in Section 3.1 (cases *b00* and *b01* respectively), by placing the AHD-GPK 345 kV line out of service. It is important to note that the MWSI level in both sensitivity cases is 1480 MW.

- Case *b0c-s709aa.xzqV424.sav* (*b0c*). Without the GI-0217 Plant.
- Case *b1c-s709aa.xzqV424.sav* (*b1c*). With the GI-0217 Plant.

Case summaries are shown in Appendices B.1 and B.2 respectively.

All regional and local faults listed in Table 3.1 were tested on the sensitivity cases. The results from these simulations are shown in Appendices B.3 and B.4. With the exception of the following faults, all other regional faults met the MAPP stability criteria.

- Regional faults *fd1*, *fd3* and *fd4* resulted in transient voltage violations at the Jamestown 345 kV bus as shown below:
  - Fault *fd1*: 69% voltages (without GI-0217) vs. 66% (with GI-0217)
  - Fault *fd3*: 70% voltages (without GI-0217) vs. 67% (with GI-0217)
  - Fault *fd4*: 68% voltages (without GI-0217) vs. 65% (with GI-0217)

As mentioned previously, faults *fd1* and *fd4* are not a concern because their counterparts (*fdk* and *fdl*) exhibit no violations. While fault *fd3* resulted in transient voltage violations with Belfield, no corresponding violations were seen without Belfield. An examination of the plot file without Belfield showed the minimum transient voltage at the Jamestown 345 kV bus is just slightly above the 70% transient voltage criteria (70.35% to be precise).

- Regional fault *nbz* resulted in transient voltage violations at the Arrowhead 230 kV bus and at several other 115 and 230 kV buses in the Arrowhead area. The violations were observed both in the pre- and post-project sensitivity cases and the impact of the GI-0217 plant on these violations is insignificant.
- Regional fault *nmz* resulted in one transient voltage violation at the Birch Lake 115 kV bus in Northern MN. This fault is a variant of fault *nbz* but with the Forbes SVC kept on-line. The violation was observed both in the pre- and post-project sensitivity cases and the impact of the GI-0217 plant on the transient voltages is insignificant (80% voltages both with and without Belfield).



It is important to note that the transient voltage violations following faults *nbz* and *nmz* are a consequence of heavy loadings on the MH-US 500 kV lines (D602F and F601C) and on the series capacitors at Chisago (the loading on the Chisago series capacitors is 109% based on the 1732 MVA normal rating, both with and without Belfield). Past study experience has shown that these violations can be mitigated by reducing the flow on the F601C line. Considering that the GI-0217 plant does not exacerbate the *nbz* and *nmz* violations<sup>†</sup>, the flow reduction on the F601C line has not been tested in this study.

Also worth noting is the fact that faults *nbz* and *nmz* did not result in violations in the analyses performed in Sections 3.2 and 3.3 ; without and with the GI-0217 plant. This confirms the beneficial impact the Arrowhead-Gardner Park transmission has on dynamic performance following these types of events.

The results of the local fault analysis are consistent with those reported in Section 3.3. As before, faults involving the loss of the 345 kV lines between Belfield and Antelope Valley (faults *au3*, *au9* and *ad3*) lead to significant and unacceptable lightly damped oscillations throughout the system. Faults *au3* and *au9* also resulted in transient voltage violations at Little Miss, Baker, Hettinger and at several other nearby buses. As before, tripping the GI-0217 plant within a few hundred msec. following the outage of the Belfield-Charlie Creek 345 kV is an effective solution for mitigating these local violations.

### 3.5 Sensitivity Analysis with Prior-Queued Project G132 Included

Project G132 is a prior-queued wind farm that has requested interconnection on the Ellendale-Wishek 230 kV line. Based on the available information, the proposed wind farm will comprise GE 1.5 MW wind turbine-generators based on doubly-fed induction generator technology. The net injection at the point of interconnection is 180 MW.

Two sensitivity cases were developed starting with the pre- and post-Belfield cases described in Section 3.1 (cases *b00* and *b01* respectively), by modeling the proposed G132 wind farm. Load flow and stability data for modeling the proposed wind farm were provided as part of the 2006 NMORWG Study Package. The output of the G132 wind farm was dispatched against scaleable ND load thus maintaining NDEX at 2080 MW. As in the original analysis, the Arrowhead-Gardner Park 345 kV line is included in the base cases. MWSI was loaded to its existing 1480 MW limit with AHD-GPK open and then AHD-GPK was closed. As before, MHEX was set to 2175 MW. The following sensitivity cases were developed:

---

<sup>†</sup> The impact of the proposed plant on the *nbz* and *nmz* violations is insignificant mainly because the output of the GI-0217 plant is dispatched to ND load (NDEX is held constant at 2080 MW). Such a redispatch does not increase MH-US 500 kV line flows. As a result, the transient voltages are not exacerbated following these faults.

- Case *b0d-s709aa.xzqV424.sav (b0d)*. Without the GI-0217 Plant.
- Case *b1d-s709aa.xzqV424.sav (b1d)*. With the GI-0217 Plant.

Case summaries are shown in [Appendices C.1](#) and [C.2](#).

All regional and local faults listed in [Table 3.1](#) were tested on the sensitivity cases. The results from these simulations are shown in [Appendices C.3](#) and [C.4](#).

Project G132 appears to have no significant impact on system stability. [Table 3.2](#) compares the pre-project transient voltages at Groton 345 kV following faults *ag1* and *ei2* without and with G132. As shown in this table, Project G132 improves the transient voltages at Groton. This supports the reason for not modeling G132 in the analysis performed previously in [Sections 3.2](#) through [3.4](#).

With regard to the impact of the GI-0217 plant on dynamic performance, the overall conclusions are very similar to those presented previously.

- As before, regional faults *fd1*, *fd3* and *fd4* resulted in transient voltage violations at the Jamestown 345 kV bus as shown below:
  - Fault *fd1*: 69% voltages (without GI-0217) vs. 66% (with GI-0217)
  - Fault *fd3*: 69% voltages (without GI-0217) vs. 67% (with GI-0217)
  - Fault *fd4*: 67% voltages (without GI-0217) vs. 64% (with GI-0217)

Again, faults *fd1* and *fd4* are not a concern because their counterparts (*fdk* and *fdl*) exhibit no violations. Other than for contingency *fd3*, the impact of the GI-0217 plant on regional stability performance is insignificant.

- Also as before, local faults involving the loss of the 345 kV lines between Belfield and Antelope Valley (faults *au3*, *au9* and *ad3*) lead to significant and unacceptable lightly damped oscillations throughout the system. Faults *au3* and *au9* also resulted in transient voltage violations at Little Miss, Baker, Hettinger and at several other nearby buses. As before, tripping the GI-0217 plant within a few hundred msec. following the outage of the Belfield-Charlie Creek 345 kV is an effective solution for mitigating these local violations.

### 3.6 Mitigation of *fd3* Violations

The results presented in [Sections 3.2](#) through [3.5](#) indicate that the addition of the GI-0217 plant leads to incremental degradation of transient voltages at the Jamestown 345 kV bus following fault *fd3*.

At the request of WAPA, two options were investigated to resolve the *fd3* violations:

Option 1 - Reactive Support at Jamestown 345: The transient voltage violations in the Jamestown area are, in part, due to lower than nominal pre-fault voltages at Jamestown 345. Capacitor banks were added at the Jamestown 345 kV bus in order to improve the base case voltages and to eliminate the *fd3* transient voltage violations. For the purposes of this analysis, capacitor banks were added in increments of 10 MVar.

Results are shown in [Table 3.3](#). These results suggest that with the addition of the GI-0217 plant, depending on the base case assumptions, an additional (i.e., in addition to the compensation required to address these violations without the GI-0217 Plant) 70 to 90 MVar capacitor bank (or switched shunt) is required to alleviate the *fd3* violations.

Other observations from [Table 3.3](#) are:

- The addition of the proposed plant increases the Center-Jamestown 345kV line flow by approx. 46 MW. The corresponding TDF is approx. 9.3%.
- Pre-fault voltages at Jamestown are marginally better without AHD-GPK than with AHD-GPK (cases *b00* vs. *b0c*, also *b01* vs. *b1c*). Transient voltages at Jamestown also are slightly better without AHD-GPK.
- Adding G132 increases flows on Center-Jamestown 345 kV and reduces pre-fault voltage at Jamestown (*b00* vs. *b0d*, also *b01* vs. *b1d*).
- For similar levels of MVar support at Jamestown, the impact of G132 on transient voltages at Jamestown is insignificant (impacts of less than 0.01 pu were observed).
- Adding both G132 and GI-0217 increases the Center-Jamestown flow and reduces the pre-fault voltage at Jamestown to 0.9490 pu. With a 100 MVar capacitor, the pre-fault voltage at Jamestown increases to 0.9874 pu (vs. 0.9932 without G132). This pre-fault voltage however, is insufficient to prevent transient voltage violations. A 120 MVar capacitor, however, provides sufficient pre-fault voltage support (0.9967 pu in case *b1d-jt*) so as to prevent transient voltage violations.

Option 2 – Series Compensation on Leland Olds-Groton and Leland Olds-Ft. Thompson 345 kV lines: As shown above, there is an incremental increase in flows on the Center-Jamestown 345 kV line following the addition of the GI-0217 plant. As a result of the flow increase, the pre-fault voltages at Jamestown 345 kV become depressed. The intent of the series compensation, therefore, is to reduce the flows on the Center-Jamestown 345 kV lines and thus improve the

pre-fault voltage levels at Jamestown. In lieu of Option 1, series compensation was modeled on the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines in order to improve the Jamestown 345 voltages and to eliminate the *fd3* transient voltage violations. For the purposes of this analysis, series compensation was added on each line in increments of 10%.

Results are shown in [Table 3.4](#). These results suggest that with the addition of the GI-0217 plant, depending on the base case assumptions, additional series compensation (i.e., in addition to the compensation required to address these violations without the GI-0217 Plant) of 20% to 30% is required to alleviate the *fd3* violations.

### 3.7 Effect of Delayed Recovery on Square Butte HVdc Line on *fd3* Violations

Minnesota Power indicated recently that the recovery time of the Square Butte HVdc, as modeled in the NMORWG package, was based on the old GE strategy. A PSS/E command file was provided to model the existing control arrangement wherein the HVdc controls initiate a block for 3-phase faults if the rectifier ac bus voltages fall below 0.5 p.u. The command file basically changes the minimum blocking time from 120 msec to 220 msec. In other words, recovery time is slower than with the older controls.

A review of the previously obtained results indicated that there is only one fault that causes the rectifier ac bus voltage (i.e., Square Butte 230 kV voltage) to dip below 0.5 pu, fault *fd3*. For all other 3-ph faults, the voltage stays well above 0.5 pu. Fault *fd3* was repeated on the previously developed cases. Results show that the transient voltages at Jamestown 345 are worse than before. See [Table 3.5](#).

Next, the analysis performed in [Section 3.6](#) was repeated, this time considering the delayed Square Butte HVdc recovery. Results indicate that the previously proposed series compensation and reactive support solutions are inadequate to mitigate the *fd3* violations and that additional compensation is needed. Results are presented in [Tables 3.6](#) and [3.7](#).

As shown in [Table 3.6](#), capacitors alone are not sufficient to mitigate the *fd3* violations. Dynamic VAr support in the form of SVCs are needed in addition to capacitor banks. Results indicate that in addition to the compensation required to address the violations without the GI-0217 plant, an additional 30 to 35 MVar capacitor and an additional 20 to 30 MVar SVC mitigate the post-project *fd3* violations.

Fault *fd3* was repeated on post-project case *b01* (see [Table 3.6](#)), this time with fast switched capacitors instead of SVCs. Fast switched capacitors were inserted manually at Jamestown 345 kV according to the following schedule:

Switch in 80 MVAR of fast switched capacitors 6 cycles<sup>‡</sup> after fault clearing

Switch in an additional 80 MVAR of fast switched capacitors 12 cycles after fault clearing.

Figure 3.6 shows a plot of the Jamestown 345 transient voltage following fault *fd3*. Also shown is the fast switched capacitor admittance in MVAR. Note that the fast switched capacitors are unable to arrest the transient voltage violations. The minimum transient voltage is 0.68 pu. Figure 3.7 shows a similar plot for post-project case *b01-kt* with a 40 MVAR SVC in lieu of fast switched shunts. As shown in Figure 3.7, the SVC is effective in mitigating the *fd3* transient voltage violations. These figures show that system performance depends more on how rapidly the post-fault voltages can be brought up than on the amount of MVAR support. With an SVC, the angular swings of generators in the North Dakota Coal Fields are reduced. Figure 3.8 shows the angular excursions of the Young 2 and Coyote generators following fault *fd3*. Note that the angular excursions are higher with fast switched caps than with an SVC. Compared with fast switched shunts, the SVC is able to rapidly support post-fault system voltages and this reduces the angular excursions of the generators. Smaller excursions in the generator rotor angles lead to improved transient voltages. These results suggest that fast switched capacitors are not effective in mitigating the transient voltage violations and that an SVC is required for fast dynamic voltage support.

Series compensation results shown are in Table 3.7. The level of compensation required to address the *fd3* violations is in the order of 60% to 75%. Such large compensation levels result in excessive base case flows on the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines (approx. 97% loading on each line based on the corresponding Rate A ratings with 75% series compensation in the post-project cases). Clearly, series compensation is not a practical solution.

If however, the pre-project violations are resolved through other means (such as providing reactive support at Jamestown, but without series compensating the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines), then series compensation could be considered to resolve the post-project violations. The results of this analysis suggest that compensating each line by 15% could be a possible solution to resolve the post-project *fd3* violations.

### 3.8 Mitigation of *fd3* Violations with Faster Fault Clearing

Fault *fd3* was repeated on the original pre- and post-project cases (cases *b00* and *b01* respectively), this time using a fault clearing time of 4 cycles in-lieu of the 5 cycle clearing time. As in Section 3.7, delayed recovery was modeled on the Square Butte HVdc line.

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<sup>‡</sup> 6 cycle capacitor insertion times were chosen based on the switching logic for the fast switched capacitors at Prairie 115 kV.

With a fault clearing time of 4 cycles, there are no criteria violations in the pre- and post-project cases. The minimum transient voltages at Jamestown are: 0.7330 pu (without Belfield) and 0.7054 pu (with Belfield). [Figure 3.9](#) shows a plot of the transient voltages at Jamestown 345 in the post-project case (case *b01*) with the 5 cycle and 4 cycle fault clearing times. Note that the 4 cycle fault clearing time significantly improves the minimum transient voltage at Jamestown.

The feasibility of using faster breakers at the Square Butte 230 kV substation on the Square Butte-Stanton 230 kV line should be investigated.

### 3.9 Additional Regional Faults

Additional regional faults were run on the original pre- and post-project cases (cases *b00* and *b01*) respectively. See [Table 3.8](#). These faults were tested because recent studies have shown that these faults have a tendency to depress transient voltages in the Jamestown area (with delayed clearing on the Square Butte HVdc line).

Simulation summary tables for these faults are included in Appendices [A.3](#) and [A.4](#) respectively.

The impact of the proposed GI-0217 project is most significant for four of these faults namely, *b13*, *ec3*, *ed3* and *ef3*. See columns 3 and 4 of [Table 3.9](#). Faults *b13*, *ec3* and *ed3* resulted in post-project transient voltage violations at the Jamestown 345 kV bus where as no corresponding violations were observed in the pre-project case.

Fault *ef3* (5 cycle 3 phase fault at Stanton 230 cleared by tripping the Stanton-Coal Creek-McHenry 230 kV lines) rendered the system unstable in the post-project case. Although no such instability was observed in the pre-project case, transient voltage violations were observed at the Jamestown 345 kV bus.

Faults *b13*, *ec3*, *ed3* and *ef3* were tested on the post-project case with a 4 cycle fault clearing time (in lieu of the present 5 cycles). See faults *b19*, *ec9*, *ed9* and *ef9* in column 4 of [Table 3.9](#). No criteria violations were observed for faults *b19*, *ec9* and *ed9*. Performance following fault *ef9* is significantly better. The system is stable but there is one transient voltage violation at the Jamestown 345 kV bus (0.69 pu) in the post-project case. Together with the 4 cycle fault clearing, the *ef9* violation may be mitigated by adding a 20 MVA switched shunt at the Jamestown 345 kV bus.

To achieve the 4 cycle fault clearing time, the feasibility of using faster breakers at the following substations should be investigated:

- Square Butte 230 kV substation on the Square Butte-Stanton 230 kV line. This would resolve both the *fd3* and *ed3* violations.



- Center 230 kV substation on the Center-Heskett 230 kV line (for fault *ec3*).
- Stanton 230 kV substation on the Stanton-Leland Olds 230 kV line (for fault *b13*) and the Stanton-Coal Creek-McHenry 230 kV line (for fault *ef3*). In addition to the 4 cycle clearing, mitigation of fault *ef3* would require the addition of a 20 MVAR switched shunt at Jamestown 345 kV as described above.

### 3.10 Sensitivity Analysis with Proposed Belfield-Hettinger 230 kV Line

The intent of this analysis is to check post-project stability performance with the following transmission reinforcements:

1. Addition of a Belfield-Hettinger 230 kV line, and
2. Addition of second Belfield 345/230 kV transformer (identical to the first)

As will be seen in [Section 4.5](#) of this report, the above network upgrades were found to be effective in mitigating injection related steady-state criteria violations.

The above upgrades were added to post-project case *b01*. The resulting case is named *b1e-s709aa.xzqV424.sav* (case *b1e*). See [Appendix D](#) for a case summary.

A limited number of faults were tested. These included regional fault *fd3*, the [Table 3.9](#) regional faults, and local faults *au3*, *au9*, *ad3* and *ax3*. In addition, the following fault was also tested:

Fault *ay3*: 5 cycle 3-phase fault at Belfield 230.  
Clear the Belfield-Hettinger 230 kV line.

Simulation summary tables for these faults are shown in [Appendix D](#).

As before, fault *fd3* with the present 5 cycle clearing and with delayed Square Butte HVdc recovery resulted in transient voltage violations in the Jamestown area. The above transmission reinforcements do seem to improve the Jamestown transient voltages by about 0.015 pu. The transient voltage violations are: 0.6087 pu (without reinforcements) and 0.6241 pu (with reinforcements). With 4 cycle *fd3* fault clearing, there are no criteria violations.

Column 5 of [Table 3.9](#) summarizes the results of testing faults *b13*, *ec3*, *ed3* and *ef3*. With the exception of fault *ed3*, the other three faults resulted in transient voltage violations at the Jamestown 345 kV bus. With 4 cycle clearing, no violations were observed for faults *b13*, *ec3* and *ef3*. See faults *b19*, *ecs* and *ef9*.

The local impact of the GI-0217 plant was examined next. As before contingencies *au3*, *au9*, and *ad3* (all of which lead to the outage of the 345 kV connection between the Belfield and Antelope Valley Stations), lead to significant and unacceptable lightly damped oscillations throughout the system. As

previously noted, installation of a well-tuned PSS for the proposed plant is recommended to damp out these oscillations.

Interestingly, the above transmission reinforcements eliminate the need to trip the proposed GI-0217 plant following the loss of any section of the 345 kV line between Belfield and Antelope Valley. With the proposed upgrades, no transient voltage violations were observed following faults *au3* and *au9* (recall that the results presented in Sections 3.3 through 3.5 indicated transient voltage violations following these faults). This performance improvement can be attributed to the availability of the new transmission outlet between the Belfield and Hettinger.

Also, no stability criteria violations were observed following fault *ay3* (fault and loss of the Belfield-Hettinger 230 kV line).

### 3.11 Voltage Stability Analysis

*This portion of the study was performed by Western Area Power Administration.*

Based on the requirement in the MAPP Operating Studies Manual to evaluate for potential voltage collapse, the worst case 345kV outage of the Jamestown-Center 345 kV line in North Dakota was run with the winter north package base case to evaluate how adding this new unit to the North Dakota coal fields area might impact the existing voltage stability limits. Therefore, investigation of potential voltage stability was performed in two ways. First, the new Belfield unit was dispatched to existing North Dakota AC (NDAC) units. This run was done to simulate the potential injection of the new unit when other coal field units are down. The other method looked at the dispatch of the new Belfield unit east of the Twin Cities to simulate the addition of Belfield to the North Dakota coal field generation source and a potential additional increment of generation in excess of the existing NDAC generation.

The NMORWG package has a routine that increases OTP load and the zone 90 and 990 loads while keeping the MHEX interface constant. Winter peak cases were developed with north MHEX of 700 MW. The cases were developed as shown in the following table showing case name, NDEX and description:

Case	NDEX	Description
nrt-wp06aa	375	pkg2006 winter north base case
urn-wp06aa.9N60410	413	pkg2006 winter north base case w/ ND units at urge
unb-wp06aa.9N70410	414	urn-wp06aa case w/ Belfield dispatched to NDAC
ub2-wp06aa.fN90410	855	urn-wp06aa case w/ Belfield dispatched east of Twin Cities
ub3-wp06aa.fN90410	855	ub2-wp06aa case w/ Bel-Het 230 & Bel 345/230 TX added

The *peakload.data* file located in the NMORWG 2006 study package shows that the expected 2006 winter peak load for North Dakota zone 90/990 is 3427 MW. Examination of the following table shows that when the Belfield unit is dispatched



against existing North Dakota AC units, the maximum load level is maintained similar to the existing system when the proposed generation at Belfield is injecting into North Dakota coal fields. However, when the new Belfield unit is dispatched out of the North Dakota coal fields the maximum achievable load level is negatively impacted by the addition of the new unit.

Case	Center-Jamestown Outage	
	OTP Load	Zone 90/990 Load
nrt-wp06aa	2983	4167
urn-wp06aa.9N60410	2980	4167
unb-wp06aa.9N70410	2984	4177
ub2-wp06aa.fN90410	2926	4067
ub3-wp06aa.fN90410	2937	4087

A final run with the addition of the proposed new Belfield-Hettinger 230 kV line and a second 345/230 kV transformer at Belfield (these reinforcements are effect in mitigating the injection related steady-state criteria violations as explained in [Section 4.5](#)) shows that additional system improvements will be needed to deliver this unit across the NDEX from a voltage stability perspective.

### 3.12 Conclusions

The results of the stability analysis indicate that the addition of the proposed GI-0217 plant would adversely impact both local and regional stability performance.

For local-type contingencies, the dynamic performance following outage of any 345 kV section of the line between Belfield and Antelope Valley is unacceptable. In addition to significant system-wide oscillations, transient voltage violations were observed at several nearby buses following the outage of the Belfield-Charlie Creek 345 kV line, regardless of whether this outage is triggered by a fault. Installation of both a generation tripping scheme (to trip the proposed plant following the loss of the Belfield-Charlie Creek 345 kV line) and a well-tuned PSS at Belfield (to damp oscillations following the loss of the Charlie Creek-Antelope Valley 345 kV line) is recommended to alleviate the local area stability problems.

For regional contingencies, stability criteria violations were observed for the following faults (these faults were simulated with delayed recovery modeled on the Square Butte HVdc line):

- *fd3* – 5 cycle 3-phase fault on Square Butte-Stanton 230 kV line
- *bl3* – 5 cycle 3-phase fault on Stanton-Leland Olds 230 kV line
- *ec3* – 5 cycle 3-phase fault on Center-Heskett 230 kV line
- *ed3* – 5 cycle 3-phase fault on Stanton-Square Butte 230 kV line
- *ef3* – 5 cycle 3-phase fault on Stanton-Coal Creek-McHenry 230 kV line

Particular attention was given to fault *fd3* because this fault resulted in the lowest transient voltages at the Jamestown 345 kV bus. Three options were investigated to alleviate the pre- and post-project *fd3* violations:

Option 1 involves providing reactive support in the form of capacitors and SVCs at the Jamestown 345 kV bus. Results indicate that in addition to the compensation required to address the violations without the GI-0217 plant, an additional 30 to 35 MVAR capacitor and an additional 20 to 30 MVAR SVC mitigate the post-project *fd3* violations.

Option 2 involves adding series compensation on the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines. Considering that the level of series compensation required to mitigate the pre- and post-project *fd3* violations is in the order of 60% to 75%, this solution is not considered viable.

Option 3 involves reducing the *fd3* fault clearing time from the present 5 cycles to 4 cycles. With 4 cycle fault clearing, there are no pre- and post-project criteria violations.

Similarly, the transient voltage violations following faults *b13*, *ec3* and *ed3* can be mitigated by reducing the corresponding fault clearing times from the existing 5 cycles to 4 cycles. Mitigation of fault *ef3* would require both 4 cycle clearing and a 20 MVAR switched shunt at the Jamestown 345 kV bus.

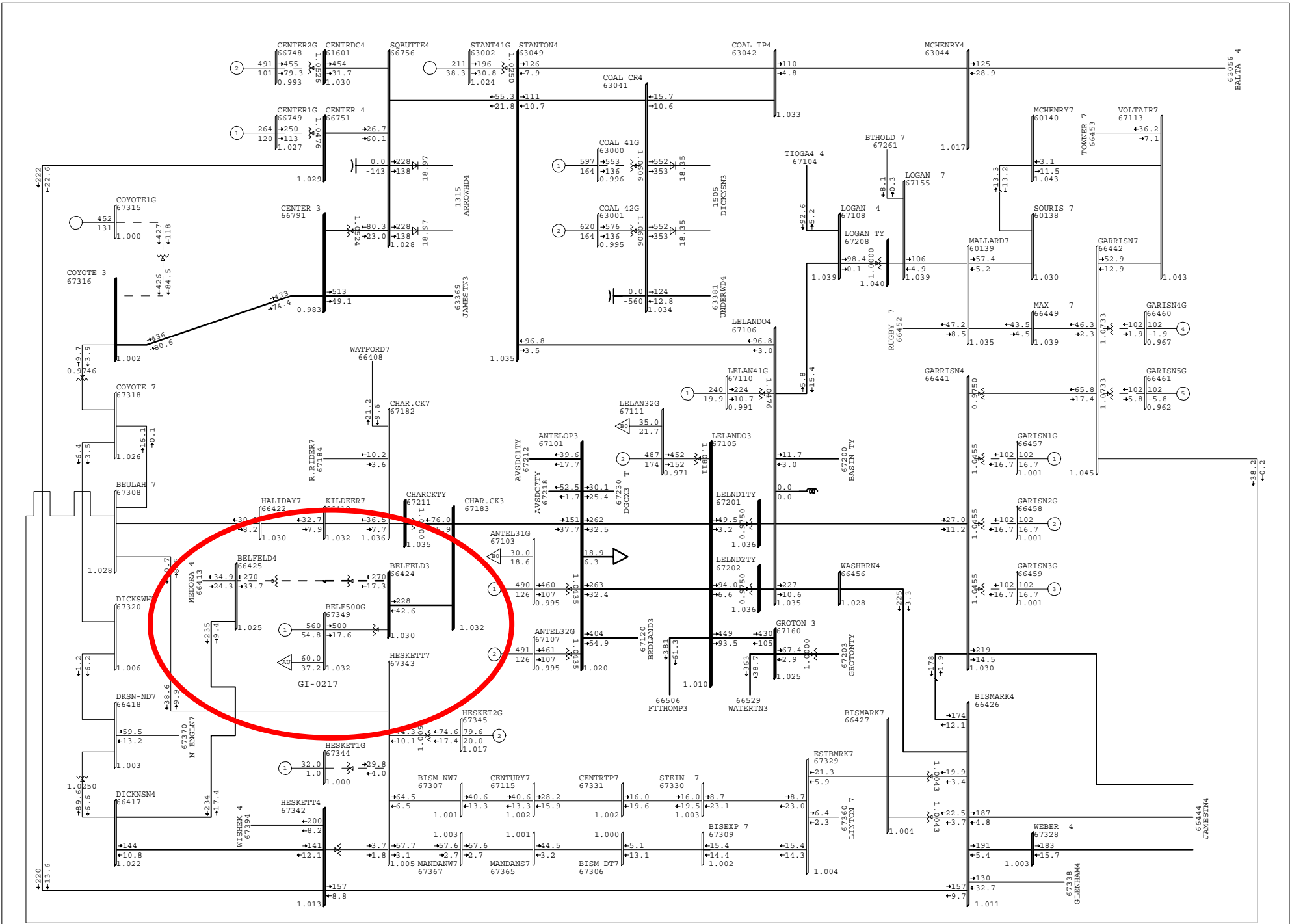
To achieve the 4 cycle fault clearing time, the feasibility of using faster breakers at the following substations should be investigated:

- Square Butte 230 kV substation on the Square Butte-Stanton 230 kV line. This would resolve both the *fd3* and *ed3* violations.
- Center 230 kV substation on the Center-Heskett 230 kV line (for fault *ec3*).
- Stanton 230 kV substation on the Stanton-Leland Olds 230 kV line (for fault *b13*) and the Stanton-Coal Creek-McHenry 230 kV line (for fault *ef3*). In addition to the 4 cycle clearing, mitigation of fault *ef3* would require the addition of a 20 MVAR switched shunt at Jamestown 345 kV as described above.

Finally, a sensitivity analysis was performed to check post-project stability performance with a new Belfield-Hettinger 230 kV line and a second 345/230 kV transformer at Belfield (these reinforcements are effective in mitigating the injection related steady-state criteria violations as shown in [Section 4.5](#)). As before, faults *fd3*, *b13*, *ec3* and *ef3* resulted in transient voltage violations in the Jamestown area. Results indicate that these violations are less severe than those previously observed. In other words, the proposed Belfield area reinforcements help improve the transient voltages at Jamestown 345. No transient voltage violations were observed following fault *ed3*. With 4 cycle fault clearing, there were no criteria violations for faults *fd3*, *b13*, *ec3* and *ef3*. As

before, the feasibility of using faster breakers at the Square Butte, Center and Stanton 230 kV substations should be investigated. Examination of the local area fault results indicate that with the proposed upgrades, there is no need to trip the proposed GI-0217 plant following the loss of any section of the 345 kV line between Belfield and Antelope Valley. Installation of a well-tuned PSS is still recommended to damp out the oscillations that were observed.





B01-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1237,OHMH=-196,OHMP=151,EWTW=99,BD=165  
 NORTH DAKOTA COAL FIELDS FRI, SEP 01 2006 11:19

100% RATE  
 0.950 UV 1.050 OV  
 KV: 515, 230, 345

BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR

Figure 3.1b: North Dakota Coalfields - With Belfield Plant - 2072 MW NDEX

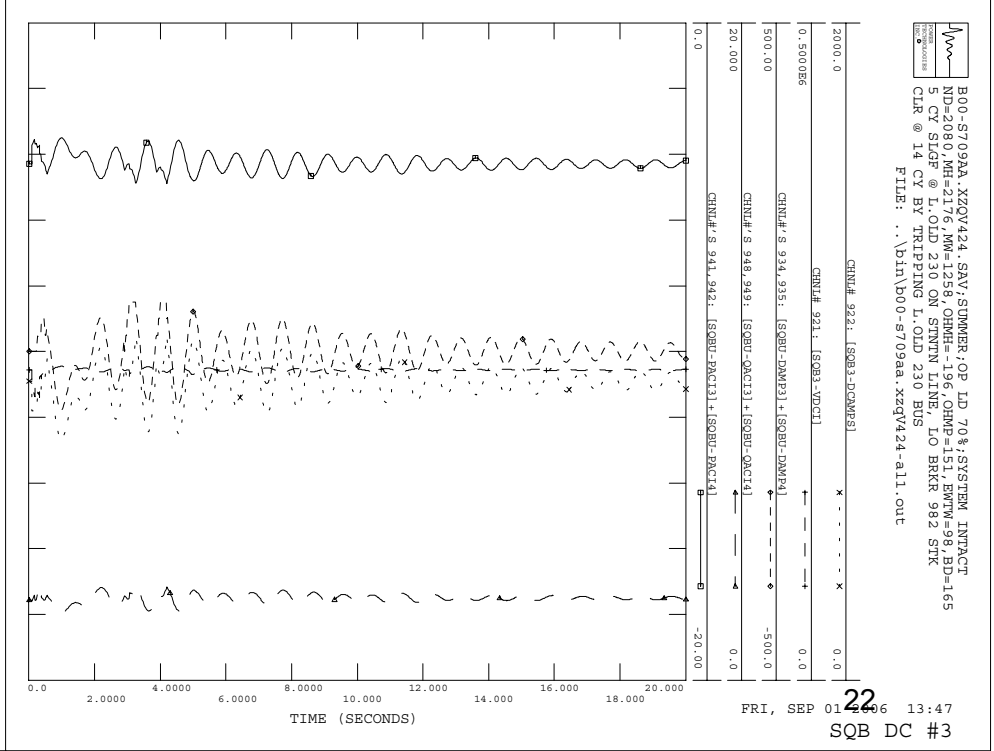
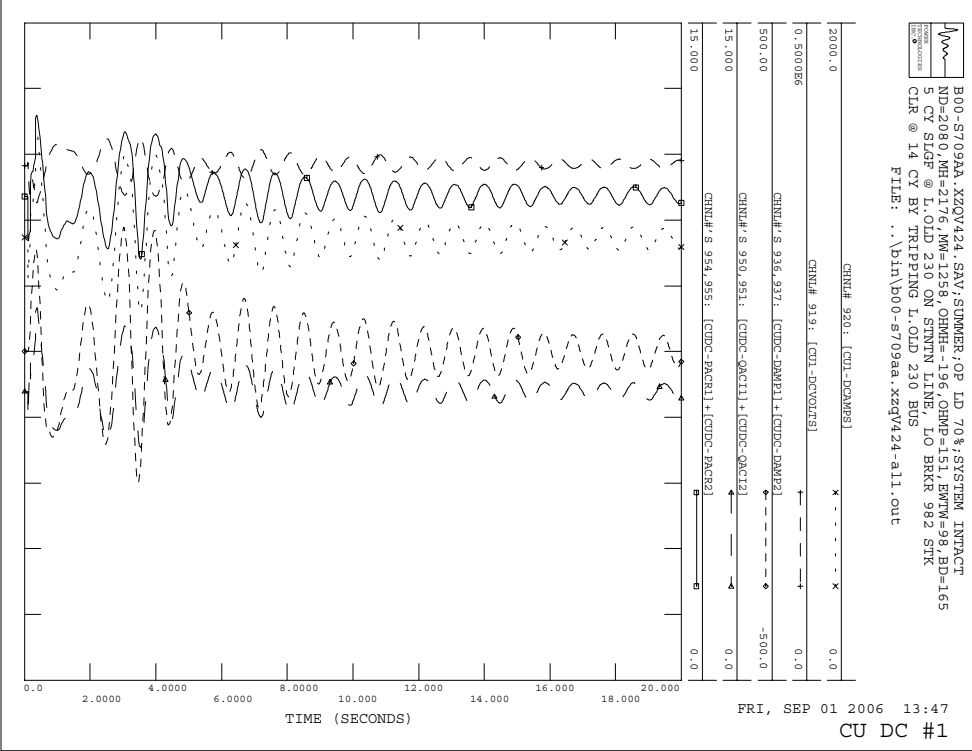
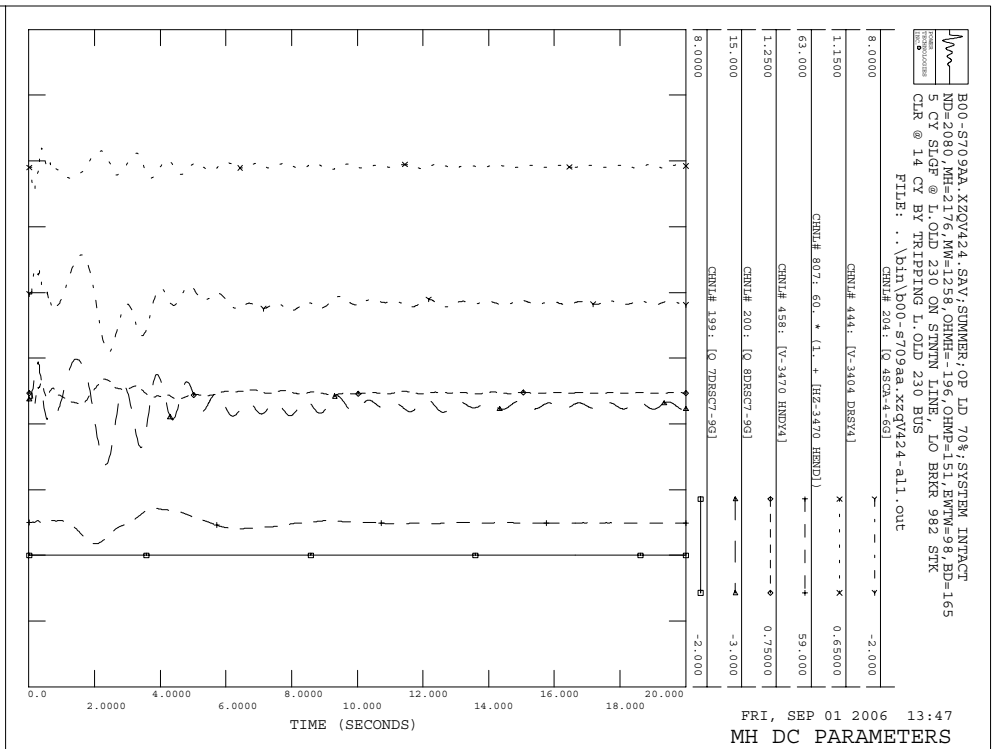
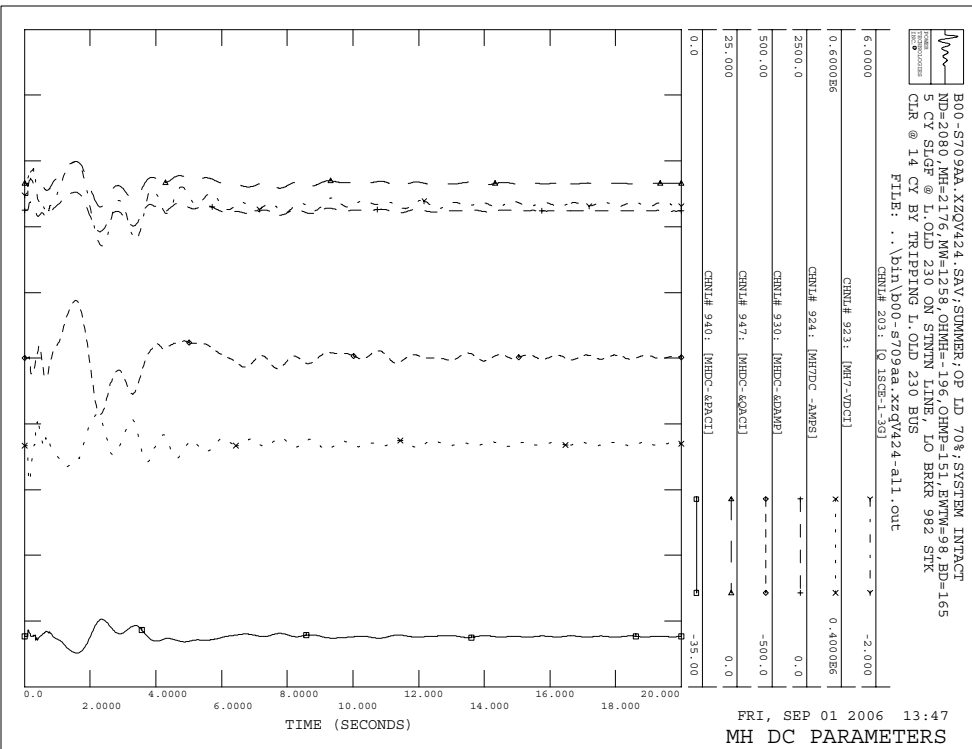


Figure 3.2a: Baseline Analysis - Contingency a1

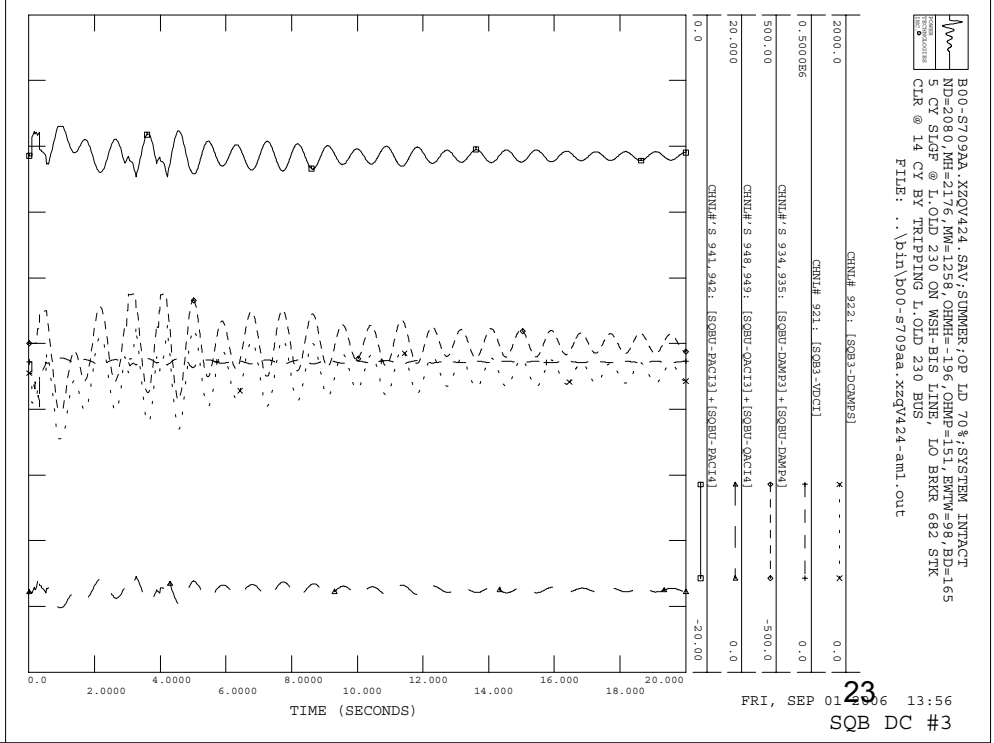
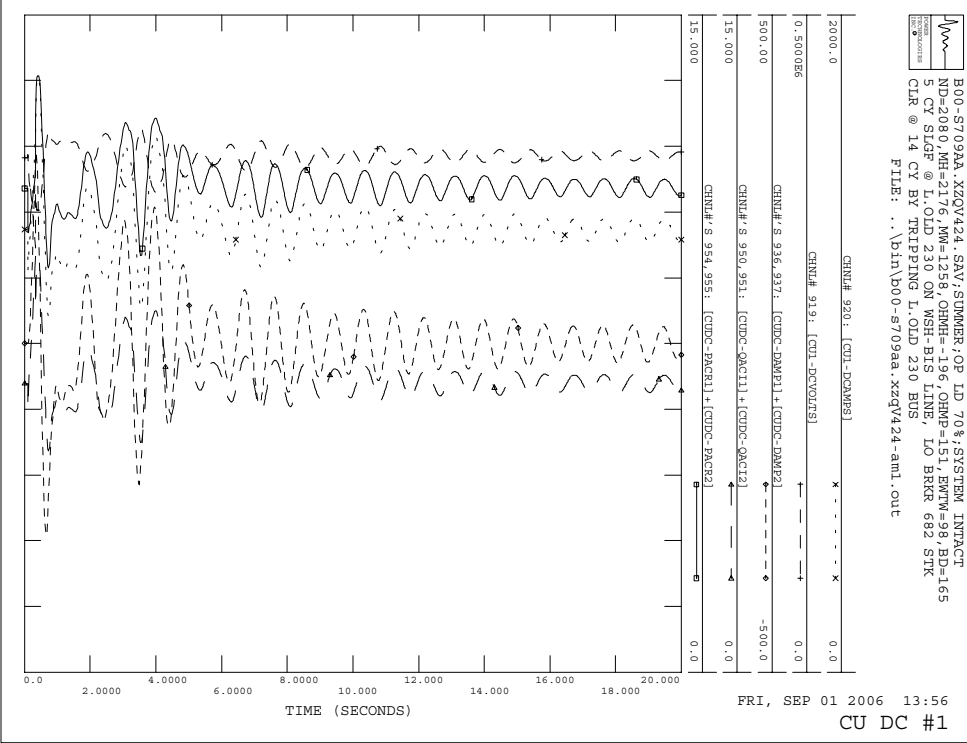
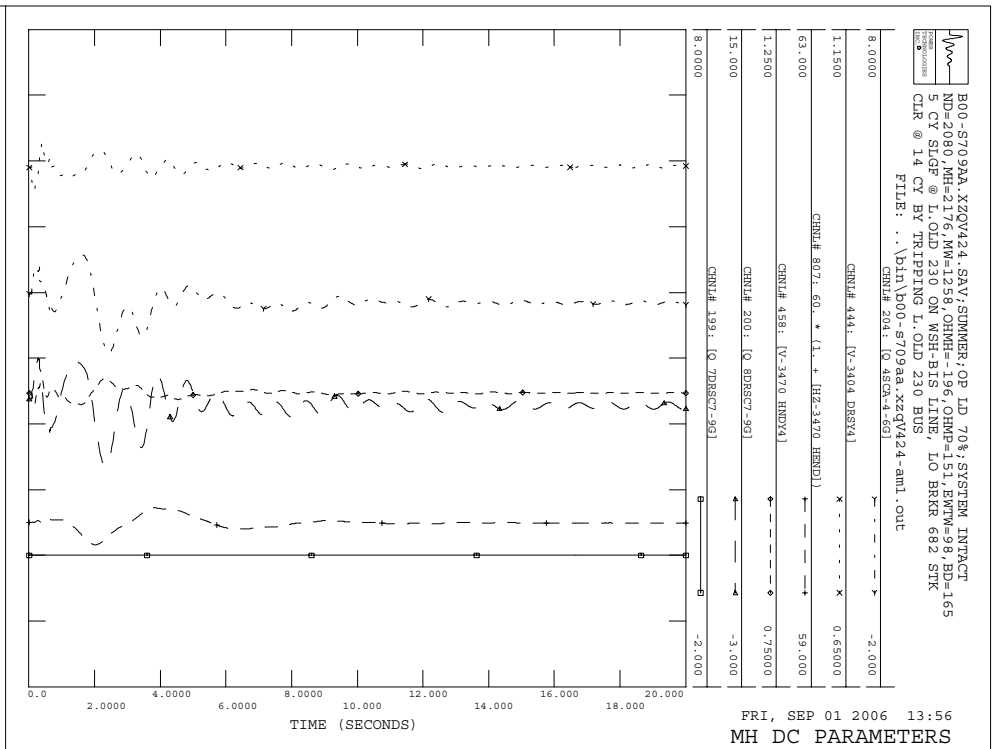
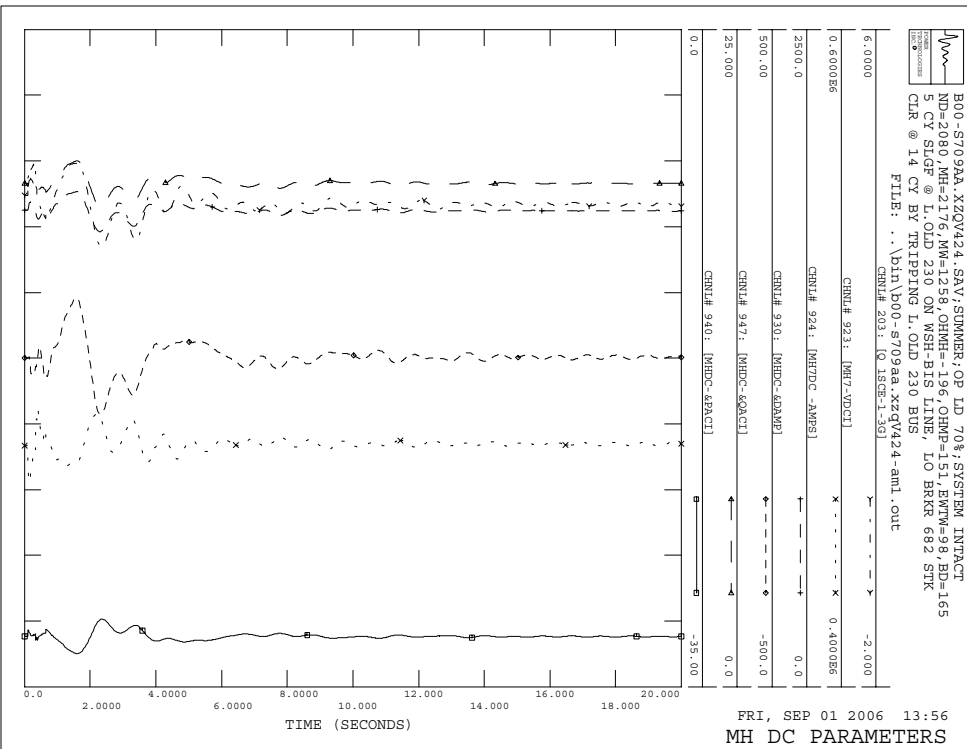


Figure 3.2b: Baseline Analysis - Contingency am1

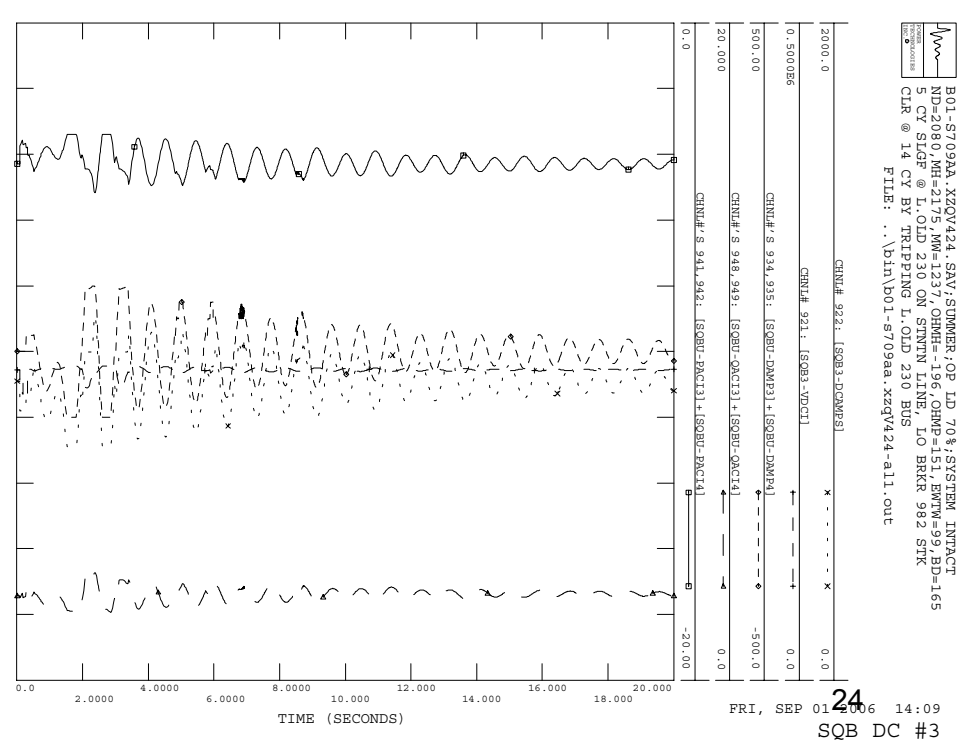
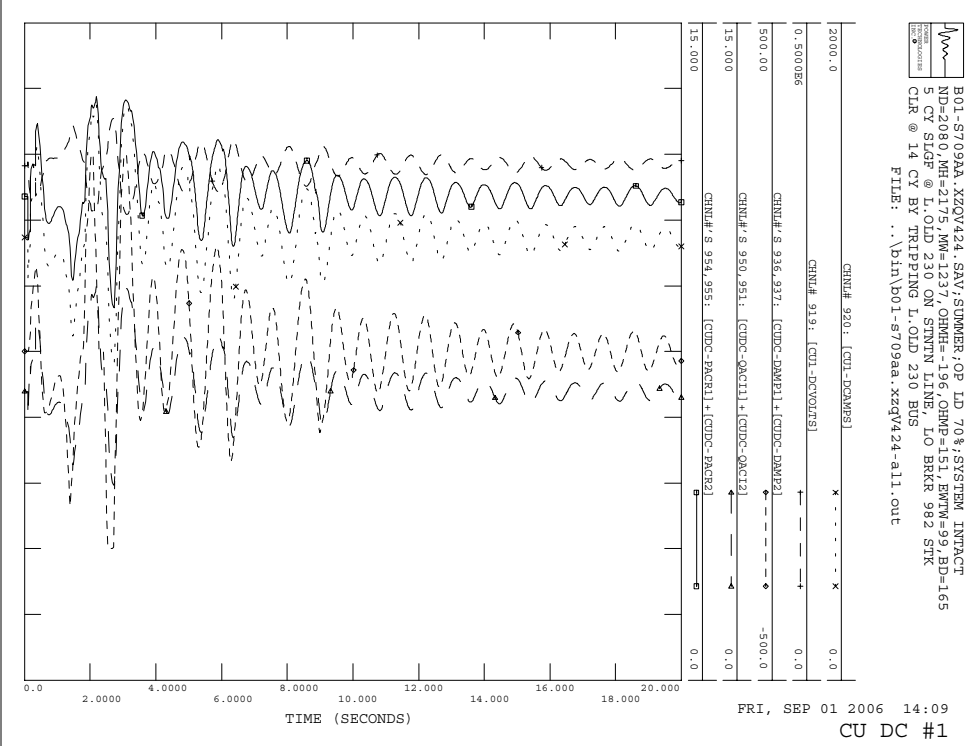
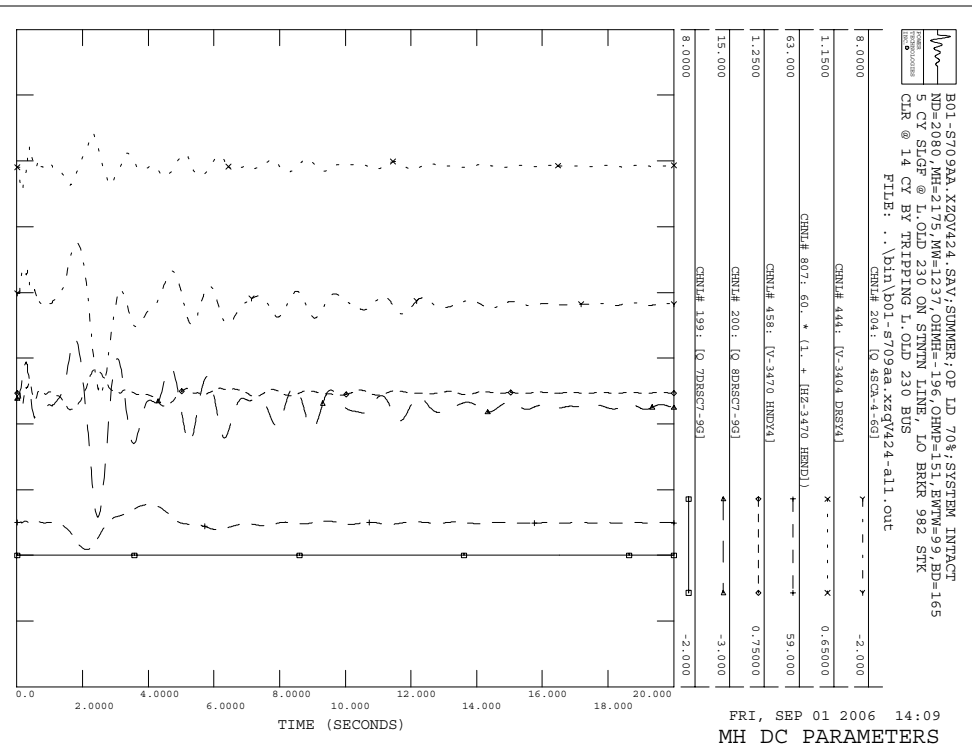
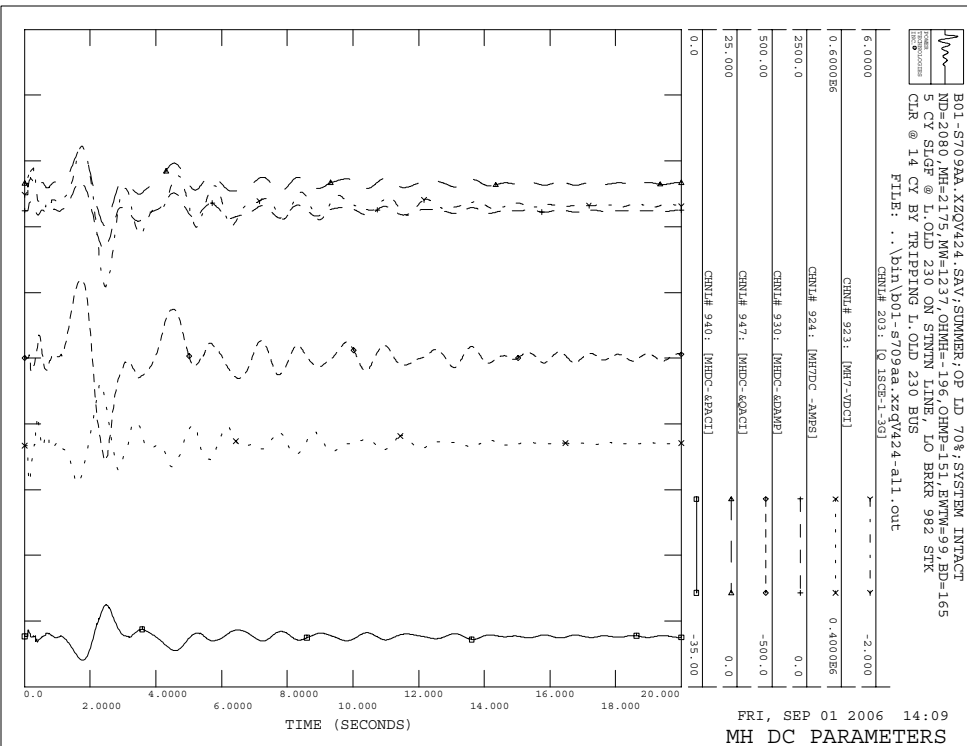


Figure 3.3a: Analysis with Belfield Plant in Service - Contingency a1



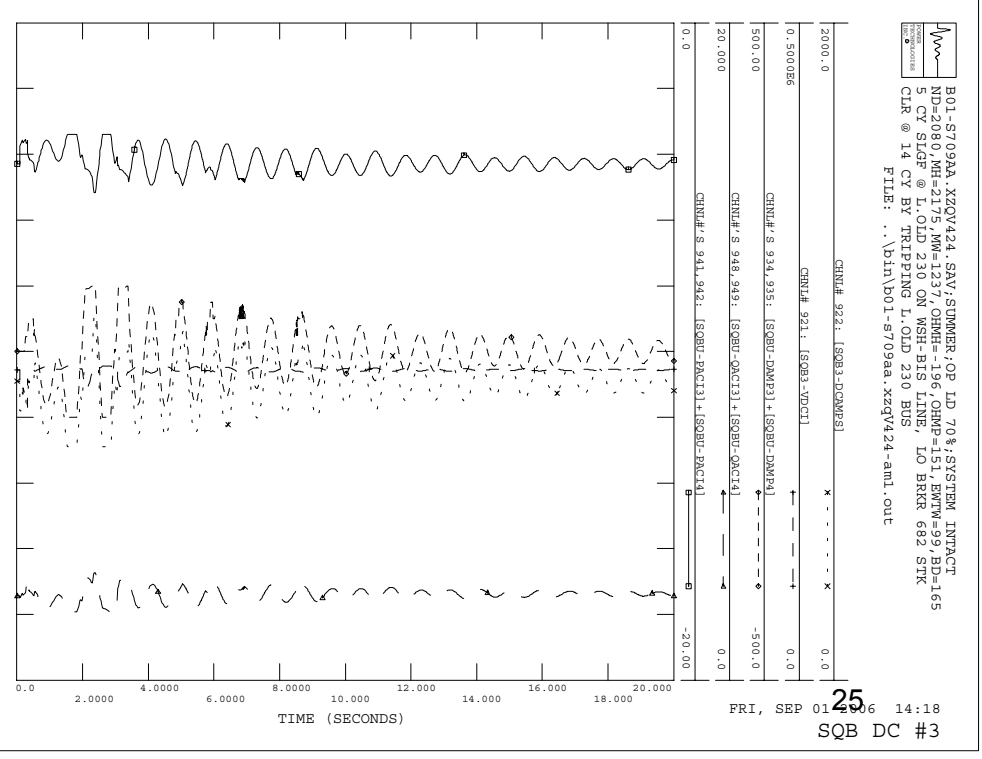
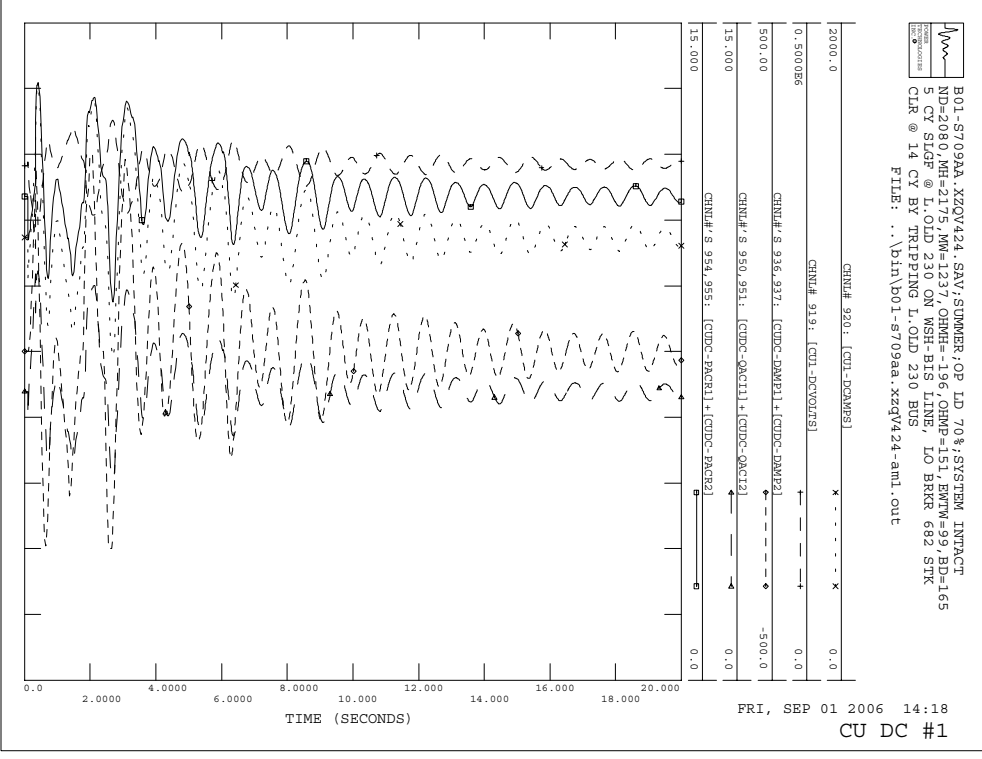
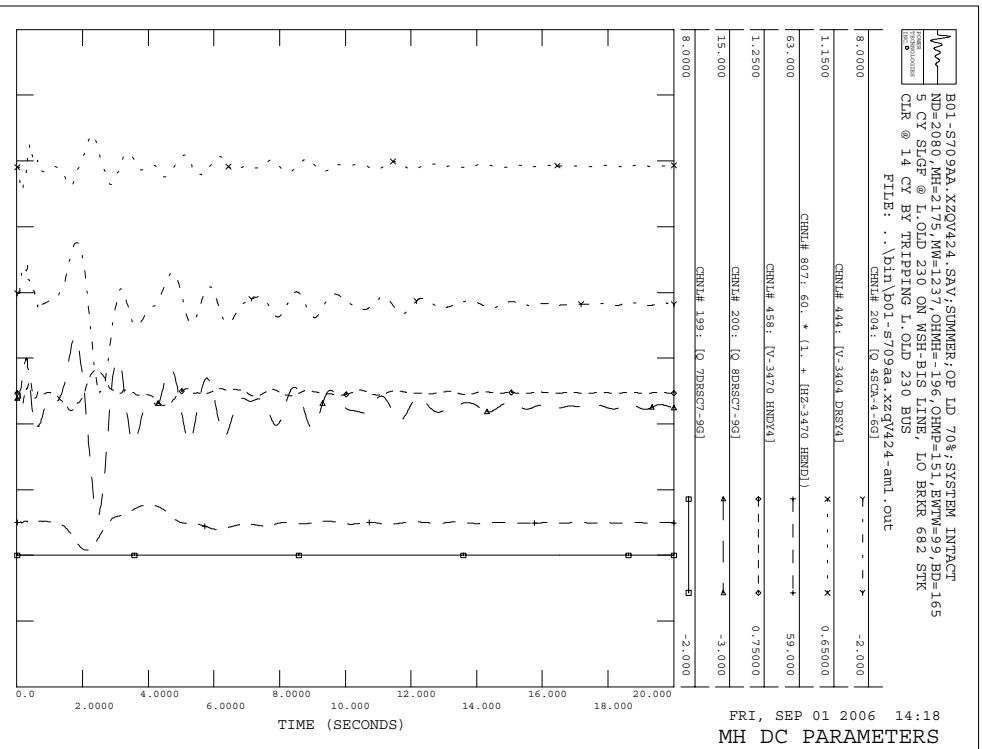
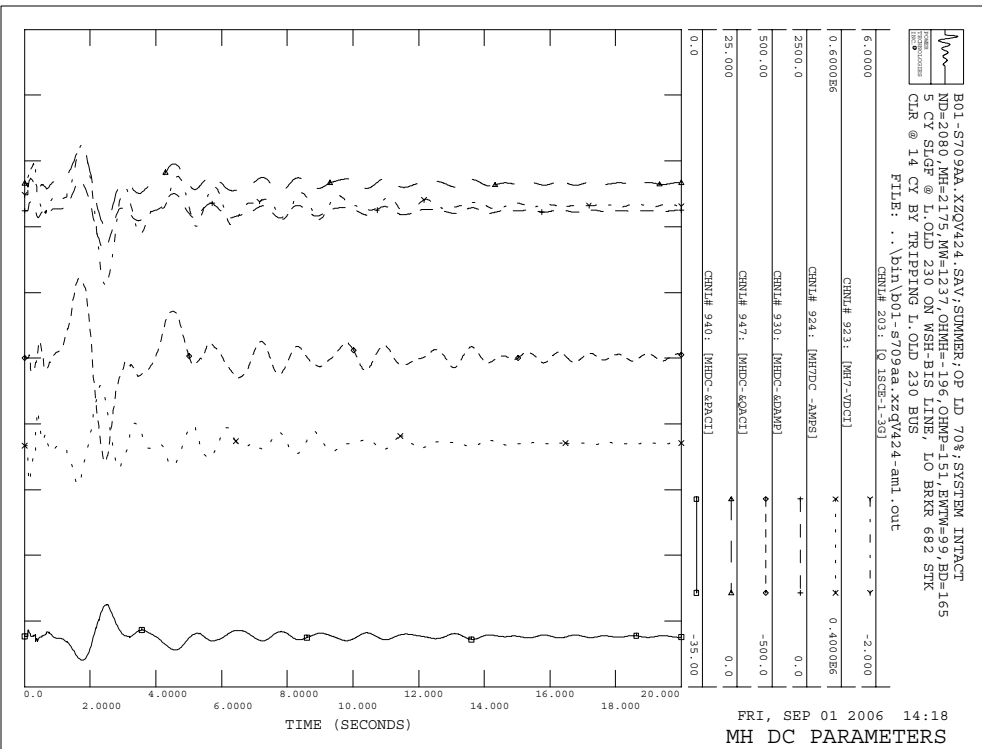


Figure 3.3b: Analysis with Belfield Plant in Service - Contingency am1

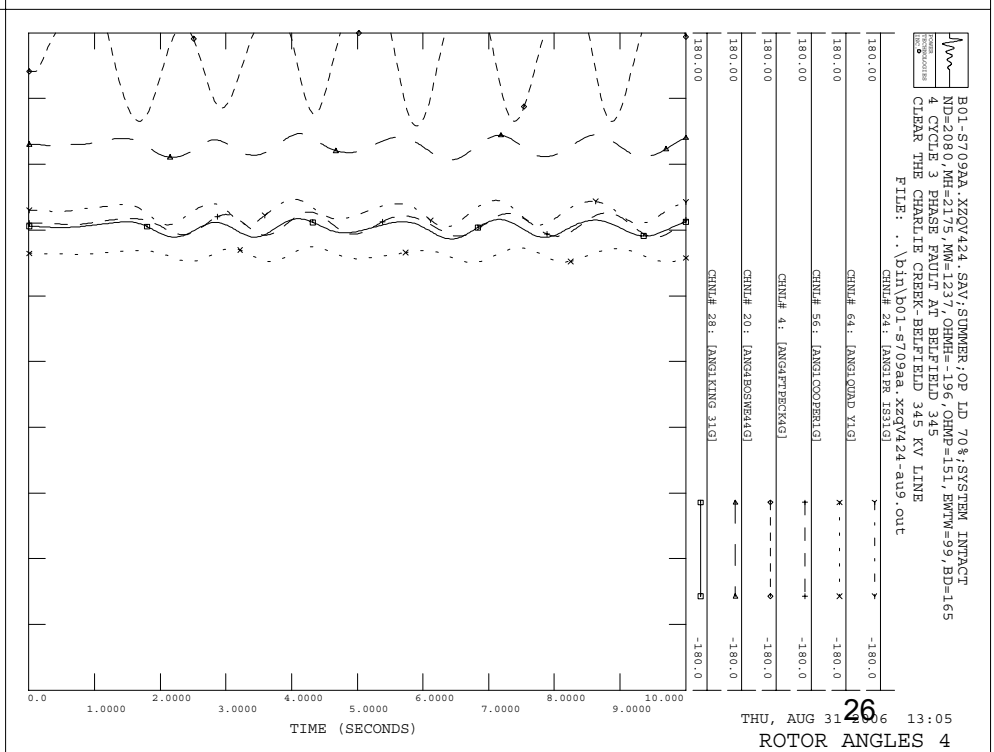
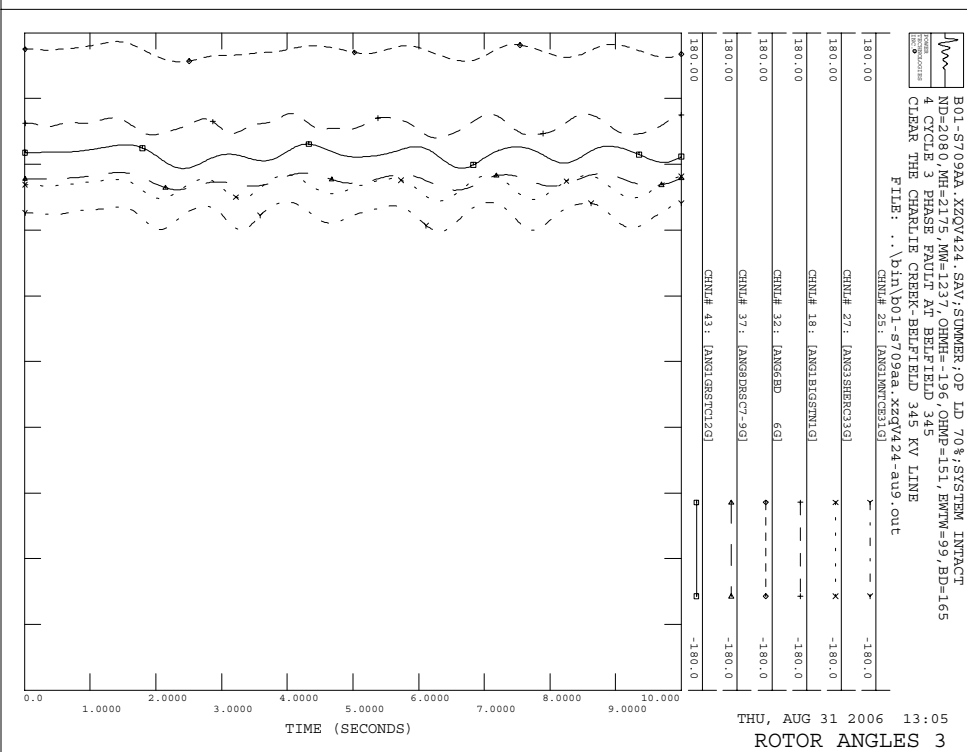
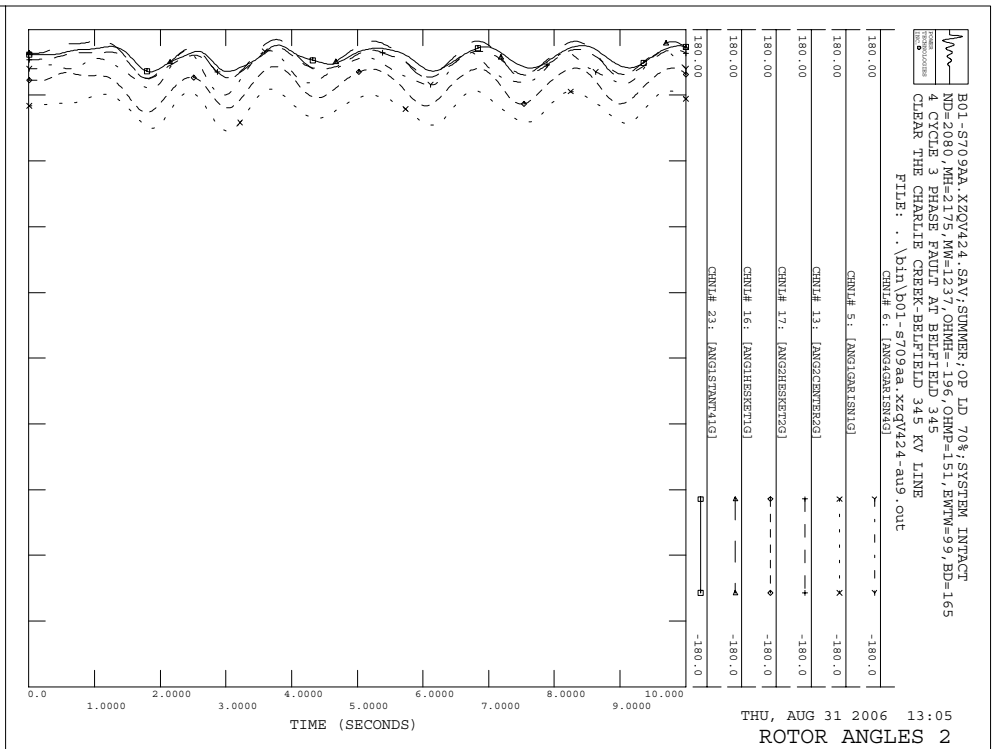
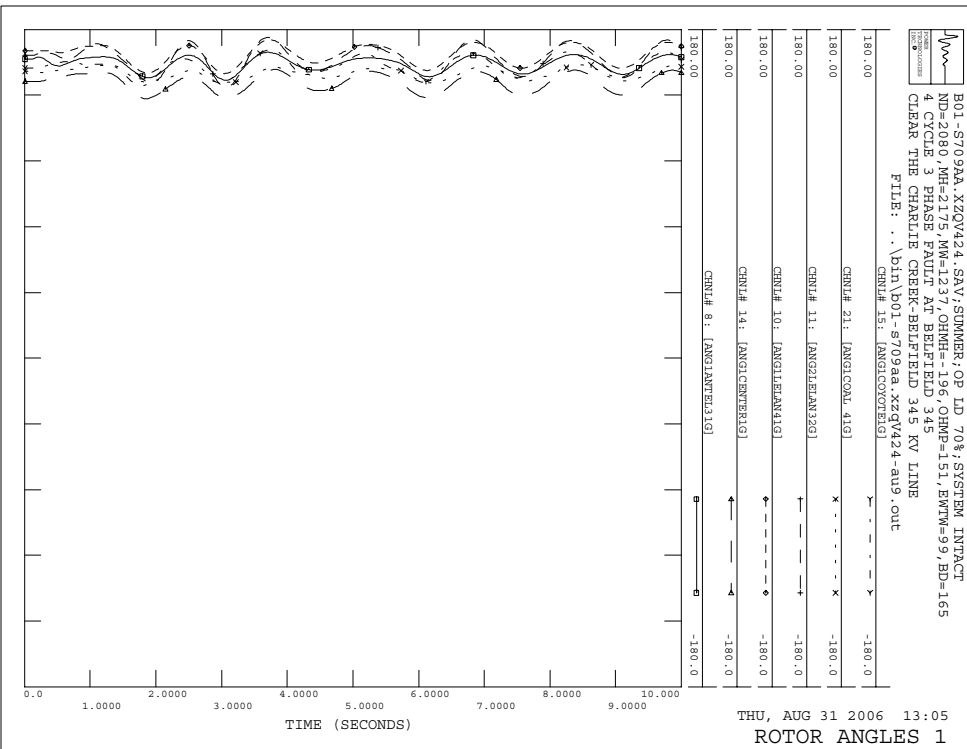


Figure 3.4 - Simulation Results for Contingency au9 leading to the outage of the Belfield-Charlie Creek 345 kV line

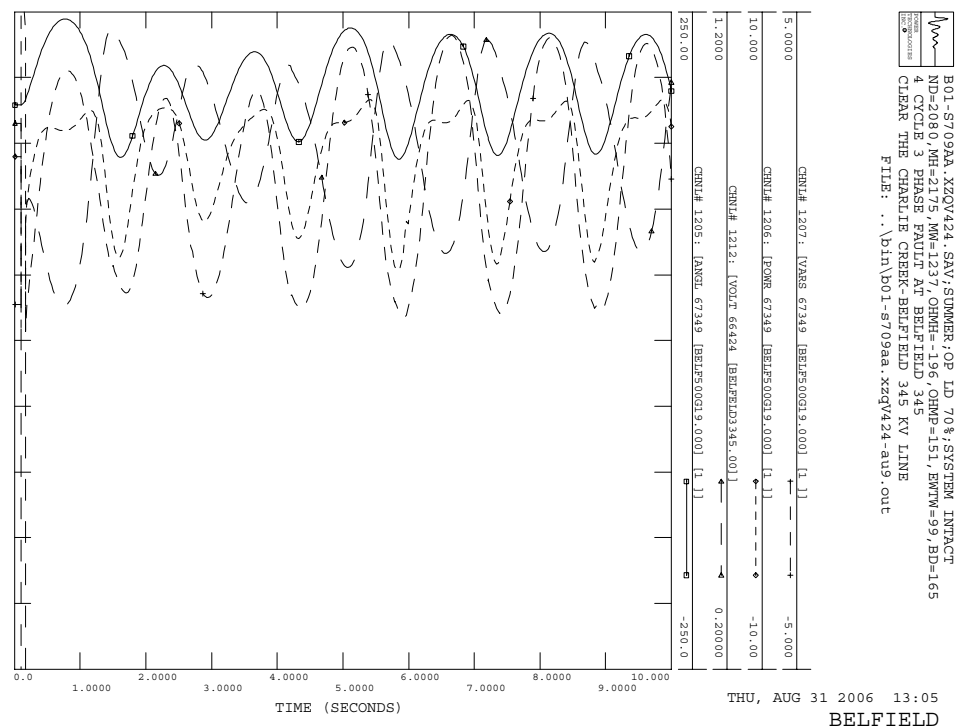
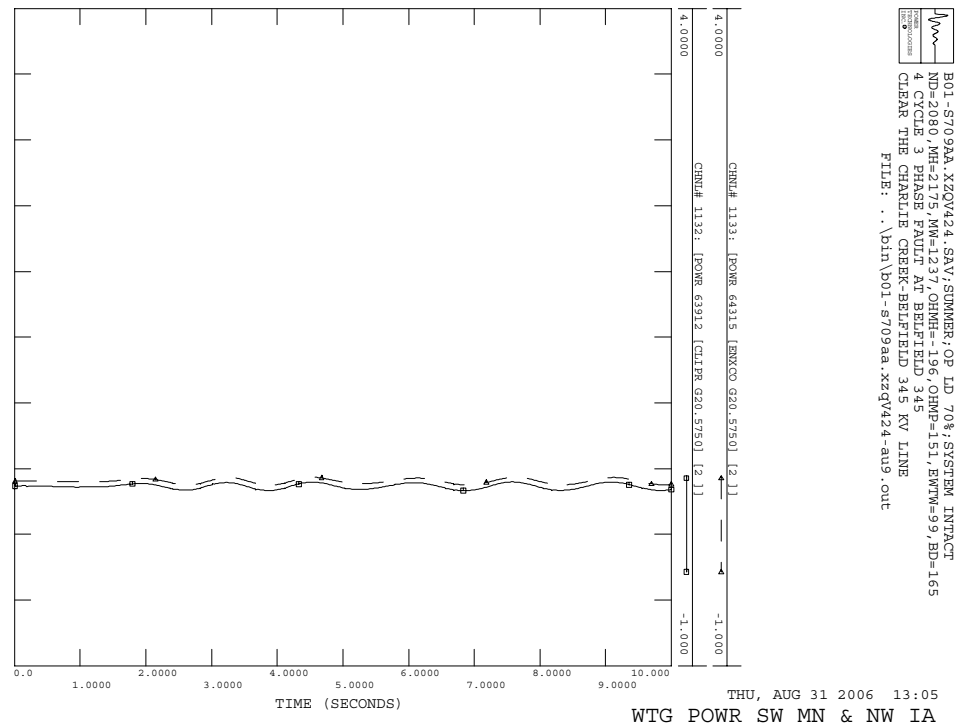
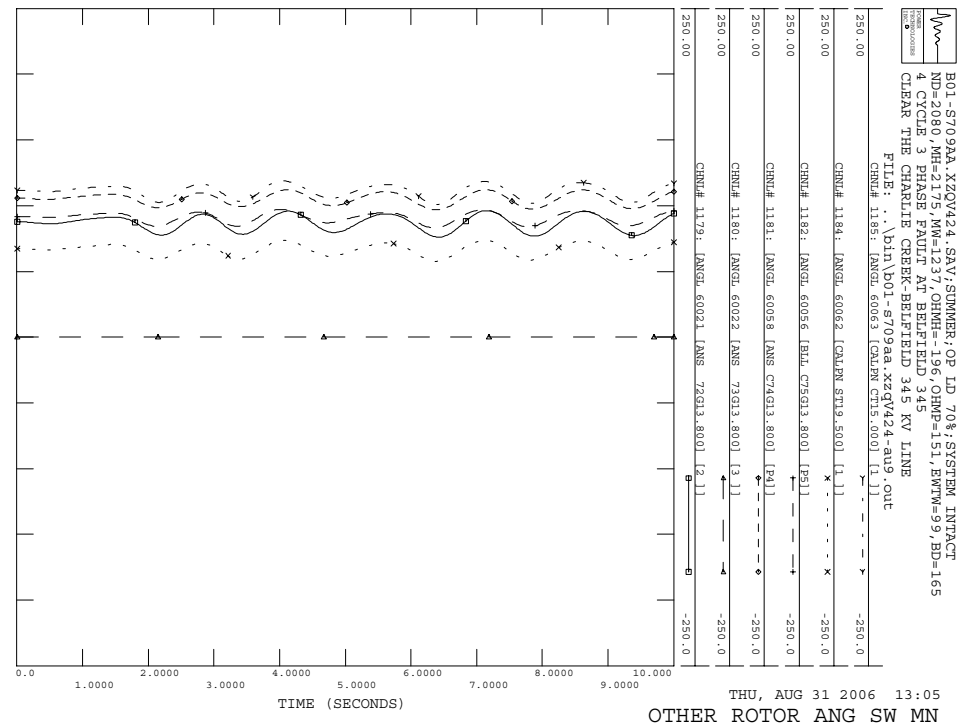


Figure 3.4 (Cont.)

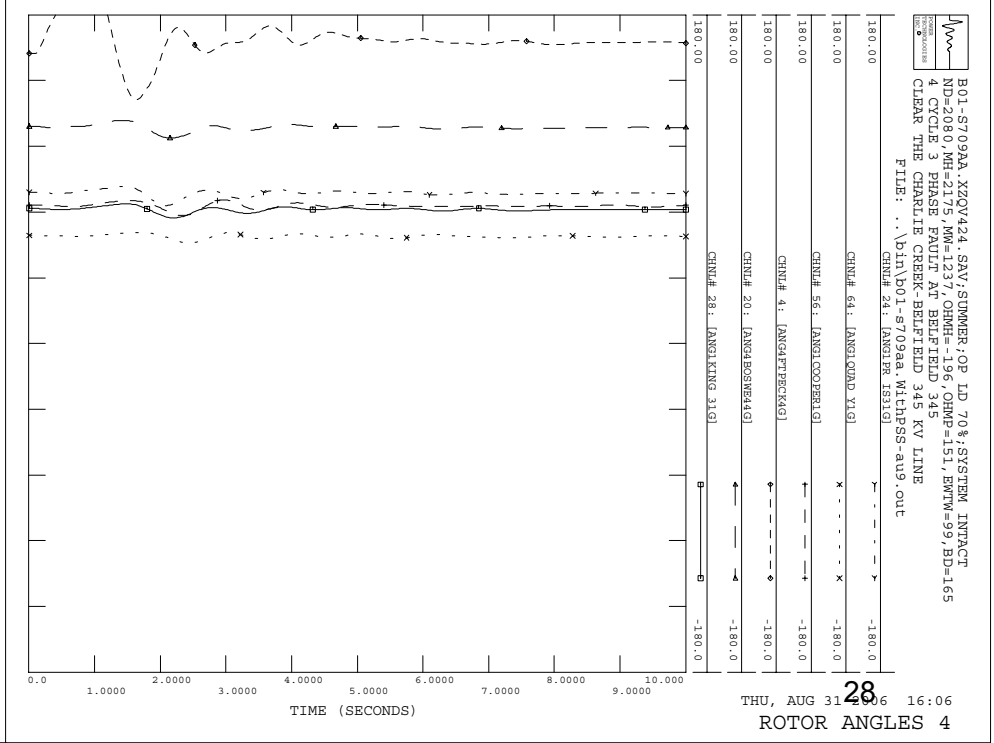
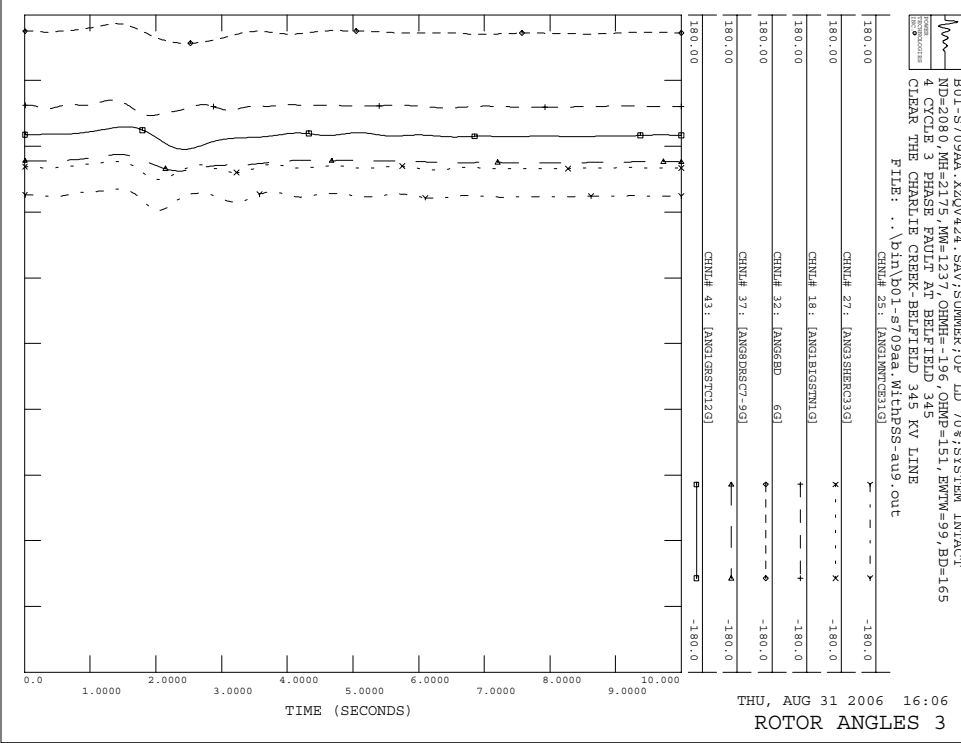
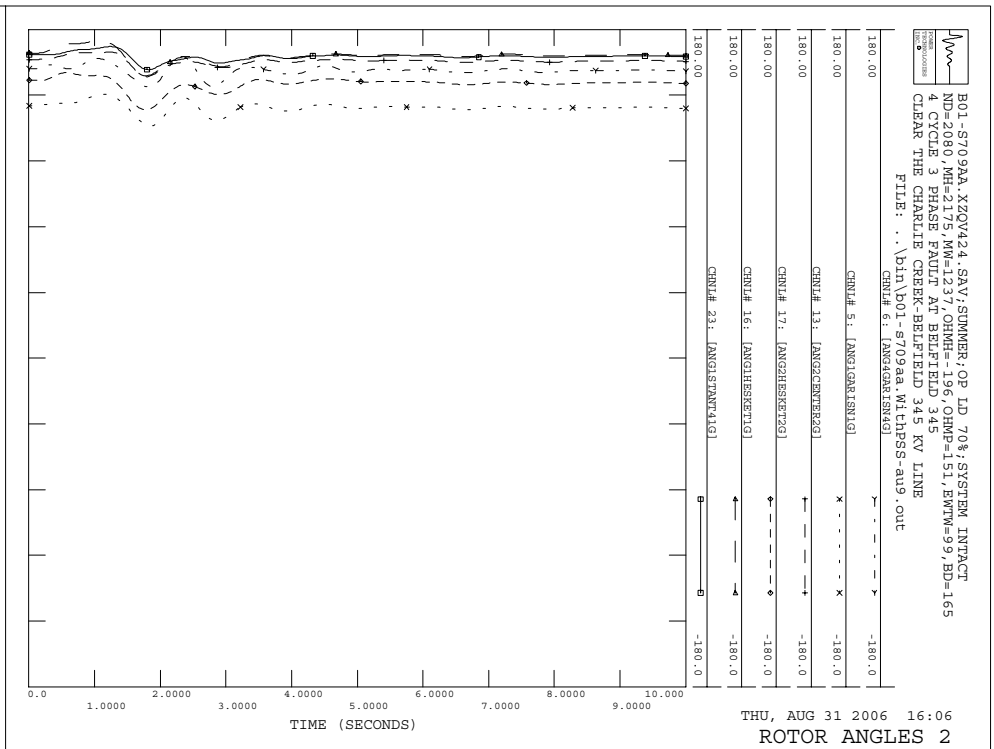
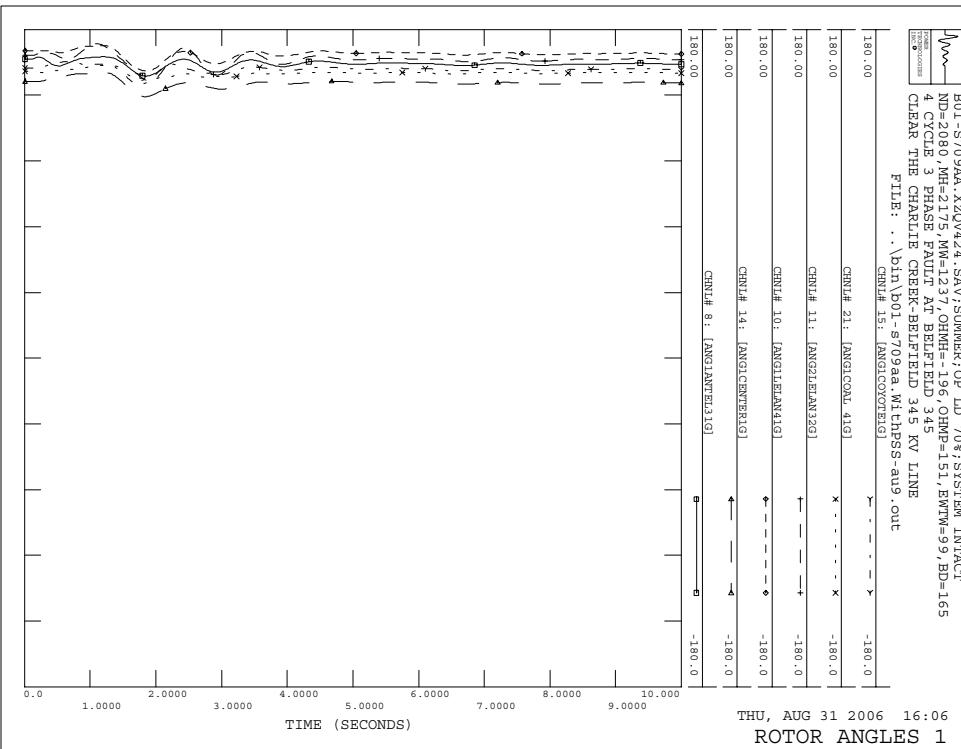


Figure 3.5 - Same as Figure 3.4 but with a PSS at the Belfield Plant

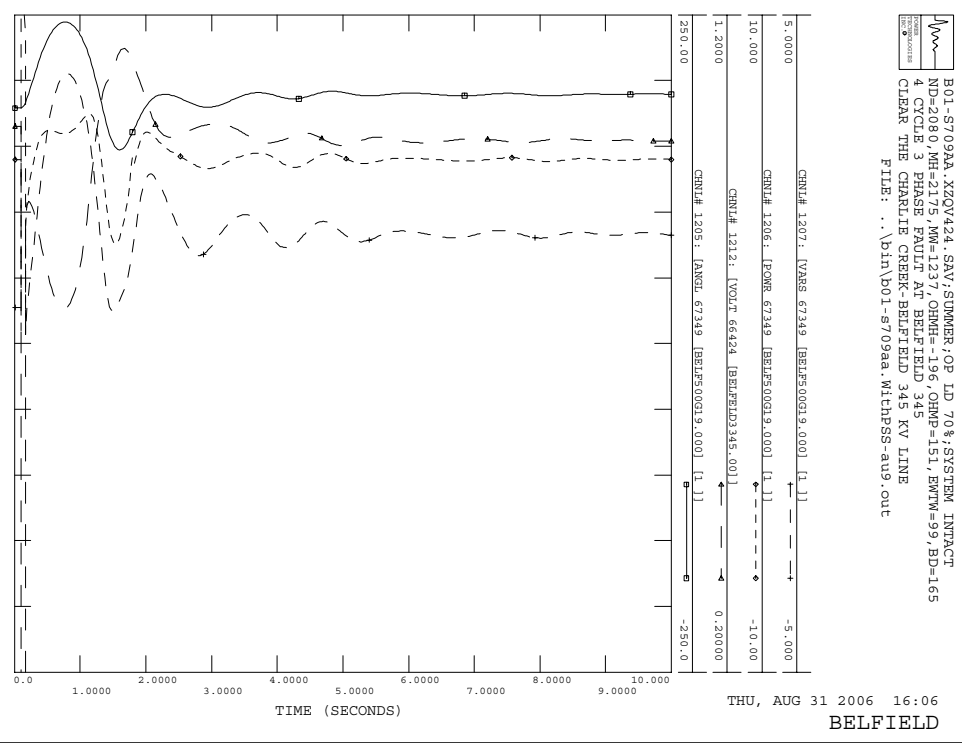
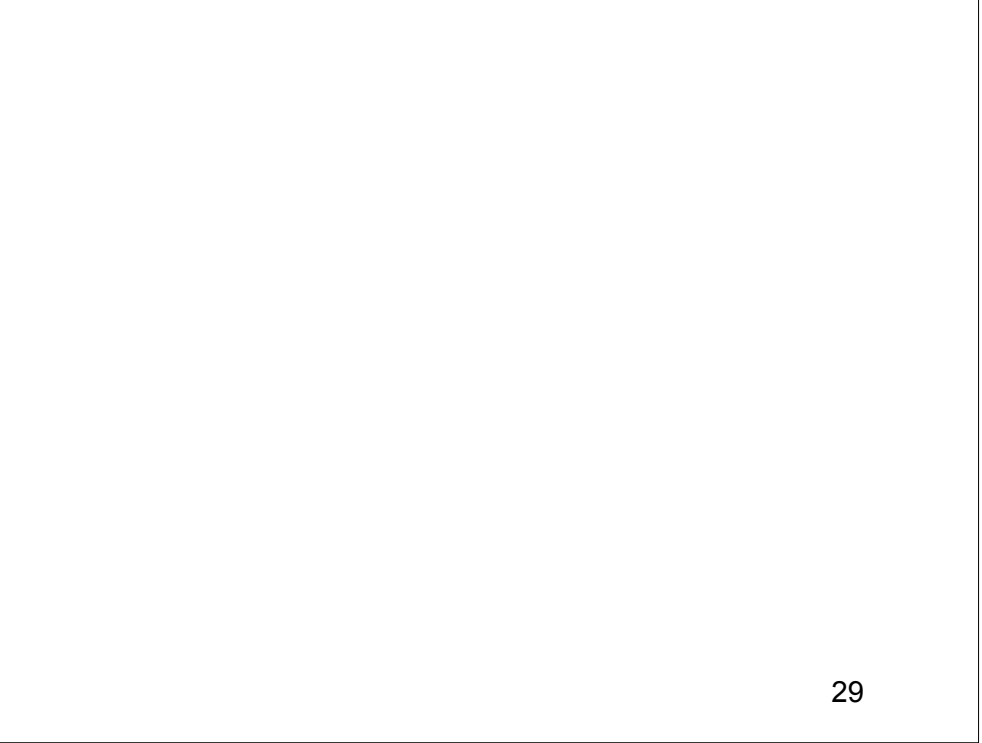
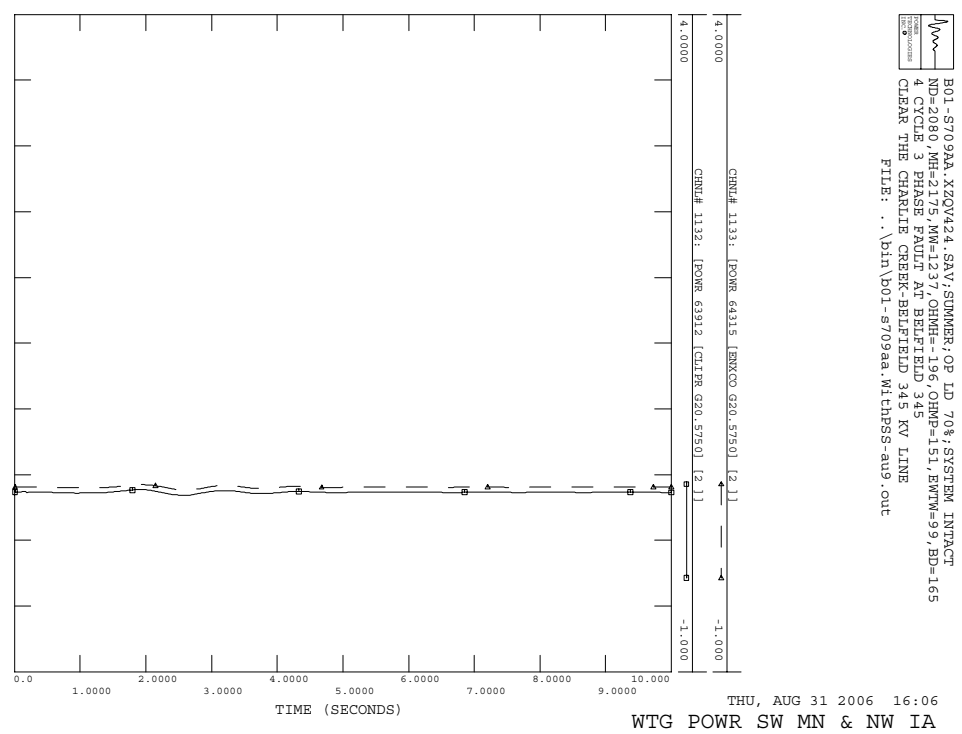
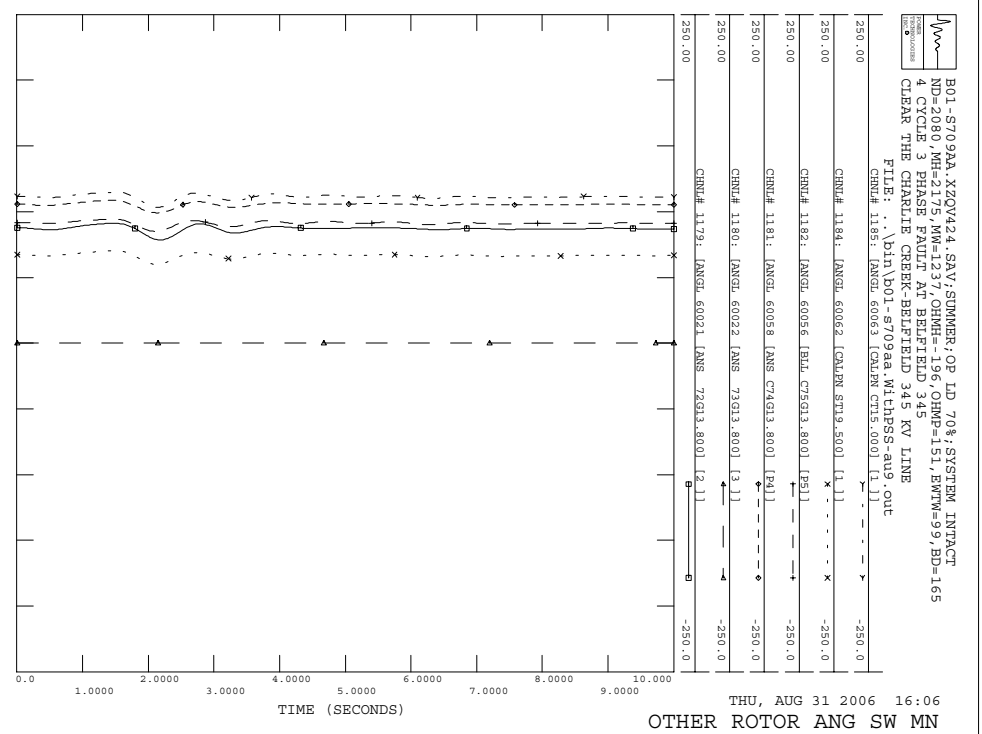
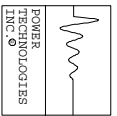
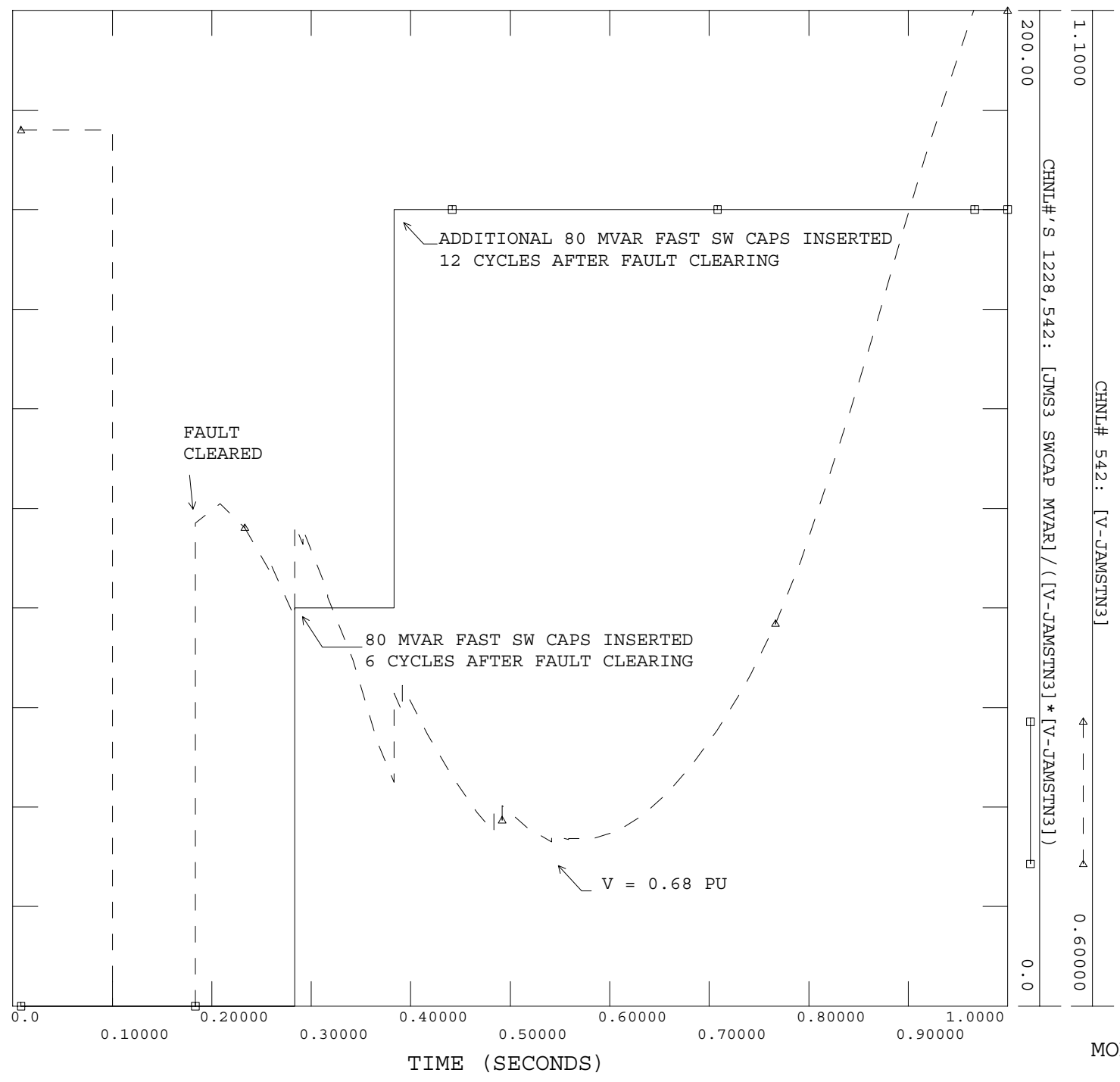
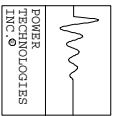


Figure 3.5 (Cont.)



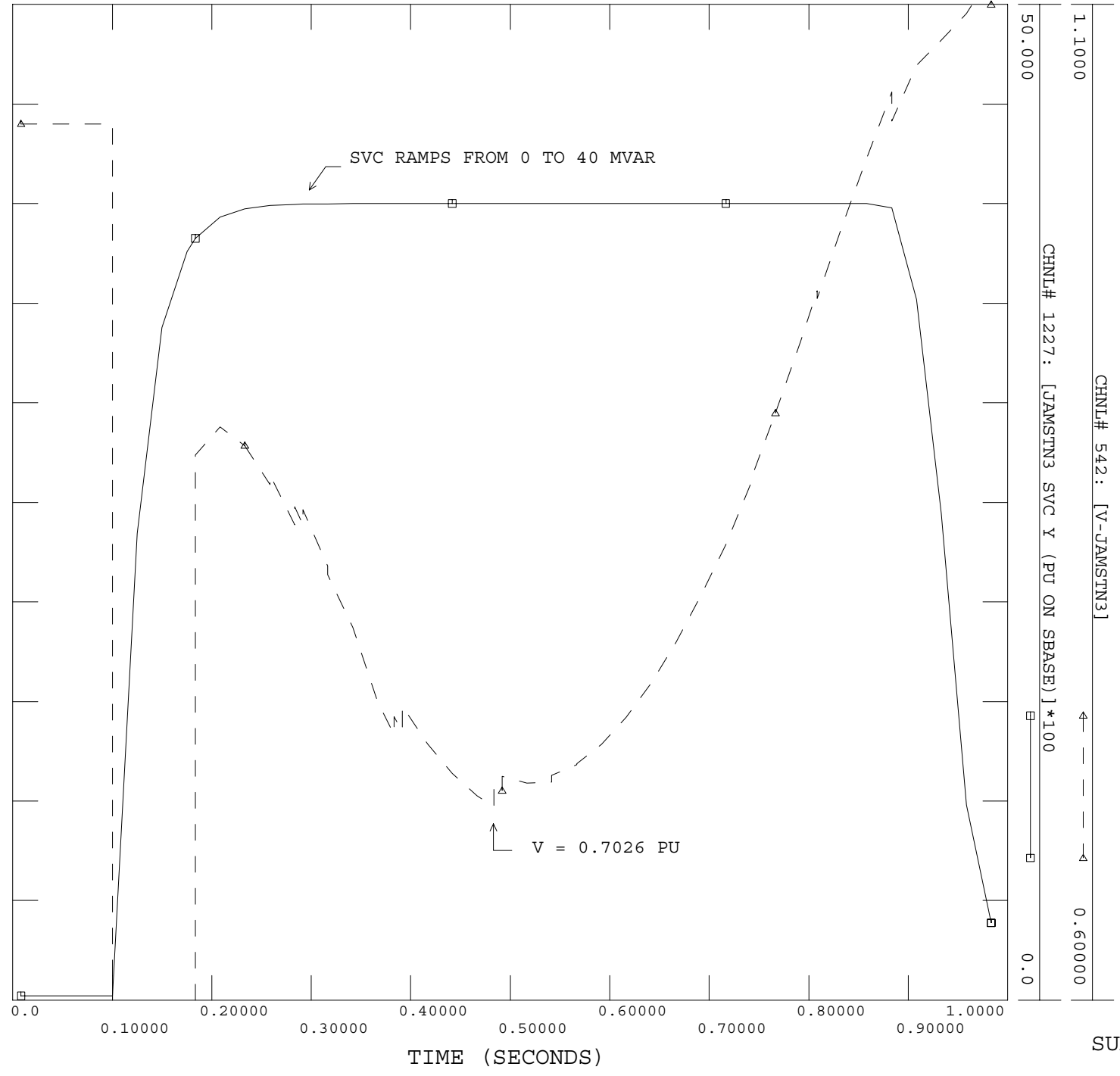
B01-FS09AA.SAV;:SYSTEM INTACT  
ND=2080, MH=2172, MW=1239, OHMH=-197, OHMP=150, EWTW=96, BD=168  
5.0 CY 3 PH FLT @ SQUARE BUTTE 230 ON STANTON LINE  
CLR SQUARE BUTTE-STANTON 230 KV LINE  
FILE: b01-fs09aa-fds.out

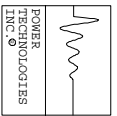




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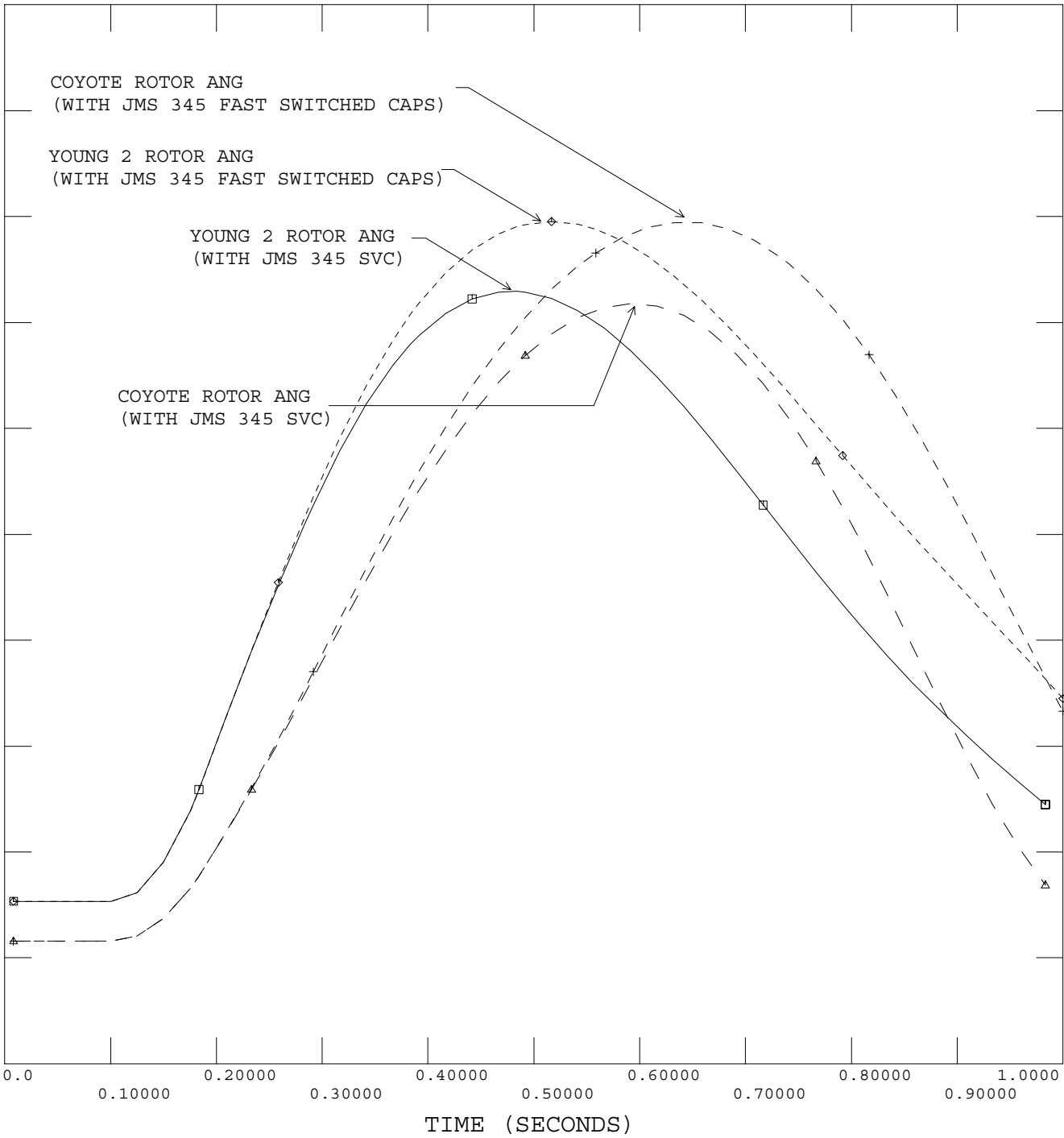
B01-KT09AA.SAV;:SYSTEM INTACT  
ND=2080, MH=2172, MW=1239, OHMH=-197, OHMP=150, EWTW=96, BD=168  
3 PH FLT @ SQUARE BUTTE 230 ON STANTON LINE  
CLEAR SQUARE BUTTE AT 4 CY, STANTON AT 5 CY  
FILE: C:\Projects\...\Belfield Study\pkg-gi0217\bin\b01-kt09aa-fd3-tb.out



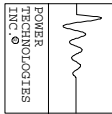


B01-KT09AA.SAV;:SYSTEM INTACT  
ND=2080, MH=2172, MW=1239, OHMH=-197, OHMP=150, EWTW=96, BD=168  
5.0 CY 3 PH FLT @ SQUARE BUTTE 230 ON STANTON LINE  
CLR SQUARE BUTTE-STANTON 230 KV LINE

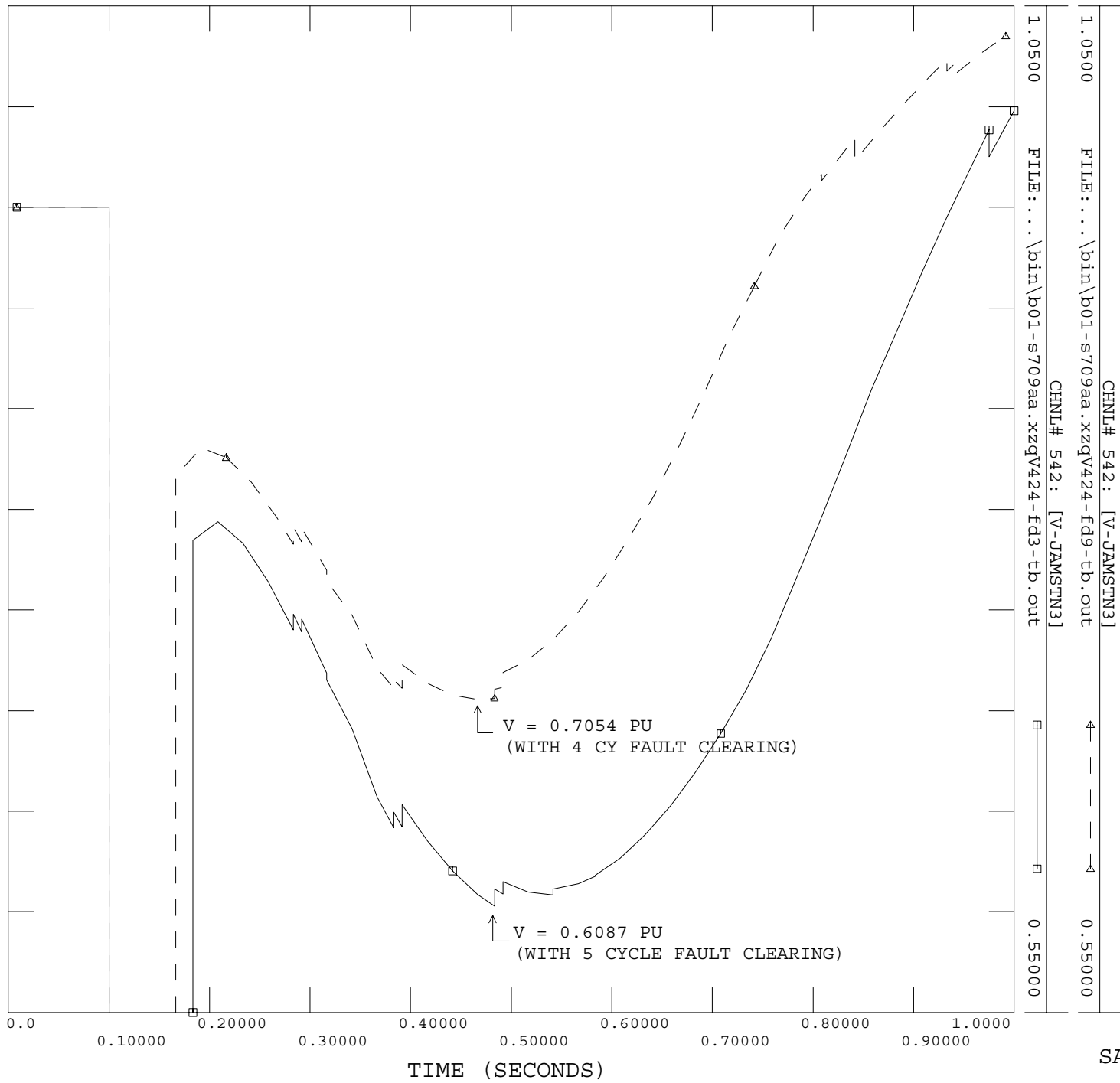
250.00	FILE:C:\Projects\...\bin\b01-fs09aa-fds.out	CHN1# 15: [ANG1COYOTE1G]	+	-----+	150.00
250.00	FILE:C:\Projects\...\bin\b01-fs09aa-fds.out	CHN1# 13: [ANG2CENTER2G]			
250.00	FILE:C:\Projects\...\bin\b01-fs09aa-fds.out	CHN1# 15: [ANG1COYOTE1G]	◇	-----◇	150.00
250.00	FILE:C:\Projects\...\bin\b01-kt09aa-fd3-tb.out	CHN1# 13: [ANG2CENTER2G]	△	-----△	150.00
250.00	FILE:C:\Projects\...\bin\b01-kt09aa-fd3-tb.out	CHN1# 13: [ANG2CENTER2G]	□	-----□	150.00







B01-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
ND=2080,MH=2175,MW=1237,OHMH=-196,OHMP=151,EWTW=99,BD=165  
4.0 CY 3 PH FLT @ SQUARE BUTTE 230 ON STANTON LINE  
CLR SQUARE BUTTE-STANTON 230 KV LINE



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**Table 3.1: List of Contingencies Studied**

Code	Description	System
<b>Regional Faults</b>		
ag1	Single line to ground fault with breaker fail at Leland Olds on the Ft. Thompson 345 kV line	N. Dakota
ag3	Three phase fault at Leland Olds on the Ft. Thompson 345 kV line.	N. Dakota
ah3	4 cycle 3 phase fault at Leland Olds 345. Clear the Leland Olds-Groton 345 kV line	N. Dakota
al1	5 cycle slgf @ Leland Olds 230 on Stanton line, Leland Olds breaker 982 stuck. Clear @ 14 cycles by tripping Leland Olds 230 bus.	N. Dakota
am1	5 cycle slgf @ Leland Olds 230 on Washburn-Bismarck line, Leland Olds breaker 682 stuck. Clear @ 14 cycles by tripping Leland Olds 230 bus.	N. Dakota
ei2	Permanent bipole fault on the CUDC line. Both Coal Creek units tripped at 0.28 sec.	N. Dakota
fd1	5 cycle slgf @ Square Butte-Stanton, breaker 18 stuck, Square Butte dc bipole blocked @ 1 cycle. Clear @ 11 cycles by tripping Square Butte-Stanton, ramp Square Butte dc pole 1 > 275 @ 17 cycles.	N. Dakota
fdk	Same as fd1 but with addition of Young 2 unit trip @ 11 cycles	N. Dakota
fd3	5 cycle 3 phase fault @ Square Butte 230 on Stanton line. Clear Square Butte-Stanton 230 kV line.	N. Dakota
fd4	5 cycle slgf @ Square Butte-Stanton, breaker 17 stuck, Square Butte dc bipole blocked @ 1 cycle. Clear @ 12 cycles by tripping Square Butte-Stanton, ramp Square Butte dc back @ 17 cycles.	N. Dakota
fdl	Same as fd4 but with addition of Young 2 unit trip @ 12 cycles	N. Dakota
nbz	Three-phase fault at Chisago on Chisago County-Forbes 500 kV line. Trip F601C, transfer trip D602F. 100% reduction initiated from Chisago. Forbes SVC trips.	500 kV
nmz	Three-phase fault at Chisago on Chisago County-Forbes 500 kV line. Trip F601C, transfer trip D602F. 100% reduction initiated from Chisago. Leave Forbes SVC on MP System following disturbance.	500 kV
pcs	Single line to ground fault with breaker fail at King with 8P6 stuck.	Prony
pct	Eau-Claire - Arpin 345 kV line trip without a fault.	Prony
pys	Single line to ground fault with breaker fail at Prairie Island with 8H9 stuck.	Prony
pyt	Prairie Island-Byron 345 kV line trip without a fault.	Prony
<b>Local Faults</b>		
au3	4 cycle 3 phase fault at Charlie Creek 345. Clear the Charlie Creek-Belfield 345 kV line.	N. Dakota
au9	4 cycle 3 phase fault at Belfield 345. Clear the Charlie Creek-Belfield 345 kV line.	N. Dakota
ad3	4 cycle 3 phase fault at Antelope Valley 345. Clear the Antelope Valley-Charlie Creek 345 kV line.	N. Dakota
ax3	5 cycle 3 phase fault at Belfield 230. Clear the Dickinson-Belfield 230 kV line.	N. Dakota
auj	Same as au9, but tripping the GI-0217 Plant 200 msec after fault inception	N. Dakota
au9+	Same as au9 above but with a PSS at the Belfield Plant	N. Dakota

**Table 3.2: Minimum Transient Voltages at Groton 345 kV Without and With G132  
(Without GI-0217)**

Fault	Fault Definition	Case b00 (Without G132)	Case b0d (With G132)
ag1	4 cy slgf @ l.old 345 on ftthomp line, lo brkr 2692 stk clr @ 11 cy by tripping fltd line	0.87	0.89
ei2	Permanent bipole fault on the CU dc line both coal creek units tripped at 0.28 sec	0.84	0.85

**Table 3.3: Center-Jamestown 345 kV Flows and Jamestown 345 kV Voltages  
(Without and With Reactive Support at Jamestown 345)**

Cases	JMS 345 Capacitor Size (MVar)	Pre-Fault Flow CEN-JMS 345 (MW)	Pre-Fault Voltage JMS 345 (PU)	Transient Voltage JMS 345 (PU)
<b>Original Cases</b>				
b00 (Without Belfield)	-	454.5	0.9663	0.6923
b01 (With Belfield)	-	501.1	0.9501	0.6633
b00-jt (Without Belfield)	30	458.4	0.9783	0.7024
b01-jt (With Belfield)	100	516.1	0.9932	0.7014
<b>Sensitivity Cases with AHD-GPK Line Out</b>				
b0c (Without Belfield)	-	449.0	0.9687	0.7035
b1c (With Belfield)	-	495.6	0.9541	0.6710
b1c-jt (With Belfield)	80	507.0	0.9875	0.7008
<b>Sensitivity Cases with G132 Included</b>				
b0d (Without Belfield)	-	458.8	0.9615	0.6928
b1d (With Belfield)	-	504.3	0.9490	0.6661
b0d-jt (Without Belfield)	30	462.7	0.9734	0.7031
b1d-jt (With Belfield)	120	522.0	0.9967	0.7020

**Notes:**

- Center-Jamestown 345 kV line flow measured at Jamestown.
- Last column shows minimum transient voltage at Jamestown 345 following fault fd3. Transient voltage violations marked in red.
- Per MAPP Members Reliability Criteria and Study Procedures Manual dated Nov. 19, 2004, The Jamestown 345 kV voltage is allowed to decrease to 0.68 p.u. for any Center faults.

**Table 3.4: Center-Jamestown 345 kV Flows and Jamestown 345 kV Voltages  
(Without and With Series Compensation)**

Cases	Series Compensation	Pre-Fault Flow CEN-JMS 345 (MW)	Pre-Fault Voltage JMS 345 (PU)	Transient Voltage JMS 345 (PU)
<b>Original Cases</b>				
b00 (Without Belfield)	-	454.5	0.9663	0.6923
b01 (With Belfield)	-	501.1	0.9501	0.6633
b00-xp (Without Belfield)	10%	451.0	0.9677	0.7059
b01-xp (With Belfield)	40%	482.5	0.9620	0.7114
<b>Sensitivity Cases with AHD-GPK Line Out</b>				
b0c (Without Belfield)	-	449.0	0.9687	0.7035
b1c (With Belfield)	-	495.6	0.9541	0.6710
b1c-xp (With Belfield)	20%	486.5	0.9595	0.7029
<b>Sensitivity Cases with G132 Included</b>				
b0d (Without Belfield)	-	458.8	0.9615	0.6928
b1d (With Belfield)	-	504.3	0.9490	0.6661
b0d-xp (Without Belfield)	10%	455.0	0.9634	0.7023
b1d-xp (With Belfield)	40%	486.2	0.9565	0.7034

**Notes:**

- Center-Jamestown 345 kV line flow measured at Jamestown.
- Last column shows minimum transient voltage at Jamestown 345 following fault fd3.  
Transient voltage violations marked in red.
- Leland Olds - Ft. Thompson 345 and Leland Olds - Groton 345 are each compensated by the amounts shown above.

**Table 3.5: Minimum Transient Voltages Following Fault fd3  
(Without and With Delayed Square Butte HVdc Recovery)**

Cases	Without Delayed Recovery	With Delayed Recovery
<b>Original Cases</b>		
b00 (Without Belfield)	0.6923	0.6428
b01 (With Belfield)	0.6633	0.6087
<b>Sensitivity Cases with AHD-GPK Line Out</b>		
b0c (Without Belfield)	0.7035	0.6542
b1c (With Belfield)	0.6710	0.6177
<b>Sensitivity Cases with G132 Included</b>		
b0d (Without Belfield)	0.6928	0.6542
b1d (With Belfield)	0.6661	0.6177

Transient voltages shown in per-unit.

Violations marked in red.

**Table 3.6: Center-Jamestown 345 kV Flows and Jamestown 345 kV Voltages  
(Without and With Reactive Support at Jamestown 345)  
With Delayed Square Butte HVdc Recovery**

Cases	JMS 345		Pre-Fault Flow CEN-JMS 345 (MW)	Pre-Fault Voltage JMS 345 (PU)	Transient Voltage JMS 345 (PU)
	Capacitor (MVar)	SVC (MVar)			
<b><i>Original Cases</i></b>					
b00 (Without Belfield)	-	-	454.5	0.9663	0.6428
b01 (With Belfield)	-	-	501.1	0.9501	0.6087
b00-kt (Without Belfield)	175	20	478.2	1.0400	0.7071
b01-kt (With Belfield)	210	40	531.0	1.0400	0.7026
<b><i>Sensitivity Cases with AHD-GPK Line Out</i></b>					
b0c (Without Belfield)	-	-	449.0	0.9687	0.6542
b1c (With Belfield)	-	-	495.6	0.9541	0.6177
b0c-kt (Without Belfield)	170	-	471.4	1.0400	0.7010
b1c-kt (With Belfield)	205	30	524.1	1.0400	0.7076
<b><i>Sensitivity Cases with G132 Included</i></b>					
b0d (Without Belfield)	-	-	458.8	0.9615	0.6427
b1d (With Belfield)	-	-	504.3	0.9490	0.6124
b0d-kt (Without Belfield)	180	10	483.4	1.0400	0.7074
b1d-kt (With Belfield)	210	30	537.2	1.0400	0.7047

Notes:

- Center-Jamestown 345 kV line flow measured at Jamestown.
- Last column shows minimum transient voltage at Jamestown 345 following fault fd3.  
Transient voltage violations marked in red.

**Table 3.7: Center-Jamestown 345 kV Flows and Jamestown 345 kV Voltages  
(Without and With Series Compensation)  
With Delayed Square Butte HVdc Recovery**

Cases	Series Compensation	Pre-Fault Flow CEN-JMS 345 (MW)	Pre-Fault Voltage JMS 345 (PU)	Transient Voltage JMS 345 (PU)
<b>Original Cases</b>				
b00 (Without Belfield)	-	454.5	0.9663	0.6428
b01 (With Belfield)	-	501.1	0.9501	0.6087
b00-yp (Without Belfield)	60%	423.2	0.9786	0.7060
b01-yp (With Belfield)	75%	454.7	0.9740	0.7009
<b>Sensitivity Cases with AHD-GPK Line Out</b>				
b0c (Without Belfield)	-	449.0	0.9687	0.6542
b1c (With Belfield)	-	495.6	0.9541	0.6177
b0c-yp (Without Belfield)	50%	422.8	0.9787	0.7024
b1c-yp (With Belfield)	70%	451.8	0.9745	0.7064
<b>Sensitivity Cases with G132 Included</b>				
b0d (Without Belfield)	-	458.8	0.9615	0.6427
b1d (With Belfield)	-	504.3	0.9490	0.6124
b0d-yp (Without Belfield)	60%	427.7	0.9749	0.7050
b1d-yp (With Belfield)	75%	459.8	0.9695	0.7044

Notes:

- Center-Jamestown 345 kV line flow measured at Jamestown.
- Last column shows minimum transient voltage at Jamestown 345 following fault fd3.  
Transient voltage violations marked in red.
- Leland Olds - Ft. Thompson 345 and Leland Olds - Groton 345 are each compensated by the amounts shown above.



**Table 3.8: Additional Faults**

<b>FAULT</b>	<b>FAULT DEFINITION</b>	<b>COMMENTS</b>
eb3	4.5 cy 3 ph flt @ center 345 on jamestown line clr center-jamestown 345 kv line	run delayed sqbdc restart version using tblock.idv
fo9	4.5 cy 3 ph flt @ center 345 on coyote line clr center-coyote 345 line & trip coyote @ 5 cy	run delayed sqbdc restart version using tblock.idv
ek3	4.5 cy 3 ph flt @ center 345 on 345/230 transformer clr center 345/230 kv transformer	run delayed sqbdc restart version using tblock.idv
ec3	5 cy 3 ph flt @ center 230 on heskett line clr center-heskett 230 kv line	run delayed sqbdc restart version using tblock.idv
el3	5 cy 3 ph flt @ center 230 on square butte line clr center-square butte 230 kv line	run delayed sqbdc restart version using tblock.idv
bl3	5 cycle 3 phase fault at stanton 230 clear the stanton-leland olds 230 kv line	run delayed sqbdc restart version using tblock.idv
ed3	5 cycle 3 phase fault at stanton 230 clear the stanton-square butte 230 kv line	run delayed sqbdc restart version using tblock.idv
ee3	5 cycle 3 phase fault at stanton 230 clear the stanton-coal creek 230 kv line	run delayed sqbdc restart version using tblock.idv
ef3	5 cycle 3 phase fault at stanton 230 clear the stanton-coal creek-mchenry 230 kv line	run delayed sqbdc restart version using tblock.idv
ev0	4 cycle 3 phase fault at sqbt230p1 clr tripping sbdc p1, ramp sbdc p2 > 1100 amps @ 17 cy	run delayed sqbdc restart version using tblock.idv

**Table 3.9: Additional Faults Significantly Impacted by Project GI-0217**

<b>FAULT</b>	<b>FAULT DEFINITION</b>	<b>Without GI-0217 (Case b00)</b>	<b>With GI-0217 (Case b01)</b>	<b>GI-0217 + Upgrades (Case b1e)</b>
bl3	5 cycle 3 phase fault at stanton 230	OK	<b>63369 [JAMESTN3] 0.68</b>	<b>63369 [JAMESTN3] 0.69</b>
	clear the stanton-Ieland olds 230 kv line		<b>63358 [BUFFALO3] 0.69</b>	
bl9	4 cycle version of bl3	Not Tested	OK	OK
ec3	5.0 cy 3 ph flt @ center 230 on heskett line	OK	<b>63369 [JAMESTN3] 0.67</b>	<b>63369 [JAMESTN3] 0.68</b>
	clr center-heskett 230 kv line			
ecs	4 cycle version of ec3	Not Tested	OK	OK
ed3	5 cycle 3 phase fault at stanton 230	OK	<b>63369 [JAMESTN3] 0.69</b>	OK
	clear the stanton-square butte 230 kv line			
ed9	4 cycle version of ed3	Not Tested	OK	Not Tested
ef3	5 cycle 3 phase fault at stanton 230	<b>[JAMESTN3] 0.67</b>	<b>Unstable</b>	<b>63369 [JAMESTN3] 0.65</b>
	clear the stanton-coal creek-mchenry 230 kv line	<b>[BUFFALO3] 0.69</b>		
ef9	4 cycle version of ef3	OK	<b>63369 [JAMESTN3] 0.69</b>	OK

1. Network upgrades in Case b1e: Belfield 345/230 kV transformer #2 + Belfield-Hettinger 230 kV line.

2. Per MAPP Members Reliability Criteria and Study Procedures Manual dated Nov. 19, 2004,

The Jamestown 345 kV voltage is allowed to decrease to 0.68 p.u. for any Center faults. The default voltage limit (0.70 pu) is utilized for all other faults.

## 4. STEADY-STATE ANALYSIS

### 4.1 Model Development

The starting point for the development of the pre-project model (i.e., without the proposed GI-0217 plant) was case *f11supk-final-06series.sav* included in the NMORWG 2006 Study package. This is a MAPP 2006 Series 2011 Summer Peak base case. In order to develop the pre-project case, several changes were made to this case with input from the study ad hoc group. Some of the more significant changes included the following:

- Added the following prior-queued generation projects: GI-0108 (200 MW at White 345 kV), GI-0208 (40 MW wind farm at Edgeley 115 kV) and GI-0209 (40 MW wind farm at Ft. Thompson 69 kV). Project G132 (180 MW wind farm on Ellendale-Wishek 230 kV line) was not modeled.
- Purged later-queued projects such as G392 (Big Stone 2), GI-0508 (Wilton Wind) and G291 (Edgeley Wind, OTP).
- Series compensation modeled on the LGS-Wilmarth 345 kV line.
- With input from Xcel Energy, modeled SW MN Wind at ~ 825 MW along with associated transmission upgrades.

As in the summer off-peak cases, the Arrowhead-Gardner Park 345 kV line is included in the peak model. Also, no CAPX 2020 projects are modeled in the case.

The resulting pre-project summer peak case is named *p00-sp15aa.sav*. The North Dakota load is at 100.5% of the 2015 peak load level of 3251 MW.

After establishing the pre-project case, the proposed GI-0217 plant was added in order to create the post-project summer peak case. For the purposes of this study, the GI-0217 plant was dispatched by scaling down generation in the MISO footprint to the east of the Twin Cities. The resulting post-project summer peak case is named *p01-sp15aa.sav*.

Detailed case summaries are given in [Appendix E](#). Corresponding North Dakota Coalfields one-line diagrams without and with the GI-0217 plant are depicted in Figures [4.1](#) and [4.2](#) respectively.

The impact of the GI-0217 plant was studied both under system intact and N-1 contingency conditions. Full ac power flow solutions were used. Results are described in the following sections.

## 4.2 System Intact Analysis

The incremental impact of the GI-0217 plant on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows with and without the Belfield project.

All transmission facilities rated 110 kV and above were monitored in the WAPA, OTP, GRE, MP, XEL and MH control areas. The criterion used to flag thermal overloads is 100% of continuous facility rating (Rate A in PSS/E). All overloaded facilities that have a TDF (Transfer Distribution Factor) greater than 2% of the generation addition and an increase in flow of at least 1 MW (without plant vs. with plant) are flagged as significantly affected facilities.

Monitored bus voltages that fall outside the band 0.95 pu – 1.05 pu are flagged as violations. Those buses that have a voltage change of more than 0.01 p.u. (without plant vs. with plant) are included in the SAF list.

Significantly affected facility loadings are presented in [Table 4.1](#). Newly overloaded facilities are marked in red. Results indicate that the following facilities become newly overloaded:

- Belfield 345/230 kV transformer: Marginal overload of approximately 1% over the 250 MVA normal rating.
- Belfield – Dickinson 230 kV line: The loading on this facility is 106% based on the 239 MVA normal rating. This 230 kV line, however, exhibits a conductor rating of approximately 400 MVA (Rate B in the power flow case) and thus is not considered to be of concern if replacement of terminal equipment such as a wavetrapp or a current-transformer is a possibility.

Results also indicate that the Belfield – Charlie Creek 345 kV line is close to being overloaded. The corresponding loading is 99.3% based on the 239 MVA normal rating.

Voltage criteria violations were observed at several remote buses both with and without the proposed GI-0217 plant. The incremental impact of the proposed project on bus voltages is insignificant.

## 4.3 Contingency Analysis

Contingency analyses include single branch and selected multi-element contingencies on facilities rated 115 kV and above. Single branch as well as multi-terminal outages in WAPA, and single branch contingencies in OTP, GRE, MP and XEL were considered. Select multi-terminal outages were also considered in Northern MN. All facilities rated 110 kV and above were monitored in the WAPA, OTP, GRE, MP, XEL and MH control areas.

Contingency analysis was performed using the GRE Contingency Program “*contingency.irf*”. Contingencies were solved with phase shifters and transformer taps enabled. Thermal violations were flagged based on facility emergency ratings (Rate C in PSS/E). Post-contingency power flows in excess of 90% of the Rate C rating were recorded. Facility loadings with and without the GI-0217 plant were tabulated and compared. The criteria used to flag thermal overloads is 100% of Rate C.

For N-1 contingency conditions, monitored bus voltages outside the range 0.90 pu – 1.10 pu are flagged as violations.

Significantly Affected Facilities (SAF) were identified using the same criteria as in the system intact analysis.

The following contingencies failed to converge, both with and without the proposed plant. Since these contingencies are remote from the study area, no attempt was made to solve them.

- *Loss of 115/41.6 kV Transformer at Jamestown Peaker Substation (OTP):* There are two peaking units at this 41.6 kV substation (bus 63172). The total output is approx. 40 MW. Following the loss of the 115/41.6 kV transformer, the only available transmission outlet is the Jamestown-Edgeley-Oakes 41.6 kV line connecting to the Oakes 41.6/230 kV substation. The 41.6 kV path is rated 24 MVA and is unable to support the full output of the peakers. Voltage collapse is a result of increased loadings on the 41.6 kV lines. This contingency may be resolved by tripping one or both peaking units.
- *Loss of 115/92 kV Transformer at Bay Front (XEL):* The Bay Front Generating Station is located in Northern MN (bus 60657). There are four units at this substation and the total output is 55 MW. The loss of the 115/92 kV transformer results in the loss of a strong transmission outlet at Bay Front. This contingency may be solved by tripping one or more units at Bay Front.

[Table 4.2](#) lists the significantly affected facility loadings for contingency conditions. 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 C without and with the GI-0217 plant. Where applicable, the entries in the last column represent “switching procedure identifiers” that, when used together with the corresponding single branch outages, define multi-terminal contingencies (each switching procedure has a unique identifier). [Table 4.14](#) describes the switching procedures listed in [Table 4.2](#).

Going back to [Table 4.2](#), the overloads on facilities that are in the immediate vicinity of the Belfield substation are of particular interest. These facilities include the following:

- Belfield – Charlie Creek 345 kV line: Several contingencies overloaded this line. The most limiting contingency is the loss of the Belfield 345/230 kV transformer which overloads the line to approximately 485 MVA. The conductor rating for this 345 kV line however, is 880 MVA (Rate B in the power flow case), thus suggesting that this overload should be of no major concern (i.e., probably the result of terminal equipment such as a wavetrap or a current transformer).
- Belfield – Dickinson 230 kV line: Several contingencies overload this line. The most limiting contingency is the loss of the Belfield – Charlie Creek 345 kV line that overloads the 230 kV line to approximately 426 MVA.  
Note: The results of the stability analysis recommend tripping the GI-0217 plant following the outage of the Belfield-Charlie Creek 345 kV line. If the GI-0217 plant is tripped, the Belfield – Dickinson 230 kV line will not overload. Note however from [Table 4.2](#) that this 345 kV line outage is not the only outage that overloads the Belfield-Dickinson 230 kV line. Several other contingencies load this 230kV line in excess of its 263 MVA emergency rating. As noted in [Section 4.2](#), replacement of terminal equipment on this 230 kV line will likely alleviate these other limitations.
- Dickinson – Heskett 230 kV line: The loss of the Belfield – Charlie Creek 345 kV line overloads this line to 294 MVA. Tripping the proposed GI-0217 plant will alleviate this overload.
- Belfield 345/230 kV transformer: The loss of the Belfield – Charlie Creek 345 kV line overloaded this transformer to 491 MVA (i.e., 157% loading based on the 313 MVA emergency rating). Tripping the proposed GI-0217 plant will alleviate the overload following this outage. The loss of the Charlie Creek – AVS 345 kV line also resulted in a minor overload on this transformer (4% loading over the 313 MVA emergency rating).
- Dickinson 230/115 kV transformer: The loss of the Belfield – Charlie Creek 345 kV line overloaded this transformer to 136 MVA (i.e., 108.7% loading based on the 125 MVA emergency rating). As before, tripping the proposed GI-0217 plant will alleviate this particular post-contingency overload. The loss of the Little Miss - Baker also resulted in a minor overload on this transformer (3% loading over the 125 MVA emergency rating).

It is also important to note that the proposed GI-0217 plant also aggravated the flows on several other transmission facilities that are remote from the point of interconnection. See [Table 4.2](#). These overloads have not been addressed in this study. It is assumed that mitigation of these overloads outside of the scope of the

present ER interconnection studies. Additional analysis will be required to determine if mitigation is required to resolve these overloads.

Analysis of post-contingency voltages showed voltage violations at several remote buses, both with and without the proposed project. [Table 4.3](#) lists the significantly affected bus voltages. The table lists only those buses that are adversely impacted by the addition of the proposed project.

#### 4.4 Sensitivity Analysis

WAPA requested that a sensitivity analysis be performed by making the following modeling changes to the study models. The intent of making these changes is to further stress the transmission system in the Belfield area.

1. Set Rapid City DC Tie to 200 MW West
2. Set Miles City DC Tie to 200 MW West
3. Set B10T to 165 MW South

Two sensitivity cases were developed starting from the pre- and post-Belfield cases described in [Section 4.1](#) (cases *p00* and *p01* respectively), by making the above modeling changes:

- Case *p0c-sp15aa.sav* (*p0c*). Without the GI-0217 plant.
- Case *p1c-sp15aa.sav* (*p1c*). With the GI-0217 plant.

Detailed case summaries are given in [Appendix A](#). Corresponding North Dakota Coalfields one-line diagrams without and with the GI-0217 plant are depicted in [Figures 4.3](#) and [4.4](#) respectively.

The impact of the GI-0217 plant was studied both under system intact and N-1 contingency conditions. The methodology for this analysis is the same as that described previously. Results are described in the following subsections.

##### 4.4.1 System Intact Analysis

The incremental impact of the GI-0217 plant on thermal loading of transmission facilities under system intact conditions was evaluated by comparing transmission system power flows with and without the Belfield project.

Significantly affected facility loadings are presented in [Table 4.4](#). Results indicate that the following facilities become newly overloaded (highlighted in red):

- Belfield 345/230 kV transformer: The loading on this 250 MVA transformer is approx. 151%.
- Dickinson 230/115 kV transformer: The loading on this 100 MVA transformer is approx. 106%.

Voltage criteria violations were observed at several remote buses both with and without the proposed GI-0217 plant. The incremental impact of the proposed project on bus voltages is insignificant.

#### 4.4.2 Contingency Analysis

In addition to the contingencies described in [Section 4.3](#), the following additional contingencies failed to converge, both in the pre- and post-project cases. These contingencies were not solved.

- *Loss of Dawson County – Miles City 230 kV Line:* This contingency leads to voltage instability due to a 35 MVar reactive deficiency at the Miles City 230 kV substation. WAPA indicated that the Miles City DC Tie is ramped down to 60 MW following this contingency.
- *Loss of Stegall 345/230 kV Transformer:* This contingency leads to voltage instability due to a 35 MVar reactive deficiency at the Stegall 230 kV substation.

[Table 4.5](#) lists the significantly affected facility loadings for N-1 contingency conditions. 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 C without and with the GI-0217 plant.

The overloads on facilities that are in the immediate vicinity of the Belfield substation are of particular interest. These facilities include the following:

- Belfield – Charlie Creek 345 kV line: As explained in [Section 4.3](#), the conductor rating for this 345 kV line is 880 MVA. The post-contingency overloads reported in [Table 4.5](#) should therefore be of no major concern.
- Belfield – Dickinson 230 kV line: The overloads listed in [Table 4.5](#) should not be a concern considering that this line exhibits a conductor rating of approx. 400 MVA.

Results presented in [Section 4.3](#), however, show post-contingency loadings as high as 426 MVA on this 230 kV line following the loss of the Belfield-Charlie Creek 345 kV line.

Note: The results of the stability analysis recommend tripping the GI-0217 plant following the outage of the Belfield-Charlie Creek 345 kV line. If the GI-0217 plant is tripped, the Belfield – Dickinson 230 kV line will not overload. Note however from [Tables 4.2 and 4.5](#) that this 345 kV line outage is not the only outage that overloads the Belfield-Dickinson 230 kV line. Two other contingencies overload this 230kV line in excess of its 263 MVA emergency rating. These include the outage of the Belfield-Medora 230 kV line and the outage of the Medora-Dawson Co. 230 kV line. Although the proposed plant could be run back following the outage of Belfield-Medora to alleviate this overload, the loss of the Medora-Dawson



Co. line will continue to be a limiter. As before, replacement of terminal equipment on the Belfield-Dickinson 230 kV line will likely alleviate these other limitations.

- Dickinson – S. New England 115 kV line: The loss of the Belfield – Medora 230 kV line results in a marginal overload on this 115 kV line. Post-contingency loading is 102.6% based on the 112.5 MVA emergency rating. The power flow case shows that the conductor rating is also 112.5 MVA. Although the proposed plant could be run back following the outage of Belfield-Medora to alleviate this overload, the loss of the Medora-Dawson Co. line will continue to be a limiter.
- Belfield 345/230 kV transformer: The loss of the Belfield – Charlie Creek 345 kV line overloaded this transformer to 491 MVA (i.e., 157% loading based on the 313 MVA emergency rating). While tripping the proposed GI-0217 plant will alleviate this particular post-contingency overload, note that several other contingencies also overloaded this transformer as shown in [Table 4.5](#).
- Dickinson 230/115 kV transformer: The loss of the Belfield – Medora 230 kV line overloaded this transformer to 149 MVA (i.e., 119.3% loading based on the 125 MVA emergency rating). Although the proposed plant could be run back to mitigate this particular post-contingency overload, several other contingencies also overloaded this transformer as shown in [Table 4.5](#). Note that this transformer is already overloaded under system intact conditions.

Analysis of post-contingency voltages showed voltage violations at several remote buses, both with and without the proposed project. [Table 4.6](#) lists the significantly affected bus voltages. The table lists only those buses that are adversely impacted by the addition of the proposed project.

#### 4.5 Reinforcement Analysis

Results presented in Sections 4.2 through 4.4 showed that the interconnection of the proposed GI-0217 plant would adversely impact transmission system steady-state performance. In this section, mitigation is proposed to alleviate overloads on the following facilities that are either at or in the immediate vicinity of the Belfield substation.

- Belfield 345/230 kV transformer
- Dickinson 230/115 kV transformer
- Dickinson – S. New England 115 kV line
- Belfield – Dickinson 230 kV line

Following WAPA's recommendation, the addition of a new Belfield-Hettinger 230 kV line was investigated. WAPA provided an idev file to model this 230 kV transmission line. Line parameters are shown below:

X-----FROM-----X			X-----TO-----X									
BUS#	NAME	BSKV	BUS#	NAME	BSKV	CKT	LINE R	LINE X	CHRGING	RATEA	RATEB	RATEC
66425	BELFELD4	230*	67347	HETINGR4	230	1	0.01873	0.15262	0.28025	239.0	398.0	263.0

Post-project sensitivity case *p1c* described in [Section 4.4](#) was chosen for this analysis because this case exhibits higher loadings on the Belfield 345/230 kV transformer than the original post-project case *p01* described in [Section 4.1](#). The addition of the Belfield-Hettinger 230 kV line to case *p1c* increases the system intact loading on the Belfield 345/230 kV transformer from 151% to 170% based on its 250 MVA rating. This system intact overload can be mitigated either by adding a second 250 MVA transformer or by replacing the existing transformer with a new transformer that has a normal rating of at least 450 MVA.

For the purposes of this analysis, a second 250 MVA transformer was assumed at Belfield (with parameters identical to the first one) in addition to the Belfield-Hettinger 230 kV line. One-line diagrams showing post-project system conditions without and with these network upgrades are shown in [Figures 4.4](#) and [4.5](#) respectively.

System intact and contingency analyses were repeated after adding the above network upgrades to case *p1c*. A limited number of buses (up to 5 levels away from Belfield) were selected for monitoring and contingency analysis purposes.

Results of the system intact analysis are presented in [Table 4.7](#). Monitored facility loadings above 90% of Rate A are shown. [Table 4.8](#) compares the pre- and post-project system intact loadings both without and with the network upgrades. Note from [Table 4.8](#) that the previously observed post-project overloads on the Belfield 345/230 and Dickinson 230/115 transformers have been mitigated.

Results of the contingency analysis are presented in [Table 4.9](#). [Table 4.10](#) compares the pre- and post-project loadings for selected facilities in the Belfield area both without and with the network upgrades. The following is a summary of observations:

- The addition of the network upgrades eliminated the previously observed post-project overloads on the following facilities: Dickinson 230/115 kV transformer, Belfield – Dickinson 230 kV line and the Dickinson – S.New England 115 kV line.

*Note: Since the Belfield-Dickinson 230 kV line does not overload with addition of the network upgrades, terminal equipment replacements on this 230 kV line are no longer required.*

- As before, the post-contingency overloads on the Belfield-Charlie Creek 345 kV line are inconsequential considering that the facility conductor

rating is 880 MVA. WAPA indicated that changing the terminal equipment settings (such as current transformer taps) will likely resolve this limitation.

- The overloads on the two Belfield 250 MVA transformers are not fully mitigated. The post-contingency loading on each transformer is approx. 136% for the loss of the parallel transformer.

Options to mitigate these post-contingency transformer overloads include the following:

1. Trip the remaining in-service transformer. This will force all 500 MW out of the proposed plant on to the Belfield-Charlie Creek 345 kV line. The corresponding post-contingency loading is approx. 485 MVA. See [Table 4.10](#) (switching procedure SW301 outages both Belfield transformers).
2. Run back the Belfield generator by approx. 330 MW (i.e., from 500 MW to 170 MW net) following the outage of either transformer.
3. Another possibility is to replace the existing transformer with a larger unit (say 250 MVA normal / 450 MVA emergency) and size the second transformer such that it is identical to the replacement. This will eliminate the need to trip the remaining in-service transformer or to run back the proposed plant.

Note: Although the above analysis assumed a total of two 345/230 kV transformers at Belfield (250 MVA normal / 313 MVA emergency), another possibility is to replace the existing transformer with one rated at least 450 MVA normal / 515 MVA emergency in lieu of a second transformer.

Results of the reinforcement analysis did not show system intact or post-contingency voltage violations at the monitored buses.

#### **4.6 Other Transmission Alternatives in Lieu of Belfield-Hettinger 230 kV Line**

The following other transmission alternatives were proposed by the generation developer in lieu of adding a new Belfield-Hettinger 230 kV line.

1. Addition of a second Dickinson 230/115 kV transformer and reconductoring the Dickinson-Hettinger 115 kV line, or
2. Addition of a second Belfield-Medora 230 kV line

These alternatives are examined below. As in the [Section 4.5](#) analysis, all these alternatives assume the addition of second 345/230 kV transformer at Belfield.

##### **4.6.1 Addition of a Second Dickinson Transformer and Reconductoring the Dickinson-Hettinger 115 kV Line**

A second Dickinson 230/115 kV transformer was added to the [Section 4.5](#) reinforcement case in lieu of the proposed Belfield-Hettinger 230 kV line. The

Dickinson-Hettinger 115 kV line was not upgraded / reconductored in this analysis (this was done so as to check the extent of the post-contingency loading on the Dickinson-Hettinger 115 kV line).

System intact and contingency analyses were repeated. As in [Section 4.5](#), a limited number of buses (up to 5 levels away from Belfield) were selected for monitoring and contingency analysis purposes.

Results of the system intact analysis are presented in [Table 4.11](#). Monitored facility loadings above 90% of Rate A are shown. Also shown are the loadings on the Belfield and Dickinson transformers. Note that the transformers at these two substations are no longer overloaded.

Results of the contingency analysis are presented in [Table 4.12](#). In particular, note the following:

- Belfield 345/230 kV transformers: As in [Section 4.5](#), the overloads on the Belfield transformers are not fully mitigated.
- Dickinson 230/115 kV transformers: These transformers are no longer overloaded.
- Belfield – Dickinson 230 kV line: Several contingencies overload this line. As before, the overloads listed in [Table 4.12](#) should not be a concern considering that this 230 kV line exhibits a conductor rating of approx. 400 MVA.
- Dickinson-S. New England-Hettinger 115 kV lines: The loss of the Belfield – Medora – Dawson County 230 kV lines aggravated the loading on these 115 kV lines. Post-contingency loading on the Dickinson-S. New England section following the loss of the Belfield-Medora 230 kV line is 110.6% based on the 112.5 MVA emergency rating.

Although the proposed GI-0217 plant could be runback to alleviate the overload on the Dickinson-Hettinger 115 kV line for loss of the Belfield-Medora 230 kV line (runback from 500 MW to 260 MW), the loss of the Dawson County-Medora 230 kV line would continue to overload this 115 kV line. (from [Table 4.12](#), the post-contingency loading is 107.3%).

In order to mitigate these overloads, the emergency rating on the Dickinson-Hettinger 115 kV line would need to be increased from its present value of 112.5 MVA to at least 130 MVA. The feasibility of reconductoring / rebuilding this 115 kV line should be investigated.

In summary, the results of this analysis show that the addition of a second 230/115 kV transformer at Dickinson and reconductoring / rebuilding the Dickinson-Hettinger 115 kV line is an alternate solution to building a new Belfield-Hettinger 230 kV line. Furthermore, terminal equipment uprates / replacements

will be required on Belfield-Dickinson 230 kV line to mitigate post-contingency overloads.

#### 4.6.2 Addition of a Second Belfield-Medora 230 kV Line

The second Belfield-Medora 230 kV line was proposed to check whether the previously observed overloads on the Dickinson 230/115 kV transformer, Dickinson-S. New England 115 kV line and the Belfield-Dickinson 230 kV line can be alleviated. See [Section 4.4](#).

A limited amount of analysis was performed by adding a second Belfield-Medora 230 kV line (identical to the existing line) to the reinforcement case described in [Section 4.5](#). This second line was added in lieu of the Belfield-Hettinger 230 kV line. The [Section 4.6.1](#) reinforcements were not included in this analysis.

System intact loadings on the Belfield and Dickinson transformers are shown below. Note that while the Belfield transformers are no longer overloaded, the Dickinson transformer shows an overload of 9%.

TRANSFORMER LOADINGS ABOVE 80.0 % OF RATING SET A:

X-----FROM BUS-----X				X-----TO BUS-----X				MVA	MVA		
BUS	NAME	BSKV	AREA	BUS	NAME	BSKV	AREA	CKT	LOADING	RATING	PERCENT
66220	BELFELDT	345	652	66424*	BELFELD3	345	652	1	211.4	250.0	84.5
66220*	BELFELDT	345	652	66425	BELFELD4	230	652	1	212.8	250.0	85.1
66330	BELFELDT	345	652	66424*	BELFELD3	345	652	2	211.7	250.0	84.7
66330	BELFELDT	345	652	66425*	BELFELD4	230	652	2	210.6	250.0	84.2
66417*	DICKNSN4	230	652	66418	DKSN-ND7	115	652	1	109.3	100.0	109.3

Next, a limited number of contingencies were tested. These include the following contingencies:

- Loss of Belfield-Charlie Creek 345 kV line
- Loss of either of the two Belfield 345/230 kV transformers
- Loss of Belfield-Dickinson 230 kV line
- Loss of Belfield-Medora 230 kV Circuit #1
- Loss of Medora-Dawson County 230 kV line

Results are shown in [Table 4.13](#).

As before, post-contingency overloads were observed on the two Belfield transformers.

The loss of the Dawson County-Medora 230 kV line overloaded the Dickinson transformer to 152 MVA (i.e., 121.3% loading based on the 125 MVA emergency rating).

A marginal overload of 1.7% was observed on the Dickinson-S. New England 115 kV line following the loss of the Medora-Dawson County 230 kV line. The S.New England-Hettinger 115 kV line is close to being overloaded (97% loading based on the 112.5 MVA emergency rating).

The above results indicate that in addition to the second Belfield-Medora 230 kV line and second Belfield transformer, additional reinforcements are required to alleviate the above overloads.

Possible additions include a second Dickinson transformer and reconductoring the Dickinson-S. New England 115 kV line. These additions were not investigated.

#### 4.7 Conclusions

The results of the steady-state analysis indicate that the addition of proposed GI-0217 plant would adversely impact transmission system performance, both under system intact and contingency conditions. Although several transmission facilities were significantly impacted, particular attention was given to the following facilities that became newly overloaded following the addition of the proposed plant. These facilities are at or in the immediate vicinity of the Belfield substation.

- Belfield 345/230 kV transformer
- Dickinson 230/115 kV transformer
- Dickinson – S. New England 115 kV line
- Belfield – Charlie Creek 345 kV line
- Belfield – Dickinson 230 kV line

Results indicate that the above overloads can be mitigated through the following three transmission reinforcements:

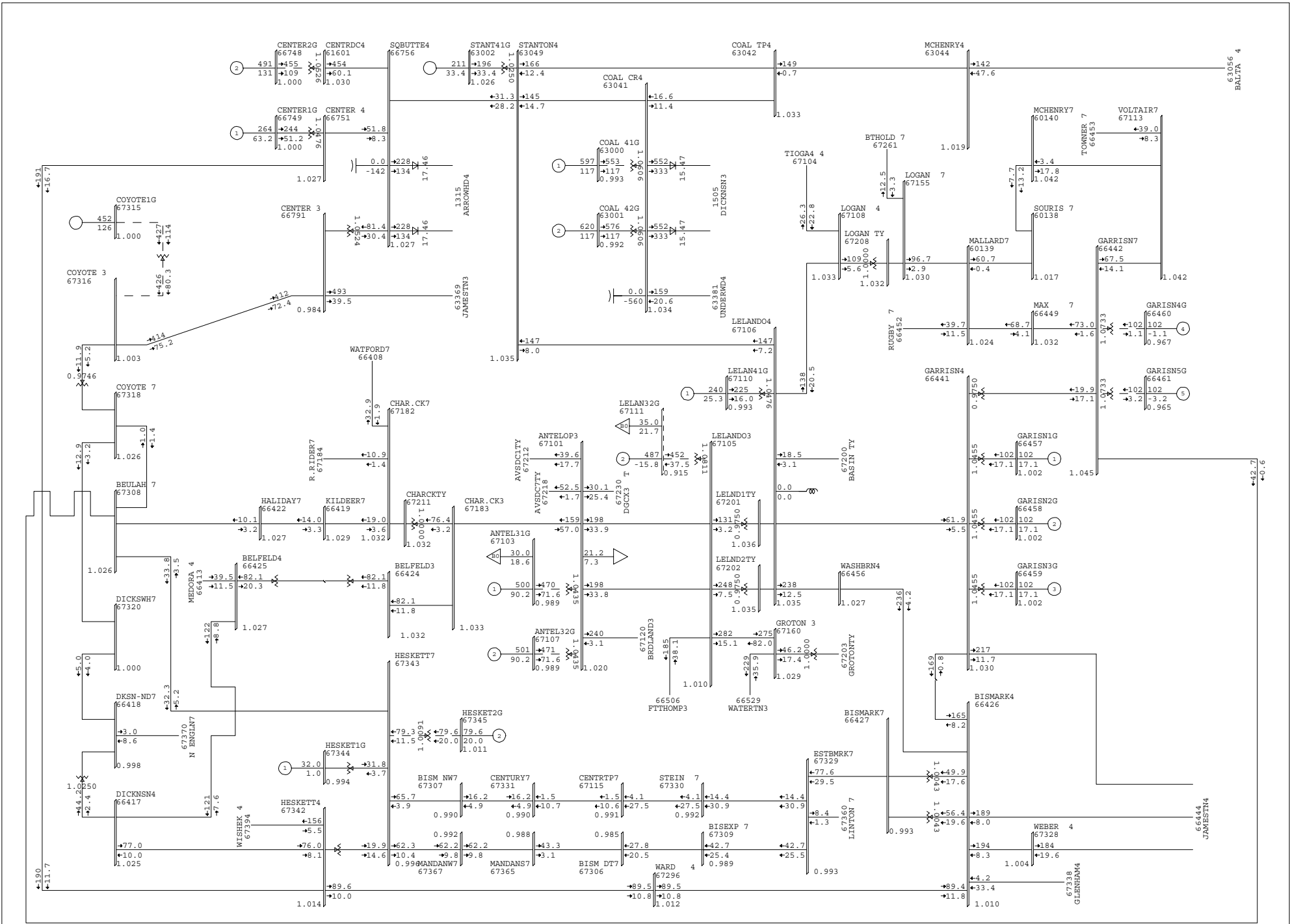
1. Addition of a Belfield-Hettinger 230 kV line.


*Instead of a Belfield-Hettinger 230 kV line, other transmission alternatives can be considered. One such alternative is to add a second 230/115 kV transformer at Dickinson and upgrade / reconductor the Dickinson-Hettinger 115 kV line such that its emergency rating is at least 130 MVA. The feasibility of reconductoring / rebuilding this 115 kV line should be investigated. Furthermore, terminal equipment upgrades / replacements will be required on Belfield-Dickinson 230 kV line to mitigate the observed post-contingency overloads.*

2. Change terminal equipment settings on the Belfield – Charlie Creek 345 kV line.
3. Addition of second Belfield 345/230 kV transformer (identical to the first). In addition, any one of the following alternatives should be implemented to avoid overloading each transformer following the loss of the parallel transformer.
  - a. Trip the remaining in-service transformer.

- b. Optionally, if it is desired to have at least one of the two transformers in-service, the proposed plant should be run back to approx. 170 MW to alleviate the overload.
- c. Yet another possibility is to replace the existing transformer with a larger unit (say 250 MVA normal / 450 MVA emergency) and size the second transformer such that it is identical to the replacement. This will eliminate the need to trip the remaining in-service transformer or to run back the proposed plant.

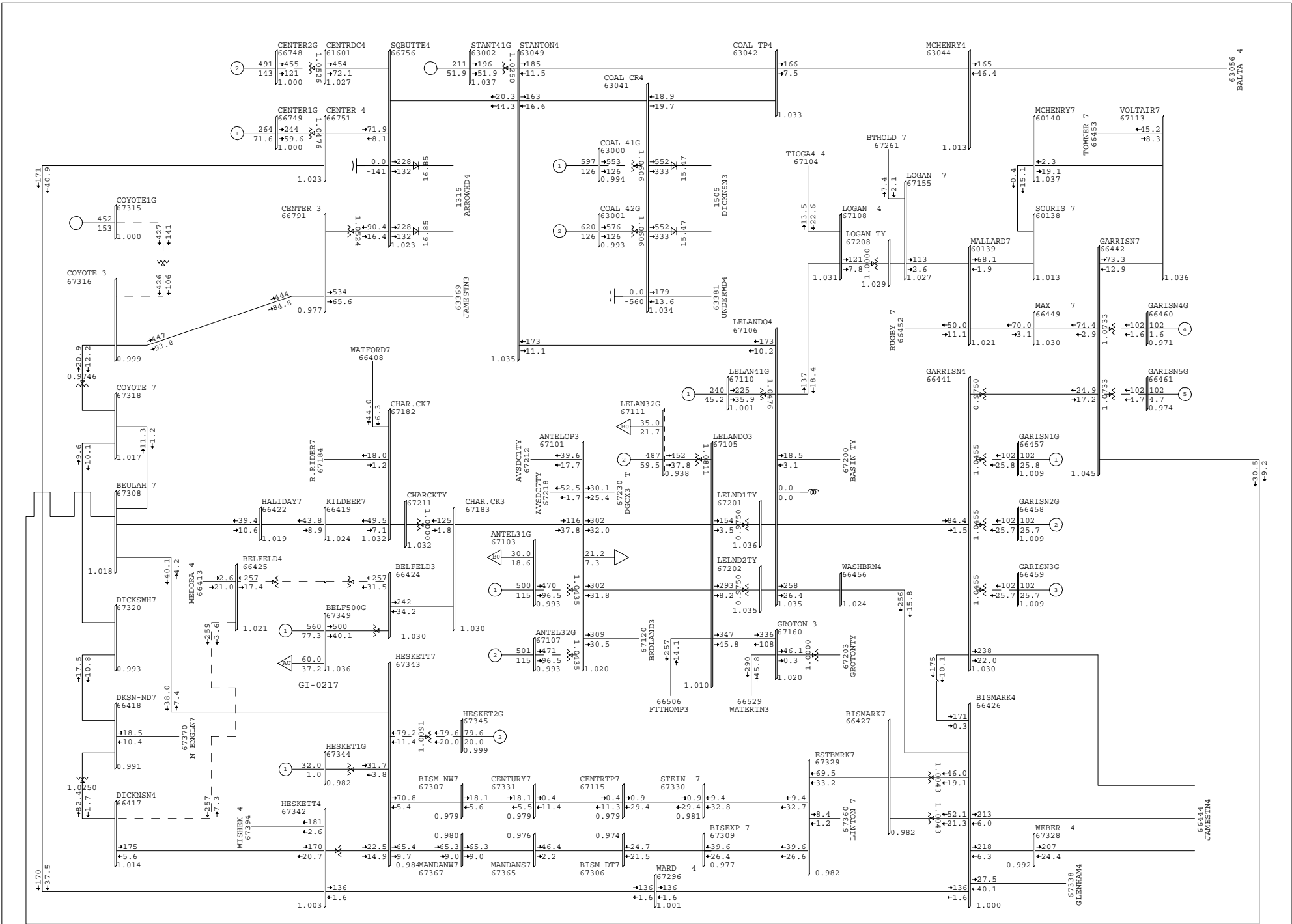
*In lieu of transformer #2 at Belfield, another possibility may be to replace the existing transformer with one rated at least 450 MVA normal / 515 MVA emergency.*



 P00-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT  
 ND=727,MH=1468,MW=295,OHMP=0,OWTP=150,EWTW=-120,BD=0  
 FRI, SEP 08 2006 14:04

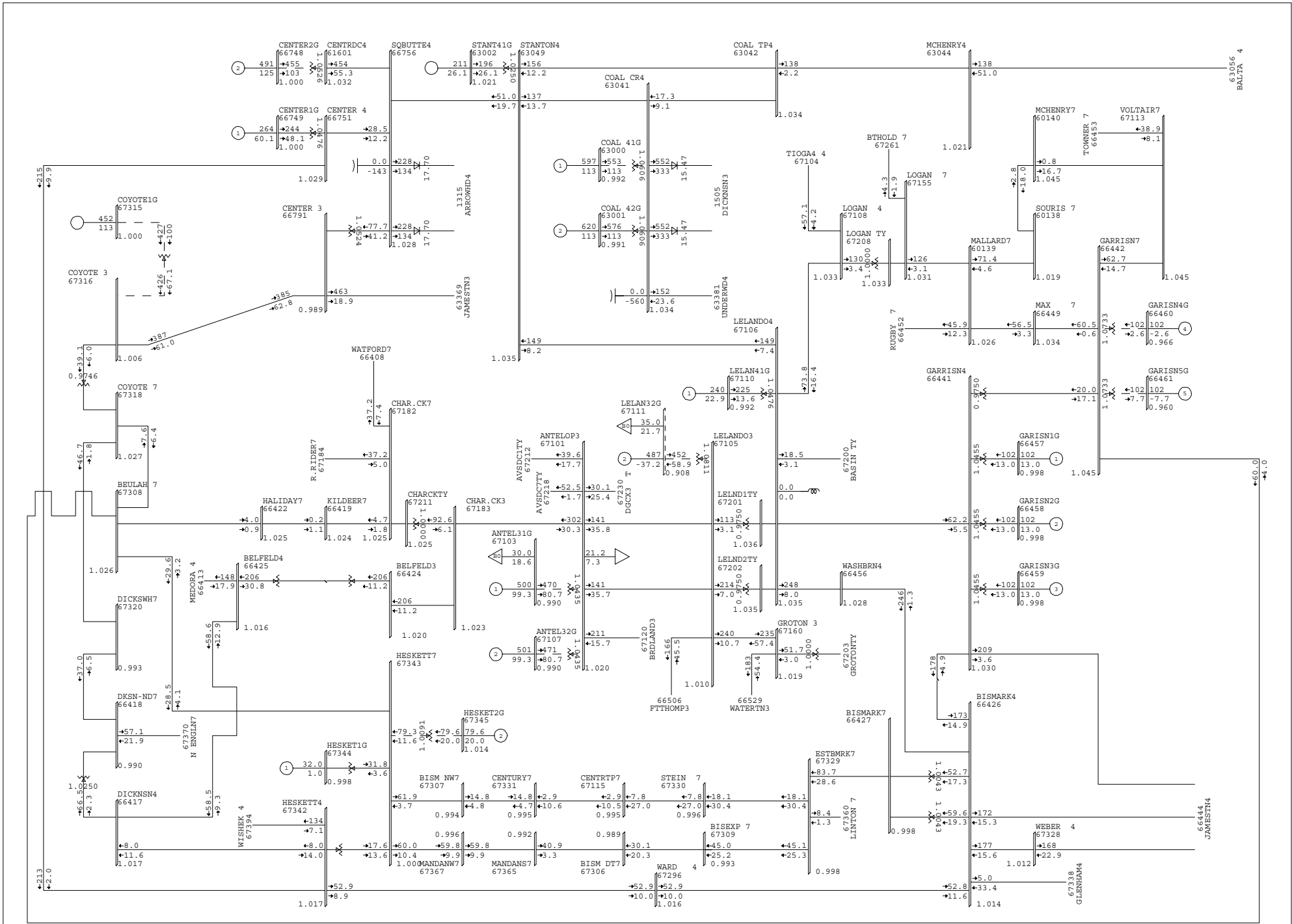
100% RATE  
 0.950 UV 1.050 OV  
 BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR





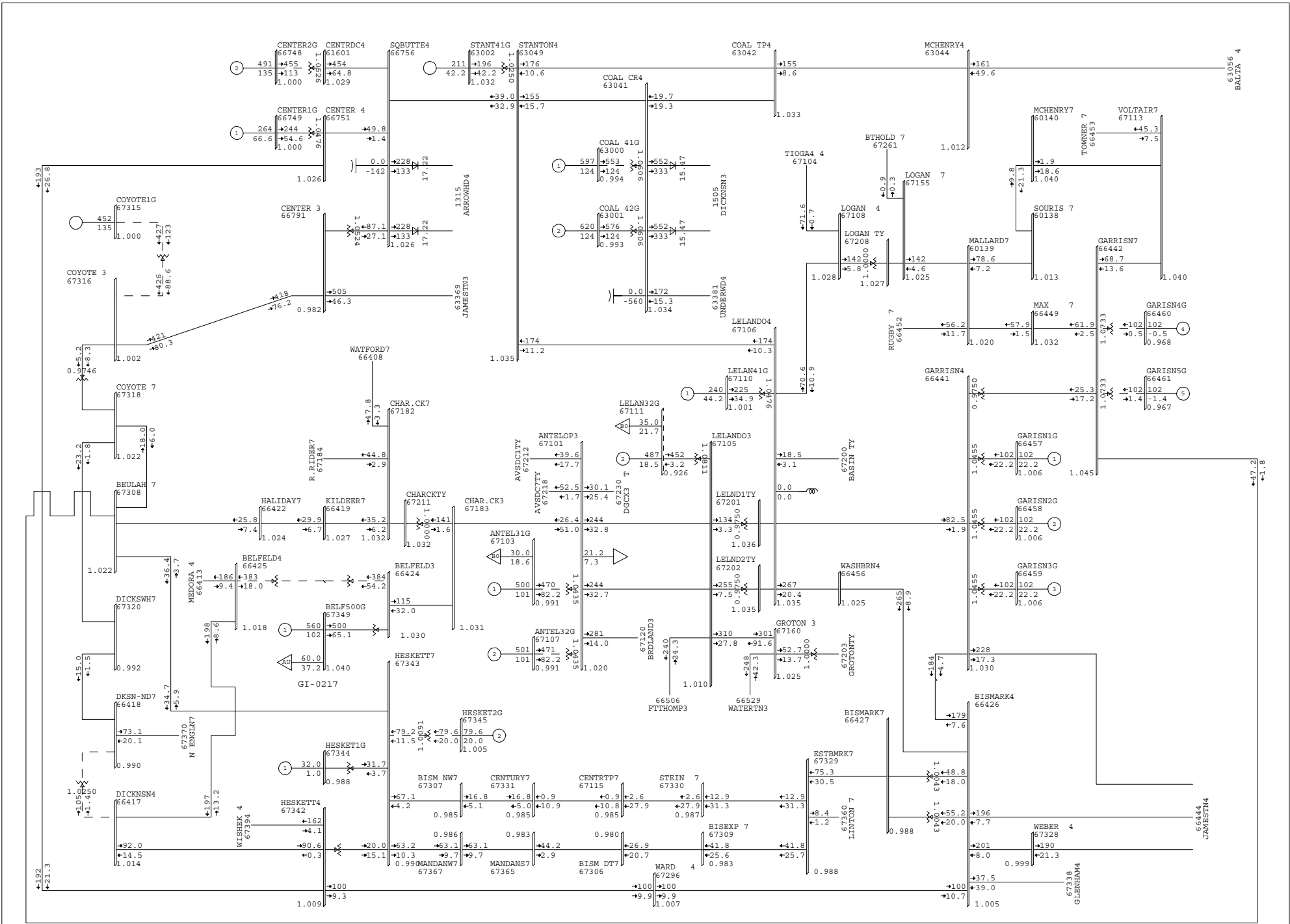
P01-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT  
 ND=1166,MH=1471,MW=396,OHMH=0,OHMP=150,EWTW=-120,BD=0  
 FRI, SEP 08 2006 14:04

100% RATE  
 0.950 UV 1.050 OV  
 BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR



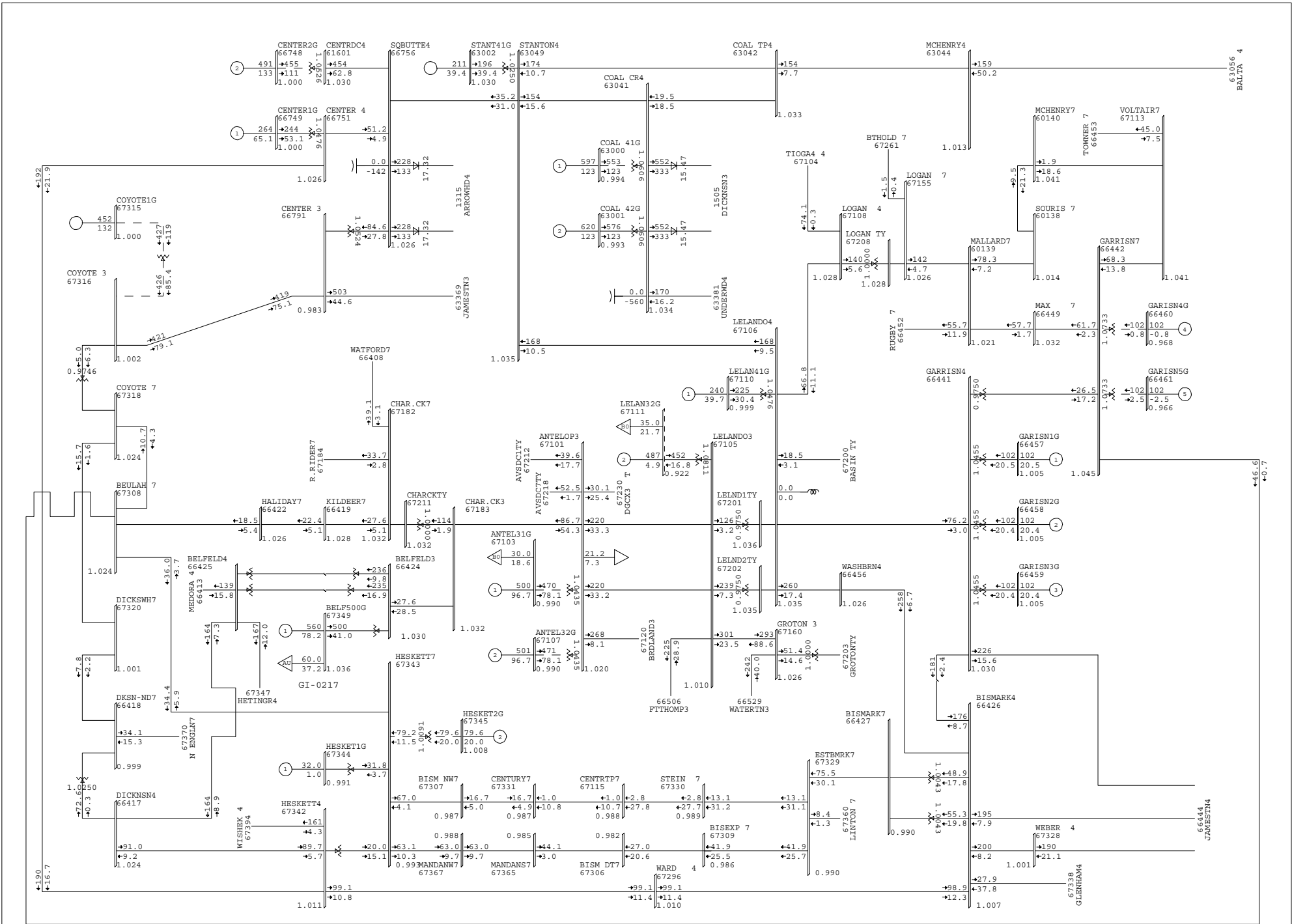
POC-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT  
 ND=542,MH=1301,MW=141,OHMH=1,OHMP=150,EWTW=-119,BD=165  
 TUE, OCT 03 2006 21:40

100% RATE  
 0.950 UV 1.050 OV  
 BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR



P1C-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT  
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 TUE, OCT 03 2006 21:40

100% RATE  
 0.950 UV 1.050 OV  
 BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR



P1E-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT  
 ND=1008,MH=1301,MW=247,OHMH=1,OHMP=150,EWTW=-119,BD=167  
 FRI, NOV 10 2006 10:22

100% RATE  
 0.950 UV 1.050 OV  
 BUS - VOLTAGE (PU)  
 BRANCH - MW/MVAR  
 EQUIPMENT - MW/MVAR

**Table 4.1: Significantly Affected Facilities - System Intact Conditions**

MONITORED ELEMENT	RATE MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF
		LOADING	CURRENT	LOADING	CURRENT	%	MVA	
		%	MVA	%	MVA			
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	33.2	82.9	100.4	251.0	67.2	168.1	0.33628
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	33.9	84.7	100.7	251.8	66.8	167.1	0.33424
66417 DICKNSN4 230 66425 BELFELD4 230 1	239.0	49.7	118.7	106.2	253.9	56.5	135.2	0.27032
66424 BELFELD3 345 67183 CHAR.CK3 345 1	239.0	34.5	82.6	99.3	237.4	64.8	154.8	0.30960

**Table 4.2: Significantly Affected Facilities - N-1 Contingency Conditions**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
<b>60138 SOURIS 7 115 60139 MALLARD7 115 1</b>	<b>123.2</b>	<b>89.4</b>	<b>110.1</b>	<b>101.7</b>	<b>125.3</b>	<b>12.3</b>	<b>15.2</b>	<b>0.03034</b>	<b>63041 COAL CR4 230 63049 STANTON4 230 1</b>	<b>SW111</b>
<b>60139 MALLARD7 115 67155 LOGAN 7 115 1</b>	<b>159.0</b>	<b>98.3</b>	<b>156.4</b>	<b>114.7</b>	<b>182.3</b>	<b>16.4</b>	<b>26.0</b>	<b>0.05194</b>	<b>63041 COAL CR4 230 63049 STANTON4 230 1</b>	<b>SW111</b>
60140 MCHENRY7 115 63082 MCHENRY1.00 1	105.0	100.8	105.9	118.7	124.6	17.9	18.7	0.03748	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60305 EAU CLA5 161 61200 PRESTOT5 161 1	295.0	113.1	333.7	117.0	345.2	3.9	11.5	0.02298	60186 AS KING3 345 60304 EAU CL 3 345 1	
60317 WHT 14 5 161 61200 PRESTOT5 161 1	300.0	111.8	335.4	115.6	346.8	3.8	11.4	0.02280	60186 AS KING3 345 60304 EAU CL 3 345 1	
63044 MCHENRY4 230 63082 MCHENRY1.00 1	105.0	107.7	113.1	124.6	130.9	16.9	17.8	0.03560	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
<b>63189 MAPLER1Y 345 66754 MAPLE R4 230 1</b>	<b>420.0</b>	<b>99.9</b>	<b>419.4</b>	<b>110.4</b>	<b>463.5</b>	<b>10.5</b>	<b>44.1</b>	<b>0.08826</b>	<b>63190 MAPLER2Y 345 66792 MAPLE R3 345 1</b>	
		<b>99.8</b>	<b>419.3</b>	<b>110.3</b>	<b>463.5</b>	<b>10.5</b>	<b>44.1</b>	<b>0.08826</b>	<b>63190 MAPLER2Y 345 66754 MAPLE R4 230 1</b>	
63189 MAPLER1Y 345 66792 MAPLE R3 345 1	420.0	102.5	430.7	113.3	476.0	10.8	45.3	0.09064	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		102.6	430.7	113.3	476.1	10.7	45.3	0.09064	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
<b>63190 MAPLER2Y 345 66754 MAPLE R4 230 1</b>	<b>420.0</b>	<b>99.9</b>	<b>419.4</b>	<b>110.4</b>	<b>463.5</b>	<b>10.5</b>	<b>44.1</b>	<b>0.08826</b>	<b>63189 MAPLER1Y 345 66792 MAPLE R3 345 1</b>	
		<b>99.8</b>	<b>419.3</b>	<b>110.3</b>	<b>463.5</b>	<b>10.5</b>	<b>44.1</b>	<b>0.08826</b>	<b>63189 MAPLER1Y 345 66754 MAPLE R4 230 1</b>	
63190 MAPLER2Y 345 66792 MAPLE R3 345 1	420.0	102.6	430.7	113.3	476.1	10.7	45.3	0.09062	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
		102.5	430.7	113.3	476.0	10.8	45.3	0.09064	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
<b>63195 BIGSTONY 230 63214 BIGSTON7 115 1</b>	<b>291.0</b>	<b>98.6</b>	<b>287.0</b>	<b>102.3</b>	<b>297.8</b>	<b>3.7</b>	<b>10.7</b>	<b>0.02144</b>	<b>66503 BLAIR 4 230 66550 GRANITF4 230 1</b>	<b>SW204</b>
<b>63195 BIGSTONY 230 63314 BIGSTON4 230 1</b>	<b>291.0</b>	<b>98.6</b>	<b>287.0</b>	<b>102.3</b>	<b>297.7</b>	<b>3.7</b>	<b>10.7</b>	<b>0.02144</b>	<b>66503 BLAIR 4 230 66550 GRANITF4 230 1</b>	<b>SW204</b>
<b>63245 WILTON 7 115 63246 BEMIDJI7 115 1</b>	<b>132.0</b>	<b>90.5</b>	<b>119.4</b>	<b>101.1</b>	<b>133.5</b>	<b>10.6</b>	<b>14.0</b>	<b>0.02806</b>	<b>61641 HUBBARD7 115 63053 HUBBARD4 230 1</b>	<b>SW936</b>
		<b>89.6</b>	<b>118.2</b>	<b>100.3</b>	<b>132.4</b>	<b>10.7</b>	<b>14.2</b>	<b>0.02832</b>	<b>60133 SHEYNNE4 230 60134 SHEYNNE7 115 5</b>	<b>SW887</b>
<b>66220 BELFELDT 345 66424 BELFELD3 345 1</b>	<b>313.0</b>	<b>0.0</b>	<b>0.0</b>	<b>157.0</b>	<b>491.3</b>	<b>157.0</b>	<b>491.3</b>	<b>0.98260</b>	<b>66424 BELFELD3 345 67183 CHAR.CK3 345 1</b>	
		<b>9.2</b>	<b>28.9</b>	<b>103.7</b>	<b>324.5</b>	<b>94.5</b>	<b>295.6</b>	<b>0.59110</b>	<b>67101 ANTELOP3 345 67183 CHAR.CK3 345 1</b>	
<b>66220 BELFELDT 345 66425 BELFELD4 230 1</b>	<b>313.0</b>	<b>0.0</b>	<b>0.0</b>	<b>157.0</b>	<b>491.3</b>	<b>157.0</b>	<b>491.3</b>	<b>0.98260</b>	<b>66424 BELFELD3 345 67183 CHAR.CK3 345 1</b>	
		<b>7.5</b>	<b>23.5</b>	<b>103.8</b>	<b>325.0</b>	<b>96.3</b>	<b>301.5</b>	<b>0.60296</b>	<b>67101 ANTELOP3 345 67183 CHAR.CK3 345 1</b>	
<b>66417 DICKNSN4 230 66418 DKSND7 115 1</b>	<b>125.0</b>	<b>22.3</b>	<b>27.8</b>	<b>108.7</b>	<b>135.8</b>	<b>86.4</b>	<b>108.0</b>	<b>0.21606</b>	<b>66424 BELFELD3 345 67183 CHAR.CK3 345 1</b>	
		<b>61.4</b>	<b>76.7</b>	<b>103.2</b>	<b>129.0</b>	<b>41.8</b>	<b>52.2</b>	<b>0.10448</b>	<b>67265 LTLMISS4 230 67304 BAKER 4 230 1</b>	
<b>66417 DICKNSN4 230 66425 BELFELD4 230 1</b>	<b>263.0</b>	<b>23.9</b>	<b>62.8</b>	<b>161.9</b>	<b>425.9</b>	<b>138.0</b>	<b>363.1</b>	<b>0.72622</b>	<b>66424 BELFELD3 345 67183 CHAR.CK3 345 1</b>	
		<b>12.2</b>	<b>32.1</b>	<b>120.2</b>	<b>316.1</b>	<b>108.0</b>	<b>284.0</b>	<b>0.56804</b>	<b>67101 ANTELOP3 345 67183 CHAR.CK3 345 1</b>	
		<b>61.8</b>	<b>162.6</b>	<b>119.5</b>	<b>314.4</b>	<b>57.7</b>	<b>151.8</b>	<b>0.30366</b>	<b>67265 LTLMISS4 230 67304 BAKER 4 230 1</b>	
		<b>65.4</b>	<b>171.9</b>	<b>118.4</b>	<b>311.3</b>	<b>53.0</b>	<b>139.4</b>	<b>0.27874</b>	<b>66426 BISMARCK4 230 66456 WASHBRN4 230 1</b>	<b>SW106</b>
		<b>65.4</b>	<b>171.9</b>	<b>118.4</b>	<b>311.3</b>	<b>53.0</b>	<b>139.4</b>	<b>0.27874</b>	<b>66456 WASHBRN4 230 67106 LELAND4 230 1</b>	<b>SW106</b>

**Table 4.2 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		59.2	155.6	116.8	307.2	57.6	151.5	0.30304	67265 LTLMISS4 230 67304 BAKER 4 230 1	SW109
		59.2	155.6	116.8	307.2	57.6	151.5	0.30304	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	SW109
		52.8	138.9	110.4	290.4	57.6	151.5	0.30302	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	
		54.7	143.9	108.5	285.3	53.8	141.4	0.28286	66411 MI CTYE4 230 67304 BAKER 4 230 1	
		55.3	145.6	107.8	283.5	52.5	137.9	0.27584	66456 WASHBRN4 230 67106 LELANDO4 230 1	
		55.3	145.6	107.7	283.3	52.4	137.7	0.27542	66426 BISMAR4 230 66456 WASHBRN4 230 1	
		47.8	125.7	105.4	277.1	57.6	151.5	0.30290	67310 BOWMAN 4 230 67347 HETINGR4 230 1	
		52.1	137.0	105.3	276.9	53.2	139.9	0.27972	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		52.1	137.0	105.3	276.9	53.2	139.9	0.27972	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		52.1	137.0	105.3	276.9	53.2	139.9	0.27972	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
66417 DICKNSN4 230 67342 HESKETT4 230 1	264.0									
		36.8	13.9	111.3	293.9	74.5	280.0	0.56002	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0									
		13.3	35.0	184.1	484.3	170.8	449.3	0.89860	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		13.3	35.0	184.1	484.3	170.8	449.3	0.89860	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		9.0	23.6	163.8	430.7	154.8	407.1	0.81424	66417 DICKNSN4 230 66425 BELFELD4 230 1	
		14.0	36.9	131.5	345.7	117.5	308.8	0.61766	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		22.1	58.1	103.0	270.9	80.9	212.8	0.42550	67265 LTLMISS4 230 67304 BAKER 4 230 1	SW109
		22.1	58.1	103.0	270.9	80.9	212.8	0.42550	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	SW109
		25.3	66.6	102.6	269.9	77.3	203.3	0.40660	66417 DICKNSN4 230 66418 DKSND-ND7 115 1	
		24.1	63.5	100.6	264.5	76.5	201.0	0.40206	67265 LTLMISS4 230 67304 BAKER 4 230 1	
66426 BISMAR4 230 67296 WARD 4 230 1	264.0									
		112.5	296.9	136.5	360.4	24.0	63.5	0.12696	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		112.5	296.9	136.5	360.4	24.0	63.5	0.12696	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
66442 GARRISN7 115 67113 VOLTAIR7 115 1	109.0									
		102.3	111.5	113.2	123.4	10.9	11.9	0.02388	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
66442 GARRISN7 115 67308 BEULAH 7 115 1	132.0									
		96.2	127.0	116.8	154.2	20.6	27.2	0.05430	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66756 SQBUTTE4 230 66791 CENTER 3 345 1	352.0									
		112.3	395.4	123.7	435.5	11.4	40.2	0.08030	66791 CENTER 3 345 67316 COYOTE 3 345 1	
		103.7	365.2	114.6	403.4	10.9	38.2	0.07636	66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67105 LELANDO3 345 67201 LELND1TY 345 1	300.0									
		109.5	328.7	129.5	388.7	20.0	60.0	0.12000	67105 LELANDO3 345 67202 LELND2TY 345 1	SW28
		109.5	328.7	129.5	388.7	20.0	60.0	0.12000	67106 LELANDO4 230 67202 LELND2TY 345 1	SW28
67106 LELANDO4 230 67201 LELND1TY 345 1	300.0									
		106.8	320.4	126.3	378.9	19.5	58.5	0.11700	67105 LELANDO3 345 67202 LELND2TY 345 1	SW28
		106.8	320.4	126.3	378.9	19.5	58.5	0.11700	67106 LELANDO4 230 67202 LELND2TY 345 1	SW28
67296 WARD 4 230 67342 HESKETT4 230 1	264.0									
		112.5	297.0	136.5	360.5	24.0	63.5	0.12700	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		112.5	297.0	136.5	360.5	24.0	63.5	0.12700	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4									
		317.0	321.5	333.6	338.3	16.6	16.8	0.03358	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0									
		139.4	122.7	154.6	136.0	15.2	13.4	0.02672	66791 CENTER 3 345 67316 COYOTE 3 345 1	

**Table 4.3: Significantly Affected Bus Voltages - N-1 Contingency Conditions**

SUBSTATION # NAME	VOLTAGE (%) WITHOUT GI-0217	VOLTAGE (%) WITH GI-0217	CHANGE %	CONTINGENCY PERFORMED FROM TO CKT	SWITCH
60170 MARSHAL7 115	88.81	87.63	1.18	60170 MARSHAL7 115 60171 LYON CO7 115 1	
60371 ERIE RD7 115	88.79	87.61	1.18	60170 MARSHAL7 115 60171 LYON CO7 115 1	
60372 SARATOG7 115	88.64	87.46	1.18	60170 MARSHAL7 115 60171 LYON CO7 115 1	
60373 SOUTH E7 115	88.69	87.51	1.18	60170 MARSHAL7 115 60171 LYON CO7 115 1	
63197 CASS LKY 115	89.67	81.85	7.82	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
63246 BEMIDJ7 115	86.73	78.66	8.07	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
63247 CASS LK7 115	86.16	78.43	7.73	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
63248 CASS N 7 115	86.13	78.4	7.73	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
63336 AUDUBON4 230	88.11	86.95	1.16	60133 SHEYNNE4 230 60134 SHEYNNE7 115 5	SW887
66478 GREGORY7 115	88.62	87.27	1.35	66475 BONESTL7 115 66478 GREGORY7 115 1	
66494 WINNER 7 115	89.39	88.07	1.32	66475 BONESTL7 115 66478 GREGORY7 115 1	
66508 S3 7 115	89.62	88.48	1.14	60170 MARSHAL7 115 60171 LYON CO7 115 1	
66552 MARS ER7 115	89.56	88.42	1.14	60170 MARSHAL7 115 60171 LYON CO7 115 1	
66710 NARY 7 115	87.46	79.97	7.49	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
66715 LEECHLK7 115	88.67	81.78	6.89	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
66716 LAPORTE7 115	88.71	81.82	6.89	63186 WILTON Y 230 63245 WILTON 7 115 1	SW948
67405 MITCHEL7 115	85.74	84.56	1.18	67404 HURONWP7 115 67410 MITCLNW7 115 1	
67410 MITCLNW7 115	85.65	84.47	1.18	67404 HURONWP7 115 67410 MITCLNW7 115 1	



**Table 4.4: Significantly Affected Facilities - System Intact Conditions  
(Sensitivity Case with RCDC 200 MW West, Miles City 200 MW West, and B10T 165 MW South)**

MONITORED ELEMENT	RATE MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF
		LOADING	CURRENT	LOADING	CURRENT	%	MVA	
		%	MVA	%	MVA			
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	81.1	202.6	150.4	376.1	69.3	173.5	0.34692
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	82.1	205.3	150.8	377.1	68.7	171.8	0.34362
66417 DICKNSN4 230 66418 DKSND7 115 1	100.0	67.1	67.1	105.6	105.6	38.5	38.5	0.07708

**Table 4.5: Significantly Affected Facilities - N-1 Contingency Conditions  
(Sensitivity Case with RCDC 200 MW West, Miles City 200 MW West, and B10T 165 MW South)**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
60133 SHEYNNE4 230 66435 FARGO 4 230 1	391.0	96.2	376.1	106.4	416.2	10.2	40.1	0.08018	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		92.1	360.2	102.0	398.8	9.9	38.6	0.07710	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		90.5	354.0	100.9	394.7	10.4	40.7	0.08144	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		90.7	354.7	100.5	392.8	9.8	38.1	0.07618	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
60138 SOURIS 7 115 60139 MALLARD7 115 1	123.2	95.6	117.7	107.4	132.3	11.8	14.5	0.02908	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 66452 RUGBY 7 115 1	88.0	86.3	76.0	102.7	90.4	16.4	14.4	0.02882	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 67155 LOGAN 7 115 1	159.0	114.1	181.4	130.0	206.7	15.9	25.3	0.05064	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
		95.5	151.8	106.6	169.4	11.1	17.7	0.03532	66442 GARRISN7 115 66449 MAX 7 115 1	
		94.4	150.1	105.5	167.7	11.1	17.6	0.03528	60139 MALLARD7 115 66449 MAX 7 115 1	
		88.4	140.5	100.7	160.1	12.3	19.6	0.03916	63041 COAL CR4 230 63042 COAL TP4 230 1	SW110
		88.4	140.5	100.7	160.1	12.3	19.6	0.03916	63042 COAL TP4 230 63044 MCHENRY4 230 1	SW110
		88.4	140.5	100.7	160.1	12.3	19.6	0.03916	63042 COAL TP4 230 63049 STANTON4 230 1	SW110
		87.7	139.5	99.9	158.9	12.2	19.4	0.03888	63042 COAL TP4 230 63044 MCHENRY4 230 1	
		86.8	138.0	99.2	157.7	12.4	19.7	0.03932	63049 STANTON4 230 67106 LELANDO4 230 1	
60140 MCHENRY7 115 63082 MCHENRY1.00 1	105.0	101.5	106.6	119.1	125.0	17.6	18.4	0.03682	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60305 EAU CLA5 161 61200 PRESTOT5 161 1	295.0	107.8	318.1	111.9	330.0	4.1	12.0	0.02390	60186 AS KING3 345 60304 EAU CL 3 345 1	
60317 WHT 14 5 161 61200 PRESTOT5 161 1	300.0	106.6	319.9	110.6	331.7	4.0	11.9	0.02370	60186 AS KING3 345 60304 EAU CL 3 345 1	
63044 MCHENRY4 230 63082 MCHENRY1.00 1	105.0	108.3	113.8	125.1	131.4	16.8	17.7	0.03530	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
63189 MAPLER1Y 345 66754 MAPLE R4 230 1	420.0	92.1	387.0	102.9	432.0	10.8	45.1	0.09016	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		92.1	387.0	102.9	432.1	10.8	45.1	0.09016	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63189 MAPLER1Y 345 66792 MAPLE R3 345 1	420.0	94.6	397.4	105.6	443.7	11.0	46.3	0.09256	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		94.6	397.5	105.7	443.8	11.1	46.3	0.09256	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66754 MAPLE R4 230 1	420.0	92.1	387.0	102.9	432.0	10.8	45.1	0.09016	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		92.1	387.0	102.9	432.1	10.8	45.1	0.09016	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66792 MAPLE R3 345 1	420.0	94.6	397.4	105.6	443.7	11.0	46.3	0.09256	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		94.6	397.5	105.7	443.8	11.1	46.3	0.09256	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
66220 BELFELDT 345 66424 BELFELD3 345 1	313.0									

**Table 4.5 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
(Sensitivity Case with RCDC 200 MW West, Miles City 200 MW West, and B10T 165 MW South)**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		0.0	0.0	156.4	489.4	156.4	489.4	0.97884	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		77.9	243.9	140.1	438.5	62.2	194.6	0.38924	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		77.9	243.9	140.1	438.5	62.2	194.6	0.38924	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		81.6	255.4	138.3	432.8	56.7	177.4	0.35476	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		81.6	255.4	138.3	432.8	56.7	177.4	0.35476	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		71.8	224.6	129.9	406.6	58.1	182.0	0.36406	66514 HURON 4 230 67205 BRDLAND4 230 1	
		71.8	224.6	129.9	406.6	58.1	182.0	0.36406	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		71.8	224.6	129.9	406.6	58.1	182.0	0.36406	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		71.8	224.6	129.9	406.6	58.1	182.0	0.36406	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		73.1	228.9	129.5	405.3	56.4	176.4	0.35272	66456 WASHBRN4 230 67106 LELAND04 230 1	
		73.1	228.9	129.4	405.2	56.3	176.3	0.35260	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		72.3	226.3	127.9	400.3	55.6	173.9	0.34784	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		70.2	219.8	127.5	399.2	57.3	179.4	0.35886	67105 LELAND03 345 67160 GROTON 3 345 1	
		71.6	224.0	127.1	397.9	55.5	173.9	0.34784	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		72.4	226.5	126.6	396.2	54.2	169.7	0.33936	66486 PHILIP 4 230 66488 PHILTAP4 230 1	SW218
66220 BELFELDT 345 66425 BELFELD4 230 1	313.0	0.0	0.0	156.4	489.4	156.4	489.4	0.97884	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		78.8	246.6	140.4	439.4	61.6	192.8	0.38556	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		78.8	246.6	140.4	439.4	61.6	192.8	0.38556	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		81.6	255.4	138.4	433.2	56.8	177.8	0.35562	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		81.6	255.4	138.4	433.2	56.8	177.8	0.35562	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		72.6	227.3	130.1	407.1	57.5	179.8	0.35958	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		72.6	227.3	130.1	407.1	57.5	179.8	0.35958	66514 HURON 4 230 67205 BRDLAND4 230 1	
		72.6	227.3	130.1	407.1	57.5	179.8	0.35958	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		72.6	227.3	130.1	407.1	57.5	179.8	0.35958	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		74.1	231.9	129.7	406.1	55.6	174.1	0.34828	66456 WASHBRN4 230 67106 LELAND04 230 1	
		74.1	231.8	129.7	405.9	55.6	174.1	0.34814	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		72.3	226.3	127.7	399.7	55.4	173.4	0.34676	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		71.0	222.3	127.7	399.6	56.7	177.3	0.35456	67105 LELAND03 345 67160 GROTON 3 345 1	
		72.4	226.6	127.4	398.8	55.0	172.2	0.34440	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		69.7	218.1	126.6	396.1	56.9	178.0	0.35606	66506 FTTHOMP3 345 67105 LELAND03 345 1	
66404 DAWSONC7 115 67356 LEWIS 7 115 1	100.0	100.1	100.1	113.6	113.6	13.5	13.6	0.02710	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		94.2	94.2	107.5	107.5	13.3	13.3	0.02654	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		76.1	76.1	99.1	99.1	23.0	23.0	0.04596	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		76.1	76.1	99.1	99.1	23.0	23.0	0.04596	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
66417 DICKNSN4 230 66418 DKSND7 115 1	125.0	82.4	103.0	119.3	149.1	36.9	46.1	0.09216	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		79.4	99.2	116.5	145.6	37.1	46.4	0.09286	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		22.6	28.2	103.6	129.5	81.0	101.3	0.20250	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		52.3	65.4	101.7	127.2	49.4	61.8	0.12356	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		59.3	74.1	100.0	125.0	40.7	50.9	0.10178	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		83.9	104.9	100.0	125.0	16.1	20.0	0.04008	67318 COYOTE 7 115 67320 DICKSWH7 115 1	
66417 DICKNSN4 230 66425 BELFELD4 230 1	263.0	35.6	93.6	105.0	276.1	69.4	182.5	0.36494	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		44.8	117.9	102.0	268.2	57.2	150.3	0.30056	66413 MEDORA 4 230 66425 BELFELD4 230 1	

**Table 4.5 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
(Sensitivity Case with RCDC 200 MW West, Miles City 200 MW West, and B10T 165 MW South)**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217		WITH GI-0217		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		42.9	112.7	99.8	262.6	<b>56.9</b>	149.9	0.29974	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66418 DKSND7 115 67370 N ENGLN7 115 1	112.5	<b>82.7</b> 80.2	<b>93.1</b> 90.2	<b>102.6</b> 99.8	<b>115.5</b> 112.3	<b>19.9</b> <b>19.6</b>	<b>22.4</b> 22.0	<b>0.04480</b> 0.04408	<b>66413 MEDORA 4 230 66425 BELFELD4 230 1</b> 66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0	<b>0.0</b> <b>0.0</b> <b>60.3</b>	<b>0.0</b> <b>0.0</b> <b>158.7</b>	<b>184.1</b> <b>184.1</b> <b>100.3</b>	<b>484.3</b> <b>484.3</b> <b>263.9</b>	<b>184.1</b> <b>184.1</b> <b>40.0</b>	<b>484.3</b> <b>484.3</b> <b>105.2</b>	<b>0.96850</b> <b>0.96850</b> <b>0.21038</b>	<b>66220 BELFELDT 345 66424 BELFELD3 345 1</b> <b>66220 BELFELDT 345 66425 BELFELD4 230 1</b> <b>66417 DICKNSN4 230 66425 BELFELD4 230 1</b>	<b>SW6</b> <b>SW6</b>
66426 BISMAR4 230 67296 WARD 4 230 1	264.0	101.5 101.5	267.9 267.9	125.3 125.3	330.7 330.7	23.8 23.8	62.8 62.8	0.12556 0.12556	66426 BISMAR4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND4 230 1	SW106 SW106
66442 GARRIS7 115 67113 VOLTAIR7 115 1	109.0	<b>95.5</b>	<b>104.1</b>	<b>106.1</b>	<b>115.7</b>	<b>10.6</b>	<b>11.6</b>	<b>0.02318</b>	<b>63041 COAL CR4 230 63049 STANTON4 230 1</b>	<b>SW111</b>
66756 SQBUTTE4 230 66791 CENTER 3 345 1	352.0	104.9 <b>96.6</b>	369.1 <b>339.9</b>	115.7 <b>107.0</b>	407.4 <b>376.7</b>	<b>10.8</b> <b>10.4</b>	38.3 <b>36.8</b>	0.07662 <b>0.07362</b>	66791 CENTER 3 345 67316 COYOTE 3 345 1 <b>66791 CENTER 3 345 67316 COYOTE 3 345 1</b>	<b>SW227</b>
<b>67105 LELAND3 345 67201 LELND1TY 345 1</b>	<b>300.0</b>	<b>93.9</b> <b>93.9</b>	<b>281.7</b> <b>281.7</b>	<b>112.3</b> <b>112.3</b>	<b>337.0</b> <b>337.0</b>	<b>18.4</b> <b>18.4</b>	<b>55.3</b> <b>55.3</b>	<b>0.11066</b> <b>0.11066</b>	<b>67105 LELAND3 345 67202 LELND2TY 345 1</b> <b>67106 LELAND4 230 67202 LELND2TY 345 1</b>	<b>SW28</b> <b>SW28</b>
<b>67106 LELAND4 230 67201 LELND1TY 345 1</b>	<b>300.0</b>	<b>91.5</b> <b>91.5</b>	<b>274.6</b> <b>274.6</b>	<b>109.5</b> <b>109.5</b>	<b>328.6</b> <b>328.6</b>	<b>18.0</b> <b>18.0</b>	<b>54.0</b> <b>54.0</b>	<b>0.10790</b> <b>0.10790</b>	<b>67105 LELAND3 345 67202 LELND2TY 345 1</b> <b>67106 LELAND4 230 67202 LELND2TY 345 1</b>	<b>SW28</b> <b>SW28</b>
67296 WARD 4 230 67342 HESKETT4 230 1	264.0	101.5 101.5	268.0 268.0	125.3 125.3	330.8 330.8	23.8 23.8	62.8 62.8	0.12552 0.12552	66426 BISMAR4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND4 230 1	SW106 SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	290.2	294.3	305.7	310.0	15.5	15.8	0.03150	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	128.9	113.4	144.1	126.8	15.2	13.4	0.02674	66791 CENTER 3 345 67316 COYOTE 3 345 1	
<b>67380 STANLEY7 115 67385 TIOGA4 7 115 1</b>	<b>61.6</b>	<b>96.0</b> <b>96.0</b> <b>88.0</b>	<b>59.2</b> <b>59.2</b> <b>54.2</b>	<b>109.4</b> <b>109.4</b> <b>106.3</b>	<b>67.4</b> <b>67.4</b> <b>65.5</b>	<b>13.4</b> <b>13.4</b> <b>18.3</b>	<b>8.3</b> <b>8.3</b> <b>11.3</b>	<b>0.01652</b> <b>0.01652</b> <b>0.02258</b>	<b>67108 LOGAN 4 230 67208 LOGAN TY 230 1</b> <b>67155 LOGAN 7 115 67208 LOGAN TY 230 1</b> <b>67104 TIOGA4 4 230 67108 LOGAN 4 230 1</b>	<b>SW29</b> <b>SW29</b>

**Table 4.6: Significantly Affected Bus Voltages - N-1 Contingency Conditions  
(Sensitivity Case with RCDC 200 MW West, Miles City 200 MW West, and B10T 165 MW South)**

SUBSTATION # NAME	VOLTAGE (%)		CHANGE %	CONTINGENCY PERFORMED			SWITCH
	WITHOUT GI-0217	WITH GI-0217		FROM	TO	CKT	
62445 4CORNRS7 115	89.46	88.35	1.11	61673	ARROWHD7 115	62445 4CORNRS7 115 1	
63246 BEMIDJI7 115	87.71	82.20	5.51	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948
	88.01	86.95	1.06	63245	WILTON 7 115	63246 BEMIDJI7 115 1	
63247 CASS LK7 115	87.10	82.35	4.75	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948
	87.39	86.37	1.02	63245	WILTON 7 115	63246 BEMIDJI7 115 1	
63248 CASS N 7 115	87.07	82.32	4.75	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948
	87.36	86.34	1.02	63245	WILTON 7 115	63246 BEMIDJI7 115 1	
66710 NARY 7 115	88.38	83.76	4.62	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948
66715 LEECHLK7 115	89.53	85.61	3.92	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948
66716 LAPORTE7 115	89.56	85.65	3.91	63186	WILTON Y 230	63245 WILTON 7 115 1	SW948

**Table 4.7: Reinforcement Analysis Results - System Intact Conditions**

<b>MONITORED ELEMENT</b>	<b>RATEA MVA</b>	<b>LOADING %</b>	<b>CURRENT MVA</b>
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	91.7	229.2
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	92.9	232.2
66330 BELFELDT 345 66424 BELFELD3 345 2	250.0	91.6	229.1
66330 BELFELDT 345 66425 BELFELD4 230 2	250.0	91.6	229.1
66791 CENTER 3 345 67316 COYOTE 3 345 1	478.0	90.5	432.8
61601 CENTRDC4 230 66756 SQBUTTE4 230 1	478.0	93.1	445.1

**Table 4.8: Reinforcement Analysis Results - System Intact Conditions  
(Comparison of Facility Loadings in Belfield Area)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)	
		LOADING	CURRENT	LOADING	CURRENT	LOADING	CURRENT
		%	MVA	%	MVA	%	MVA
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	81.1	202.6	150.4	376.1	91.7	229.2
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	82.1	205.3	150.8	377.1	92.9	232.2
66330 BELFELDT 345 66424 BELFELD3 345 2	250.0	N/A				91.6	229.1
66330 BELFELDT 345 66425 BELFELD4 230 2	250.0	N/A				91.6	229.1
66417 DICKNSN4 230 66418 DKSN-ND7 115 1	100.0	67.1	67.1	105.6	105.6	72.6	72.6

N/A = Not Applicable

**Table 4.9: Reinforcement Analysis Results - N-1 Contingency Conditions**

MONITORED ELEMENT	RATEC MVA	LOADING %	CURRENT MVA	CONTINGENCY	SWITCH
66220 BELFELDT 345 66424 BELFELD3 345 1	313.0	134.9 134.9	422.2 422.2	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66220 BELFELDT 345 66425 BELFELD4 230 1	313.0	135.8 135.8	424.9 424.9	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66330 BELFELDT 345 66424 BELFELD3 345 2	313.0	134.9 134.9	422.2 422.2	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66330 BELFELDT 345 66425 BELFELD4 230 2	313.0	134.9 134.9	422.2 422.2	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66401 CIRCLE 7 115 66404 DAWSONC7 115 1	44.0	130.1	57.2	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66401 CIRCLE 7 115 66409 WOLFPT 7 115 1	44.0	143.6	63.2	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66404 DAWSONC7 115 66407 FALLON 7 115 1	88.0	110.8	97.5	66403 DAWSONC4 230 66411 MI CTYE4 230 1	
66404 DAWSONC7 115 67356 LEWIS 7 115 1	100.0	98.6 98.6 98.6 98.6	98.6 98.6 98.6 98.6	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66405 FTPECK 4 230 66406 FTPECK 7 115 1	84.0	110.2	92.5	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66407 FALLON 7 115 66412 MI CTYE7 115 1	88.0	99.9	87.9	66403 DAWSONC4 230 66411 MI CTYE4 230 1	
66408 WATFORD7 115 67182 CHAR.CK7 115 1	88.0	94.5 94.5 94.5 94.5	83.2 83.2 83.2 83.2	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66418 DKSND7 115 67320 DICKSWH7 115 1	101.4	96.2	97.5	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0	184.1 184.1 184.1 184.1	484.3 484.3 484.3 484.3	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66426 BISMARCK4 230 66456 WASHBRN4 230 1	352.0	93.1 93.1 93.1 93.1	327.8 327.8 327.8 327.8	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66426 BISMARCK4 230 67296 WARD 4 230 1	264.0	122.8 122.8	324.3 324.3	66426 BISMARCK4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND04 230 1	SW106 SW106
66442 GARRISN7 115 67308 BEULAH 7 115 1	132.0	95.1	125.5	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66456 WASHBRN4 230 67106 LELAND04 230 1	351.0	93.5 93.5 93.5 93.5	328.2 328.2 328.2 328.2	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66756 SQBUTTE4 230 66791 CENTER 3 345 1	352.0	114.9 106.3	404.5 374.2	66791 CENTER 3 345 67316 COYOTE 3 345 1 66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67105 LELAND03 345 67201 LELND1TY 345 1	300.0	105.3 105.3	315.9 315.9	67105 LELAND03 345 67202 LELND2TY 345 1 67106 LELAND04 230 67202 LELND2TY 345 1	SW28 SW28
67106 LELAND04 230 67201 LELND1TY 345 1	300.0	102.7 102.7	308.0 308.0	67105 LELAND03 345 67202 LELND2TY 345 1 67106 LELAND04 230 67202 LELND2TY 345 1	SW28 SW28
67296 WARD 4 230 67342 HESKETT4 230 1	264.0				



**Table 4.9 (Cont.): Reinforcement Analysis Results - N-1 Contingency Conditions**

MONITORED ELEMENT	RATEC MVA	LOADING %	CURRENT MVA	CONTINGENCY	SWITCH
		122.9	324.3	66426 BISMARK4 230 66456 WASHBRN4 230 1	SW106
		122.9	324.3	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	311.9	316.3	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	143.4	126.2	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67316 COYOTE 3 345 67318 COYOTE 7 115 1	172.0	250.9	431.5	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67318 COYOTE 7 115 67320 DICKSWH7 115 1	101.4	103.4	104.9	66791 CENTER 3 345 67316 COYOTE 3 345 1	

**Table 4.10: Reinforcement Analysis Results - N-1 Contingency Conditions  
(Comparison of Facility Loadings in Belfield Area)**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)		CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	LOADING	CURRENT		
		%	MVA	%	MVA	%	MVA		
66220 BELFELDT 345 66424 BELFELD3 345 1	313.0	N/A	N/A	N/A	N/A	134.9	422.2	66330 BELFELDT 345 66424 BELFELD3 345 2	SW300
		N/A	N/A	N/A	N/A	134.9	422.2	66330 BELFELDT 345 66425 BELFELD4 230 2	SW300
		0.0	0.0	156.4	489.4	77.5	242.7	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		77.9	243.9	140.1	438.5	82.2	257.3	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		77.9	243.9	140.1	438.5	82.2	257.3	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		81.6	255.4	138.3	432.8	82.8	259.1	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		81.6	255.4	138.3	432.8	82.8	259.1	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		71.8	224.6	129.9	406.6	78.9	246.8	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		71.8	224.6	129.9	406.6	78.9	246.8	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		71.8	224.6	129.9	406.6	78.9	246.8	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		71.8	224.6	129.9	406.6	78.9	246.8	66514 HURON 4 230 67205 BRDLAND4 230 1	
		73.1	228.9	129.5	405.3	78.1	244.5	66456 WASHBRN4 230 67106 LELAND04 230 1	
		73.1	228.9	129.4	405.2	78.1	244.4	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		72.3	226.3	127.9	400.3	77.1	241.4	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		70.2	219.8	127.5	399.2	77.5	242.7	67105 LELAND03 345 67160 GROTON 3 345 1	
		71.6	224.0	127.1	397.9	75.9	237.7	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		72.4	226.5	126.6	396.2	76.8	240.4	66486 PHILIP 4 230 66488 PHILTAP4 230 1	SW218
66220 BELFELDT 345 66425 BELFELD4 230 1	313.0	N/A	N/A	N/A	N/A	135.8	424.9	66330 BELFELDT 345 66424 BELFELD3 345 2	SW300
		N/A	N/A	N/A	N/A	135.8	424.9	66330 BELFELDT 345 66425 BELFELD4 230 2	SW300
		0.0	0.0	156.4	489.4	78.4	245.5	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		78.8	246.6	140.4	439.4	83.0	259.8	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		78.8	246.6	140.4	439.4	83.0	259.8	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		81.6	255.4	138.4	433.2	83.5	261.3	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		81.6	255.4	138.4	433.2	83.5	261.3	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		72.6	227.3	130.1	407.1	79.6	249.2	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		72.6	227.3	130.1	407.1	79.6	249.2	66514 HURON 4 230 67205 BRDLAND4 230 1	
		72.6	227.3	130.1	407.1	79.6	249.2	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		72.6	227.3	130.1	407.1	79.6	249.2	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		74.1	231.9	129.7	406.1	79.0	247.2	66456 WASHBRN4 230 67106 LELAND04 230 1	
		74.1	231.8	129.7	405.9	79.0	247.1	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		72.3	226.3	127.7	399.7	77.7	243.1	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		71.0	222.3	127.7	399.6	78.3	245.1	67105 LELAND03 345 67160 GROTON 3 345 1	
		72.4	226.6	127.4	398.8	76.8	240.5	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		69.7	218.1	126.6	396.1	77.8	243.5	66506 FTTHOMP3 345 67105 LELAND03 345 1	
66330 BELFELDT 345 66424 BELFELD3 345 2	313.0	N/A	N/A	N/A	N/A	134.9	422.2	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		N/A	N/A	N/A	N/A	134.9	422.2	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
66330 BELFELDT 345 66425 BELFELD4 230 2	313.0	N/A	N/A	N/A	N/A	134.9	422.2	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		N/A	N/A	N/A	N/A	134.9	422.2	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
66417 DICKNSN4 230 66418 DKSN-ND7 115 1	125.0	82.4	103.0	119.3	149.1	69.8	87.3	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		79.4	99.2	116.5	145.6	68.6	85.7	66403 DAWSONC4 230 66413 MEDORA 4 230 1	

**Table 4.10 (Cont.): Reinforcement Analysis Results - N-1 Contingency Conditions  
(Comparison of Facility Loadings in Belfield Area)**

MONITORED ELEMENT	RATEC MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)		CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	LOADING	CURRENT		
		%	MVA	%	MVA	%	MVA		
		22.6	28.2	<b>103.6</b>	<b>129.5</b>	61.4	76.7	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		52.3	65.4	<b>101.7</b>	<b>127.2</b>	72.1	90.1	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		59.3	74.1	<b>100.0</b>	<b>125.0</b>	57.2	71.6	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		83.9	104.9	<b>100.0</b>	<b>125.0</b>	68.5	85.7	67318 COYOTE 7 115 67320 DICKSWH7 115 1	
66417 DICKNSN4 230 66425 BELFELD4 230 1	263.0	35.6	93.6	<b>105.0</b>	<b>276.1</b>	67.2	176.6	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		44.8	117.9	<b>102.0</b>	<b>268.2</b>	71.1	187.0	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		42.9	112.7	99.8	262.6	70.1	184.4	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66418 DKSND7 115 67370 N ENGLN7 115 1	112.5	82.7	93.1	<b>102.6</b>	<b>115.5</b>	44.4	49.9	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		80.2	90.2	99.8	112.3	43.3	48.8	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0	N/A	N/A	N/A	N/A	<b>184.1</b>	<b>484.3</b>	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		N/A	N/A	N/A	N/A	<b>184.1</b>	<b>484.3</b>	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		N/A	N/A	N/A	N/A	<b>184.1</b>	<b>484.3</b>	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		N/A	N/A	N/A	N/A	<b>184.1</b>	<b>484.3</b>	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
		0.0	0.0	<b>184.1</b>	<b>484.3</b>	26.5	69.6	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		0.0	0.0	<b>184.1</b>	<b>484.3</b>	26.5	69.6	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		60.3	158.7	<b>100.3</b>	<b>263.9</b>	52.7	138.5	66417 DICKNSN4 230 66425 BELFELD4 230 1	

N/A = Not Applicable

**Table 4.11: Reinforcement Analysis Results for Section 4.6.1 - System Intact Conditions  
(With Belfield 345/230 kV Transformer #2 and Dickinson 230/115 kV Transformer #2)**

MONITORED ELEMENT	RATE MVA	LOADING %	CURRENT MVA
61601 CENTRDC4 230 66756 SQBUTTE4 230 1	478	93.2	445.53
66403 DAWSONC4 230 66411 MI CTYE4 230 1	200	98.6	197.27
66417 DICKNSN4 230 66425 BELFELD4 230 1	239	94.3	225.31
66791 CENTER 3 345 67316 COYOTE 3 345 1	478	91.7	438.16

TRANSFORMER LOADINGS ABOVE 60.0 % OF RATING SET A:

X-----FROM BUS-----X				X-----TO BUS-----X				MVA		MVA	
BUS	NAME	BSKV	AREA	BUS	NAME	BSKV	AREA	CKT	LOADING	RATING	PERCENT
66220*	BELFELDT	345	652	66221	BELFELD9	13.8	652	1	30.1	50.0	60.2
66220	BELFELDT	345	652	66424*	BELFELD3	345	652	1	212.2	250.0	84.9
66220*	BELFELDT	345	652	66425	BELFELD4	230	652	1	213.1	250.0	85.3
66330	BELFELDT	345	652	66424*	BELFELD3	345	652	2	212.6	250.0	85.0
66330	BELFELDT	345	652	66425*	BELFELD4	230	652	2	211.3	250.0	84.5
66417	DICKNSN4	230	652	66418*	DKSN-ND7	115	652	1	62.7	100.0	62.7
66417	DICKNSN4	230	652	66418*	DKSN-ND7	115	652	2	62.7	100.0	62.7

**Table 4.12: Reinforcement Analysis Results for Section 4.6.1 - N-1 Contingency Conditions  
(With Belfield 345/230 kV Transformer #2 and Dickinson 230/115 kV Transformer #2)**

MONITORED ELEMENT	RATEC MVA	LOADING %	CURRENT MVA	CONTINGENCY	SWITCH
66220 BELFELDT 345 66424 BELFELD3 345 1	313.0	121.8 121.8	381.3 381.3	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66220 BELFELDT 345 66425 BELFELD4 230 1	313.0	122.2 122.2	382.6 382.6	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66330 BELFELDT 345 66424 BELFELD3 345 2	313.0	121.7 121.7	381.0 381.0	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66330 BELFELDT 345 66425 BELFELD4 230 2	313.0	121.7 121.7	381.0 381.0	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66401 CIRCLE 7 115 66404 DAWSONC7 115 1	44.0	136.6	60.1	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66401 CIRCLE 7 115 66409 WOLFPT 7 115 1	44.0	150.2	66.1	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66404 DAWSONC7 115 67356 LEWIS 7 115 1	100.0	111.0 104.8 99.2 99.2 99.2 99.2	111.0 104.8 99.2 99.2 99.2 99.2	66413 MEDORA 4 230 66425 BELFELD4 230 1 66403 DAWSONC4 230 66413 MEDORA 4 230 1 66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66405 FTPECK 4 230 66406 FTPECK 7 115 1	84.0	110.2	92.5	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66408 WATFORD7 115 67182 CHAR.CK7 115 1	88.0	94.9 94.9 94.9 94.9	83.5 83.5 83.5 83.5	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66417 DICKNSN4 230 66425 BELFELD4 230 1	263.0	113.0 110.9 108.9 108.9 106.7 97.5 97.4 96.0 96.0 95.8 94.9 94.9 94.9 92.7 92.7	297.2 291.7 286.4 286.4 280.6 256.5 256.3 252.4 252.4 252.1 249.6 249.6 249.6 243.9 243.8	66413 MEDORA 4 230 66425 BELFELD4 230 1 66403 DAWSONC4 230 66413 MEDORA 4 230 1 66426 BISMARCK4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND04 230 1 66424 BELFELD3 345 67183 CHAR.CK3 345 1 66456 WASHBRN4 230 67106 LELAND04 230 1 66426 BISMARCK4 230 66456 WASHBRN4 230 1 67182 CHAR.CK7 115 67211 CHARCKTY 345 1 67183 CHAR.CK3 345 67211 CHARCKTY 345 1 67265 LTLMISS4 230 67304 BAKER 4 230 1 67101 ANTELOP3 345 67120 BRDLAND3 345 1 67120 BRDLAND3 345 67204 BRDLNDTY 345 1 67204 BRDLNDTY 345 67205 BRDLAND4 230 1 67105 LELAND03 345 67160 GROTON 3 345 1 67265 LTLMISS4 230 67304 BAKER 4 230 1	SW106 SW106 SW34 SW34 SW30 SW30 SW109
66418 DKSND7 115 67320 DICKSWH7 115 1	101.4	95.7	97.1	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66418 DKSND7 115 67370 N ENGLN7 115 1	112.5	110.6 107.3 92.1	124.5 120.7 103.6	66413 MEDORA 4 230 66425 BELFELD4 230 1 66403 DAWSONC4 230 66413 MEDORA 4 230 1 67265 LTLMISS4 230 67304 BAKER 4 230 1	
67348 HETINGR7 115 67370 N ENGLN7 115 1	112.5	106.3 103.0	119.6 115.8	66413 MEDORA 4 230 66425 BELFELD4 230 1 66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0	184.1 184.1 184.1 184.1 97.5	484.3 484.3 484.3 484.3 256.3	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2 66417 DICKNSN4 230 66425 BELFELD4 230 1	SW301 SW301 SW301 SW301
66426 BISMARCK4 230 66456 WASHBRN4 230 1	352.0	92.1 92.1	324.3 324.3	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW301 SW301

**Table 4.12 (Cont.): Reinforcement Analysis Results for Section 4.6.1 - N-1 Contingency Conditions  
(With Belfield 345/230 kV Transformer #2 and Dickinson 230/115 kV Transformer #2)**

MONITORED ELEMENT	RATEC MVA	LOADING %	CURRENT MVA	CONTINGENCY	SWITCH
		92.1 92.1	324.3 324.3	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301
66426 BISMARCK4 230 67296 WARD 4 230 1	264.0	126.8 126.8	334.9 334.9	66426 BISMARCK4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND04 230 1	SW106 SW106
66442 GARRISN7 115 67308 BEULAH 7 115 1	132.0	96.8	127.8	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66456 WASHBRN4 230 67106 LELAND04 230 1	351.0	92.5 92.5 92.5 92.5	324.7 324.7 324.7 324.7	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1 66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW301 SW301 SW301 SW301
66756 SQBUTTE4 230 66791 CENTER 3 345 1	352.0	115.9 107.1	408.0 377.1	66791 CENTER 3 345 67316 COYOTE 3 345 1 66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67105 LELAND03 345 67201 LELND1TY 345 1	300.0	107.0 107.0	321.0 321.0	67105 LELAND03 345 67202 LELND2TY 345 1 67106 LELAND04 230 67202 LELND2TY 345 1	SW28 SW28
67106 LELAND04 230 67201 LELND1TY 345 1	300.0	104.3 104.3	312.9 312.9	67105 LELAND03 345 67202 LELND2TY 345 1 67106 LELAND04 230 67202 LELND2TY 345 1	SW28 SW28
67296 WARD 4 230 67342 HESKETT4 230 1	264.0	126.9 126.9	334.9 334.9	66426 BISMARCK4 230 66456 WASHBRN4 230 1 66456 WASHBRN4 230 67106 LELAND04 230 1	SW106 SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	312.2	316.6	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	144.6	127.2	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67316 COYOTE 3 345 67318 COYOTE 7 115 1	172.0	250.8	431.4	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67318 COYOTE 7 115 67320 DICKSWH7 115 1	101.4	103.0	104.4	66791 CENTER 3 345 67316 COYOTE 3 345 1	

**Table 4.13: Reinforcement Analysis Results for Section 4.6.2 - N-1 Contingency Conditions  
(With Belfield 345/230 kV Transformer #2 and Belfield-Medora 230 kV Line #2)**

MONITORED ELEMENT	RATEC MVA	LOADING %	CURRENT MVA	CONTINGENCY	SWITCH
66220 BELFELDT 345 66424 BELFELD3 345 1	313.0	121.4 121.4	379.8 379.8	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66220 BELFELDT 345 66425 BELFELD4 230 1	313.0	121.8 121.8	381.3 381.3	66330 BELFELDT 345 66424 BELFELD3 345 2 66330 BELFELDT 345 66425 BELFELD4 230 2	SW300 SW300
66330 BELFELDT 345 66424 BELFELD3 345 2	313.0	121.3 121.3	379.8 379.8	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66330 BELFELDT 345 66425 BELFELD4 230 2	313.0	121.3 121.3	379.8 379.8	66220 BELFELDT 345 66424 BELFELD3 345 1 66220 BELFELDT 345 66425 BELFELD4 230 1	SW6 SW6
66417 DICKNSN4 230 66418 DKSN-ND7 115 1	125.0	121.3 100.7	151.6 125.9	66403 DAWSONC4 230 66413 MEDORA 4 230 1 66424 BELFELD3 345 67183 CHAR.CK3 345 1	
66417 DICKNSN4 230 66425 BELFELD4 230 1	263.0	106.8 101.9	281.0 268.0	66403 DAWSONC4 230 66413 MEDORA 4 230 1 66424 BELFELD3 345 67183 CHAR.CK3 345 1	
66418 DKSN-ND7 115 67370 N ENGLN7 115 1	112.5	101.7	114.5	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	263.0	93.9	247.1	66417 DICKNSN4 230 66425 BELFELD4 230 1	
67348 HETINGR7 115 67370 N ENGLN7 115 1	112.5	97.4	109.6	66403 DAWSONC4 230 66413 MEDORA 4 230 1	

**Table 4.14: Switching Procedures Referenced in Tables 4.2-4.3, 4.5-4.6, 4.9-4.10 and 4.12-4.13**

SWITCHING										
SW6	OPEN	66220	BELFELDT	345	66221	BELFELDT	913.8	1		
	OPEN	66220	BELFELDT	345	66424	BELFELDT	345	1		
	OPEN	66220	BELFELDT	345	66425	BELFELDT	230	1		
SW28	OPEN	67105	LELANDO3	345	67202	LELND2TY	345	1		
	OPEN	67106	LELANDO4	230	67202	LELND2TY	345	1		
SW29	OPEN	67108	LOGAN	4	230	67208	LOGAN TY	230	1	
	OPEN	67155	LOGAN	7	115	67208	LOGAN TY	230	1	
SW30	OPEN	67120	BRDLAND3	345	67204	BRDLNDTY	345	1		
	OPEN	67204	BRDLNDTY	345	67205	BRDLAND4	230	1		
SW34	OPEN	67182	CHAR.CK7	115	67211	CHARCKTY	345	1		
	OPEN	67183	CHAR.CK3	345	67211	CHARCKTY	345	1		
SW106	OPEN	66426	BISMARCK4	230	67283	WILTTP4	230	1		
	OPEN	67283	WILTTP4	230	66441	GARRISN4	230	1		
	OPEN	66426	BISMARCK4	230	66456	WASHBRN4	230	1		
	OPEN	66456	WASHBRN4	230	67106	LELANDO4	230	1		
SW109	OPEN	67310	BOWMAN	4	230	67265	LTLMISS4	230	1	
	OPEN	67265	LTLMISS4	230	67304	BAKER	4	230	1	
	OPEN	67265	LTLMISS4	230	67263	LTLMISS7	115	1		
SW110	OPEN	63041	COAL CR4	230	63042	COAL TP4	230	1		
	OPEN	63042	COAL TP4	230	63049	STANTON4	230	1		
	OPEN	63042	COAL TP4	230	63044	MCHENRY4	230	1		
SW111	OPEN	63041	COAL CR4	230	63042	COAL TP4	230	1		
	OPEN	63042	COAL TP4	230	63049	STANTON4	230	1		
	OPEN	63042	COAL TP4	230	63044	MCHENRY4	230	1		
	OPEN	63041	COAL CR4	230	63049	STANTON4	230	1		
SW114	OPEN	63358	BUFFALO3	345	63369	JAMESTN3	345	1		
	OPEN	66792	MAPLE R3	345	63358	BUFFALO3	345	1		
	OPEN	63358	BUFFALO3	345	63198	BUFFALOY	345	1		
	OPEN	63198	BUFFALOY	345	63258	BUFFALO7	115	1		
	OPEN	63198	BUFFALOY	345	63158	BUFFALO941.6	1			
	OPEN	66792	MAPLE R3	345	63189	MAPLER1Y	345	1		
	OPEN	63189	MAPLER1Y	345	66754	MAPLE R4	230	1		
	OPEN	63189	MAPLER1Y	345	63359	MAPLER1913.8	1			
	OPEN	63190	MAPLER2Y	345	66754	MAPLE R4	230	1		
	OPEN	66792	MAPLE R3	345	63190	MAPLER2Y	345	1		
	OPEN	63190	MAPLER2Y	345	63360	MAPLER2913.8	1			
SW218	OPEN	66484	NUNDRWD4	230	66488	PHILTAP4	230	1		
	OPEN	66488	PHILTAP4	230	66519	OAHE	4	230	1	
SW227	OPEN	67316	COYOTE	3	345	67315	COYOTE1G24.0	1		
SW300	OPEN	66330	BELFELDT	345	66331	BELFELDT	345	2		
	OPEN	66330	BELFELDT	345	66424	BELFELDT	345	2		
	OPEN	66330	BELFELDT	345	66425	BELFELDT	230	2		
SW948	OPEN	63246	BEMIDJI7	115	63245	WILTON	7	115	1	
	OPEN	63245	WILTON	7	115	63281	WILT TAP	115	1	
	OPEN	63245	WILTON	7	115	66776	WILTON T	115	1	
	OPEN	66776	WILTON T	115	66968	WILTON	869.0	1		
	OPEN	66776	WILTON T	115	63145	WILTON	941.6	1		
OPEN	63245	WILTON	7	115	63186	WILTON Y	230	1		



## 5. CONSTRAINED INTERFACE ANALYSIS

Experience with operating the MAPP system indicates there are a number of stability and steady-state limitations that frequently constrain the operation of the system. For convenience purposes, these limitations have been expressed in terms of PTDF (flows are measured under system intact conditions) and OTDF (flows are measured after a specified contingencies) flowgates. Operation of the system is limited so that power flows through these flowgates does not exceed their respective prescribed limits.

The intent of this analysis is to calculate the impact of the proposed GI-0217 plant on the MAPP flowgates. All PTDF and OTDF flowgates monitored by MAPP were investigated. The emphasis, however, was not on the actual value of flows through those flowgates, but instead on the impact (distribution factor) the proposed GI-0217 plant (and associated transmission reinforcements) would have on those flowgates. Thus the results are less dependent on the assumptions used in developing the base cases, and more a consequence of the network topology between the proposed plant and the assumed sink.

The analysis was performed on the pre- and post-project summer peak power flow models described in [Section 4.4](#) i.e., cases *p0c-sp15aa.sav* and *p1c-sp15aa.sav* respectively. In addition, the post-project power flow case augmented with the network upgrades proposed in [Section 4.5](#) was also analyzed i.e., case *p1c-sp15aa.sav* with the proposed Belfield-Hettinger 230 kV line and 345/230 kV transformer #2 at Belfield.

The DFCALC IPLAN program included in the 2006 NMORWG Study Package was used for this analysis.

[Table 5.1](#) shows the interface flows in the cases without and with the GI-0217 project. The tables also show the transfer distribution factor (in percent) for the 500 MW power transfer from the proposed project to the sink. As new interfaces are regularly added to the MAPP process, this listing may not include any recently added flowgates.

It can be seen that the proposed project adversely impacts<sup>‡‡</sup> several interfaces. The following PTDF interfaces are impacted.

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‡‡ As per MAPP Design Review Subcommittee criteria (see MAPP DRS document entitled “*Steady-State Facility & Constrained Path Impact Determination Requirements & Screening Guidelines for Study Submissions*” approved July 18, 2003), the minimum PTDF threshold for MAPP PTDF Interfaces is 5% and the minimum MW impact threshold is 1 MW. PTDF Interfaces that have PTDFs  $\geq 5\%$  -and- a MW impact  $\geq$  minimum MW impact threshold are considered significantly impacted.

For OTDF Interfaces, the minimum OTDF threshold is 3% and the minimum impact threshold is 1 MW. OTDF Interfaces that have OTDFs  $\geq 3\%$  -and- a MW impact  $\geq$  minimum MW impact threshold are considered significantly impacted.

- NDEX (90.3%)
- MWSI (21.4%)
- COOPER\_S (18.4%)
- GRIS\_LNC (11.1%)
- EAUARP\_\_XCEL (11.0%)
- FTCAL\_S (10.9%)
- FORCHS\_PTDF (10.4%)
- PR\_ISL\_BYRON (10.4%)
- AHD\_GPK (7.3%)
- GGS (5.6%)
- WNE\_WKS (5.1%)

Note the large impacts on the NDEX and MWSI interfaces. These impacts are a direct result of dispatching the proposed project outside of North Dakota to the assumed sink (greater MISO footprint to the east of the Twin Cities).

Also, the following OTDF flowgates are impacted:

- LEEBYREJNEL (9.0%)
- BYCHEBYCHE (4.4%)

Mitigation may be required if it is determined that there is insufficient or no available transfer capability (ATC) on the affected MAPP constrained interfaces. This is an issue that should be addressed with the system impact study for delivery service should the proposed GI-0217 project go forward. The DFCALC outputs are included in [Appendix F](#).

**Table 5.1: Constrained Interface Analysis Results  
(GI-0217 Results Without and With Network Upgrades)**

INTERFACE	WITHOUT GI-0217 (MW)	WITH GI-0217			GI-0217 + UPGRADES		
		(MW)	CHANGE (MW)	TDF (%)	(MW)	CHANGE (MW)	TDF (%)
<b>PTDF INTERFACES</b>							
<b>COOPER_S</b>	<b>132.0</b>	<b>224.0</b>	<b>92.0</b>	<b>18.4</b>	<b>228.6</b>	<b>96.6</b>	<b>19.3</b>
<b>EAUARP_XCEL</b>	<b>182.2</b>	<b>237.0</b>	<b>54.8</b>	<b>11.0</b>	<b>237.0</b>	<b>54.8</b>	<b>11.0</b>
<b>FORCHS_PTDF</b>	<b>732.6</b>	<b>784.6</b>	<b>52.0</b>	<b>10.4</b>	<b>781.2</b>	<b>48.6</b>	<b>9.7</b>
<b>FTCAL_S</b>	<b>117.7</b>	<b>172.1</b>	<b>54.4</b>	<b>10.9</b>	<b>170.7</b>	<b>53.0</b>	<b>10.6</b>
<b>GGS</b>	<b>1329.8</b>	<b>1357.9</b>	<b>28.1</b>	<b>5.6</b>	<b>1375.4</b>	<b>45.7</b>	<b>9.1</b>
<b>GRIS_LNC</b>	<b>131.1</b>	<b>186.8</b>	<b>55.6</b>	<b>11.1</b>	<b>198.5</b>	<b>67.3</b>	<b>13.5</b>
LEECONELS	333.6	311.5	-22.1	-4.4	310.4	-23.2	-4.6
MHEX_N+	-1282.2	-1281.9	0.3	0.1	-1280.7	1.5	0.3
MHEX_S+	1301.7	1303.0	1.3	0.3	1301.7	0.0	0.0
MH_SPC_E+	-224.5	-225.1	-0.6	-0.1	-226.6	-2.1	-0.4
MH_SPC_W+	227.7	228.2	0.5	0.1	229.7	2.0	0.4
MNTZUMA_W	57.4	-2.5	-60.0	-12.0	-5.9	-63.3	-12.7
<b>MWSI</b>	<b>141.8</b>	<b>248.6</b>	<b>106.9</b>	<b>21.4</b>	<b>247.2</b>	<b>105.4</b>	<b>21.1</b>
NDDC	-3.8	-3.9	0.0	0.0	-3.8	0.0	0.0
<b>NDEX</b>	<b>542.4</b>	<b>993.7</b>	<b>451.3</b>	<b>90.3</b>	<b>1008.9</b>	<b>466.5</b>	<b>93.3</b>
<b>PR_ISL_BYRON</b>	<b>-40.5</b>	<b>11.7</b>	<b>52.1</b>	<b>10.4</b>	<b>10.2</b>	<b>50.6</b>	<b>10.1</b>
QUADCITY_W	907.7	839.7	-68.0	-13.6	837.3	-70.4	-14.1
<b>WNE_WKS</b>	<b>258.8</b>	<b>284.4</b>	<b>25.6</b>	<b>5.1</b>	<b>288.7</b>	<b>29.9</b>	<b>6.0</b>
Y2DC	-1.7	-1.7	0.0	0.0	-1.7	0.0	0.0
<b>AHD_GPK</b>	<b>223.5</b>	<b>260.0</b>	<b>36.5</b>	<b>7.3</b>	<b>259.5</b>	<b>36.0</b>	<b>7.2</b>
<b>OTDF INTERFACES</b>							
ALBGARQUAST	38.5	48.2	9.7	1.9	48.4	9.9	2.0
ARNVINARNHAZ	188.9	168.5	-20.4	-4.1	168.2	-20.7	-4.1
<b>BYCHEBYCHE</b>	<b>1344.7</b>	<b>1366.6</b>	<b>21.9</b>	<b>4.4</b>	<b>1367.2</b>	<b>22.4</b>	<b>4.5</b>
DAVCALQUARCK	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HLSXFMTIFARN	157.4	143.8	-13.6	-2.7	143.8	-13.6	-2.7
LACWGRLACSTI	1098.8	1074.9	-23.9	-4.8	1072.5	-26.2	-5.2
<b>LEEBYREJNEL</b>	<b>593.8</b>	<b>639.0</b>	<b>45.2</b>	<b>9.0</b>	<b>640.7</b>	<b>46.8</b>	<b>9.4</b>
LKFFOXLKGWLM	64.0	67.5	3.5	0.7	67.9	3.9	0.8
LORTRKWEMPAD	140.7	136.5	-4.2	-0.8	136.7	-4.0	-0.8
PADXFMPADROE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
POWREAMTZBON	53.9	31.0	-22.9	-4.6	29.9	-24.0	-4.8
S1226TEKAMAH	101.3	79.5	-21.8	-4.4	79.8	-21.5	-4.3
SALXFMQUADAV	341.8	326.5	-15.3	-3.1	326.3	-15.5	-3.1
SALXFMWEMPAD	315.3	302.5	-12.8	-2.6	302.4	-12.9	-2.6
SPETRILAKRAU	-17.9	-28.0	-10.1	-2.0	-27.0	-9.1	-1.8
SPHWMCSUMEMC	-3.4	-7.0	-3.6	-0.7	-8.2	-4.8	-1.0

## 6. SHORT-CIRCUIT ANALYSIS

### 6.1 Base Case Development

The pre-project model required for this analysis is short-circuit case *01sc-062802.sav* included in the 2006 NMORWG Study Package.

Starting from this case, two post-project cases were developed by adding the proposed GI-0217 project – the first case without the network upgrades proposed in [Section 4.5](#) and the second case with these upgrades. 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.

[Table 6.1](#) lists the three-phase and SLG fault current levels at those substations where the fault current levels increase by 100 A or more. 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 impacted substations.

At those substations for which breaker ratings were available, the comparison showed that the calculated fault current levels did not exceed the respective lowest breaker ratings. For the remaining substations, 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 breaker replacements may be required.

**Table 6.1: Fault Currents Without and With Proposed GI-0217 Plant  
(GI-0217 Fault Currents Without and With Network Upgrades)**

BUS			MIN. BREAKER RATING AMP	WITHOUT GI-0217 (1)		WITH GI-0217 (2)		GI-0217+UPGRADES (3)		CHANGE (2)-(1)		CHANGE (3)-(1)	
NO.	NAME	kV		FAULT CURRENT (AMP)		FAULT CURRENT (AMP)		FAULT CURRENT (AMP)		AMP		AMP	
				3-PH	SLG	3-PH	SLG	3-PH	SLG	3-PH	SLG	3-PH	SLG
66424	BELFELD3	345	40,000	3587.0	3152.6	6894.3	8088.0	7206.4	8549.5	3307.3	4935.4	3619.4	5396.9
66425	BELFELD4	230	40,000	4878.9	4639.2	6636.3	7278.4	8365.4	9639.6	1757.4	2639.2	3486.5	5000.4
67182	CHAR.CK7	115	40,000	9297.1	7805.7	11234.7	9636.2	11306.2	9697.7	1937.6	1830.5	2009.1	1892.0
67183	CHAR.CK3	345	40,000	4444.3	3529.2	6308.3	5005.2	6415.3	5073.1	1864.0	1476.0	1971.0	1543.9
66417	DICKNSN4	230	35,788	4530.7	3762.6	5475.6	4680.7	6140.9	5192.6	944.9	918.1	1610.2	1430.0
67347	HETINGR4	230	40,000	1842.8	1864.0	1873.3	1885.1	3015.4	2784.9	30.5	21.1	1172.6	920.9
66413	MEDORA 4	230	20,000	3459.8	2657.6	4100.1	3071.6	4508.6	3281.5	640.3	414.0	1048.8	623.9
67101	ANTELOP3	345	40,000	13719.7	16250.1	14478.9	16973.8	14498.1	16991.8	759.2	723.7	778.4	741.7
66470	BISON 4	230		1859.0	1730.9	1879.7	1743.0	2503.9	2131.5	20.7	12.1	644.9	400.6
67310	BOWMAN 4	230	40,000	1685.9	1560.4	1716.9	1578.2	2277.9	1925.5	31.0	17.8	592.0	365.1
66418	DKSN-ND7	115	20,000	5106.3	4470.2	5453.5	4878.4	5625.9	5045.3	347.2	408.2	519.6	575.1
67348	HETINGR7	115	20,000	2597.2	2992.5	2639.7	3030.9	3110.5	3505.7	42.5	38.4	513.3	513.2
67105	LELANDO3	345	40,000	13997.9	15014.7	14411.2	15327.4	14416.8	15331.7	413.3	312.7	418.9	317.0
66497	MAURINE4	230	31,500	2086.9	2103.4	2101.9	2113.5	2481.0	2374.6	15.0	10.1	394.1	271.2
67106	LELANDO4	230	37,653	19135.5	20460.1	19509.2	20739.0	19513.5	20742.2	373.7	278.9	378.0	282.1
66404	DAWSONC7	115	20,000	4700.8	5939.1	4924.0	6179.3	5075.3	6338.8	223.2	240.2	374.5	399.7
66480	MAURINE7	115	20,000	3113.9	3651.6	3127.0	3663.6	3426.2	3942.3	13.1	12.0	312.3	290.7
67304	BAKER 4	230	40,000	1687.0	1750.6	1727.4	1779.5	1986.3	1966.0	40.4	28.9	299.3	215.4
67320	DICKSWH7	115	40,000	4290.3	3302.6	4493.8	3478.4	4587.0	3544.7	203.5	175.8	296.7	242.1
67342	HESKETT4	230	40,000	11713.3	9355.8	11932.7	9472.8	11992.3	9504.8	219.4	117.0	279.0	149.0
66403	DAWSONC4	230	31,500	2697.8	3102.9	2862.7	3253.0	2964.4	3341.9	164.9	150.1	266.6	239.0
66419	KILDEER7	115	N/A	4269.3	2819.9	4498.0	2942.6	4503.1	2945.4	228.7	122.7	233.8	125.5
67332	GLENDCT7	115	20,000	3570.6	3519.1	3694.4	3599.5	3798.5	3665.4	123.8	80.4	227.9	146.3
67184	R.RIDER7	115	none	3710.5	2560.4	3924.3	2676.4	3926.4	2678.2	213.8	116.0	215.9	117.8
67370	N ENGLN7	115	8,000	2929.4	2216.3	3019.0	2275.9	3136.3	2330.4	89.6	59.6	206.9	114.1
67305	BAKER 7	115	20,000	2336.1	2758.9	2378.4	2798.2	2531.8	2942.2	42.3	39.3	195.7	183.3
66484	NUNDRWD4	230	40,000	2912.2	2911.9	2921.5	2918.1	3105.7	3040.6	9.3	6.2	193.5	128.7
66426	BISMARCK4	230	31,500	11692.8	8940.7	11848.8	9010.0	11876.5	9023.2	156.0	69.3	183.7	82.5
66485	NUNDRWD7	115	40,000	4007.8	4681.1	4016.6	4689.1	4184.9	4842.1	8.8	8.0	177.1	161.0
67350	GASCOYN7	115	N/A	1549.3	1298.1	1564.3	1305.2	1720.4	1387.1	15.0	7.1	171.1	89.0
66411	MI CTYE4	230	40,000	1796.6	1902.5	1855.5	1946.5	1965.8	2027.2	58.9	44.0	169.2	124.7
67322	DICKNTH7	115	8,000	3235.7	2235.6	3350.0	2314.8	3401.5	2344.0	114.3	79.2	165.8	108.4

BUS			MIN. BREAKER RATING AMP	WITHOUT GI-0217 (1)		WITH GI-0217 (2)		GI-0217+UPGRADES (3)		CHANGE (2)-(1)		CHANGE (3)-(1)	
NO.	NAME	kV		FAULT CURRENT (AMP)		FAULT CURRENT (AMP)		FAULT CURRENT (AMP)		AMP		AMP	
				3-PH	SLG	3-PH	SLG	3-PH	SLG	3-PH	SLG	3-PH	SLG
66412	MI CTYE7	115	20,000	2597.9	3103.2	2659.8	3162.0	2756.9	3253.5	61.9	58.8	159.0	150.3
66258	BISON 8	69		1868.9	1938.0	1875.1	1942.5	2025.1	2068.0	6.2	4.5	156.2	130.0
67318	COYOTE 7	115	40,000	9440.1	8827.8	9555.4	8902.6	9567.0	8910.3	115.3	74.8	126.9	82.5
67308	BEULAH 7	115	20,000	8950.4	7097.6	9065.8	7154.7	9072.4	7157.9	115.4	57.1	122.0	60.3
66751	CENTER 4	230	40,000	16283.2	16686.6	16384.3	16756.9	16403.1	16770.2	101.1	70.3	119.9	83.6
66756	SQBUTTE4	230	40,000	17405.0	18765.0	17506.6	18842.3	17524.1	18855.8	101.6	77.3	119.1	90.8
66451	RICHLND7	115	20,000	3880.4	3530.5	3982.4	3591.1	3988.5	3594.5	102.0	60.6	108.1	64.0
66408	WATFORD7	115	22,000	2960.2	1923.3	3067.5	1973.8	3068.2	1974.5	107.3	50.5	108.0	51.2
66407	FALLON 7	115	20,000	2414.6	2036.7	2470.6	2063.2	2521.8	2087.0	56.0	26.5	107.2	50.3
66496	RUSHMRE7	115		2949.8	2616.9	2955.0	2619.6	3056.1	2672.5	5.2	2.7	106.3	55.6
66490	RAPIDCY7	115	40,000	2890.9	2514.5	2896.1	2517.1	2997.0	2567.9	5.2	2.6	106.1	53.4
67356	LEWIS 7	115	20,000	3893.6	3843.1	3991.9	3909.5	3999.6	3914.5	98.3	66.4	106.0	71.4
67181	BICNTNL7	115	N/A	2953.6	2057.4	3057.3	2106.8	3057.3	2107.1	103.7	49.4	103.7	49.7
66248	MAURINE8	69	20,000	2364.1	2538.4	2368.6	2541.8	2466.1	2618.6	4.5	3.4	102.0	80.2

**Note:**  
Fault Currents in columns 9 and 10 are with the following network upgrades: Belfield 345/230 kV transformer #2 + Belfield-Hettinger 230 kV line.  
N/A: Not applicable.

## 7. CONCLUSIONS

The impact of interconnecting 500 MW of generation at the Belfield 345 kV substation in Stark County, ND has been evaluated. The evaluation involved assessment of system performance based on stability analysis, steady-state analysis, constrained interface analysis, and short-circuit analysis.

The following is a summary of study results.

### Stability Analysis:

The results of the stability analysis indicate that the addition of the proposed GI-0217 plant would adversely impact both local and regional stability performance.

For local-type contingencies, the dynamic performance following outage of any 345 kV section of the line between Belfield and Antelope Valley is unacceptable. In addition to significant system-wide oscillations, transient voltage violations were observed at several nearby buses following the outage of the Belfield-Charlie Creek 345 kV line, regardless of whether this outage is triggered by a fault. Installation of both a generation tripping scheme (to trip the proposed plant following the loss of the Belfield-Charlie Creek 345 kV line) and a well-tuned PSS at Belfield (to damp oscillations following the loss of the Charlie Creek-Antelope Valley 345 kV line) is recommended to alleviate the local area stability problems.

For regional contingencies, stability criteria violations were observed for the following faults (these faults were simulated with delayed recovery modeled on the Square Butte HVdc line):

- *fd3* – 5 cycle 3-phase fault on Square Butte-Stanton 230 kV line
- *bl3* – 5 cycle 3-phase fault on Stanton-Leland Olds 230 kV line
- *ec3* – 5 cycle 3-phase fault on Center-Heskett 230 kV line
- *ed3* – 5 cycle 3-phase fault on Stanton-Square Butte 230 kV line
- *ef3* – 5 cycle 3-phase fault on Stanton-Coal Creek-McHenry 230 kV line

Particular attention was given to fault *fd3* because this fault resulted in the lowest transient voltages at the Jamestown 345 kV bus. Three options were investigated to alleviate the pre- and post-project *fd3* violations:

Option 1 involves providing reactive support in the form of capacitors and SVCs at the Jamestown 345 kV bus. Results indicate that in addition to the compensation required to address the violations without the GI-0217 plant, an additional 30 to 35 MVar capacitor and an additional 20 to 30 MVar SVC mitigate the post-project *fd3* violations.

Option 2 involves adding series compensation on the Leland Olds-Groton and Leland Olds-Ft.Thompson 345 kV lines. Considering that the level of series

compensation required to mitigate the pre- and post-project *fd3* violations is in the order of 60% to 75%, this solution is not considered viable.

Option 3 involves reducing the *fd3* fault clearing time from the present 5 cycles to 4 cycles. With 4 cycle fault clearing, there are no pre- and post-project criteria violations.

Similarly, the transient voltage violations following faults *b13*, *ec3* and *ed3* can be mitigated by reducing the corresponding fault clearing times from the existing 5 cycles to 4 cycles. Mitigation of fault *ef3* would require both 4 cycle clearing and a 20 MVAR switched shunt at the Jamestown 345 kV bus.

To achieve the 4 cycle fault clearing time, the feasibility of using faster breakers at the following substations should be investigated:

- Square Butte 230 kV substation on the Square Butte-Stanton 230 kV line. This would resolve both the *fd3* and *ed3* violations.
- Center 230 kV substation on the Center-Heskett 230 kV line (for fault *ec3*).
- Stanton 230 kV substation on the Stanton-Leland Olds 230 kV line (for fault *b13*) and the Stanton-Coal Creek-McHenry 230 kV line (for fault *ef3*). In addition to the 4 cycle clearing, mitigation of fault *ef3* would require the addition of a 20 MVAR switched shunt at Jamestown 345 kV as described above.

A sensitivity analysis was performed to check post-project stability performance with a new Belfield-Hettinger 230 kV line and a second 345/230 kV transformer at Belfield. As before, faults *fd3*, *b13*, *ec3* and *ef3* resulted in transient voltage violations in the Jamestown area. Results indicate that these violations are less severe than those previously observed. In other words, the proposed Belfield area reinforcements help improve the transient voltages at Jamestown 345. No transient voltage violations were observed following fault *ed3*. With 4 cycle fault clearing, there were no criteria violations for faults *fd3*, *b13*, *ec3* and *ef3*. As before, the feasibility of using faster breakers at the Square Butte, Center and Stanton 230 kV substations should be investigated. Examination of the local area fault results indicate that with the proposed reinforcements, there is no need to trip the proposed GI-0217 plant following the loss of any section of the 345 kV line between Belfield and Antelope Valley. This performance improvement can be attributed to the availability of the new transmission outlet between the Belfield and Hettinger.

#### Steady-State Analysis:

The results of the steady-state analysis indicate that the addition of proposed GI-0217 plant would adversely impact transmission system performance, both under system intact and contingency conditions. Although several transmission facilities were significantly impacted, particular attention was given to the following



facilities that became newly overloaded following the addition of the proposed plant. These facilities are at or in the immediate vicinity of the Belfield substation.

- Belfield 345/230 kV transformer
- Dickinson 230/115 kV transformer
- Dickinson – S. New England 115 kV line
- Belfield – Charlie Creek 345 kV line
- Belfield – Dickinson 230 kV line

Results indicate that the above overloads can be mitigated through the following three network reinforcements:

1. Addition of a Belfield-Hettinger 230 kV line.

*Instead of a Belfield-Hettinger 230 kV line, other transmission alternatives can be considered. One such alternative is to add a second 230/115 kV transformer at Dickinson and upgrade / reconductor the Dickinson-Hettinger 115 kV line such that its emergency rating is at least 130 MVA. The feasibility of reconductoring / rebuilding this 115 kV line should be investigated. Furthermore, terminal equipment upgrades / replacements will be required on Belfield-Dickinson 230 kV line to mitigate the observed post-contingency overloads.*

2. Change terminal equipment settings on the Belfield – Charlie Creek 345 kV line.
3. Addition of second Belfield 345/230 kV transformer (identical to the first). In addition, any one of the following alternatives should be implemented to avoid overloading each transformer following the loss of the parallel transformer.
  - a. Trip the remaining in-service transformer.
  - b. Optionally, if it is desired to have at least one of the two transformers in-service, the proposed plant should be run back to approx. 170 MW to alleviate the overload.
  - c. Yet another possibility is to replace the existing transformer with a larger unit (say 250 MVA normal / 450 MVA emergency) and size the second transformer such that it is identical to the replacement. This will eliminate the need to trip the remaining in-service transformer or to run back the proposed plant.

*In lieu of transformer #2 at Belfield, another possibility may be to replace the existing transformer with one rated at least 450 MVA normal / 515 MVA emergency.*

#### Constrained Interface Analysis

The study also evaluated the impact of the proposed project on constrained interfaces in the MAPP system. These results are for informational purposes only

to identify potential third party flowgate issues for the requested delivery component of the transmission. Results indicate that the proposed project adversely impacts several MAPP interfaces. See [Section 5](#) of this report. Mitigation may be required if it is determined that there is insufficient or no available transfer capability (ATC) on the affected MAPP constrained interfaces. Such an assessment can be made as part of the delivery studies, if deemed necessary.

#### Short-Circuit Analysis:

The addition of the proposed GI-0217 project increases fault currents in the study area. Pre- and post-project fault currents were compared against the lowest breaker rating at each of the impacted substations to determine whether breakers at these substations could be overdutied.

Not all the impacted stations had the breaker ratings available. At the stations for which breaker ratings were available, the comparison did not indicate fault levels exceeding the respective lowest breaker ratings. For the remaining substations, 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 breaker replacements may be required.

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.

## 8. REFERENCES

[1] “300 MW Yearly Firm Network Transmission Service Request – Follow-up evaluation of 130 MW NDEX Increase”, by WAPA UGPR, September 24, 2004.

## **Appendix A – Stability Analysis Results – Original Cases**

# Appendix A.1: Summary for Case b00-s709aa.xzqV424.sav (Without GI-0217)

B00-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2176,MW=1258,OHMH=-196,OHMP=151,EWTW=98,BD=165

## POWER FLOW SUMMARY

```

-----
NDEX:      2080 MW      ECL-ARP:   529 MW
MHEX:      2176 MW      PRI-BYN:   729 MW
MWSI:      1258 MW      AHD-GPK:   554 MW
                                     NI-WUMS:   150 MW
COOPER S:  1068 MW      WNE-WKS:   511 MW
FTCAL S:   664 MW      GGS:       1501 MW
GRIS-LNC:  683 MW      QC WEST:   -42 MW
-----
  
```

LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 1808.6 MW, 61.8% OF 2925.0 MW  
 NSP (AREA 600) 8433.6 MW, 87.6% OF 9632.0 MW  
 MAN HYDRO (AREA 667) 2126.0 MW, 71.7% OF 2964.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 267	MH total gross	4724	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 45	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	372
MP	1944/ 163	northwest	816	SPC>WAPA (B10T)	165
NSP	8433/ 493	SPC total gross	2241	MH>SPC (3-230)	20
N. Dakota	1808/ 291	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	151
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	98
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1621
NSP	1779 MVARs	net	2848	D602F @Dorsey	1831
N. Dakota	362 MVARs	Total net	6720	L20D @Letell	226
		WAPA SD Hydro	1497	R50M @Richer	148
		Pleasant Valley	0	G82R @Glenboro	-30
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	1077		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	11/ 110	CU (1,2)	1103
Wshell #2 7-7	104/ 72%	Boundary Dam	19/ 165	SQ BU (3,4)	455
Drayton#1 4-7	43/ 31%	Whiteshell	70/ 200	MH Bipole 1	1514
Drayton#2 4-7	55/ 29%	Int Falls	87/ 150	MH Bipole 2	1715
Dorsey #1 2-4	877/ 73%	St. Lawrence	15/ 0	MH (BP1+BP2)	3230
Dorsey #2 2-4	989/ 82%			Miles City E>W	-150
Forbes 2-4	69/ 10%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	487	Forbes	500	21 400/ -450
SCE 1-3G	18.2	3	397	Fargo	13.2	-8 20/ -135
SCA 4-6G	18.2	3	397	Watertown	20.0	13 125/ -86
Total		1281	1560/ -810	Series Caps		Num In Serv
Margin		279				
				Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	0	Arrowhead	230 160	Chisago T 9	34.5 51

Drayton	115	20	Blackberry	230	47	Chisago T 10	34.5	51
Drayton	13.8	-20	Minntac	115	45	Forbes	230	70
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	40	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	0
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	40	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu		Bus Voltages	V,pu		Bus Voltages	V,kV	
Adams	345	1.009	Arrowhead	230	1.014	Whiteshell	110	118.9
Alexandria	115	1.005	Badoura	115	1.019	Kenora	220	248.0
Audubon	115	1.027	Blackberry	230	1.029	Dryden	220	251.9
Bemidji	115	1.015	Boise Cascade	13.8	1.054	Fort Frances	220	246.8
Byron	345	1.024	Boise Cascade	115	1.022	Mackenzie	220	256.6
Chisago Co.	345	1.015	ETCO	115	1.004	Lakehead	220	256.3
Chisago Co.	500	1.009	Forbes	230	1.016	Marathon	220	260.7
Drayton	230	1.022	Forbes	500	1.008	Wawa	220	258.2
Eau Claire	345	1.023	Hubbard	115	1.020	Mississagi	220	250.5
WEST FARIBAULT	115	1.011	Intl Falls	115	1.023	Fort Frances	118	120.1
LaPorte	115	1.012	Minntac	115	1.012	Lakehead	118	122.8
Maple River	230	1.013	Moranville	230	1.020	Birch	118	117.5
Marshall Tap	115	1.023	Riverton	230	1.015	Marathon	118	125.2
Owatonna	161	0.999	Running	230	1.023			0.0
Prairie	115	1.031	Shannon	230	1.029			0.0
Prairie	230	1.025			0.000			0.0
Ramsey	230	1.025	Groton	345	1.034			0.0
Roseau County	230	1.019	Watertown	230	1.030			0.0
Roseau County	500	1.058	Watertown	345	1.036			0.0
Sheyenne	230	1.017			0.000			0.0
Thief R Falls	115	1.024	Dorsey	230	1.045			0.0
Tioga	230	1.024	Dorsey	500	1.030			0.0
Wahpeton	230	1.009			0.000			0.0
Winger	115	1.036			0.000			0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	332%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	684%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	348%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	221%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	328%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1687%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	919%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	879%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## Appendix A.2: Summary for Case b01 (With GI-0217)

B01-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1237,OHMH=-196,OHMP=151,EWTW=99,BD=165

### POWER FLOW SUMMARY

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-----
NDEX:      2080 MW      ECL-ARP:   522 MW
MHEX:      2175 MW      PRI-BYN:   715 MW
MWSI:      1237 MW      AHD-GPK:   547 MW
                                NI-WUMS:   151 MW
COOPER S:  1067 MW      WNE-WKS:   512 MW
FTCAL S:   662 MW      GGS:       1505 MW
GRIS-LNC:  692 MW      QC WEST:   -40 MW
  
```

#### LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:

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NORTH DAKOTA (ZONE 90,990) 2255.7 MW, 77.1% OF 2925.0 MW
NSP (AREA 600) 8453.3 MW, 87.8% OF 9632.0 MW
MAN HYDRO (AREA 667) 2126.0 MW, 71.7% OF 2964.0 MW
  
```

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 267	MH total gross	4723	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 44	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	356
MP	1944/ 158	northwest	816	SPC>WAPA (B10T)	165
NSP	8453/ 490	SPC total gross	2241	MH>SPC (3-230)	21
N. Dakota	2255/ 343	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	151
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	99
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1610
NSP	1783 MVARs	net	2848	D602F @Dorsey	1826
N. Dakota	443 MVARs	Total net	6720	L20D @Letell	244
		WAPA SD Hydro	1497	R50M @Richer	147
		Pleasant Valley	0	G82R @Glenboro	-42
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	1048		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	11/ 110	CU (1,2)	1103
Wshell #2 7-7	104/ 72%	Boundary Dam	24/ 166	SQ BU (3,4)	455
Drayton#1 4-7	48/ 34%	Whiteshell	68/ 200	MH Bipole 1	1514
Drayton#2 4-7	61/ 33%	Int Falls	85/ 150	MH Bipole 2	1715
Dorsey #1 2-4	873/ 72%	St. Lawrence	15/ 0	MH (BP1+BP2)	3230
Dorsey #2 2-4	986/ 82%			Miles City E>W	-150
Forbes 2-4	71/ 10%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	488	Forbes	500	18
SCE 1-3G	18.2	3	398	Fargo	13.2	7
SCA 4-6G	18.2	3	398	Watertown	20.0	-23
					125/	-86

Total Margin	1286	1560/ -810	Series Caps	Num In Serv
	274		Roseau	500 2 of 2
			Chisago	500 1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR

Balta (FS)	230	0	Arrowhead	230	160	Chisago T 9	34.5	51
Drayton	115	20	Blackberry	230	47	Chisago T 10	34.5	51
Drayton	13.8	-20	Minntac	115	45	Forbes	230	70
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	80	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	80	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.009	Arrowhead	230 1.014	Whiteshell	110 118.9
Alexandria	115 0.997	Badoura	115 1.035	Kenora	220 248.1
Audubon	115 1.020	Blackberry	230 1.030	Dryden	220 251.9
Bemidji	115 1.010	Boise Cascade	13.8 1.055	Fort Frances	220 247.0
Byron	345 1.025	Boise Cascade	115 1.023	Mackenzie	220 256.6
Chisago Co.	345 1.016	ETCO	115 1.006	Lakehead	220 256.3
Chisago Co.	500 1.011	Forbes	230 1.018	Marathon	220 260.7
Drayton	230 1.013	Forbes	500 1.010	Wawa	220 258.2
Eau Claire	345 1.025	Hubbard	115 1.032	Mississagi	220 250.5
WEST FARIBAULT	115 1.011	Intl Falls	115 1.024	Fort Frances	118 120.2
LaPorte	115 1.018	Minntac	115 1.014	Lakehead	118 122.8
Maple River	230 1.008	Moranville	230 1.020	Birch	118 117.5
Marshall Tap	115 1.022	Riverton	230 1.022	Marathon	118 125.2
Owatonna	161 0.999	Running	230 1.024		0.0
Prairie	115 1.029	Shannon	230 1.030		0.0
Prairie	230 1.018		0.000		0.0
Ramsey	230 1.002	Groton	345 1.024		0.0
Roseau County	230 1.020	Watertown	230 1.030		0.0
Roseau County	500 1.058	Watertown	345 1.033		0.0
Sheyenne	230 1.014		0.000		0.0
Thief R Falls	115 1.010	Dorsey	230 1.045		0.0
Tioga	230 1.038	Dorsey	500 1.031		0.0
Wahpeton	230 1.002		0.000		0.0
Winger	115 1.027		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	342%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	702%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	352%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	223%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	330%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1221%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	819%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	882%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A



### Appendix A.3: Simulation Summary Tables for Baseline Analysis

Case No.	1	2	3	4
Case Name	b00-s709aa.xzqV424-ag1	b00-s709aa.xzqV424-ag3	b00-s709aa.xzqV424-ah3	b00-s709aa.xzqV424-al1
Disturbance	ag1	ag3	ah3	al1
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 19:39	AUG 30 2006 19:42	AUG 30 2006 19:22	SEP 01 2006 13:40
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.98   1.03	0.98   1.03	0.98   1.03	1.00   1.03
Boise 115	1.00   1.04	0.99   1.04	0.99   1.04	1.01   1.04
Dorsey 230	1.02   1.06	1.02   1.06	1.02   1.06	1.04   1.06
Forbes 230	0.99   1.03	0.99   1.03	0.99   1.03	1.01   1.04
Riverton 230	0.96   1.05	0.96   1.05	0.96   1.05	1.00   1.05
Coal Creek 230	0.95   1.13	0.95   1.13	0.95   1.13	0.98   1.09
Dickinson 345	0.94   1.04	0.94   1.04	0.94   1.04	0.96   1.03
Drayton 230	0.98   1.11	0.98   1.10	0.97   1.11	1.00   1.06
Groton 345	0.87   1.08	0.87   1.08	0.99   1.09	0.88   1.11
Tioga 230	0.97   1.06	0.97   1.06	0.97   1.06	1.00   1.04
Wahpeton 115	0.94   1.10	0.93   1.10	0.93   1.09	1.00   1.08
Watertown 345	0.94   1.06	0.95   1.06	1.00   1.07	0.95   1.08
<b>Dynamic Voltage Warnings</b>				
	none	none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold				KING 3 / 43.89%
Forbes DC Red (DCAR)	393%	400%	408%	446%
K22W (max +dP @ t, d-ang)	12.1@(2.55832,1.9)	15.7@(2.51666,0.5)	15.0@(2.56665,-0.3)	32.4@(2.75832,-7.6)
K22W (max -dP @ t, d-ang)	22.6@(0.81666,5.7)	22.7@(0.76666,6.1)	22.0@(0.79166,5.8)	4.7@(0.39166,0.3)
K22W (max d-ang @ t, dP)	8.7@(1.11666,-6.5)	9.0@(1.05833,-8.0)	8.3@(1.08333,-8.0)	-15.2@(20.00806,11.1)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	164% / 253%	161% / 247%	160% / 247%	199% / 312%
B2R at Rugby/L20D at Drayton	999% / 679%	999% / 659%	999% / 667%	999% / 692%
R50M / F3M	710% / 263%	702% / 259%	700% / 261%	833% / 275%
B10T	167%	156%	173%	193%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   3   0)	(0   3   0)	(0   3   0)	(0   2   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(1   7   1) / (0   0   0)	(1   6   1) / (0   0   0)	(1   6   2) / (0   0   0)	(1   4   1) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shay 115 / Split Rock 115	(1   5   2) / (0   0   0)	(1   5   3) / (0   2   2)	(1   5   3) / (0   2   2)	(1   3   1) / (0   0   0)
<b>Damping Performance</b>				
	N/A	N/A	N/A	NONE

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	5	6	7	8
Case Name	b00-s709aa.xzqV424-am1	b00-s709aa.xzqV424-ei2	b00-s709aa.xzqV424-fd1	b00-s709aa.xzqV424-fdk
Disturbance	am1	ei2	fd1	fdk
Prior Outage	None	None	None	None
Date/Time	SEP 01 2006 13:48	AUG 30 2006 19:24	AUG 30 2006 19:26	AUG 30 2006 19:28
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	1.00   1.03	0.95   1.05	0.99   1.05	1.01   1.06
Boise 115	1.01   1.04	0.98   1.05	0.99   1.04	1.00   1.03
Dorsey 230	1.04   1.06	1.02   1.07	1.02   1.06	1.03   1.06
Forbes 230	1.01   1.04	0.95   1.03	0.98   1.04	1.00   1.04
Riverton 230	1.00   1.05	0.87   1.07	0.93   1.07	0.98   1.06
Coal Creek 230	0.97   1.10	0.98   1.15	0.96   1.15	0.97   1.10
Dickinson 345	0.94   1.03	0.98   1.05	0.94   1.05	0.95   1.04
Drayton 230	1.00   1.09	0.92   1.12	0.97   1.13	1.00   1.08
Groton 345	0.88   1.11	0.84   1.14	0.90   1.12	0.98   1.10
Tioga 230	1.00   1.04	0.98   1.06	0.98   1.05	1.00   1.05
Wahpeton 115	1.00   1.08	0.83   1.13	0.87   1.12	0.97   1.10
Watertown 345	0.95   1.08	0.88   1.12	0.93   1.09	1.00   1.08
<b>Dynamic Voltage Warnings</b>				
	none		63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMESTN3] 0.69	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	KING 3 / 43.49%			
Forbes DC Red (DCAR)	443%	507%	331%	477%
K22W (max +dP @ t, d-ang)	32.6@(2.75832,-7.9)	71.1@(2.88332,-28.8)	21.8@(2.70832,-1.4)	42.1@(2.39999,-16.5)
K22W (max -dP @ t, d-ang)	6.3@(0.39166,0.5)	12.1@(0.65000,1.6)	23.3@(0.88333,3.8)	2.7@(0.31667,-0.2)
K22W (max d-ang @ t, dP)	-15.1@(20.00806,11.2)	-37.1@(2.28333,52.8)	7.2@(1.20833,-3.7)	-18.0@(1.91666,29.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	201% / 314%	116% / 175%	159% / 245%	188% / 292%
B2R at Rugby/L20D at Drayton	999% / 686%	999% / 505%	999% / 658%	999% / 630%
R50M / F3M	828% / 276%	611% / 198%	700% / 250%	739% / 248%
B10T	195%	67%	141%	144%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   2   0)	(0   2   0)	(0   1   0)	(0   1   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   2) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(1   5   1) / (0   0   0)	(1   10   2) / (0   0   0)	(1   7   2) / (0   0   0)	(1   3   1) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   1   0) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shay 115 / Split Rock 115	(1   3   1) / (0   0   0)	(1   5   0) / (0   2   2)	(1   5   0) / (0   2   2)	(1   4   0) / (0   0   0)
<b>Damping Performance</b>				
	NONE	N/A	N/A	N/A

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	9	10	11	12
Case Name	b00-s709aa.xzqV424-fd3	b00-s709aa.xzqV424-fd4	b00-s709aa.xzqV424-fdl	b00-s709aa.xzqV424-nbz
Disturbance	fd3	fd4	fdl	nbz
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 19:30	AUG 30 2006 19:33	AUG 30 2006 19:35	AUG 30 2006 19:37
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCDC	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.94   1.04	0.95   1.04	0.97   1.05	0.88   1.09
Boise 115	1.00   1.04	0.99   1.04	1.00   1.04	0.95   1.05
Dorsey 230	1.02   1.06	1.02   1.06	1.03   1.06	1.04   1.19
Forbes 230	0.99   1.04	0.98   1.05	1.00   1.04	0.92   1.09
Riverton 230	0.92   1.07	0.93   1.09	0.98   1.07	0.85   1.07
Coal Creek 230	0.95   1.16	0.95   1.15	0.97   1.10	0.92   1.11
Dickinson 345	0.92   1.05	0.93   1.06	0.95   1.04	0.91   1.06
Drayton 230	0.98   1.12	0.98   1.14	0.99   1.11	0.97   1.10
Groton 345	0.87   1.12	0.90   1.13	0.97   1.11	0.85   1.10
Tioga 230	0.98   1.05	0.98   1.05	1.00   1.05	0.97   1.07
Wahpeton 115	0.86   1.12	0.87   1.14	0.97   1.12	0.84   1.10
Watertown 345	0.92   1.10	0.94   1.11	1.00   1.09	0.89   1.08
<b>Dynamic Voltage Warnings</b>				
	63369 [JAMESTN3] 0.69 63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69	63199 [JAMSTN1Y] 0.67 63200 [JAMSTN2Y] 0.67 63369 [JAMESTN3] 0.67 63269 [JAMSTWN7] 0.69 63270 [LADISH 7] 0.69 63271 [AVIKO 7] 0.69 63272 [JAMESPK7] 0.69 +more	none	
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.166			/ 0.133
Forbes DC Red (DCAR)	347%	318%	475%	507%
K22W (max +dP @ t, d-ang)	25.6@(2.64999,-3.9)	25.5@(2.66665,-2.7)	45.6@(2.39166,-16.5)	142.6@(2.55832,-63.3)
K22W (max -dP @ t, d-ang)	22.4@(0.76666,5.2)	22.8@(0.85000,4.2)	2.7@(0.39166,-0.4)	88.6@(0.24167,7.5)
K22W (max d-ang @ t, dP)	9.4@(1.12500,-10.1)	8.0@(1.17500,-2.5)	-18.1@(1.90833,31.4)	-65.4@(2.32499,136.1)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	167% / 258%	168% / 261%	187% / 291%	0.18333 sec / 0.18333 sec
B2R at Rugby/L20D at Drayton	999% / 598%	999% / 600%	999% / 575%	999% / 576%
R50M / F3M	736% / 266%	725% / 262%	735% / 253%	389% / 150%
B10T	117%	118%	123%	91%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   2   0 )	( 0   1   0 )	( 0   1   0 )	( 0   2   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 1   7   2 ) / ( 0   0   0 )	( 1   8   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   3   0 )
Shey 115 / Split Rock 115	( 1   5   1 ) / ( 0   2   2 )	( 1   5   0 ) / ( 0   2   2 )	( 1   4   0 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   2   2 )
<b>Damping Performance</b>				
	N/A	N/A	N/A	N/A

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	13	14	15	16
Case Name	b00-s709aa.xzqV424-nmz	b00-s709aa.xzqV424-pcs	b00-s709aa.xzqV424-pct	b00-s709aa.xzqV424-pys
Disturbance	nmz	pcs	pct	pys
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 20:07	SEP 01 2006 11:33	SEP 01 2006 11:40	SEP 01 2006 11:46
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.92   1.07	0.88   1.00	0.95   0.98	0.98   1.02
Boise 115	0.94   1.05	0.99   1.06	1.02   1.03	1.00   1.05
Dorsey 230	1.04   1.20	1.03   1.09	1.04   1.05	1.03   1.08
Forbes 230	0.98   1.04	1.00   1.04	1.00   1.02	1.01   1.06
Riverton 230	0.87   1.06	0.98   1.03	1.01   1.02	1.01   1.03
Coal Creek 230	0.93   1.11	0.96   1.07	1.02   1.04	0.98   1.08
Dickinson 345	0.92   1.06	0.95   1.04	0.98   1.00	0.97   1.04
Drayton 230	0.97   1.09	1.00   1.05	1.01   1.03	1.00   1.04
Groton 345	0.86   1.10	0.97   1.05	1.02   1.04	0.99   1.05
Tioga 230	0.98   1.07	0.98   1.04	1.02   1.03	0.99   1.03
Wahpeton 115	0.85   1.11	0.99   1.06	1.03   1.04	1.00   1.05
Watertown 345	0.89   1.09	0.99   1.05	1.03   1.04	1.01   1.04
<b>Dynamic Voltage Warnings</b>				
		none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.133			
Forbes DC Red (DCAR)	507%	154%	324%	158%
K22W (max +dP @ t, d-ang)	135.4@(2.59165,-60.9)	5.1@(3.53331,2.5)	0.0@(0.01667,0.0)	9.2@(2.55832,-0.9)
K22W (max -dP @ t, d-ang)	90.1@(0.23333,7.1)	45.6@(0.39166,8.3)	26.6@(2.29166,12.3)	31.8@(1.68333,9.7)
K22W (max d-ang @ t, dP)	-63.8@(2.30833,128.8)	26.0@(1.10833,-38.8)	12.6@(19.99972,-17.9)	19.6@(1.08333,-22.7)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	0.18333 sec / 0.18333 sec	168% / 258%	220% / 345%	168% / 257%
B2R at Rugby/L20D at Drayton	999% / 589%	999% / 606%	999% / 837%	999% / 663%
R50M / F3M	396% / 148%	627% / 329%	810% / 329%	675% / 301%
B10T	100%	138%	287%	163%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   2   0)	(0   0   0)	(0   0   0)	(0   0   0)
Eau Cl 345 / Park Lk 115	(3   3   1) / (0   0   0)	(3   4   2) / (0   3   3)	(3   3   2) / (0   0   0)	(3   4   4) / (0   3   3)
Prairie 115 / Ramsey 230	(1   5   1) / (0   0   0)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   1   1) / (0   0   0)
Roseau 230 / Running 230	(0   1   0) / (1   3   1)	(0   0   0) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(1   5   1) / (0   2   2)	(1   2   2) / (0   0   0)	(1   1   1) / (0   0   0)	(1   2   2) / (0   0   0)
<b>Damping Performance</b>				
	N/A	NONE	NONE	NONE

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	17	18	19	20
Case Name	b00-s709aa.xzqV424-pyt	b00-s709aa.xzqV424-au3	b00-s709aa.xzqV424-au9	b00-s709aa.xzqV424-ad3
Disturbance	pyt	au3	au9	ad3
Prior Outage	None	None	None	None
Date/Time	SEP 01 2006 11:52	OCT 02 2006 11:29	OCT 02 2006 11:32	OCT 02 2006 11:35
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.99   1.01	1.01   1.02	1.01   1.02	0.99   1.03
Boise 115	1.02   1.03	1.02   1.03	1.02   1.03	1.00   1.04
Dorsey 230	1.04   1.05	1.04   1.05	1.04   1.05	1.03   1.06
Forbes 230	1.01   1.03	1.01   1.02	1.01   1.02	0.99   1.03
Riverton 230	1.01   1.03	1.01   1.02	1.01   1.02	0.98   1.06
Coal Creek 230	1.02   1.05	1.02   1.06	1.02   1.05	0.96   1.12
Dickinson 345	0.98   1.00	0.98   1.01	0.99   1.01	0.95   1.04
Drayton 230	1.02   1.03	1.01   1.03	1.02   1.03	0.99   1.09
Groton 345	1.02   1.04	1.01   1.05	1.01   1.04	0.90   1.08
Tioga 230	1.02   1.03	1.02   1.03	1.02   1.03	0.98   1.05
Wahpeton 115	1.03   1.04	1.02   1.04	1.02   1.04	0.97   1.10
Watertown 345	1.03   1.04	1.03   1.04	1.03   1.04	0.96   1.06
<b>Dynamic Voltage Warnings</b>				
	none	none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	SHERC3 / 63.40%			
Forbes DC Red (DCAR)	353%	479%	486%	386%
K22W (max +dP @ t, d-ang)	0.0@(0.01667,0.0)	3.6@(2.27499,0.0)	2.9@(2.27499,-0.1)	16.2@(2.43332,-1.2)
K22W (max -dP @ t, d-ang)	19.3@(1.75833,8.6)	3.5@(0.62500,0.7)	3.0@(0.61666,0.5)	15.2@(0.71666,3.5)
K22W (max d-ang @ t, dP)	9.1@(2.10833,-18.3)	1.1@(0.89166,-0.4)	0.9@(0.89166,-0.3)	5.5@(1.01666,-2.3)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	221% / 348%	210% / 330%	212% / 333%	180% / 280%
B2R at Rugby/L20D at Drayton	999% / 839%	999% / 861%	999% / 873%	999% / 718%
R50M / F3M	846% / 329%	848% / 312%	854% / 316%	760% / 274%
B10T	284%	293%	301%	185%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   0   0 )	( 0   0   0 )	( 0   0   0 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )	( 1   2   1 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )	( 1   5   2 ) / ( 0   0   0 )
<b>Damping Performance</b>				
	NONE	N/A	N/A	N/A

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	21	22	23	24
Case Name	b00-s709aa.xzqV424-ax3	b00-s709aa.xzqV424-fd3-tb	b00-s709aa.xzqV424-fd9-tb	b00-s709aa.xzqV424-eb3-tb
Disturbance	ax3	fd3-tb	fd9-tb	eb3-tb
Prior Outage	None	None	None	None
Date/Time	OCT 02 2006 11:38	NOV 11 2006 0:59	JAN 06 2007 17:08	FEB 22 2007 0:06
Comments		fd3 with delayed	4 cycle version of fd3	Delayed Square Butte HVDC
		Sq. Butte HVDC recovery	With delayed Sq. Butte HVDC	Recovery
<b>Steady State Flows</b>			recovery	
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	1.01   1.02	0.94   1.04	0.96   1.04	0.99   1.03
Boise 115	1.02   1.03	0.99   1.06	1.00   1.04	1.01   1.03
Dorsey 230	1.04   1.05	1.01   1.06	1.02   1.06	1.03   1.05
Forbes 230	1.01   1.02	0.98   1.04	0.99   1.04	1.00   1.03
Riverton 230	1.01   1.02	0.90   1.08	0.93   1.06	1.00   1.04
Coal Creek 230	1.02   1.06	0.94   1.17	0.95   1.14	0.96   1.11
Dickinson 345	0.99   1.01	0.92   1.06	0.93   1.05	0.95   1.02
Drayton 230	1.02   1.03	0.96   1.12	0.98   1.11	0.99   1.05
Groton 345	1.01   1.05	0.84   1.14	0.90   1.10	0.95   1.04
Tioga 230	1.02   1.03	0.96   1.05	0.99   1.05	1.00   1.04
Wahpeton 115	1.02   1.04	0.82   1.13	0.88   1.11	0.99   1.06
Watertown 345	1.03   1.04	0.89   1.11	0.94   1.08	0.99   1.04
<b>Dynamic Voltage Warnings</b>				
	none	63199 [JAMSTN1Y] 0.64 63200 [JAMSTN2Y] 0.64 63369 [JAMESTN3] 0.64 63270 [LADISH 7] 0.66 63271 [AVIKO 7] 0.66 63272 [JAMESPK7] 0.66 63273 [JAMETAP7] 0.66 +more	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold		/ 0.166	/ 0.166	
Forbes DC Red (DCAR)	482%	313%	362%	418%
K22W (max +dP @ t, d-ang)	3.8@(2.26666,-0.2)	30.3@(2.70832,-3.4)	19.8@(2.61665,-1.7)	9.9@(2.50832,-2.1)
K22W (max -dP @ t, d-ang)	3.1@(0.62500,0.6)	27.3@(0.89166,7.5)	19.7@(0.72500,3.3)	10.3@(0.78333,1.9)
K22W (max d-ang @ t, dP)	-0.9@(1.60833,-2.0)	11.4@(1.19166,-10.1)	7.7@(1.11666,-6.3)	3.3@(1.09166,-3.3)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	211% / 332%	156% / 241%	173% / 270%	186% / 290%
B2R at Rugby/L20D at Drayton	999% / 859%	999% / 542%	999% / 662%	999% / 661%
R50M / F3M	852% / 313%	704% / 254%	721% / 276%	770% / 285%
B10T	293%	92%	151%	288%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   0   0)	(0   3   0)	(0   1   0)	(0   2   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(1   1   1) / (0   0   0)	(1   10   1) / (0   0   0)	(1   6   2) / (0   0   0)	(1   8   3) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   1   1) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shay 115 / Split Rock 115	(1   1   1) / (0   0   0)	(1   5   0) / (0   2   2)	(1   5   1) / (0   0   0)	(1   3   3) / (0   0   0)
<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

Case No.	25	26	27	28
Case Name	b00-s709aa.xzqV424-fo9-tb	b00-s709aa.xzqV424-ek3-tb	b00-s709aa.xzqV424-ec3-tb	b00-s709aa.xzqV424-el3-tb
Disturbance	fo9-tb	ek3-tb	ec3-tb	el3-tb
Prior Outage	None	None	None	None
Date/Time	FEB 22 2007 0:09	FEB 22 2007 0:11	FEB 22 2007 0:12	FEB 22 2007 0:14
Comments	Delayed Square Butte HVDC	Delayed Square Butte HVDC	Delayed Square Butte HVDC	Delayed Square Butte HVDC
	Recovery	Recovery	Recovery	Recovery
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2079 / 373	2079 / 373	2079 / 373	2079 / 373
MHEX / L20D	2176 / 226	2176 / 226	2176 / 226	2176 / 226
ECL-ARP / PRI-BYN	529 / 729	529 / 729	529 / 729	529 / 729
MWSI / MNEX	1258	1258	1258	1258
D602F / F601C	1832 / 1621	1832 / 1621	1832 / 1621	1832 / 1621
B10T / MH>SPC	164 / 20	164 / 20	164 / 20	164 / 20
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-30	-30	-30	-30
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36	277 / 36	277 / 36
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCDC	554 / 0	554 / 0	554 / 0	554 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008	1.058 / 1.008
Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023	1.009 / 1.023
Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019	1.023 / 1.019
Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033	1.022 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 348%	221% / 348%	221% / 348%	221% / 348%
B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%	999% / 920%	999% / 920%
R50M/F3M	878% / 329%	878% / 329%	878% / 329%	878% / 329%
B10T	334%	334%	334%	334%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	1.02   1.03	1.01   1.01	0.96   1.03	0.96   1.03
Boise 115	1.01   1.03	1.02   1.02	1.00   1.04	1.00   1.04
Dorsey 230	1.04   1.05	1.04   1.04	1.02   1.07	1.02   1.07
Forbes 230	1.01   1.03	1.01   1.02	0.99   1.04	0.99   1.04
Riverton 230	1.02   1.04	1.01   1.02	0.92   1.06	0.93   1.06
Coal Creek 230	1.01   1.09	1.03   1.04	0.91   1.15	0.93   1.14
Dickinson 345	0.99   1.03	0.99   1.00	0.93   1.05	0.93   1.05
Drayton 230	1.01   1.04	1.02   1.02	0.96   1.15	0.98   1.13
Groton 345	1.02   1.07	1.03   1.03	0.88   1.11	0.89   1.10
Tioga 230	1.01   1.03	1.02   1.02	0.98   1.05	0.99   1.05
Wahpeton 115	1.03   1.06	1.03   1.03	0.87   1.11	0.89   1.10
Watertown 345	1.03   1.06	1.03   1.04	0.93   1.09	0.93   1.08
<b>Dynamic Voltage Warnings</b>				
	none	none		
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold			/ 0.175	/ 0.175
Forbes DC Red (DCAR)	482%	504%	371%	378%
K22W (max +dP @ t, d-ang)	37.8@(2.14166,-14.4)	0.4@(2.11666,-0.1)	23.1@(2.59999,-2.6)	23.6@(2.54999,-2.9)
K22W (max -dP @ t, d-ang)	4.7@(0.25000,0.4)	0.2@(2.55832,-0.1)	26.8@(0.72500,4.2)	23.8@(0.67500,3.2)
K22W (max d-ang @ t, dP)	-14.6@(2.37499,33.9)	-0.2@(1.32500,0.1)	8.6@(1.10000,-5.5)	7.4@(1.07500,-4.7)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	203% / 318%	220% / 346%	166% / 257%	171% / 265%
B2R at Rugby/L20D at Drayton	999% / 688%	999% / 894%	999% / 642%	999% / 678%
R50M / F3M	838% / 276%	875% / 327%	711% / 269%	711% / 273%
B10T	188%	330%	130%	150%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0 0 0)	(0 0 0)	(0 3 0)	(0 3 0)
Eau Cl 345 / Park Lk 115	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)
Prairie 115 / Ramsey 230	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 7 1)/(0 0 0)	(1 5 1)/(0 0 0)
Roseau 230 / Running 230	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
Shey 115 / Split Rock 115	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 5 1)/(0 2 2)	(1 5 2)/(0 2 2)
<b>Damping Performance</b>	N/A	N/A	N/A	N/A





**Appendix A.3 (Cont.): Simulation Summary Tables for Baseline Analysis**

1	<b>Case No.</b>	33	34	35	36
2	<b>Case Name</b>	b00-s709aa.xzqV424-ef3-tb	b00-s709aa.xzqV424-ef9-tb		
3	<b>Disturbance</b>	ef3-tb	ef9-tb		
4	<b>Prior Outage</b>	None	None		
5	<b>Date/Time</b>	FEB 22 2007 0:24	FEB 23 2007 10:43		
6	<b>Comments</b>	Delayed Square Butte HVDC	4 cycle version of ef3		
7		Recovery	With delayed Sq. Butte HVDC		
8	<b>Steady State Flows</b>		Recovery		
9	NDEX / EAST BIAS	2079 / 373	2079 / 373		
10	MHEX / L20D	2176 / 226	2176 / 226		
11	ECL-ARP / PRI-BYN	529 / 729	529 / 729		
12	MWSI / MNEX	1258	1258		
13	D602F / F601C	1832 / 1621	1832 / 1621		
14	B10T / MH>SPC	164 / 20	164 / 20		
15	OH E-W / OH>MH	98 / -196	98 / -196		
16	R50M / OH>MP	148 / 151	148 / 151		
17	G82R	-30	-30		
18	Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104		
19	Dorsey Reserve / Wtrtn SVC	277 / 36	277 / 36		
20	Forbes SVC / MSC	21 / 600	21 / 600		
21	Arrowhd-Wstrn/ RCDC	554 / 0	554 / 0		
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045		
24	Roseau 500/Forbes 500	1.058 / 1.008	1.058 / 1.008		
25	Chisago 500/EauClaire 345	1.009 / 1.023	1.009 / 1.023		
26	Int Falls 115/Badoura 115	1.023 / 1.019	1.023 / 1.019		
27	Drayton 230/Groton 345	1.022 / 1.033	1.022 / 1.033		
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	221% / 348%	221% / 348%		
30	B2R at Rugby/L20D at Drayton	999% / 920%	999% / 920%		
31	R50M/F3M	878% / 329%	878% / 329%		
32	B10T	334%	334%		
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.95   1.04	0.96   1.04		
35	Boise 115	0.99   1.06	1.00   1.05		
36	Dorsey 230	1.02   1.07	1.02   1.07		
37	Forbes 230	0.98   1.05	0.99   1.04		
38	Riverton 230	0.90   1.08	0.92   1.07		
39	Coal Creek 230	1.00   1.10	1.01   1.09		
40	Dickinson 345	0.95   1.03	0.96   1.03		
41	Drayton 230	0.93   1.15	0.95   1.12		
42	Groton 345	0.79   1.15	0.85   1.13		
43	Tioga 230	0.94   1.06	0.96   1.05		
44	Wahpeton 115	0.82   1.15	0.86   1.12		
45	Watertown 345	0.86   1.12	0.90   1.10		
46	<b>Dynamic Voltage Warnings</b>				
47		63369 [JAMESTN3] 0.67	none		
48		63200 [JAMSTN2Y] 0.68			
49		63199 [JAMSTN1Y] 0.68			
50		63198 [BUFFALOY] 0.69			
51		63358 [BUFFALO3] 0.69			
52		63269 [JAMSTWN7] 0.69			
53		63270 [LADISH 7] 0.69 +more			
54	<b>Worst Case Angle Damping</b>				
55	Dorsey SUVP / UdHold	/ 0.150	/ 0.150		
56	Forbes DC Red (DCAR)	291%	342%		
57	K22W (max +dP @ t, d-ang)	32.6@(2.99165,-0.3)	22.7@(2.86665,0.7)		
58	K22W (max -dP @ t, d-ang)	29.5@(0.95000,5.2)	20.8@(0.92500,3.7)		
59	K22W (max d-ang @ t, dP)	12.0@(1.34166,-4.8)	-8.5@(2.11666,-5.9)		
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	160% / 247%	175% / 272%		
63	B2R at Rugby/L20D at Drayton	999% / 486%	999% / 576%		
64	R50M / F3M	709% / 242%	728% / 259%		
65	B10T	82%	123%		
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	( 0   3   0 )	( 0   3   0 )		
68	Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )		
69	Prairie 115 / Ramsey 230	( 1   12   2 ) / ( 0   0   0 )	( 1   10   2 ) / ( 0   0   0 )		
70	Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )		
71	Shey 115 / Split Rock 115	( 1   5   0 ) / ( 0   2   2 )	( 1   5   0 ) / ( 0   2   2 )		
72	<b>Damping Performance</b>	N/A	N/A		

**Appendix A.4 - Simulation Summary Tables With GI-0217**

Case No.	1	2	3	4
Case Name	b01-s709aa.xzqV424-ag1	b01-s709aa.xzqV424-ag3	b01-s709aa.xzqV424-ah3	b01-s709aa.xzqV424-al1
Disturbance	ag1	ag3	ah3	al1
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 17:01	AUG 30 2006 17:05	AUG 30 2006 16:36	SEP 01 2006 14:00
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.98   1.02	0.97   1.03	0.97   1.03	0.99   1.05
Boise 115	1.00   1.04	0.99   1.04	0.99   1.04	1.00   1.05
Dorsey 230	1.03   1.06	1.02   1.05	1.02   1.05	1.03   1.07
Forbes 230	1.00   1.03	1.00   1.03	1.00   1.03	1.00   1.05
Riverton 230	0.97   1.05	0.96   1.05	0.96   1.05	0.99   1.08
Coal Creek 230	0.95   1.13	0.94   1.13	0.95   1.13	0.95   1.12
Dickinson 345	0.94   1.04	0.94   1.04	0.94   1.04	0.95   1.04
Drayton 230	0.97   1.10	0.97   1.10	0.96   1.10	0.97   1.08
Groton 345	0.86   1.07	0.85   1.07	0.98   1.10	0.84   1.14
Tioga 230	0.99   1.08	0.98   1.07	0.98   1.07	1.00   1.07
Wahpeton 115	0.92   1.08	0.91   1.08	0.91   1.07	0.96   1.10
Watertown 345	0.94   1.07	0.93   1.06	0.99   1.08	0.93   1.12
<b>Dynamic Voltage Warnings</b>				
	none	none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold				KING 3 / 53.83%
Forbes DC Red (DCAR)	402%	398%	391%	461%
K22W (max +dP @ t, d-ang)	13.2@(2.71665,2.5)	14.8@(2.70832,1.5)	14.9@(2.79165,0.9)	39.7@(2.89165,-5.8)
K22W (max -dP @ t, d-ang)	25.0@(0.88333,6.6)	26.8@(0.86666,8.0)	27.8@(0.90833,8.1)	3.6@(0.39166,0.1)
K22W (max d-ang @ t, dP)	9.9@(1.19166,-8.5)	11.3@(1.17500,-11.5)	11.3@(1.22500,-12.5)	-15.3@(2.19166,15.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	164% / 252%	160% / 246%	155% / 237%	197% / 309%
B2R at Rugby/L20D at Drayton	999% / 601%	999% / 597%	999% / 584%	999% / 530%
R50M / F3M	706% / 265%	693% / 264%	676% / 261%	837% / 250%
B10T	166%	156%	171%	169%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   3   0)	(0   3   0)	(0   3   0)	(0   3   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   8   3) / (0   0   0)	(2   10   4) / (0   0   0)	(2   11   4) / (0   0   0)	(2   9   2) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shy 115 / Split Rock 115	(2   5   3) / (0   0   0)	(2   5   4) / (0   0   0)	(2   5   4) / (0   0   0)	(2   5   0) / (0   0   0)
<b>Damping Performance</b>	N/A	N/A	N/A	NONE

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	5	6	7	8
Case Name	b01-s709aa.xzqV424-am1	b01-s709aa.xzqV424-ei2	b01-s709aa.xzqV424-fd1	b01-s709aa.xzqV424-fdk
Disturbance	am1	ei2	fd1	fdk
Prior Outage	None	None	None	None
Date/Time	SEP 01 2006 14:10	AUG 30 2006 16:40	AUG 30 2006 16:43	AUG 30 2006 16:46
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCDL	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	1.00   1.05	0.95   1.05	0.99   1.05	1.01   1.06
Boise 115	1.00   1.05	0.98   1.06	0.99   1.06	1.00   1.04
Dorsey 230	1.03   1.07	1.01   1.07	1.02   1.07	1.03   1.06
Forbes 230	1.00   1.04	0.95   1.03	0.99   1.04	1.00   1.04
Riverton 230	0.99   1.07	0.88   1.07	0.94   1.07	0.99   1.07
Coal Creek 230	0.95   1.12	0.96   1.16	0.96   1.15	0.98   1.11
Dickinson 345	0.95   1.04	0.98   1.05	0.93   1.05	0.95   1.04
Drayton 230	0.97   1.08	0.91   1.12	0.95   1.11	0.99   1.07
Groton 345	0.85   1.14	0.80   1.16(1.55)	0.87   1.12	0.97   1.12
Tioga 230	1.00   1.07	0.98   1.09	1.00   1.08	1.01   1.06
Wahpeton 115	0.96   1.10	0.81   1.13	0.85   1.10	0.95   1.10
Watertown 345	0.94   1.12	0.87   1.14	0.93   1.11	1.01   1.10
<b>Dynamic Voltage Warnings</b>				
	none		63199 [JAMSTN1Y] 0.65 63200 [JAMSTN2Y] 0.65 63369 [JAMESTN3] 0.65 63269 [JAMSTWN7] 0.67 63270 [LADISH 7] 0.67 63271 [AVIKO 7] 0.67 3272 [JAMESPK7] 0.67 +mor	none
Worst Case Angle Damping	KING 3 / 55.74%			
Dorsey SUVP / UdHold				
Forbes DC Red (DCAR)	457%	507%	332%	481%
K22W (max +dP @ t, d-ang)	39.0@(2.89165,-5.7)	71.2@(1.93333,-27.4)	27.8@(2.87498,-0.6)	45.6@(2.53332,-15.4)
K22W (max -dP @ t, d-ang)	4.9@(0.39166,0.3)	12.6@(1.14166,-2.7)	26.6@(0.94166,4.9)	2.4@(0.31667,-0.2)
K22W (max d-ang @ t, dP)	-15.3@(2.19166,16.1)	-41.3@(2.39999,53.1)	9.5@(1.30000,-7.1)	-20.0@(1.93333,27.8)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	196% / 308%	119% / 179%	153% / 235%	190% / 296%
B2R at Rugby/L20D at Drayton	999% / 527%	999% / 420%	999% / 535%	999% / 542%
R50M / F3M	834% / 250%	614% / 187%	677% / 240%	742% / 244%
B10T	167%	56%	125%	132%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   3   0)	(0   3   0)	(0   3   0)	(0   1   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   2) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   9   2) / (0   0   0)	(2   13   2) / (0   0   0)	(2   11   3) / (0   0   0)	(2   5   2) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   1   0) / (1   3   2)	(0   1   0) / (1   2   1)	(0   0   0) / (1   1   1)
Shay 115 / Split Rock 115	(2   5   0) / (0   0   0)	(2   5   0) / (0   2   2)	(2   5   2) / (0   2   2)	(2   5   1) / (0   0   0)
Damping Performance	NONE	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	9	10	11	12
Case Name	b01-s709aa.xzqV424-fd3	b01-s709aa.xzqV424-fd4	b01-s709aa.xzqV424-fdl	b01-s709aa.xzqV424-nbz
Disturbance	fd3	fd4	fdl	nbz
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 16:49	AUG 30 2006 16:52	AUG 30 2006 16:55	AUG 30 2006 16:58
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.04	0.95   1.04	0.97   1.04	0.89   1.09
Boise 115	0.99   1.05	0.99   1.05	1.01   1.04	0.94   1.05
Dorsey 230	1.02   1.06	1.02   1.06	1.03   1.06	1.04   1.19
Forbes 230	0.99   1.04	0.99   1.05	1.00   1.04	0.93   1.08
Riverton 230	0.93   1.08	0.94   1.08	0.99   1.07	0.86   1.07
Coal Creek 230	0.95   1.16	0.96   1.15	0.97   1.11	0.93   1.12
Dickinson 345	0.93   1.05	0.94   1.05	0.95   1.04	0.92   1.07
Drayton 230	0.96   1.10	0.97   1.13	0.98   1.10	0.96   1.12
Groton 345	0.87   1.13	0.89   1.14	0.97   1.13	0.83   1.12
Tioga 230	0.99   1.07	0.99   1.07	1.01   1.06	0.98   1.08
Wahpeton 115	0.84   1.11	0.85   1.12	0.95   1.11	0.83   1.10
Watertown 345	0.92   1.12	0.94   1.12	1.00   1.11	0.89   1.11
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.66	63199 [JAMSTN1Y] 0.64	none	
	63200 [JAMSTN2Y] 0.66	63200 [JAMSTN2Y] 0.64		
	63369 [JAMESTN3] 0.66	63369 [JAMESTN3] 0.64		
	63271 [AVIKO 7] 0.68	63270 [LADISH 7] 0.65		
	63272 [JAMESPK7] 0.68	63271 [AVIKO 7] 0.65		
	63273 [JAMETAP7] 0.68	63272 [JAMESPK7] 0.65		
	3274 [JAMSDTN7] 0.68 +more	3273 [JAMETAP7] 0.65 +more		
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.166			/ 0.133
Forbes DC Red (DCAR)	336%	317%	477%	507%
K22W (max +dP @ t, d-ang)	28.7@(2.72499,-1.6)	29.5@(2.76665,-0.9)	50.0@(2.51666,-15.2)	144.5@(2.69999,-63.2)
K22W (max -dP @ t, d-ang)	23.8@(0.96666,8.4)	23.9@(0.89166,4.7)	2.4@(0.32500,-0.3)	87.9@(0.24167,7.4)
K22W (max d-ang @ t, dP)	10.5@(1.19166,-11.0)	9.3@(1.24166,-4.6)	-19.9@(1.91666,28.5)	-67.9@(2.36666,126.0)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	165% / 254%	166% / 256%	190% / 295%	0.18333 sec / 0.18333 sec
B2R at Rugby/L20D at Drayton	999% / 497%	999% / 501%	999% / 493%	999% / 537%
R50M / F3M	724% / 256%	729% / 254%	739% / 252%	371% / 146%
B10T	100%	106%	112%	96%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   1   0 )	( 0   2   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   11   3 ) / ( 0   0   0 )	( 2   10   3 ) / ( 0   0   0 )	( 2   7   2 ) / ( 0   0   0 )	( 2   8   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   3   0 )
Shay 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   0 ) / ( 0   2   2 )	( 2   5   0 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   2   2 )
<b>Damping Performance</b>				
	N/A	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	13	14	15	16
Case Name	b01-s709aa.xzqV424-nmz	b01-s709aa.xzqV424-pcs	b01-s709aa.xzqV424-pct	b01-s709aa.xzqV424-pys
Disturbance	nmz	pcs	pct	pys
Prior Outage	None	None	None	None
Date/Time	AUG 30 2006 17:17	SEP 01 2006 13:13	SEP 01 2006 13:20	SEP 01 2006 13:26
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.94   1.07	0.89   1.00	0.96   0.98	0.99   1.03
Boise 115	0.94   1.05	1.00   1.06	1.02   1.03	1.00   1.05
Dorsey 230	1.04   1.19	1.02   1.09	1.04   1.05	1.03   1.08
Forbes 230	0.98   1.04	0.99   1.04	1.01   1.02	1.00   1.06
Riverton 230	0.88   1.07	0.99   1.04	1.01   1.03	1.00   1.05
Coal Creek 230	0.94   1.12	0.97   1.07	1.02   1.05	0.98   1.07
Dickinson 345	0.93   1.07	0.96   1.05	0.98   1.00	0.98   1.04
Drayton 230	0.96   1.13	1.00   1.06	1.01   1.03	0.99   1.03
Groton 345	0.83   1.12	0.98   1.05	1.01   1.04	0.99   1.05
Tioga 230	0.98   1.08	1.00   1.05	1.03   1.05	1.01   1.05
Wahpeton 115	0.83   1.11	0.99   1.06	1.02   1.03	1.00   1.05
Watertown 345	0.89   1.11	1.01   1.05	1.03   1.04	1.01   1.04
<b>Dynamic Voltage Warnings</b>				
		none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.133			
Forbes DC Red (DCAR)	507%	165%	322%	169%
K22W (max +dP @ t, d-ang)	139.9@(2.72499,-60.3)	4.3@(2.89165,-0.3)	0.0@(0.10000,0.0)	9.6@(2.79998,-2.0)
K22W (max -dP @ t, d-ang)	89.4@(0.23333,7.0)	44.8@(0.39166,8.1)	25.7@(2.57499,11.1)	28.4@(1.65833,10.5)
K22W (max d-ang @ t, dP)	-66.2@(2.37499,120.5)	24.0@(1.10833,-38.8)	12.1@(19.99972,-17.2)	18.7@(1.10000,-24.3)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	0.18333 sec / 0.18333 sec	183% / 283%	222% / 349%	180% / 278%
B2R at Rugby/L20D at Drayton	999% / 540%	999% / 545%	999% / 744%	999% / 599%
R50M / F3M	385% / 147%	671% / 330%	816% / 330%	707% / 317%
B10T	104%	136%	289%	158%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   2   0)	(0   0   0)	(0   0   0)	(0   0   0)
Eau Cl 345 / Park Lk 115	(3   3   1) / (0   0   0)	(3   4   2) / (0   3   3)	(3   3   2) / (0   0   0)	(3   4   4) / (0   3   3)
Prairie 115 / Ramsey 230	(2   9   2) / (0   0   0)	(2   4   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   2   2) / (0   0   0)
Roseau 230 / Running 230	(0   1   0) / (1   3   0)	(0   0   0) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(2   5   2) / (0   2   2)	(2   3   3) / (0   0   0)	(2   2   2) / (0   0   0)	(2   3   3) / (0   0   0)
<b>Damping Performance</b>				
	N/A	NONE	NONE	NONE

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	17	18	19	20
Case Name	b01-s709aa.xzqV424-pyt	b01-s709aa.xzqV424-au3	b01-s709aa.xzqV424-au9	b01-s709aa.WithPSS-au9
Disturbance	pyt	au3	au9	au9
Prior Outage	None	None	None	None
Date/Time	SEP 01 2006 13:32	AUG 31 2006 13:06	AUG 31 2006 13:02	AUG 31 2006 16:03
Comments				With PSS
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	1.00   1.01	0.99   1.04	0.99   1.03	1.01   1.03
Boise 115	1.02   1.04	1.00   1.04	1.00   1.04	1.01   1.04
Dorsey 230	1.04   1.05	1.03   1.06	1.03   1.06	1.04   1.05
Forbes 230	1.01   1.03	1.00   1.03	1.00   1.03	1.00   1.03
Riverton 230	1.02   1.04	0.98   1.06	0.99   1.06	1.01   1.04
Coal Creek 230	1.02   1.05	0.95   1.11	0.96   1.10	0.99   1.09
Dickinson 345	0.98   1.01	0.95   1.04	0.96   1.03	0.97   1.03
Drayton 230	1.01   1.03	0.97   1.08	0.97   1.07	0.99   1.03
Groton 345	1.02   1.03	0.97   1.09	0.98   1.09	1.00   1.07
Tioga 230	1.03   1.04	0.98   1.08	0.99   1.08	1.01   1.06
Wahpeton 115	1.02   1.04	0.95   1.09	0.96   1.08	0.99   1.07
Watertown 345	1.03   1.04	1.00   1.08	1.01   1.07	1.02   1.06
<b>Dynamic Voltage Warnings</b>				
	none	67263 [LTLMISS7] 0.66 67265 [LTLMISS4] 0.69 67304 [BAKER 4] 0.69	67263 [LTLMISS7] 0.64 67265 [LTLMISS4] 0.66 67304 [BAKER 4] 0.67 66417 [DICKNSN4] 0.67 67370 [N ENGLN7] 0.68 67305 [BAKER 7] 0.69 67310 [BOWMAN 4] 0.69 +more	67263 [LTLMISS7] 0.64 67265 [LTLMISS4] 0.66 67304 [BAKER 4] 0.67 66417 [DICKNSN4] 0.67 67370 [N ENGLN7] 0.68 67305 [BAKER 7] 0.69 67310 [BOWMAN 4] 0.69 +more
Worst Case Angle Damping	SHERC3 / 67.15%	STANT4 / -58.21%	SHERC3 / -8.49%	KING 3 / 75.38%
Dorsey SUVV / UdHold				
Forbes DC Red (DCAR)	355%	417%	430%	461%
K22W (max +dP @ t, d-ang)	0.0@(0.10000,0.0)	19.6@(7.49991,-0.7)	19.8@(3.17498,-0.6)	13.7@(3.09998,-0.8)
K22W (max -dP @ t, d-ang)	19.0@(1.70833,8.2)	14.8@(8.26657,-1.3)	13.8@(3.85830,-2.0)	6.5@(1.28333,2.4)
K22W (max d-ang @ t, dP)	8.9@(2.06666,-16.9)	-6.8@(6.63326,0.4)	-6.1@(6.59993,-1.7)	-5.3@(2.39166,0.2)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	224% / 353%	184% / 285%	185% / 287%	197% / 308%
B2R at Rugby/L20D at Drayton	999% / 748%	999% / 632%	999% / 659%	999% / 682%
R50M / F3M	851% / 330%	769% / 270%	773% / 268%	812% / 286%
B10T	289%	163%	191%	200%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   0   0 )	( 0   3   0 )	( 0   3   0 )	( 0   0   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 0   0   0 )	( 2   9   3 ) / ( 0   0   0 )	( 2   8   3 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   2   2 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   0   0 )	( 2   5   3 ) / ( 0   0   0 )	( 2   3   3 ) / ( 0   0   0 )
Damping Performance	NONE	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	21	22	23	24
Case Name	b01-s709aa.xzqV424-ad3	b01-s709aa.xzqV424-ax3	b01-s709aa.xzqV424-auj	b01-s709aa.xzqV424-aut
Disturbance	ad3	ax3	auj	aut
Prior Outage	None	None	None	None
Date/Time	AUG 31 2006 13:47	AUG 31 2006 13:30	AUG 31 2006 14:03	NOV 18 2006 23:32
Comments				No fault trip of Belfield-Ch.Crk 345
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.99   1.03	1.01   1.03	1.02   1.04	1.00   1.03
Boise 115	1.00   1.04	1.01   1.03	1.01   1.04	1.01   1.04
Dorsey 230	1.03   1.06	1.04   1.05	1.04   1.06	1.04   1.05
Forbes 230	1.00   1.04	1.01   1.03	1.01   1.03	1.01   1.03
Riverton 230	0.98   1.06	1.00   1.04	1.03   1.05	1.00   1.05
Coal Creek 230	0.96   1.12	0.99   1.08	1.01   1.09	0.98   1.09
Dickinson 345	0.95   1.04	0.97   1.02	0.99   1.03	0.97   1.02
Drayton 230	0.97   1.09	0.99   1.03	1.01   1.04	0.98   1.06
Groton 345	0.92   1.09	0.99   1.06	1.04   1.09	0.99   1.07
Tioga 230	0.98   1.07	1.02   1.05	1.03   1.05	1.00   1.06
Wahpeton 115	0.95   1.09	0.99   1.05	1.03   1.07	0.97   1.07
Watertown 345	0.98   1.07	1.01   1.05	1.04   1.08	1.01   1.06
<b>Dynamic Voltage Warnings</b>				
	none	none	none	67263 [LTLMISS7] 0.67
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold	KING 3 / 3.82%	ANTEL3 / 61.38%		
Forbes DC Red (DCAR)	392%	442%	500%	435%
K22W (max +dP @ t, d-ang)	16.7@(2.68332,0.1)	8.6@(2.51666,0.6)	44.3@(2.14166,-16.3)	13.0@(2.99165,0.3)
K22W (max -dP @ t, d-ang)	17.7@(5.84160,-1.7)	6.5@(1.93333,-1.8)	0.7@(0.24167,0.0)	9.1@(3.66664,-2.5)
K22W (max d-ang @ t, dP)	5.5@(1.05000,-2.8)	-2.3@(1.77500,-4.0)	-16.4@(2.39166,39.0)	-3.7@(3.45831,-4.7)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	181% / 282%	203% / 319%	205% / 322%	201% / 314%
B2R at Rugby/L20D at Drayton	999% / 649%	999% / 704%	999% / 601%	999% / 707%
R50M / F3M	764% / 273%	829% / 296%	856% / 265%	818% / 284%
B10T	180%	256%	152%	225%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	(0   3   0)	(0   0   0)	(0   0   0)	(0   0   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   12   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   4   3) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(2   5   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   5   4) / (0   0   0)
<b>Damping Performance</b>				
	N/A	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	25	26	27	28
Case Name	b01-s709aa.xzqV424-fd3-tb	b01-s709aa.xzqV424-fd9-tb	b01-s709aa.xzqV424-eb3-tb	b01-s709aa.xzqV424-fo9-tb
Disturbance	fd3-tb	fd9-tb	eb3-tb	fo9-tb
Prior Outage	None	None	None	None
Date/Time	NOV 11 2006 1:01	JAN 06 2007 17:10	FEB 22 2007 0:29	FEB 22 2007 0:31
Comments	fd3 with delayed	4 cycle version of fd3	Delayed Square Butte HVDC	Delayed Square Butte HVDC
	Sq. Butte HVDC recovery	With delayed Sq. Butte HVDC	Recovery	Recovery
<b>Steady State Flows</b>		<b>recovery</b>		
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.94   1.04	0.96   1.03	0.99   1.03	1.02   1.03
Boise 115	0.98   1.06	1.00   1.04	1.01   1.03	1.01   1.04
Dorsey 230	1.01   1.07	1.02   1.06	1.04   1.05	1.04   1.06
Forbes 230	0.98   1.04	0.99   1.04	1.01   1.03	1.01   1.03
Riverton 230	0.91   1.07	0.94   1.07	1.01   1.05	1.03   1.06
Coal Creek 230	0.95   1.17	0.97   1.15	0.96   1.09	1.01   1.10
Dickinson 345	0.92   1.06	0.93   1.05	0.95   1.02	0.99   1.03
Drayton 230	0.94   1.14	0.97   1.09	0.98   1.05	1.01   1.05
Groton 345	0.82   1.15	0.90   1.11	0.94   1.03	1.01   1.08
Tioga 230	0.97   1.08	1.00   1.07	1.01   1.05	1.02   1.05
Wahpeton 115	0.80   1.12	0.87   1.10	0.97   1.04	1.03   1.07
Watertown 345	0.89   1.13	0.95   1.09	0.99   1.04	1.03   1.07
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.61 63200 [JAMSTN2Y] 0.61 63369 [JAMSTN3] 0.61 63270 [LADISH 7] 0.62 63271 [AVIKO 7] 0.62 63272 [JAMESPK7] 0.62 63273 [JAMETAP7] 0.62 +more	none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold	/ 0.166	/ 0.166		
Forbes DC Red (DCAR)	292%	348%	422%	467%
K22W (max +dP @ t, d-ang)	36.7@(2.84165,-0.9)	24.1@(2.68332,-0.2)	16.5@(2.65832,-3.7)	41.5@(2.27499,-15.3)
K22W (max -dP @ t, d-ang)	32.8@(0.96666,9.6)	20.4@(0.80833,4.3)	10.6@(0.85833,2.1)	4.6@(0.25000,0.4)
K22W (max d-ang @ t, dP)	14.6@(1.29166,-13.8)	8.7@(1.18333,-6.0)	-5.0@(3.04998,4.4)	-16.0@(1.84166,30.7)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	148% / 226%	173% / 268%	190% / 296%	209% / 328%
B2R at Rugby/L20D at Drayton	999% / 441%	999% / 549%	999% / 571%	999% / 601%
R50M / F3M	666% / 236%	728% / 268%	782% / 282%	849% / 275%
B10T	72%	133%	286%	183%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   2   0 )	( 0   3   1 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   2 ) / ( 0   0   0 )	( 2   8   3 ) / ( 0   0   0 )	( 2   9   5 ) / ( 0   0   0 )	( 2   3   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   5   0 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   0   0 )	( 2   5   5 ) / ( 0   0   0 )	( 2   3   3 ) / ( 0   0   0 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A



**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

1	<b>Case No.</b>	29	30	31	32
2	<b>Case Name</b>	b01-s709aa.xzqV424-ek3-tb	b01-s709aa.xzqV424-ec3-tb	b01-s709aa.xzqV424-ecs-tb	b01-s709aa.xzqV424-el3-tb
3	<b>Disturbance</b>	ek3-tb	ec3-tb	ecs-tb	el3-tb
4	<b>Prior Outage</b>	None	None	None	None
5	<b>Date/Time</b>	FEB 22 2007 0:33	FEB 22 2007 0:35	FEB 23 2007 10:49	FEB 22 2007 0:37
6	<b>Comments</b>	Delayed Square Butte HVDC	Delayed Square Butte HVDC	4 cycle version of ec3	Delayed Square Butte HVDC
7		Recovery	Recovery	With Delayed Sq. Butte	Recovery
8	<b>Steady State Flows</b>			HVDC Recovery	
9	NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
10	MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
11	ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
12	MWSI / MNEX	1236	1236	1236	1236
13	D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
14	B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
15	OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
16	R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
17	G82R	-42	-42	-42	-42
18	Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
19	Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
20	Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
21	Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
24	Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
25	Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
26	Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
27	Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
30	B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
31	R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
32	B10T	341%	341%	341%	341%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	1.01   1.01	0.96   1.04	0.97   1.03	0.96   1.04
35	Boise 115	1.02   1.02	1.00   1.05	1.01   1.04	1.00   1.05
36	Dorsey 230	1.04   1.04	1.03   1.06	1.03   1.06	1.03   1.06
37	Forbes 230	1.02   1.02	0.99   1.04	1.00   1.04	0.99   1.04
38	Riverton 230	1.02   1.02	0.93   1.07	0.95   1.06	0.94   1.07
39	Coal Creek 230	1.03   1.04	0.92   1.14	0.94   1.14	0.93   1.13
40	Dickinson 345	0.99   1.00	0.93   1.05	0.93   1.04	0.93   1.04
41	Drayton 230	1.01   1.01	0.96   1.14	0.97   1.12	0.98   1.12
42	Groton 345	1.02   1.03	0.87   1.10	0.92   1.08	0.88   1.10
43	Tioga 230	1.04   1.04	1.00   1.07	1.01   1.06	1.00   1.07
44	Wahpeton 115	1.02   1.03	0.86   1.10	0.90   1.09	0.88   1.09
45	Watertown 345	1.03   1.03	0.93   1.09	0.96   1.07	0.94   1.09
46	<b>Dynamic Voltage Warnings</b>				
47		none	63199 [JAMSTN1Y] 0.67 63200 [JAMSTN2Y] 0.67 63369 [JAMESTN3] 0.67 63270 [LADISH 7] 0.69 63271 [AVIKO 7] 0.69 63272 [JAMESPK7] 0.69 63273 [JAMETAP7] 0.69 +more		
48					
49					
50					
51					
52					
53					
54	<b>Worst Case Angle Damping</b>				
55	Dorsey SUVP / UdHold		/ 0.175	/ 0.175	/ 0.175
56	Forbes DC Red (DCAR)	503%	378%	403%	384%
57	K22W (max +dP @ t, d-ang)	0.6@(2.17499,-0.1)	30.1@(2.68332,-2.6)	21.2@(2.64165,-0.5)	28.4@(2.62499,-2.6)
58	K22W (max -dP @ t, d-ang)	0.3@(2.64999,-0.2)	25.9@(0.74166,4.2)	21.4@(0.69166,2.8)	22.5@(0.69166,3.1)
59	K22W (max d-ang @ t, dP)	-0.2@(1.42500,0.2)	9.5@(1.17500,-8.6)	7.2@(1.12500,-5.1)	8.1@(1.15000,-6.8)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	223% / 350%	169% / 262%	181% / 281%	176% / 273%
63	B2R at Rugby/L20D at Drayton	999% / 793%	999% / 552%	999% / 633%	999% / 567%
64	R50M / F3M	879% / 328%	715% / 264%	725% / 271%	716% / 268%
65	B10T	337%	132%	174%	148%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0 0 0)	(0 3 0)	(0 3 0)	(0 3 0)
68	Eau Cl 345 / Park Lk 115	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)
69	Prairie 115 / Ramsey 230	(2 2 2)/(0 0 0)	(2 1 3)/(0 0 0)	(2 8 3)/(0 0 0)	(2 8 2)/(0 0 0)
70	Roseau 230 / Running 230	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
71	Shey 115 / Split Rock 115	(2 2 2)/(0 0 0)	(2 5 3)/(0 2 2)	(2 5 3)/(0 0 0)	(2 5 3)/(0 2 2)
72	<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	33	34	35	36
Case Name	b01-s709aa.xzqV424-bl3-tb	b01-s709aa.xzqV424-bl9-tb	b01-s709aa.xzqV424-ed3-tb	b01-s709aa.xzqV424-ed9-tb
Disturbance	bl3-tb	bl9-tb	ed3-tb	ed9-tb
Prior Outage	None	None	None	None
Date/Time	FEB 22 2007 0:39	FEB 23 2007 10:47	FEB 22 2007 0:42	FEB 23 2007 10:51
Comments	Delayed Square Butte HVDC	4 cycle version of bl3	Delayed Square Butte HVDC	4 cycle version of ed3
	Recovery	With Delayed Sq. Butte	Recovery	With Delayed Sq. Butte
<b>Steady State Flows</b>		HVDC Recovery		HVDC Recovery
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.96   1.04	0.97   1.03	0.96   1.04	0.97   1.03
Boise 115	0.99   1.05	1.00   1.05	0.99   1.05	1.00   1.05
Dorsey 230	1.02   1.07	1.02   1.07	1.02   1.07	1.03   1.07
Forbes 230	0.98   1.04	0.99   1.04	0.99   1.05	0.99   1.04
Riverton 230	0.92   1.08	0.94   1.06	0.92   1.08	0.94   1.07
Coal Creek 230	1.01   1.10	1.02   1.09	1.01   1.10	1.02   1.09
Dickinson 345	0.95   1.03	0.96   1.02	0.95   1.03	0.96   1.02
Drayton 230	0.93   1.13	0.95   1.10	0.94   1.13	0.95   1.11
Groton 345	0.82   1.16(1.36)	0.88   1.13	0.83   1.15	0.88   1.13
Tioga 230	0.98   1.08	1.00   1.07	0.98   1.08	1.00   1.07
Wahpeton 115	0.83   1.13	0.87   1.10	0.84   1.12	0.88   1.11
Watertown 345	0.89   1.13	0.93   1.11	0.89   1.13	0.93   1.11
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.68 63200 [JAMSTN2Y] 0.68 63369 [JAMESTN3] 0.68 63271 [AVIKO 7] 0.69 63272 [JAMESPK7] 0.69 63273 [JAMETAP7] 0.69 63274 [JAMSDTN7] 0.69 +more	none	63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMESTN3] 0.69 66712 [PRAIRIE7] 1.23	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.150	/ 0.150	/ 0.150	/ 0.150
Forbes DC Red (DCAR)	323%	363%	318%	364%
K22W (max +dP @ t, d-ang)	21.0@(1.72500,1.8)	17.2@(1.65000,0.7)	16.7@(1.65833,4.2)	18.2@(2.92498,2.0)
K22W (max -dP @ t, d-ang)	26.7@(0.91666,5.2)	19.2@(0.82500,2.8)	29.3@(0.93333,6.0)	21.4@(0.85833,3.5)
K22W (max d-ang @ t, dP)	-12.0@(2.20833,-7.7)	-9.2@(2.11666,-6.8)	11.6@(1.30000,-6.8)	-8.6@(2.11666,-7.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	166% / 257%	177% / 273%	161% / 249%	177% / 274%
B2R at Rugby/L20D at Drayton	999% / 440%	999% / 518%	999% / 453%	999% / 520%
R50M / F3M	706% / 240%	716% / 258%	706% / 244%	719% / 259%
B10T	81%	124%	83%	120%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   2   2 )	( 2   5   0 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   2   2 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

Case No.	37	38	39	40
Case Name	b01-s709aa.xzqV424-ee3-tb	b01-s709aa.xzqV424-ev0-tb	b01-s709aa.xzqV424-ef3-tb	b01-s709aa.xzqV424-ef9-tb
Disturbance	ee3-tb	ev0-tb	ef3-tb	ef9-tb
Prior Outage	None	None	None	None
Date/Time	FEB 22 2007 0:45	FEB 22 2007 0:49	FEB 22 2007 0:48	FEB 23 2007 10:54
Comments	Delayed Square Butte HVDC	Delayed Square Butte HVDC	Delayed Square Butte HVDC	4 cycle version of ef3
	Recovery	Recovery	Recovery	With Delayed Sq. Butte
<b>Steady State Flows</b>				HVDC Recovery
NDEX / EAST BIAS	2081 / 356	2081 / 356	2081 / 356	2081 / 356
MHEX / L20D	2175 / 244	2175 / 244	2175 / 244	2175 / 244
ECL-ARP / PRI-BYN	522 / 714	522 / 714	522 / 714	522 / 714
MWSI / MNEX	1236	1236	1236	1236
D602F / F601C	1825 / 1609	1825 / 1609	1825 / 1609	1825 / 1609
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	99 / -196	99 / -196	99 / -196	99 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-42	-42	-42	-42
Dorsey bipole / CU bipole	3230 / 1104	3230 / 1104	3230 / 1104	3230 / 1104
Dorsey Reserve / Wtrtn SVC	275 / -40	275 / -40	275 / -40	275 / -40
Forbes SVC / MSC	18 / 600	18 / 600	18 / 600	18 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045	1.031 / 1.045
Roseau 500/Forbes 500	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010	1.058 / 1.010
Chisago 500/EauClaire 345	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025	1.011 / 1.025
Int Falls 115/Badoura 115	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034	1.024 / 1.034
Drayton 230/Groton 345	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025	1.013 / 1.025
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	224% / 353%	224% / 353%	224% / 353%	224% / 353%
B2R at Rugby/L20D at Drayton	999% / 820%	999% / 820%	999% / 820%	999% / 820%
R50M/F3M	883% / 330%	883% / 330%	883% / 330%	883% / 330%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.96   1.04	1.00   1.04	0.91   0.96	0.96   1.04
Boise 115	0.99   1.05	1.00   1.04	1.00   1.03	0.99   1.05
Dorsey 230	1.02   1.07	1.03   1.06	1.01   1.05	1.02   1.07
Forbes 230	0.99   1.05	1.00   1.03	0.97   1.01	0.99   1.04
Riverton 230	0.92   1.07	0.95   1.05	0.77   0.93	0.93   1.08
Coal Creek 230	1.01   1.10	0.94   1.11	1.01   1.07	1.02   1.09
Dickinson 345	0.95   1.03	0.93   1.04	0.94   0.96	0.96   1.02
Drayton 230	0.94   1.13	0.97   1.10	(1.26)0.70   0.97	0.95   1.10
Groton 345	0.82   1.15	0.89   1.07	(1.26)0.44   0.86	0.82   1.14
Tioga 230	0.98   1.08	1.01   1.06	0.80   0.98	0.96   1.07
Wahpeton 115	0.84   1.12	0.89   1.06	(1.26)0.47   0.84	0.84   1.12
Watertown 345	0.89   1.13	0.94   1.07	(1.26)0.62   0.92	0.89   1.12
<b>Dynamic Voltage Warnings</b>				
	60141] 1.23 66712] 1.23	none	63199 [JAMSTN1Y] 0.64 63200 [JAMSTN2Y] 0.64 63369 [JAMESTN3] 0.64 63270 [LADISH 7] 0.65 63271 [AVIKO 7] 0.65 63272 [JAMESPK7] 0.65 63273 [JAMETAP7] 0.65 +more	63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMESTN3] 0.69
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.150	/ 0.166	/ 0.150	/ 0.150
Forbes DC Red (DCAR)	319%	413%	507%	354%
K22W (max +dP @ t, d-ang)	18.3@(1.66666,3.9)	21.4@(2.67499,-3.4)	11.5@(0.15000,-0.4)	19.3@(3.18331,2.3)
K22W (max -dP @ t, d-ang)	28.9@(0.92500,5.8)	21.0@(0.75000,2.6)	26.9@(0.88333,3.0)	23.4@(0.92500,3.2)
K22W (max d-ang @ t, dP)	11.7@(1.30000,-7.6)	7.4@(1.19166,-9.1)	3.0@(0.88333,-26.9)	-12.4@(2.34166,4.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	163% / 252%	166% / 255%	178% / 275%	175% / 271%
B2R at Rugby/L20D at Drayton	999% / 448%	999% / 614%	999% / 737%	999% / 461%
R50M / F3M	707% / 244%	705% / 254%	727% / 261%	738% / 254%
B10T	81%	183%	341%	91%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   3   3 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   2 ) / ( 0   0   0 )	( 2   6   2 ) / ( 0   0   0 )	( 2   12   8 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   5   0 ) / ( 0   2   2 )	( 2   5   5 ) / ( 0   2   2 )	( 2   5   5 ) / ( 0   2   2 )	( 2   5   1 ) / ( 0   2   2 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix A.4 (Cont.) - Simulation Summary Tables With GI-0217**

1	<b>Case No.</b>	41
2	<b>Case Name</b>	b01-jt09aa-ef9-tb
3	<b>Disturbance</b>	ef9-tb
4	<b>Prior Outage</b>	None
5	<b>Date/Time</b>	FEB 23 2007 22:12
6	<b>Comments</b>	ef9 with 20 MVAR
7		switched shunt at JMS 345
8	<b>Steady State Flows</b>	and Delayed Sq.Butte HVDC
9	NDEX / EAST BIAS	2082 / 357
10	MHEX / L20D	2175 / 244
11	ECL-ARP / PRI-BYN	522 / 715
12	MWSI / MNEX	1237
13	D602F / F601C	1825 / 1609
14	B10T / MH>SPC	166 / 21
15	OH E-W / OH>MH	99 / -196
16	R50M / OH>MP	147 / 151
17	G82R	-42
18	Dorsey bipole / CU bipole	3230 / 1104
19	Dorsey Reserve / Wtrtn SVC	276 / -41
20	Forbes SVC / MSC	18 / 600
21	Arrowhd-Wstrn/ RCDC	547 / 0
22	<b>Steady State Vltgs</b>	
23	Dorsey 500/Dorsey 230	1.031 / 1.045
24	Roseau 500/Forbes 500	1.058 / 1.010
25	Chisago 500/EauClaire 345	1.011 / 1.025
26	Int Falls 115/Badoura 115	1.024 / 1.035
27	Drayton 230/Groton 345	1.014 / 1.025
28	<b>SS OS Relay Margins</b>	
29	D602F at Forbes/Dorsey	224% / 353%
30	B2R at Rugby/L20D at Drayton	999% / 821%
31	R50M/F3M	884% / 330%
32	B10T	340%
33	<b>Min/MaxTransientVltg</b>	
34	Arrowhd 230	0.96   1.04
35	Boise 115	0.99   1.05
36	Dorsey 230	1.02   1.07
37	Forbes 230	0.99   1.04
38	Riverton 230	0.93   1.08
39	Coal Creek 230	1.02   1.09
40	Dickinson 345	0.96   1.02
41	Drayton 230	0.95   1.11
42	Groton 345	0.82   1.14
43	Tioga 230	0.96   1.07
44	Wahpeton 115	0.85   1.13
45	Watertown 345	0.89   1.12
46	<b>Dynamic Voltage Warnings</b>	
47		
48		
49		
50		
51		
52		
53		
54	<b>Worst Case Angle Damping</b>	
55	Dorsey SUVP / UdHold	/ 0.150
56	Forbes DC Red (DCAR)	351%
57	K22W (max +dP @ t, d-ang)	19.2@(3.19998,2.5)
58	K22W (max -dP @ t, d-ang)	24.5@(0.95000,3.9)
59	K22W (max d-ang @ t, dP)	-12.4@(2.34166,4.1)
60	<b>OS Rel Trip / Marg</b>	
61	MH - OH	
62	D602F at Forbes/Dorsey	175% / 271%
63	B2R at Rugby/L20D at Drayton	999% / 462%
64	R50M / F3M	738% / 254%
65	B10T	91%
66	<b>FSCAPS (SS/Unav/Final)</b>	
67	Balta 230	( 0   3   0 )
68	Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 2   12   3 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )
72	<b>Damping Performance</b>	N/A

**Appendix B – Stability Analysis Results – Sensitivity Cases With  
AHD-GPK Outaged**

## Appendix B.1: Summary for Case b0c-s709aa.xzvV424.sav (Without GI-0217)

BOC-S709AA.XZVV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1480,OHMH=-198,OHMP=150,EWTW=96,BD=166

### POWER FLOW SUMMARY

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NDEX:      2080 MW      ECL-ARP:   685 MW
MHEX:      2175 MW      PRI-BYN:   794 MW
MWSI:      1480 MW      AHD-GPK:    0 MW
              NI-WUMS:   165 MW
COOPER S:  1082 MW      WNE-WKS:   515 MW
FTCAL S:   683 MW      GGS:       1506 MW
GRIS-LNC:  693 MW      QC WEST:   -89 MW
  
```

LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 1809.5 MW, 61.9% OF 2925.0 MW  
 NSP (AREA 600) 8476.4 MW, 88.0% OF 9632.0 MW  
 MAN HYDRO (AREA 667) 2126.0 MW, 71.7% OF 2964.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 268	MH total gross	4727	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 45	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	339
MP	1944/ 157	northwest	816	SPC>WAPA (B10T)	166
NSP	8476/ 566	SPC total gross	2241	MH>SPC (3-230)	22
N. Dakota	1809/ 292	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-198
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	150
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	96
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1904
NSP	1788 MVARs	net	2848	D602F @Dorsey	1804
N. Dakota	362 MVARs	Total net	6720	L20D @Letell	245
		WAPA SD Hydro	1497	R50M @Richer	139
		Pleasant Valley	0	G82R @Glenboro	-13
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	1192		

Tfms	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	105/ 73%	Stinson	39/ 111	CU (1,2)	1104
Wshell #2 7-7	105/ 73%	Boundary Dam	17/ 167	SQ BU (3,4)	455
Drayton#1 4-7	45/ 32%	Whiteshell	76/ 201	MH Bipole 1	1516
Drayton#2 4-7	57/ 30%	Int Falls	96/ 149	MH Bipole 2	1716
Dorsey #1 2-4	867/ 72%	St. Lawrence	15/ 0	MH (BP1+BP2)	3233
Dorsey #2 2-4	977/ 81%			Miles City E>W	-150
Forbes 2-4	120/ 17%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	497 600/ -330	Forbes	500 33	400/ -450
SCE 1-3G	18.2	3	405 480/ -240	Fargo	13.2 -11	20/ -135
SCA 4-6G	18.2	3	405 480/ -240	Watertown	20.0 -29	125/ -86
Total		1308	1560/ -810	Series Caps		Num In Serv
Margin		252		Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	0	Arrowhead 230	160	Chisago T 9 34.5	51
Drayton 115	20	Blackberry 230	47	Chisago T 10 34.5	51
Drayton 13.8	-20	Minntac 115	45	Forbes 230	70

Eau Claire(FS)	161	356	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	40	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	40	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.004	Arrowhead	230 1.024	Whiteshell	110 118.9
Alexandria	115 1.003	Badoura	115 1.019	Kenora	220 247.8
Audubon	115 1.029	Blackberry	230 1.029	Dryden	220 251.7
Bemidji	115 1.016	Boise Cascade	13.8 1.053	Fort Frances	220 246.5
Byron	345 1.020	Boise Cascade	115 1.021	Mackenzie	220 256.4
Chisago Co.	345 0.997	ETCO	115 1.001	Lakehead	220 256.2
Chisago Co.	500 0.989	Forbes	230 1.007	Marathon	220 260.7
Drayton	230 1.019	Forbes	500 0.995	Wawa	220 258.2
Eau Claire	345 1.004	Hubbard	115 1.020	Mississagi	220 250.4
WEST FARIBAULT	115 1.007	Intl Falls	115 1.022	Fort Frances	118 119.8
LaPorte	115 1.012	Minntac	115 1.007	Lakehead	118 122.8
Maple River	230 1.014	Moranville	230 1.025	Birch	118 117.5
Marshall Tap	115 1.022	Riverton	230 1.010	Marathon	118 125.2
Owatonna	161 0.995	Running	230 1.027		0.0
Prairie	115 1.030	Shannon	230 1.027		0.0
Prairie	230 1.025		0.000		0.0
Ramsey	230 1.026	Groton	345 1.030		0.0
Roseau County	230 1.025	Watertown	230 1.030		0.0
Roseau County	500 1.057	Watertown	345 1.034		0.0
Sheyenne	230 1.018		0.000		0.0
Thief R Falls	115 1.023	Dorsey	230 1.045		0.0
Tioga	230 1.025	Dorsey	500 1.029		0.0
Wahpeton	230 1.011		0.000		0.0
Winger	115 1.036		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	328%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	676%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	350%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	221%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	329%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	2195%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	828%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	968%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## Appendix B.2: Summary for Case b1c-s709aa.xzvV424.sav (With GI-0217)

B1C-S709AA.XZVV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1480,OHMH=-196,OHMP=150,EWTW=98,BD=167

### POWER FLOW SUMMARY

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NDEX:      2080 MW      ECL-ARP:   687 MW
MHEX:      2175 MW      PRI-BYN:   792 MW
MWSI:      1480 MW      AHD-GPK:    0 MW
              NI-WUMS:   165 MW
COOPER S:  1091 MW      WNE-WKS:   518 MW
FTCAL S:   688 MW      GGS:       1511 MW
GRIS-LNC:  702 MW      QC WEST:   -92 MW
  
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#### LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:

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NORTH DAKOTA (ZONE 90,990) 2259.7 MW,  77.3% OF 2925.0 MW
NSP (AREA 600) 8445.0 MW,  87.7% OF 9632.0 MW
MAN HYDRO (AREA 667) 2126.0 MW,  71.7% OF 2964.0 MW
  
```

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 268	MH total gross	4727	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 45	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	321
MP	1944/ 153	northwest	816	SPC>WAPA (B10T)	167
NSP	8445/ 561	SPC total gross	2241	MH>SPC (3-230)	23
N. Dakota	2259/ 341	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	150
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	98
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1889
NSP	1781 MVARs	net	2848	D602F @Dorsey	1797
N. Dakota	443 MVARs	Total net	6720	L20D @Letell	263
		WAPA SD Hydro	1497	R50M @Richer	138
		Pleasant Valley	0	G82R @Glenboro	-24
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	1141		

Tfms	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	39/ 109	CU (1,2)	1104
Wshell #2 7-7	104/ 72%	Boundary Dam	20/ 168	SQ BU (3,4)	455
Drayton#1 4-7	50/ 35%	Whiteshell	76/ 200	MH Bipole 1	1516
Drayton#2 4-7	63/ 34%	Int Falls	96/ 150	MH Bipole 2	1716
Dorsey #1 2-4	862/ 71%	St. Lawrence	15/ 0	MH (BP1+BP2)	3232
Dorsey #2 2-4	972/ 81%			Miles City E>W	-150
Forbes 2-4	115/ 17%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	497 600/ -330	Forbes	500 21	400/ -450
SCE 1-3G	18.2	3	405 480/ -240	Fargo	13.2 0	20/ -135
SCA 4-6G	18.2	3	405 480/ -240	Watertown	20.0 -26	125/ -86
Total		1309	1560/ -810	Series Caps		Num In Serv
Margin		251		Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	0	Arrowhead 230	160	Chisago T 9 34.5	51
Drayton 115	20	Blackberry 230	47	Chisago T 10 34.5	51



Drayton	13.8	-20	Minntac	115	45	Forbes	230	70
Eau Claire(FS)	161	356	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	80	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	80	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.004	Arrowhead	230 1.025	Whiteshell	110 118.9
Alexandria	115 0.996	Badoura	115 1.034	Kenora	220 247.9
Audubon	115 1.023	Blackberry	230 1.031	Dryden	220 251.8
Bemidji	115 1.012	Boise Cascade	13.8 1.053	Fort Frances	220 246.6
Byron	345 1.020	Boise Cascade	115 1.022	Mackenzie	220 256.5
Chisago Co.	345 0.999	ETCO	115 1.002	Lakehead	220 256.3
Chisago Co.	500 0.992	Forbes	230 1.009	Marathon	220 260.7
Drayton	230 1.010	Forbes	500 0.997	Wawa	220 258.2
Eau Claire	345 1.006	Hubbard	115 1.032	Mississagi	220 250.4
WEST FARIBAULT	115 1.008	Intl Falls	115 1.022	Fort Frances	118 119.9
LaPorte	115 1.018	Minntac	115 1.009	Lakehead	118 122.8
Maple River	230 1.011	Moranville	230 1.026	Birch	118 117.5
Marshall Tap	115 1.022	Riverton	230 1.018	Marathon	118 125.2
Owatonna	161 0.996	Running	230 1.028		0.0
Prairie	115 1.030	Shannon	230 1.028		0.0
Prairie	230 1.019		0.000		0.0
Ramsey	230 1.005	Groton	345 1.022		0.0
Roseau County	230 1.026	Watertown	230 1.030		0.0
Roseau County	500 1.058	Watertown	345 1.032		0.0
Sheyenne	230 1.016		0.000		0.0
Thief R Falls	115 1.010	Dorsey	230 1.045		0.0
Tioga	230 1.039	Dorsey	500 1.030		0.0
Wahpeton	230 1.005		0.000		0.0
Winger	115 1.028		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	337%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	692%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	355%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	224%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	328%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1659%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	739%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	975%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

### Appendix B.3: Simulation Summary Tables for Baseline Analysis With AHD-GPK Out

Case No.	1	2	3	4	5
Case Name	b0c-s709aa.xzV424-ag1	b0c-s709aa.xzV424-ag3	b0c-s709aa.xzV424-ah3	b0c-s709aa.xzV424-al1	b0c-s709aa.xzV424-am1
Disturbance	ag1	ag3	ah3	al1	am1
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 15:46	SEP 20 2006 15:49	SEP 20 2006 15:17	SEP 20 2006 16:13	SEP 20 2006 16:23
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 339	2080 / 339	2080 / 339	2080 / 339	2080 / 339
MHEX / L20D	2175 / 245	2175 / 245	2175 / 245	2175 / 245	2175 / 245
ECL-ARP / PRI-BYN	685 / 794	685 / 794	685 / 794	685 / 794	685 / 794
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904
B10T / MH>SPC	166 / 22	166 / 22	166 / 22	166 / 22	166 / 22
OH E-W / OH>MH	96 / -198	96 / -198	96 / -198	96 / -198	96 / -198
R50M / OH>MP	139 / 150	139 / 150	139 / 150	139 / 150	139 / 150
G82R	-13	-13	-13	-13	-13
Dorsey bipole / CU bipole	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103
Dorsey Reserve / Wtrtn SVC	252 / -29	252 / -29	252 / -29	252 / -29	252 / -29
Forbes SVC / MSC	33 / 600	33 / 600	33 / 600	33 / 600	33 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995
Chisago 500/EauClaire 345	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004
Int Falls 115/Badoura 115	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019
Drayton 230/Groton 345	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	221% / 351%	221% / 351%	221% / 351%	221% / 351%	221% / 351%
B2R at Rugby/L20D at Drayton	999% / 828%	999% / 828%	999% / 828%	999% / 828%	999% / 828%
R50M/F3M	968% / 330%	968% / 330%	968% / 330%	968% / 330%	968% / 330%
B10T	328%	328%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.99   1.05	0.99   1.05	0.99   1.05	1.01   1.04	1.01   1.04
Boise 115	0.99   1.04	0.99   1.04	0.99   1.03	1.01   1.04	1.01   1.04
Dorsey 230	1.02   1.06	1.02   1.06	1.02   1.06	1.04   1.06	1.04   1.06
Forbes 230	0.98   1.03	0.98   1.03	0.98   1.03	0.99   1.03	0.99   1.03
Riverton 230	0.96   1.05	0.96   1.04	0.96   1.05	0.99   1.04	0.99   1.05
Coal Creek 230	0.95   1.13	0.94   1.13	0.95   1.13	0.99   1.08	0.97   1.10
Dickinson 345	0.93   1.03	0.93   1.03	0.93   1.04	0.96   1.02	0.94   1.02
Drayton 230	0.98   1.09	0.97   1.10	0.96   1.10	1.00   1.06	0.99   1.09
Groton 345	0.87   1.08	0.87   1.07	0.99   1.09	0.89   1.12	0.89   1.12
Tioga 230	0.97   1.06	0.97   1.05	0.97   1.05	1.00   1.04	1.00   1.04
Wahpeton 115	0.94   1.10	0.93   1.09	0.93   1.09	1.01   1.09	1.00   1.08
Watertown 345	0.95   1.07	0.95   1.06	1.00   1.08	0.96   1.10	0.96   1.09
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold				KING 3 / 39.07%	KING 3 / 39.00%
Forbes DC Red (DCAR)	379%	374%	385%	437%	435%
K22W (max +dP @ t, d-ang)	10.7@(2.54165,2.5)	12.1@(2.52499,1.9)	11.7@(2.58332,1.1)	32.5@(2.74998,-7.9)	32.9@(2.74998,-8.3)
K22W (max -dP @ t, d-ang)	22.6@(0.80833,5.5)	23.4@(0.76666,6.4)	23.0@(0.79166,6.1)	4.8@(0.39166,0.3)	6.3@(0.39166,0.5)
K22W (max d-ang @ t, dP)	8.6@(1.11666,-6.0)	9.6@(1.07500,-8.3)	9.0@(1.10000,-9.1)	-15.1@(20.00806,10.9)	-15.1@(20.00806,10.9)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	163% / 253%	159% / 246%	158% / 245%	196% / 309%	197% / 309%
B2R at Rugby/L20D at Drayton	999% / 623%	999% / 616%	999% / 621%	999% / 630%	999% / 626%
R50M / F3M	775% / 264%	760% / 264%	757% / 266%	906% / 272%	898% / 273%
B10T	168%	164%	180%	190%	194%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   3   0)	(0   2   0)	(0   2   0)	(0   2   0)	(0   2   0)
Eau Cl 345 / Park Lk 115	(4   4   4) / (0   0   0)	(4   4   4) / (0   0   0)	(4   4   4) / (0   0   0)	(4   4   4) / (0   0   0)	(4   4   4) / (0   0   0)
Prairie 115 / Ramsey 230	(1   5   1) / (0   0   0)	(1   6   1) / (0   0   0)	(1   6   2) / (0   0   0)	(1   4   1) / (0   0   0)	(1   4   1) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(1   5   2) / (0   0   0)	(1   5   3) / (0   0   0)	(1   5   3) / (0   0   0)	(1   3   0) / (0   0   0)	(1   3   0) / (0   0   0)
Damping Performance	N/A	N/A	N/A	NONE	NONE

**Appendix B.3 (Cont.): Simulation Summary Tables for Baseline Analysis With AHD-GPK Out**

Case No.	6	7	8	9	10
Case Name	b0c-s709aa.xzvV424-ei2	b0c-s709aa.xzvV424-fd1	b0c-s709aa.xzvV424-fdk	b0c-s709aa.xzvV424-fd3	b0c-s709aa.xzvV424-fd4
Disturbance	ei2	fd1	fdk	fd3	fd4
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 15:20	SEP 20 2006 15:24	SEP 20 2006 15:27	SEP 20 2006 15:30	SEP 20 2006 15:33
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 339	2080 / 339	2080 / 339	2080 / 339	2080 / 339
MHEX / L20D	2175 / 245	2175 / 245	2175 / 245	2175 / 245	2175 / 245
ECL-ARP / PRI-BYN	685 / 794	685 / 794	685 / 794	685 / 794	685 / 794
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904
B10T / MH>SPC	166 / 22	166 / 22	166 / 22	166 / 22	166 / 22
OH E-W / OH>MH	96 / -198	96 / -198	96 / -198	96 / -198	96 / -198
R50M / OH>MP	139 / 150	139 / 150	139 / 150	139 / 150	139 / 150
G82R	-13	-13	-13	-13	-13
Dorsey bipole / CU bipole	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103
Dorsey Reserve / Wtrtn SVC	252 / -29	252 / -29	252 / -29	252 / -29	252 / -29
Forbes SVC / MSC	33 / 600	33 / 600	33 / 600	33 / 600	33 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995
Chisago 500/EauClaire 345	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004
Int Falls 115/Badoura 115	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019
Drayton 230/Groton 345	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	221% / 351%	221% / 351%	221% / 351%	221% / 351%	221% / 351%
B2R at Rugby/L20D at Drayton	999% / 828%	999% / 828%	999% / 828%	999% / 828%	999% / 828%
R50M/F3M	968% / 330%	968% / 330%	968% / 330%	968% / 330%	968% / 330%
B10T	328%	328%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.92   1.06	1.00   1.08	1.02   1.07	0.95   1.05	0.96   1.06
Boise 115	0.97   1.05	0.99   1.04	1.00   1.03	0.99   1.04	0.99   1.04
Dorsey 230	1.01   1.07	1.02   1.06	1.03   1.06	1.02   1.06	1.02   1.06
Forbes 230	0.91   1.03	0.97   1.04	0.99   1.03	0.97   1.03	0.96   1.04
Riverton 230	0.86   1.06	0.94   1.07	0.99   1.06	0.92   1.07	0.93   1.08
Coal Creek 230	0.99   1.15	0.96   1.15	0.97   1.10	0.95   1.15	0.95   1.15
Dickinson 345	0.97   1.05	0.93   1.05	0.95   1.03	0.92   1.05	0.93   1.05
Drayton 230	0.92   1.12	0.96   1.12	0.99   1.07	0.97   1.12	0.98   1.12
Groton 345	0.84   1.14	0.90   1.12	0.98   1.11	0.88   1.12	0.91   1.13
Tioga 230	0.98   1.07	0.99   1.05	1.00   1.05	0.98   1.05	0.98   1.05
Wahpeton 115	0.83   1.13	0.87   1.13	0.98   1.11	0.87   1.12	0.88   1.15
Watertown 345	0.88   1.13	0.95   1.09	1.01   1.09	0.93   1.11	0.95   1.11
<b>Dynamic Voltage Warnings</b>					
		63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMESTN3] 0.69	none		63369 [JAMESTN3] 0.68 63200 [JAMSTN2Y] 0.69 63199 [JAMSTN1Y] 0.69
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold				/ 0.166	
Forbes DC Red (DCAR)	507%	303%	457%	330%	306%
K22W (max +dP @ t, d-ang)	78.6@(2.85832,-32.4)	19.9@(2.70832,-0.6)	46.0@(2.40832,-18.3)	24.1@(2.64999,-3.5)	22.5@(2.67499,-1.3)
K22W (max -dP @ t, d-ang)	14.5@(0.66666,2.5)	22.7@(0.87500,3.0)	1.9@(0.30833,-0.4)	21.3@(0.73333,4.3)	22.2@(0.83333,3.3)
K22W (max d-ang @ t, dP)	-38.9@(2.28333,59.0)	6.4@(1.20833,-2.1)	-19.8@(1.93333,33.7)	8.7@(1.11666,-8.9)	7.2@(1.16666,-1.1)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	112% / 170%	161% / 250%	186% / 291%	166% / 259%	171% / 269%
B2R at Rugby/L20D at Drayton	999% / 454%	999% / 627%	999% / 575%	999% / 554%	999% / 575%
R50M / F3M	660% / 192%	771% / 255%	795% / 241%	811% / 270%	781% / 270%
B10T	60%	151%	140%	121%	129%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	( 0   2   0 )	( 0   1   0 )	( 0   0   0 )	( 0   2   0 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 4   4   3 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 1   10   2 ) / ( 0   0   0 )	( 1   6   2 ) / ( 0   0   0 )	( 1   3   1 ) / ( 0   0   0 )	( 1   7   1 ) / ( 0   0   0 )	( 1   7   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 1   5   0 ) / ( 0   2   2 )	( 1   5   0 ) / ( 0   0   0 )	( 1   4   0 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   2   2 )	( 1   5   0 ) / ( 0   0   0 )
<b>Damping Performance</b>					
	N/A	N/A	N/A	N/A	N/A

**Appendix B.3 (Cont.): Simulation Summary Tables for Baseline Analysis With AHD-GPK Out**

1	<b>Case No.</b>	11	12	13	14
2	<b>Case Name</b>	b0c-s709aa.xzV424-fdl	b0c-s709aa.xzV424-nbz	b0c-s709aa.xzV424-nmz	b0c-s709aa.xzV424-pcs
3	<b>Disturbance</b>	fdl	nbz	nmz	pcs
4	<b>Prior Outage</b>	None	None	None	None
5	<b>Date/Time</b>	SEP 20 2006 15:36	SEP 20 2006 15:39	SEP 21 2006 10:14	SEP 20 2006 16:34
6	<b>Comments</b>				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2080 / 339	2080 / 339	2080 / 339	2080 / 339
10	MHEX / L20D	2175 / 245	2175 / 245	2175 / 245	2175 / 245
11	ECL-ARP / PRI-BYN	685 / 794	685 / 794	685 / 794	685 / 794
12	MWSI / MNEX	1480	1480	1480	1480
13	D602F / F601C	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904
14	B10T / MH>SPC	166 / 22	166 / 22	166 / 22	166 / 22
15	OH E-W / OH>MH	96 / -198	96 / -198	96 / -198	96 / -198
16	R50M / OH>MP	139 / 150	139 / 150	139 / 150	139 / 150
17	G82R	-13	-13	-13	-13
18	Dorsey bipole / CU bipole	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103
19	Dorsey Reserve / Wtrtn SVC	252 / -29	252 / -29	252 / -29	252 / -29
20	Forbes SVC / MSC	33 / 600	33 / 600	33 / 600	33 / 600
21	Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
24	Roseau 500/Forbes 500	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995
25	Chisago 500/EauClaire 345	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004
26	Int Falls 115/Badoura 115	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019
27	Drayton 230/Groton 345	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	221% / 351%	221% / 351%	221% / 351%	221% / 351%
30	B2R at Rugby/L20D at Drayton	999% / 828%	999% / 828%	999% / 828%	999% / 828%
31	R50M/F3M	968% / 330%	968% / 330%	968% / 330%	968% / 330%
32	B10T	328%	328%	328%	328%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.98   1.06	(0.61)0.78   1.08	0.85   1.05	1.01   1.07
35	Boise 115	1.00   1.04	0.97   1.06	0.95   1.06	1.02   1.06
36	Dorsey 230	1.03   1.06	1.05   1.19	1.04   1.20	1.04   1.10
37	Forbes 230	0.98   1.03	0.87   1.08	0.96   1.03	1.01   1.06
38	Riverton 230	0.98   1.06	0.75   1.06	0.79   1.04	1.00   1.06
39	Coal Creek 230	0.97   1.10	0.91   1.13	0.91   1.12	0.97   1.08
40	Dickinson 345	0.95   1.04	0.88   1.08	0.89   1.07	0.96   1.05
41	Drayton 230	0.99   1.10	0.97   1.10	0.97   1.10	1.03   1.08
42	Groton 345	0.98   1.12	0.82   1.11	0.84   1.11	0.99   1.08
43	Tioga 230	1.00   1.05	0.97   1.07	0.98   1.07	0.99   1.05
44	Wahpeton 115	0.98   1.12	0.81   1.10	0.84   1.10	1.01   1.08
45	Watertown 345	1.01   1.10	0.86   1.09	0.88   1.09	1.01   1.07
46	<b>Dynamic Voltage Warnings</b>				
47		none	61638 [BRCHLKT7] 0.78 61614 [98L TAP4] 0.79 61615 [ARROWHD4] 0.79 61616 [HILLTOP4] 0.79 61655 [CROMWLL7] 0.80 61679 [GARY 7] 0.80 61672 [HILLTOP7] 0.80 +more	61638 [BRCHLKT7] 0.80	none
48					
49					
50					
51					
52					
53					
54	<b>Worst Case Angle Damping</b>			KING 3 / 19.65%	KING 3 / 66.41%
55	Dorsey SUVP / UdHold		/ 0.133	/ 0.133	
56	Forbes DC Red (DCAR)	477%	507%	507%	-86%
57	K22W (max +dP @ t, d-ang)	48.6@(2.40832,-17.9)	158.9@(2.62499,-63.1)	150.6@(2.59999,-60.3)	91.7@(2.49166,-31.1)
58	K22W (max -dP @ t, d-ang)	1.9@(0.32500,-0.4)	90.4@(0.23333,7.5)	91.6@(0.23333,7.4)	46.2@(0.39166,8.5)
59	K22W (max d-ang @ t, dP)	-19.5@(1.93333,35.5)	-63.9@(2.43332,148.6)	-81.2@(10.00821,74.4)	-48.2@(20.00806,49.0)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	185% / 289%	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	221% / 351%
63	B2R at Rugby/L20D at Drayton	999% / 521%	999% / 470%	999% / 487%	999% / 817%
64	R50M / F3M	791% / 246%	531% / 147%	514% / 161%	968% / 296%
65	B10T	119%	70%	79%	201%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	( 0   0   0 )	( 0   2   0 )	( 0   2   0 )	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 4   4   4 ) / ( 0   0   0 )	( 4   4   1 ) / ( 0   0   0 )	( 4   4   1 ) / ( 0   0   0 )	( 4   4   2 ) / ( 0   3   3 )
69	Prairie 115 / Ramsey 230	( 1   5   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   3   0 )	( 0   0   0 ) / ( 1   3   0 )	( 0   0   0 ) / ( 1   1   0 )
71	Shey 115 / Split Rock 115	( 1   4   0 ) / ( 0   0   0 )	( 1   5   0 ) / ( 0   2   2 )	( 1   5   1 ) / ( 0   2   2 )	( 1   2   1 ) / ( 0   0   0 )
72	<b>Damping Performance</b>	N/A	N/A	N/A	NONE

**Appendix B.3 (Cont.): Simulation Summary Tables for Baseline Analysis With AHD-GPK Out**

Case No.	15	16	17	18	19
Case Name	b0c-s709aa.xzvV424-pct	b0c-s709aa.xzvV424-pys	b0c-s709aa.xzvV424-pyt	b0c-s709aa.xzvV424-au3	b0c-s709aa.xzvV424-au9
Disturbance	pct	pys	pyt	au3	au9
Prior Outage	None	None	None	None	None
Date/Time	SEP 21 2006 8:40	SEP 21 2006 8:55	SEP 21 2006 8:47	SEP 21 2006 9:43	SEP 21 2006 9:50
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 339	2080 / 339	2080 / 339	2080 / 339	2080 / 339
MHEX / L20D	2175 / 245	2175 / 245	2175 / 245	2175 / 245	2175 / 245
ECL-ARP / PRI-BYN	685 / 794	685 / 794	685 / 794	685 / 794	685 / 794
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904	1804 / 1904
B10T / MH>SPC	166 / 22	166 / 22	166 / 22	166 / 22	166 / 22
OH E-W / OH>MH	96 / -198	96 / -198	96 / -198	96 / -198	96 / -198
R50M / OH>MP	139 / 150	139 / 150	139 / 150	139 / 150	139 / 150
G82R	-13	-13	-13	-13	-13
Dorsey bipole / CU bipole	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103	3233 / 1103
Dorsey Reserve / Wtrtn SVC	252 / -29	252 / -29	252 / -29	252 / -29	252 / -29
Forbes SVC / MSC	33 / 600	33 / 600	33 / 600	33 / 600	33 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995	1.057 / 0.995
Chisago 500/EauClaire 345	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004	0.990 / 1.004
Int Falls 115/Badoura 115	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019	1.022 / 1.019
Drayton 230/Groton 345	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030	1.019 / 1.030
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	221% / 351%	221% / 351%	221% / 351%	221% / 351%	221% / 351%
32R at Rugby/L20D at Drayton	999% / 828%	999% / 828%	999% / 828%	999% / 828%	999% / 828%
R50M/F3M	968% / 330%	968% / 330%	968% / 330%	968% / 330%	968% / 330%
B10T	328%	328%	328%	328%	328%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	1.01   1.03	1.02   1.04	1.02   1.04	1.02   1.03	1.02   1.03
Boise 115	1.02   1.04	0.99   1.05	1.02   1.04	1.02   1.02	1.02   1.02
Dorsey 230	1.04   1.06	1.03   1.08	1.04   1.05	1.04   1.05	1.04   1.05
Forbes 230	1.00   1.03	1.00   1.06	1.00   1.02	1.00   1.01	1.00   1.01
Riverton 230	1.01   1.04	1.00   1.04	1.01   1.03	1.00   1.02	1.00   1.02
Coal Creek 230	1.01   1.05	0.98   1.08	1.02   1.05	1.02   1.06	1.02   1.05
Dickinson 345	0.97   1.01	0.97   1.03	0.97   1.00	0.98   1.00	0.98   1.00
Drayton 230	1.01   1.04	0.99   1.04	1.01   1.03	1.01   1.03	1.01   1.02
Groton 345	1.02   1.05	0.99   1.04	1.02   1.04	1.01   1.04	1.01   1.04
Tioga 230	1.01   1.04	0.99   1.04	1.02   1.03	1.02   1.03	1.02   1.03
Wahpeton 115	1.03   1.06	1.01   1.05	1.03   1.05	1.02   1.04	1.02   1.04
Watertown 345	1.02   1.04	1.01   1.04	1.02   1.04	1.02   1.04	1.03   1.04
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
SHERC3 / 59.69%		SHERC3 / 76.31%	SHERC3 / 56.44%	KING 3 / 69.44%	KING 3 / 67.59%
Dorsey SUVV / UdHold					
Forbes DC Red (DCAR)	127%	84%	299%	475%	481%
K22W (max +dP @ t, d-ang)	0.0@(0.06667,0.0)	6.3@(3.49997,2.1)	0.0@(0.06667,0.0)	3.5@(2.27499,0.0)	2.8@(2.27499,-0.1)
K22W (max -dP @ t, d-ang)	44.0@(2.55832,20.9)	40.8@(1.71666,14.8)	23.8@(1.83333,11.0)	3.5@(0.61666,0.7)	3.0@(0.61666,0.6)
K22W (max d-ang @ t, dP)	21.2@(2.33332,-43.4)	23.1@(1.13333,-24.4)	11.8@(2.21666,-23.3)	1.1@(0.89166,-0.3)	0.9@(0.88333,-0.4)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	221% / 351%	174% / 270%	221% / 351%	210% / 332%	212% / 336%
32R at Rugby/L20D at Drayton	999% / 718%	999% / 601%	999% / 748%	999% / 778%	999% / 788%
R50M / F3M	892% / 330%	743% / 321%	930% / 330%	933% / 314%	939% / 317%
B10T	263%	166%	164%	288%	296%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)
Eau Cl 345 / Park Lk 115	(4 4 2)/(0 0 0)	(4 4 4)/(0 3 3)	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)
Prairie 115 / Ramsey 230	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)
Roseau 230 / Running 230	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 0)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
Shey 115 / Split Rock 115	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)
<b>Damping Performance</b>					
	NONE	NONE	NONE	NONE	NONE

**Appendix B.3 (Cont.): Simulation Summary Tables for Baseline Analysis With AHD-GPK Out**

1	<b>Case No.</b>	20	21
2	<b>Case Name</b>	b0c-s709aa.xzvV424-ad3	b0c-s709aa.xzvV424-ax3
3	<b>Disturbance</b>	ad3	ax3
4	<b>Prior Outage</b>	None	None
5	<b>Date/Time</b>	SEP 21 2006 10:06	SEP 21 2006 9:58
6	<b>Comments</b>		
7			
8	<b>Steady State Flows</b>		
9	NDEX / EAST BIAS	2080 / 339	2080 / 339
10	MHEX / L20D	2175 / 245	2175 / 245
11	ECL-ARP / PRI-BYN	685 / 794	685 / 794
12	MWSI / MNEX	1480	1480
13	D602F / F601C	1804 / 1904	1804 / 1904
14	B10T / MH>SPC	166 / 22	166 / 22
15	OH E-W / OH>MH	96 / -198	96 / -198
16	R50M / OH>MP	139 / 150	139 / 150
17	G82R	-13	-13
18	Dorsey bipole / CU bipole	3233 / 1103	3233 / 1103
19	Dorsey Reserve / Wtrtn SVC	252 / -29	252 / -29
20	Forbes SVC / MSC	33 / 600	33 / 600
21	Arrowhd-Wstn/ RCDC	0 / 0	0 / 0
22	<b>Steady State Vltgs</b>		
23	Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045
24	Roseau 500/Forbes 500	1.057 / 0.995	1.057 / 0.995
25	Chisago 500/EauClaire 345	0.990 / 1.004	0.990 / 1.004
26	Int Falls 115/Badoura 115	1.022 / 1.019	1.022 / 1.019
27	Drayton 230/Groton 345	1.019 / 1.030	1.019 / 1.030
28	<b>SS OS Relay Margins</b>		
29	D602F at Forbes/Dorsey	221% / 351%	221% / 351%
30	B2R at Rugby/L20D at Drayton	999% / 828%	999% / 828%
31	R50M/F3M	968% / 330%	968% / 330%
32	B10T	328%	328%
33	<b>Min/MaxTransientVltg</b>		
34	Arrowhd 230	1.00   1.05	1.02   1.03
35	Boise 115	1.00   1.04	1.02   1.03
36	Dorsey 230	1.03   1.06	1.04   1.05
37	Forbes 230	0.98   1.03	1.00   1.01
38	Riverton 230	0.98   1.06	1.00   1.02
39	Coal Creek 230	0.96   1.12	1.02   1.06
40	Dickinson 345	0.95   1.04	0.98   1.00
41	Drayton 230	0.99   1.08	1.01   1.03
42	Groton 345	0.91   1.09	1.01   1.04
43	Tioga 230	0.98   1.05	1.02   1.03
44	Wahpeton 115	0.98   1.11	1.02   1.04
45	Watertown 345	0.97   1.07	1.03   1.04
46	<b>Dynamic Voltage Warnings</b>		
47		none	none
48			
49			
50			
51			
52			
53			
54	Worst Case Angle Damping	KING 3 / 72.93%	KING 3 / 66.54%
55	Dorsey SUVV / UdHold		
56	Forbes DC Red (DCAR)	376%	478%
57	K22W (max +dP @ t, d-ang)	15.2@(2.41666,-1.1)	3.8@(2.26666,-0.2)
58	K22W (max -dP @ t, d-ang)	14.8@(0.71666,3.4)	3.2@(0.61666,0.6)
59	K22W (max d-ang @ t, dP)	5.3@(1.00833,-2.0)	0.9@(0.87500,-0.4)
60	<b>OS Rel Trip / Marg</b>		
61	MH - OH		
62	D602F at Forbes/Dorsey	179% / 281%	211% / 334%
63	B2R at Rugby/L20D at Drayton	999% / 656%	999% / 776%
64	R50M / F3M	833% / 276%	936% / 314%
65	B10T	185%	288%
66	<b>FSCAPS (SS/Unav/Final)</b>		
67	Balta 230	( 0   0   0 )	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 1   2   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / Split Rock 115	( 1   5   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )
72	<b>Damping Performance</b>	NONE	NONE

**Appendix B.4: Simulation Summary Tables With GI-0217 and With AHD-GPK Out**

Case No.	1	2	3	4	5
Case Name	ag1	ag3	b1c-s709aa.xzV424-ah3	b1c-s709aa.xzV424-af1	b1c-s709aa.xzV424-am1
Disturbance	ag1	ag3	ah3	al1	am1
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 10:33	SEP 20 2006 10:36	SEP 20 2006 10:07	SEP 20 2006 11:03	SEP 20 2006 11:14
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 321	2080 / 321	2080 / 321	2080 / 321	2080 / 321
MHEX / L20D	2175 / 263	2175 / 263	2175 / 263	2175 / 263	2175 / 263
ECL-ARP / PRI-BYN	687 / 792	687 / 792	687 / 792	687 / 792	687 / 792
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889
B10T / MH>SPC	167 / 23	167 / 23	167 / 23	167 / 23	167 / 23
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	138 / 150	138 / 150	138 / 150	138 / 150	138 / 150
G82R	-24	-24	-24	-24	-24
Dorsey bipole / CU bipole	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103
Dorsey Reserve / Wtrtn SVC	251 / -27	251 / -27	251 / -27	251 / -27	251 / -27
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCD	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997
Chisago 500/EauClaire 345	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006
Int Falls 115/Badoura 115	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034
Drayton 230/Groton 345	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%	225% / 356%	225% / 356%
B2R at Rugby/L20D at Drayton	999% / 739%	999% / 739%	999% / 739%	999% / 739%	999% / 739%
R50M/F3M	975% / 329%	975% / 329%	975% / 329%	975% / 329%	975% / 329%
B10T	337%	337%	337%	337%	337%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.99   1.05	0.99   1.04	0.99   1.05	0.99   1.06	1.00   1.06
Boise 115	0.99   1.04	0.99   1.04	0.99   1.04	0.99   1.05	1.00   1.05
Dorsey 230	1.02   1.06	1.02   1.05	1.02   1.05	1.03   1.07	1.03   1.07
Forbes 230	0.99   1.03	0.99   1.03	0.98   1.03	0.99   1.04	0.99   1.04
Riverton 230	0.97   1.05	0.96   1.04	0.96   1.04	0.98   1.08	0.98   1.07
Coal Creek 230	0.94   1.13	0.95   1.13	0.94   1.13	0.95   1.12	0.95   1.12
Dickinson 345	0.93   1.03	0.93   1.03	0.93   1.03	0.94   1.04	0.94   1.04
Drayton 230	0.96   1.10	0.96   1.10	0.96   1.10	0.97   1.08	0.97   1.08
Groton 345	0.84   1.06	0.83   1.06	0.97   1.09	0.84   1.14	0.84   1.14
Tioga 230	0.99   1.08	0.98   1.07	0.98   1.07	1.00   1.07	1.00   1.07
Wahpeton 115	0.93   1.09	0.91   1.08	0.91   1.07	0.96   1.11	0.97   1.10
Watertown 345	0.94   1.06	0.93   1.05	0.98   1.07	0.93   1.11	0.93   1.11
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVV / UdHold				KING 3 / 45.46%	KING 3 / 47.29%
Forbes DC Red (DCAR)	388%	384%	375%	451%	446%
K22W (max +dP @ t, d-ang)	12.9@(2.74165,2.8)	14.5@(2.72499,1.7)	15.7@(2.79998,0.4)	45.0@(2.90832,-6.1)	41.6@(2.89998,-6.8)
K22W (max -dP @ t, d-ang)	26.5@(0.89166,7.2)	28.3@(0.87500,8.6)	29.2@(0.91666,8.6)	3.9@(0.39166,0.2)	5.4@(0.39166,0.4)
K22W (max d-ang @ t, dP)	10.8@(1.20833,-9.4)	12.3@(1.19166,-12.7)	12.1@(1.24166,-13.8)	-15.7@(2.20833,15.0)	-15.9@(2.21666,15.6)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	161% / 249%	157% / 242%	153% / 235%	191% / 300%	190% / 299%
B2R at Rugby/L20D at Drayton	999% / 558%	999% / 543%	999% / 532%	999% / 483%	999% / 477%
R50M / F3M	761% / 265%	745% / 265%	731% / 261%	894% / 243%	892% / 242%
B10T	166%	157%	173%	170%	165%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0 3 0)	(0 3 0)	(0 3 0)	(0 3 0)	(0 3 0)
Eau Cl 345 / Park Lk 115	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)	(4 4 4)/(0 0 0)
Prairie 115 / Ramsey 230	(2 8 3)/(0 0 0)	(2 8 3)/(0 0 0)	(2 10 4)/(0 0 0)	(2 8 2)/(0 0 0)	(2 9 2)/(0 0 0)
Roseau 230 / Running 230	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 0)	(0 0 0)/(1 1 1)
Shey 115 / Split Rock 115	(2 5 3)/(0 0 0)	(2 5 4)/(0 0 0)	(2 5 4)/(0 0 0)	(2 5 0)/(0 0 0)	(2 5 0)/(0 0 0)
<b>Damping Performance</b>					
	N/A	N/A	N/A	NONE	NONE

**Appendix B.4 (Cont.): Simulation Summary Tables With GI-0217 and With AHD-GPK Out**

Case No.	6	7	8	9	10
Case Name	b1c-s709aa.xzV424-ei2	b1c-s709aa.xzV424-fd1	b1c-s709aa.xzV424-fdk	b1c-s709aa.xzV424-fd3	b1c-s709aa.xzV424-fd4
Disturbance	ei2	fd1	fdk	fd3	fd4
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 10:10	SEP 20 2006 10:14	SEP 20 2006 10:17	SEP 20 2006 10:20	SEP 20 2006 10:23
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 321	2080 / 321	2080 / 321	2080 / 321	2080 / 321
MHEX / L20D	2175 / 263	2175 / 263	2175 / 263	2175 / 263	2175 / 263
ECL-ARP / PRI-BYN	687 / 792	687 / 792	687 / 792	687 / 792	687 / 792
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889
B10T / MH>SPC	167 / 23	167 / 23	167 / 23	167 / 23	167 / 23
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	138 / 150	138 / 150	138 / 150	138 / 150	138 / 150
G82R	-24	-24	-24	-24	-24
Dorsey bipole / CU bipole	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103
Dorsey Reserve / Wtrtn SVC	251 / -27	251 / -27	251 / -27	251 / -27	251 / -27
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997
Chisago 500/EauClaire 345	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006
Int Falls 115/Badoura 115	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034
Drayton 230/Groton 345	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%	225% / 356%	225% / 356%
B2R at Rugby/L20D at Drayton	999% / 739%	999% / 739%	999% / 739%	999% / 739%	999% / 739%
R50M/F3M	975% / 329%	975% / 329%	975% / 329%	975% / 329%	975% / 329%
B10T	337%	337%	337%	337%	337%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.93   1.05	1.01   1.08	1.02   1.07	0.96   1.06	0.96   1.06
Boise 115	0.97   1.05	0.98   1.06	1.00   1.04	0.99   1.05	0.99   1.05
Dorsey 230	1.00   1.07	1.01   1.06	1.03   1.06	1.02   1.06	1.02   1.06
Forbes 230	0.92   1.02	0.98   1.04	0.99   1.03	0.98   1.04	0.97   1.04
Riverton 230	0.86   1.07	0.94   1.08	0.99   1.07	0.92   1.07	0.93   1.08
Coal Creek 230	0.96   1.16	0.96   1.15	0.97   1.11	0.95   1.16	0.96   1.15
Dickinson 345	0.97   1.05	0.93   1.05	0.95   1.04	0.92   1.05	0.93   1.05
Drayton 230	0.90   1.12	0.96   1.11	0.98   1.07	0.96   1.10	0.96   1.12
Groton 345	0.79   1.15	0.87   1.12	0.97   1.11	0.85   1.12	0.87   1.13
Tioga 230	0.98   1.09	1.00   1.08	1.01   1.06	0.99   1.07	0.99   1.07
Wahpeton 115	0.81   1.13	0.86   1.11	0.96   1.10	0.85   1.11	0.86   1.12
Watertown 345	0.86   1.14	0.92   1.10	1.00   1.10	0.91   1.11	0.93   1.12
<b>Dynamic Voltage Warnings</b>					
		63199 [JAMSTN1Y] 0.66 63200 [JAMSTN2Y] 0.66 63369 [JAMSTN3] 0.66 63270 [LADISH 7] 0.68 63271 [AVIKO 7] 0.68 63272 [JAMESPK7] 0.68 63273 [JAMETAP7] 0.68 +m	none	63199 [JAMSTN1Y] 0.67 63200 [JAMSTN2Y] 0.67 63369 [JAMSTN3] 0.67 63271 [AVIKO 7] 0.68 63272 [JAMESPK7] 0.68 63273 [JAMETAP7] 0.68 63274 [JAMSDTN7] 0.68 +m	63199 [JAMSTN1Y] 0.65 63200 [JAMSTN2Y] 0.65 63369 [JAMSTN3] 0.65 63270 [LADISH 7] 0.66 63271 [AVIKO 7] 0.66 63272 [JAMESPK7] 0.66 63273 [JAMETAP7] 0.66 +m
Worst Case Angle Damping				/ 0.166	
Dorsey SUVV / UdHold					
Forbes DC Red (DCAR)	507%	293%	466%	301%	288%
K22W (max +dP @ t, d-ang)	80.3@(3.11665,-29.5)	29.8@(2.87498,-0.9)	50.3@(2.53332,-17.3)	31.9@(2.74998,-2.6)	30.7@(2.78332,-0.9)
K22W (max -dP @ t, d-ang)	12.6@(0.65833,2.2)	26.7@(0.93333,4.2)	1.8@(0.30833,-0.4)	24.7@(0.95833,8.6)	25.6@(0.87500,4.4)
K22W (max d-ang @ t, dP)	-43.8@(2.42499,58.0)	-9.6@(2.20833,-14.7)	-21.7@(1.94166,31.2)	11.2@(1.20833,-11.4)	10.0@(1.26666,-3.2)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	113% / 172%	149% / 229%	189% / 295%	158% / 244%	160% / 247%
B2R at Rugby/L20D at Drayton	999% / 377%	999% / 489%	999% / 495%	999% / 446%	999% / 454%
R50M / F3M	662% / 175%	725% / 235%	799% / 236%	766% / 252%	782% / 253%
B10T	50%	128%	131%	99%	107%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	( 0   3   0 )	( 0   2   0 )	( 0   1   0 )	( 0   2   0 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 4   4   3 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   2 ) / ( 0   0   0 )	( 2   10   3 ) / ( 0   0   0 )	( 2   4   2 ) / ( 0   0   0 )	( 2   9   3 ) / ( 0   0   0 )	( 2   9   3 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   3   2 )	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   2   2 )	( 2   5   1 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   2   2 )	( 2   5   0 ) / ( 0   2   2 )
Damping Performance	N/A	N/A	N/A	N/A	N/A



**Appendix B.4 (Cont.): Simulation Summary Tables With GI-0217 and With AHD-GPK Out**

Case No.	11	12	13	14	15
Case Name	b1c-s709aa.xzvV424-fdl	b1c-s709aa.xzvV424-nbz	b1c-s709aa.xzvV424-nmz	b1c-s709aa.xzvV424-pcs	b1c-s709aa.xzvV424-pct
Disturbance	fdl	nbz	nmz	pcs	pct
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 10:26	SEP 20 2006 10:30	SEP 20 2006 14:58	SEP 20 2006 13:37	SEP 20 2006 12:32
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 321	2080 / 321	2080 / 321	2080 / 321	2080 / 321
MHEX / L20D	2175 / 263	2175 / 263	2175 / 263	2175 / 263	2175 / 263
ECL-ARP / PRI-BYN	687 / 792	687 / 792	687 / 792	687 / 792	687 / 792
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889
B10T / MH>SPC	167 / 23	167 / 23	167 / 23	167 / 23	167 / 23
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	138 / 150	138 / 150	138 / 150	138 / 150	138 / 150
G82R	-24	-24	-24	-24	-24
Dorsey bipole / CU bipole	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103
Dorsey Reserve / Wtrtn SVC	251 / -27	251 / -27	251 / -27	251 / -27	251 / -27
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997
Chisago 500/EauClaire 345	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006
Int Falls 115/Badoura 115	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034
Drayton 230/Groton 345	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%	225% / 356%	225% / 356%
B2R at Rugby/L20D at Drayton	999% / 739%	999% / 739%	999% / 739%	999% / 739%	999% / 739%
R50M/F3M	975% / 329%	975% / 329%	975% / 329%	975% / 329%	975% / 329%
B10T	337%	337%	337%	337%	337%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.98   1.05	(0.60)0.79   1.07	0.86   1.04	1.02   1.08	1.01   1.04
Boise 115	1.00   1.04	0.98   1.06	0.95   1.06	1.02   1.06	1.02   1.04
Dorsey 230	1.03   1.06	1.04   1.19	1.04   1.20	1.04   1.10	1.04   1.06
Forbes 230	0.99   1.03	0.87   1.08	0.97   1.03	1.01   1.07	1.00   1.03
Riverton 230	0.99   1.07	0.77   1.05	0.80   1.04	1.01   1.07	1.02   1.04
Coal Creek 230	0.97   1.11	0.91   1.14	0.92   1.13	0.97   1.08	1.01   1.05
Dickinson 345	0.95   1.04	0.89   1.07	0.90   1.06	0.96   1.06	0.97   1.01
Drayton 230	0.97   1.09	0.95   1.12	0.96   1.11	1.02   1.05	1.00   1.03
Groton 345	0.96   1.13	0.77   1.09	0.80   1.09	0.99   1.08	1.01   1.04
Tioga 230	1.01   1.06	0.98   1.08	0.98   1.08	1.01   1.07	1.03   1.05
Wahpeton 115	0.96   1.11	0.80   1.07	0.82   1.08	1.00   1.08	1.02   1.05
Watertown 345	1.00   1.11	0.83   1.08	0.85   1.08	1.01   1.07	1.02   1.04
<b>Dynamic Voltage Warnings</b>					
	none	61638 [BRCHLKT7] 0.78 61615 [ARROWHD4] 0.79 61616 [HILLTOP4] 0.79 61614 [98L TAP4] 0.79 61655 [CROMWLL7] 0.80 61672 [HILLTOP7] 0.80 679 [GARY 7] 0.80 +mc	61638 [BRCHLKT7] 0.81	none	none
Worst Case Angle Damping				KING 3 / 65.06%	SHERC3 / 59.09%
Dorsey SUVV / UdHold		/ 0.133	/ 0.133		
Forbes DC Red (DCAR)	483%	507%	507%	-77%	122%
K22W (max +dP @ t, d-ang)	53.9@(2.51666,-16.7)	165.5@(2.74998,-66.4)	155.6@(2.73332,-61.7)	93.2@(3.14998,-33.6)	0.0@(0.10000,0.0)
K22W (max -dP @ t, d-ang)	1.7@(0.32500,-0.4)	89.6@(0.23333,7.5)	90.9@(0.23333,7.3)	45.6@(0.39166,8.4)	45.3@(2.66665,20.5)
K22W (max d-ang @ t, dP)	-21.1@(1.92500,31.1)	-67.6@(2.54165,149.4)	-64.1@(2.45832,134.6)	-48.6@(20.00806,48.9)	21.2@(2.27499,-42.1)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	188% / 294%	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec	225% / 356%	225% / 356%
B2R at Rugby/L20D at Drayton	999% / 449%	999% / 431%	999% / 449%	999% / 718%	999% / 640%
R50M / F3M	795% / 246%	522% / 148%	495% / 157%	975% / 304%	901% / 329%
B10T	111%	66%	80%	204%	265%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	( 0   1   0 )	( 0   2   0 )	( 0   2   0 )	( 0   0   0 )	( 0   0   0 )
Eau Cl 345 / Park Lk 115	( 4   4   4 ) / ( 0   0   0 )	( 4   4   1 ) / ( 0   0   0 )	( 4   4   1 ) / ( 0   0   0 )	( 4   4   2 ) / ( 0   3   3 )	( 4   4   2 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   6   2 ) / ( 0   0   0 )	( 2   9   2 ) / ( 0   0   0 )	( 2   7   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   3   0 )	( 0   0   0 ) / ( 1   3   0 )	( 0   0   0 ) / ( 1   1   0 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   5   0 ) / ( 0   0   0 )	( 2   5   4 ) / ( 0   2   2 )	( 2   5   3 ) / ( 0   2   2 )	( 2   3   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
Damping Performance	N/A	N/A	N/A	NONE	NONE

**Appendix B.4 (Cont.): Simulation Summary Tables With GI-0217 and With AHD-GPK Out**

Case No.	16	17	18	19	20
Case Name	b1c-s709aa.xzV424-pys	b1c-s709aa.xzV424-pyt	b1c-s709aa.xzV424-au3	b1c-s709aa.xzV424-au9	b1c-s709aa.xzV424-ad3
Disturbance	pys	pyt	au3	au9	ad3
Prior Outage	None	None	None	None	None
Date/Time	SEP 20 2006 13:47	SEP 20 2006 12:20	SEP 20 2006 12:41	SEP 20 2006 12:50	SEP 20 2006 13:18
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 321	2080 / 321	2080 / 321	2080 / 321	2080 / 321
MHEX / L20D	2175 / 263	2175 / 263	2175 / 263	2175 / 263	2175 / 263
ECL-ARP / PRI-BYN	687 / 792	687 / 792	687 / 792	687 / 792	687 / 792
MWSI / MNEX	1480	1480	1480	1480	1480
D602F / F601C	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889	1797 / 1889
B10T / MH>SPC	167 / 23	167 / 23	167 / 23	167 / 23	167 / 23
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	138 / 150	138 / 150	138 / 150	138 / 150	138 / 150
G82R	-24	-24	-24	-24	-24
Dorsey bipole / CU bipole	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103	3232 / 1103
Dorsey Reserve / Wtrtn SVC	251 / -27	251 / -27	251 / -27	251 / -27	251 / -27
Forbes SVC / MSC	21 / 600	21 / 600	21 / 600	21 / 600	21 / 600
Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045	1.030 / 1.045
Roseau 500/Forbes 500	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997	1.058 / 0.997
Chisago 500/EauClaire 345	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006	0.992 / 1.006
Int Falls 115/Badoura 115	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034	1.022 / 1.034
Drayton 230/Groton 345	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022	1.010 / 1.022
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	225% / 356%	225% / 356%	225% / 356%	225% / 356%	225% / 356%
B2R at Rugby/L20D at Drayton	999% / 739%	999% / 739%	999% / 739%	999% / 739%	999% / 739%
R50M/F3M	975% / 329%	975% / 329%	975% / 329%	975% / 329%	975% / 329%
B10T	337%	337%	337%	337%	337%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	1.01   1.04	1.02   1.04	1.00   1.05	0.99   1.05	0.99   1.05
Boise 115	1.00   1.05	1.02   1.04	0.99   1.05	0.98   1.05	0.98   1.05
Dorsey 230	1.03   1.08	1.04   1.05	0.98   1.07	0.96   1.07	0.97   1.07
Forbes 230	0.99   1.06	1.00   1.03	0.98   1.03	0.97   1.03	0.97   1.04
Riverton 230	1.01   1.05	1.02   1.04	0.98   1.06	0.97   1.06	0.97   1.06
Coal Creek 230	0.98   1.07	1.02   1.05	0.95   1.11	0.96   1.11	0.95   1.12
Dickinson 345	0.97   1.03	0.97   1.00	0.94   1.04	0.95   1.03	0.94   1.04
Drayton 230	0.99   1.03	1.00   1.03	0.95   1.07	0.93   1.07	0.93   1.09
Groton 345	0.99   1.04	1.01   1.03	0.96   1.09	0.96   1.08	0.91   1.09
Tioga 230	1.01   1.05	1.03   1.05	0.98   1.08	0.98   1.08	0.98   1.08
Wahpeton 115	1.01   1.05	1.02   1.04	0.96   1.09	0.95   1.09	0.94   1.09
Watertown 345	1.01   1.04	1.02   1.03	1.00   1.08	1.00   1.07	0.97   1.08
<b>Dynamic Voltage Warnings</b>					
	none	none	67263 [LTLMISS7] 0.56 67265 [LTLMISS4] 0.58 67304 [BAKER 4] 0.58 67305 [BAKER 7] 0.60 67310 [BOWMAN 4] 0.66 67310 [BOWMAN 4] 0.61 67348 [HETINGR7] 0.62 412 [MI CTYE7] 0.63 +m	67263 [LTLMISS7] 0.62 67265 [LTLMISS4] 0.64 67304 [BAKER 4] 0.65 67310 [BOWMAN 4] 0.66 67305 [BAKER 7] 0.67 67348 [HETINGR7] 0.68 50 [GASCOYN7] 0.68 +m	none
Worst Case Angle Damping	SHERC3 / 74.83%	SHERC3 / 61.08%	STANT4 / -57.89%	SHERC3 / -15.21%	KING 3 / 8.98%
Dorsey SUVV / UdHold			/ 16.649	/ 16.874	/ 15.574
Forbes DC Red (DCAR)	97%	297%	407%	414%	374%
K22W (max +dP @ t, d-ang)	3.8@(3.59164,1.7)	0.0@(0.10000,0.0)	57.6@(18.03309,-11.9)	46.2@(19.46640,-10.5)	57.1@(18.04975,-13.8)
K22W (max -dP @ t, d-ang)	37.4@(1.71666,15.0)	24.2@(2.64999,11.0)	16.0@(9.51655,-1.8)	18.9@(17.26643,-2.7)	20.9@(5.84160,-0.7)
K22W (max d-ang @ t, dP)	22.5@(1.15000,-26.2)	11.8@(2.14166,-22.4)	-20.5@(18.52475,28.0)	-22.4@(20.00806,43.5)	-17.0@(17.31643,24.0)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	188% / 291%	225% / 356%	170% / 260%	166% / 251%	172% / 263%
B2R at Rugby/L20D at Drayton	999% / 538%	999% / 665%	999% / 571%	999% / 573%	999% / 587%
R50M / F3M	776% / 329%	936% / 329%	785% / 244%	783% / 255%	802% / 262%
B10T	158%	281%	161%	170%	178%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	( 0   0   0 )	( 0   0   0 )	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 4   4   4 ) / ( 0   3   3 )	( 4   4   4 ) / ( 0   0   0 )	( 4   4   3 ) / ( 0   0   0 )	( 4   4   3 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   0 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 2   3   3 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   0   0 )	( 2   5   1 ) / ( 0   0   0 )
Damping Performance	NONE	NONE	NONE	NONE	NONE

**Appendix B.4 (Cont.): Simulation Summary Tables With GI-0217 and With AHD-GPK Out**

1	<b>Case No.</b>	21	22
2	<b>Case Name</b>	b1c-s709aa.xzvV424-ax3	b1c-s709aa.xzvV424-auj
3	<b>Disturbance</b>	ax3	auj
4	<b>Prior Outage</b>	None	None
5	<b>Date/Time</b>	SEP 20 2006 13:00	SEP 20 2006 10:39
6	<b>Comments</b>		
7			
8	<b>Steady State Flows</b>		
9	NDEX / EAST BIAS	2080 / 321	2080 / 321
10	MHEX / L20D	2175 / 263	2175 / 263
11	ECL-ARP / PRI-BYN	687 / 792	687 / 792
12	MWSI / MNEX	1480	1480
13	D602F / F601C	1797 / 1889	1797 / 1889
14	B10T / MH>SPC	167 / 23	167 / 23
15	OH E-W / OH>MH	98 / -196	98 / -196
16	R50M / OH>MP	138 / 150	138 / 150
17	G82R	-24	-24
18	Dorsey bipole / CU bipole	3232 / 1103	3232 / 1103
19	Dorsey Reserve / Wtrtn SVC	251 / -27	251 / -27
20	Forbes SVC / MSC	21 / 600	21 / 600
21	Arrowhd-Wstrn/ RCDC	0 / 0	0 / 0
22	<b>Steady State Vltgs</b>		
23	Dorsey 500/Dorsey 230	1.030 / 1.045	1.030 / 1.045
24	Roseau 500/Forbes 500	1.058 / 0.997	1.058 / 0.997
25	Chisago 500/EauClaire 345	0.992 / 1.006	0.992 / 1.006
26	Int Falls 115/Badoura 115	1.022 / 1.034	1.022 / 1.034
27	Drayton 230/Groton 345	1.010 / 1.022	1.010 / 1.022
28	<b>SS OS Relay Margins</b>		
29	D602F at Forbes/Dorsey	225% / 356%	225% / 356%
30	B2R at Rugby/L20D at Drayton	999% / 739%	999% / 739%
31	R50M/F3M	975% / 329%	975% / 329%
32	B10T	337%	337%
33	<b>Min/MaxTransientVltg</b>		
34	Arrowhd 230	1.01   1.04	1.02   1.04
35	Boise 115	1.01   1.03	1.00   1.03
36	Dorsey 230	1.04   1.05	1.03   1.05
37	Forbes 230	1.00   1.02	1.00   1.02
38	Riverton 230	1.00   1.04	1.02   1.05
39	Coal Creek 230	0.99   1.08	1.01   1.09
40	Dickinson 345	0.96   1.02	0.99   1.03
41	Drayton 230	0.99   1.03	1.00   1.04
42	Groton 345	0.98   1.05	1.03   1.09
43	Tioga 230	1.02   1.05	1.02   1.06
44	Wahpeton 115	0.99   1.05	1.02   1.08
45	Watertown 345	1.01   1.05	1.04   1.08
46	<b>Dynamic Voltage Warnings</b>		
47		none	none
48			
49			
50			
51			
52			
53			
54	<b>Worst Case Angle Damping</b>	ANTEL3 / 58.80%	
55	<b>Dorsey SUVP / UdHold</b>		
56	<b>Forbes DC Red (DCAR)</b>	430%	500%
57	K22W (max +dP @ t, d-ang)	9.0@(2.51666,0.5)	47.4@(2.14999,-17.5)
58	K22W (max -dP @ t, d-ang)	6.6@(1.93333,-1.9)	0.7@(0.24167,0.0)
59	K22W (max d-ang @ t, dP)	-2.3@(1.78333,-4.3)	-17.8@(2.41666,40.8)
60	<b>OS Rel Trip / Marg</b>		
61	MH - OH		
62	D602F at Forbes/Dorsey	202% / 319%	201% / 317%
63	B2R at Rugby/L20D at Drayton	999% / 637%	999% / 545%
64	R50M / F3M	907% / 293%	925% / 259%
65	B10T	252%	148%
66	<b>FSCAPS (SS/Unav/Final)</b>		
67	Balta 230	( 0   0   0 )	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 4   4   4 ) / ( 0   0   0 )	( 4   4   4 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / Split Rock 115	( 2   2   2 ) / ( 0   0   0 )	( 2   2   1 ) / ( 0   0   0 )
72	<b>Damping Performance</b>	NONE	N/A

**Appendix C – Stability Analysis Results – Sensitivity Cases With  
Prior-Queued Project G132 Included**

## Appendix C.1: Summary for Case b0d-s709aa.xzqV424.sav (Without GI-0217)

B0D-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1239,OHMH=-196,OHMP=151,EWTW=98,BD=163

### POWER FLOW SUMMARY

NDEX:	2080 MW	ECL-ARP:	520 MW
MHEX:	2175 MW	PRI-BYN:	718 MW
MWSI:	1239 MW	AHD-GPK:	549 MW
		NI-WUMS:	151 MW
COOPER S:	1065 MW	WNE-WKS:	510 MW
FTCAL S:	662 MW	GGG:	1499 MW
GRIS-LNC:	682 MW	QC WEST:	-36 MW

#### LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:

NORTH DAKOTA (ZONE 90,990)	1977.0 MW,	67.6% OF	2925.0 MW
NSP (AREA 600)	8465.0 MW,	87.9% OF	9632.0 MW
MAN HYDRO (AREA 667)	2126.0 MW,	71.7% OF	2964.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 267	MH total gross	4722	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 45	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	374
MP	1944/ 163	northwest	816	SPC>WAPA (B10T)	163
NSP	8464/ 495	SPC total gross	2241	MH>SPC (3-230)	19
N. Dakota	1977/ 297	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	151
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	98
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1611
NSP	1785 MVARs	net	2848	D602F @Dorsey	1821
N. Dakota	392 MVARs	Total net	6720	L20D @Letell	234
		WAPA SD Hydro	1497	R50M @Richer	148
		Pleasant Valley	0	G82R @Glenboro	-28
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	927		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	11/ 110	CU (1,2)	1104
Wshell #2 7-7	104/ 72%	Boundary Dam	19/ 164	SQ BU (3,4)	455
Drayton#1 4-7	45/ 32%	Whiteshell	69/ 200	MH Bipole 1	1514
Drayton#2 4-7	57/ 30%	Int Falls	86/ 150	MH Bipole 2	1714
Dorsey #1 2-4	876/ 73%	St. Lawrence	15/ 0	MH (BP1+BP2)	3228
Dorsey #2 2-4	987/ 82%			Miles City E>W	-150
Forbes	2-4 79/ 11%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	504 600/ -330	Forbes	500 -55	400/ -450
SCE 1-3G	18.2	3	411 480/ -240	Fargo	13.2 11	20/ -135
SCA 4-6G	18.2	3	411 480/ -240	Watertown	20.0 -37	125/ -86
Total Margin		1327	1560/ -810	Series Caps		Num In Serv
		233		Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS)	230 0	Arrowhead	230 160	Chisago T 9	34.5 51
Drayton	115 20	Blackberry	230 47	Chisago T 10	34.5 51
Drayton	13.8 -20	Minntac	115 45	Forbes	230 70

Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co. (FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	40	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	40	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.009	Arrowhead	230 1.008	Whiteshell	110 118.9
Alexandria	115 0.996	Badoura	115 1.015	Kenora	220 248.2
Audubon	115 1.019	Blackberry	230 1.025	Dryden	220 252.0
Bemidji	115 1.007	Boise Cascade	13.8 1.057	Fort Frances	220 247.2
Byron	345 1.025	Boise Cascade	115 1.025	Mackenzie	220 256.7
Chisago Co.	345 1.009	ETCO	115 0.998	Lakehead	220 256.3
Chisago Co.	500 1.002	Forbes	230 1.007	Marathon	220 260.7
Drayton	230 1.014	Forbes	500 0.996	Wawa	220 258.2
Eau Claire	345 1.022	Hubbard	115 1.015	Mississagi	220 250.5
WEST FARIBAULT	115 1.009	Intl Falls	115 1.026	Fort Frances	118 120.3
LaPorte	115 1.006	Minntac	115 1.006	Lakehead	118 122.8
Maple River	230 1.007	Moranville	230 1.016	Birch	118 117.5
Marshall Tap	115 1.022	Riverton	230 1.010	Marathon	118 125.2
Owatonna	161 0.999	Running	230 1.016		0.0
Prairie	115 1.020	Shannon	230 1.023		0.0
Prairie	230 1.016		0.000		0.0
Ramsey	230 1.017	Groton	345 1.033		0.0
Roseau County	230 1.015	Watertown	230 1.030		0.0
Roseau County	500 1.057	Watertown	345 1.035		0.0
Sheyenne	230 1.012		0.000		0.0
Thief R Falls	115 1.012	Dorsey	230 1.045		0.0
Tioga	230 1.023	Dorsey	500 1.029		0.0
Wahpeton	230 1.003		0.000		0.0
Winger	115 1.026		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	335%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	689%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	343%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	217%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	331%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1673%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	865%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	869%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## Appendix C.2: Summary for Case b1d-s709aa.xzqV424.sav (With GI-0217)

BLD-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
 ND=2080,MH=2175,MW=1239,OHMH=-196,OHMP=151,EWTW=98,BD=165

### POWER FLOW SUMMARY

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-----
NDEX:      2080 MW      ECL-ARP:   522 MW
MHEX:      2175 MW      PRI-BYN:   717 MW
MWSI:      1239 MW      AHD-GPK:   547 MW
                        NI-WUMS:   151 MW
COOPER S:  1075 MW      WNE-WKS:   513 MW
FTCAL S:   666 MW      GGS:       1504 MW
GRIS-LNC:  691 MW      QC WEST:   -39 MW
  
```

#### LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:

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NORTH DAKOTA (ZONE 90,990) 2427.6 MW, 83.0% OF 2925.0 MW
NSP (AREA 600) 8432.5 MW, 87.5% OF 9632.0 MW
MAN HYDRO (AREA 667) 2126.0 MW, 71.7% OF 2964.0 MW
  
```

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 268	MH total gross	4724	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 44	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	357
MP	1944/ 158	northwest	816	SPC>WAPA (B10T)	165
NSP	8432/ 491	SPC total gross	2241	MH>SPC (3-230)	21
N. Dakota	2427/ 347	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	151
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	98
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1595
NSP	1779 MVARs	net	2848	D602F @Dorsey	1811
N. Dakota	474 MVARs	Total net	6720	L20D @Letell	255
		WAPA SD Hydro	1497	R50M @Richer	147
		Pleasant Valley	0	G82R @Glenboro	-39
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	878		

Tfms	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	11/ 110	CU (1,2)	1104
Wshell #2 7-7	104/ 72%	Boundary Dam	23/ 166	SQ BU (3,4)	455
Drayton#1 4-7	51/ 36%	Whiteshell	69/ 200	MH Bipole 1	1515
Drayton#2 4-7	65/ 34%	Int Falls	86/ 150	MH Bipole 2	1715
Dorsey #1 2-4	869/ 72%	St. Lawrence	15/ 0	MH (BP1+BP2)	3230
Dorsey #2 2-4	980/ 81%			Miles City E>W	-149
Forbes 2-4	81/ 12%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	499 600/ -330	Forbes	500 -61	400/ -450
SCE 1-3G	18.2	3	407 480/ -240	Fargo	13.2 7	20/ -135
SCA 4-6G	18.2	3	407 480/ -240	Watertown	20.0 -37	125/ -86
Total		1314	1560/ -810	Series Caps		Num In Serv
Margin		246		Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	0	Arrowhead 230	160	Chisago T 9 34.5	51
Drayton 115	20	Blackberry 230	47	Chisago T 10 34.5	51

Drayton	13.8	-20	Minntac	115	45	Forbes	230	70
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	80	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	80	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.009	Arrowhead	230 1.010	Whiteshell	110 118.9
Alexandria	115 0.989	Badoura	115 1.032	Kenora	220 248.2
Audubon	115 1.018	Blackberry	230 1.027	Dryden	220 252.0
Bemidji	115 1.011	Boise Cascade	13.8 1.058	Fort Frances	220 247.4
Byron	345 1.025	Boise Cascade	115 1.026	Mackenzie	220 256.7
Chisago Co.	345 1.011	ETCO	115 1.000	Lakehead	220 256.3
Chisago Co.	500 1.005	Forbes	230 1.009	Marathon	220 260.8
Drayton	230 1.015	Forbes	500 0.999	Wawa	220 258.2
Eau Claire	345 1.024	Hubbard	115 1.029	Mississagi	220 250.5
WEST FARIBAULT	115 1.011	Intl Falls	115 1.027	Fort Frances	118 120.4
LaPorte	115 1.016	Minntac	115 1.008	Lakehead	118 122.8
Maple River	230 1.008	Moranville	230 1.017	Birch	118 117.5
Marshall Tap	115 1.021	Riverton	230 1.018	Marathon	118 125.2
Owatonna	161 0.999	Running	230 1.018		0.0
Prairie	115 1.032	Shannon	230 1.025		0.0
Prairie	230 1.021		0.000		0.0
Ramsey	230 1.003	Groton	345 1.026		0.0
Roseau County	230 1.017	Watertown	230 1.030		0.0
Roseau County	500 1.058	Watertown	345 1.033		0.0
Sheyenne	230 1.014		0.000		0.0
Thief R Falls	115 1.041	Dorsey	230 1.045		0.0
Tioga	230 1.036	Dorsey	500 1.029		0.0
Wahpeton	230 0.999		0.000		0.0
Winger	115 1.033		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	340%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	698%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	350%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	221%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	332%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1285%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	780%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	880%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A



**Appendix C.3: Simulation Summary Tables for Baseline Analysis (With Project G132)**

Case No.	1	2	3	4	5
Case Name	b0d-s709aa.xzqV424-ag1	b0d-s709aa.xzqV424-ag3	b0d-s709aa.xzqV424-ah3	b0d-s709aa.xzqV424-al1	b0d-s709aa.xzqV424-am1
Disturbance	ag1	ag3	ah3	al1	am1
Prior Outage	None	None	None	None	None
Date/Time	SEP 21 2006 15:14	SEP 21 2006 15:17	SEP 21 2006 14:49	SEP 21 2006 15:43	SEP 21 2006 15:54
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 374	2080 / 374	2080 / 374	2080 / 374	2080 / 374
MHEX / L20D	2175 / 234	2175 / 234	2175 / 234	2175 / 234	2175 / 234
ECL-ARP / PRI-BYN	520 / 718	520 / 718	520 / 718	520 / 718	520 / 718
MWSI / MNEX	1239	1239	1239	1239	1239
D602F / F601C	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611
B10T / MH>SPC	163 / 19	163 / 19	163 / 19	163 / 19	163 / 19
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-28	-28	-28	-28	-28
Dorsey bipole / CU bipole	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104
Dorsey Reserve / Wtrtn SVC	233 / -37	233 / -37	233 / -37	233 / -37	233 / -37
Forbes SVC / MSC	-55 / 600	-55 / 600	-55 / 600	-55 / 600	-55 / 600
Arrowhd-Wstrn/ RCDC	549 / 0	549 / 0	549 / 0	549 / 0	549 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996
Chisago 500/EauClaire 345	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022
Int Falls 115/Badoura 115	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015
Drayton 230/Groton 345	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	217% / 343%	217% / 343%	217% / 343%	217% / 343%	217% / 343%
B2R at Rugby/L20D at Drayton	999% / 865%	999% / 865%	999% / 865%	999% / 865%	999% / 865%
R50M/F3M	869% / 331%	869% / 331%	869% / 331%	869% / 331%	869% / 331%
B10T	335%	335%	335%	335%	335%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.98   1.02	0.97   1.02	0.97   1.03	1.00   1.03	1.00   1.03
Boise 115	1.00   1.04	1.00   1.04	1.00   1.05	1.01   1.04	1.01   1.04
Dorsey 230	1.03   1.06	1.02   1.06	1.02   1.06	1.04   1.06	1.04   1.06
Forbes 230	0.98   1.02	0.98   1.02	0.98   1.02	1.00   1.03	1.00   1.03
Riverton 230	0.96   1.05	0.96   1.04	0.96   1.04	1.00   1.05	1.00   1.04
Coal Creek 230	0.95   1.13	0.95   1.13	0.95   1.13	0.99   1.08	0.97   1.11
Dickinson 345	0.94   1.04	0.94   1.04	0.94   1.04	0.96   1.02	0.95   1.02
Drayton 230	0.97   1.10	0.97   1.10	0.96   1.10	0.99   1.07	1.00   1.08
Groton 345	0.89   1.08	0.88   1.08	1.00   1.09	0.90   1.12	0.90   1.12
Tioga 230	0.97   1.05	0.97   1.05	0.97   1.05	1.00   1.03	1.00   1.03
Wahpeton 115	0.94   1.09	0.93   1.08	0.93   1.08	1.01   1.07	1.00   1.07
Watertown 345	0.96   1.07	0.96   1.06	1.01   1.08	0.97   1.09	0.97   1.09
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold				KING 3 / 38.21%	KING 3 / 39.21%
Forbes DC Red (DCAR)	394%	391%	394%	453%	444%
K22W (max +dP @ t, d-ang)	11.9@(2.52499,1.8)	13.9@(2.49999,1.0)	11.1@(2.54999,0.3)	31.7@(2.75832,-7.6)	31.4@(2.74165,-7.8)
K22W (max -dP @ t, d-ang)	20.7@(0.79166,4.9)	22.0@(0.75000,5.8)	20.7@(0.76666,5.4)	4.8@(0.39166,0.3)	6.1@(0.39166,0.5)
K22W (max d-ang @ t, dP)	7.8@(1.10000,-5.4)	8.9@(1.05833,-7.5)	8.1@(1.08333,-7.9)	-15.2@(20.00806,11.2)	-15.8@(20.00806,11.8)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	162% / 251%	158% / 244%	158% / 244%	199% / 313%	199% / 312%
B2R at Rugby/L20D at Drayton	999% / 640%	999% / 644%	999% / 648%	999% / 659%	999% / 658%
R50M / F3M	706% / 266%	694% / 265%	691% / 267%	824% / 278%	819% / 280%
B10T	172%	168%	182%	187%	190%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   3   0)	(0   3   0)	(0   3   0)	(0   2   0)	(0   2   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(1   7   2) / (0   0   0)	(1   6   2) / (0   0   0)	(1   7   2) / (0   0   0)	(1   5   1) / (0   0   0)	(1   5   1) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   2   2)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shey 115 / Split Rock 115	(1   5   2) / (0   0   0)	(1   5   3) / (0   0   0)	(1   5   3) / (0   0   0)	(1   3   1) / (0   0   0)	(1   3   2) / (0   0   0)
Damping Performance	N/A	N/A	N/A	NONE	NONE

**Appendix C.3 (Cont.): Simulation Summary Tables for Baseline Analysis (With Project G132)**

Case No.	6	7	8	9
Case Name	b0d-s709aa.xzqV424-ei2	b0d-s709aa.xzqV424-fd1	b0d-s709aa.xzqV424-fdk	b0d-s709aa.xzqV424-fd3
Disturbance	ei2	fd1	fdk	fd3
Prior Outage	None	None	None	None
Date/Time	SEP 21 2006 14:52	SEP 21 2006 14:55	SEP 21 2006 14:58	SEP 21 2006 15:01
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 374	2080 / 374	2080 / 374	2080 / 374
MHEX / L20D	2175 / 234	2175 / 234	2175 / 234	2175 / 234
ECL-ARP / PRI-BYN	520 / 718	520 / 718	520 / 718	520 / 718
MWSI / MNEX	1239	1239	1239	1239
D602F / F601C	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611
B10T / MH>SPC	163 / 19	163 / 19	163 / 19	163 / 19
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-28	-28	-28	-28
Dorsey bipole / CU bipole	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104
Dorsey Reserve / Wtrtn SVC	233 / -37	233 / -37	233 / -37	233 / -37
Forbes SVC / MSC	-55 / 600	-55 / 600	-55 / 600	-55 / 600
Arrowhd-Wstrn/ RCD	549 / 0	549 / 0	549 / 0	549 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996
Chisago 500/EauClaire 345	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022
Int Falls 115/Badoura 115	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015
Drayton 230/Groton 345	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	217% / 343%	217% / 343%	217% / 343%	217% / 343%
B2R at Rugby/L20D at Drayton	999% / 865%	999% / 865%	999% / 865%	999% / 865%
R50M/F3M	869% / 331%	869% / 331%	869% / 331%	869% / 331%
B10T	335%	335%	335%	335%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.05	0.99   1.05	1.01   1.06	0.94   1.03
Boise 115	0.98   1.06	1.00   1.05	1.01   1.04	1.00   1.04
Dorsey 230	1.01   1.07	1.02   1.06	1.03   1.06	1.02   1.06
Forbes 230	0.94   1.03	0.98   1.03	0.99   1.03	0.98   1.03
Riverton 230	0.87   1.06	0.93   1.07	0.98   1.06	0.92   1.06
Coal Creek 230	0.99   1.14	0.96   1.15	0.97   1.10	0.95   1.15
Dickinson 345	0.98   1.05	0.94   1.05	0.95   1.04	0.93   1.05
Drayton 230	0.92   1.12	0.97   1.12	0.99   1.07	0.97   1.11
Groton 345	0.85   1.14	0.91   1.11	0.99   1.11	0.89   1.12
Tioga 230	0.98   1.06	0.99   1.05	1.00   1.04	0.98   1.04
Wahpeton 115	0.83   1.11	0.87   1.11	0.97   1.10	0.86   1.11
Watertown 345	0.89   1.12	0.95   1.09	1.01   1.09	0.94   1.10
<b>Dynamic Voltage Warnings</b>				
		63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMSTN3] 0.69	none	63369 [JAMSTN3] 0.69 63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold				/ 0.166
Forbes DC Red (DCAR)	507%	337%	478%	351%
K22W (max +dP @ t, d-ang)	70.1@(2.85832,-29.0)	18.3@(2.69999,-1.7)	42.8@(2.40832,-16.9)	24.9@(2.64165,-4.0)
K22W (max -dP @ t, d-ang)	11.8@(0.64166,1.5)	21.3@(0.87500,3.2)	2.7@(0.31667,-0.2)	20.9@(0.74166,4.5)
K22W (max d-ang @ t, dP)	-36.8@(2.26666,53.2)	6.4@(1.20000,-3.1)	-18.3@(1.92500,31.1)	8.6@(1.10000,-10.0)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	116% / 174%	160% / 248%	184% / 288%	165% / 257%
B2R at Rugby/L20D at Drayton	999% / 495%	999% / 627%	999% / 602%	999% / 582%
R50M / F3M	607% / 201%	703% / 259%	730% / 250%	736% / 272%
B10T	72%	157%	145%	124%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   2   0 )	( 0   1   0 )	( 0   1   0 )	( 0   2   0 )
Eau Cl 345 / Park Lk 115	( 3   3   2 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 1   10   2 ) / ( 0   0   0 )	( 1   7   2 ) / ( 0   0   0 )	( 1   3   1 ) / ( 0   0   0 )	( 1   7   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   2   2 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shey 115 / Split Rock 115	( 1   5   0 ) / ( 0   2   2 )	( 1   5   1 ) / ( 0   0   0 )	( 1   4   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   2   2 )
<b>Damping Performance</b>				
	N/A	N/A	N/A	N/A

**Appendix C.3 (Cont.): Simulation Summary Tables for Baseline Analysis (With Project G132)**

Case No.	10	11	12	13
Case Name	b0d-s709aa.xzqV424-fd4	b0d-s709aa.xzqV424-fdl	b0d-s709aa.xzqV424-nbz	b0d-s709aa.xzqV424-nmz
Disturbance	fd4	fdl	nbz	nmz
Prior Outage	None	None	None	None
Date/Time	SEP 21 2006 15:04	SEP 21 2006 15:07	SEP 21 2006 15:11	SEP 22 2006 9:24
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 374	2080 / 374	2080 / 374	2080 / 374
MHEX / L20D	2175 / 234	2175 / 234	2175 / 234	2175 / 234
ECL-ARP / PRI-BYN	520 / 718	520 / 718	520 / 718	520 / 718
MWSI / MNEX	1239	1239	1239	1239
D602F / F601C	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611
B10T / MH>SPC	163 / 19	163 / 19	163 / 19	163 / 19
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-28	-28	-28	-28
Dorsey bipole / CU bipole	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104
Dorsey Reserve / Wtrtn SVC	233 / -37	233 / -37	233 / -37	233 / -37
Forbes SVC / MSC	-55 / 600	-55 / 600	-55 / 600	-55 / 600
Arrowhd-Wstrn/ RCD	549 / 0	549 / 0	549 / 0	549 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996
Chisago 500/EauClaire 345	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022
Int Falls 115/Badoura 115	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015
Drayton 230/Groton 345	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	217% / 343%	217% / 343%	217% / 343%	217% / 343%
B2R at Rugby/L20D at Drayton	999% / 865%	999% / 865%	999% / 865%	999% / 865%
R50M/F3M	869% / 331%	869% / 331%	869% / 331%	869% / 331%
B10T	335%	335%	335%	335%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.03	0.97   1.04	0.89   1.09	0.93   1.07
Boise 115	1.00   1.04	1.01   1.04	0.95   1.06	0.94   1.06
Dorsey 230	1.02   1.06	1.03   1.06	1.04   1.20	1.04   1.19
Forbes 230	0.97   1.04	0.99   1.03	0.93   1.08	0.97   1.03
Riverton 230	0.93   1.08	0.98   1.06	0.86   1.06	0.87   1.05
Coal Creek 230	0.95   1.15	0.97   1.10	0.93   1.11	0.94   1.11
Dickinson 345	0.94   1.05	0.95   1.04	0.92   1.06	0.93   1.06
Drayton 230	0.97   1.13	0.99   1.10	0.97   1.08	0.97   1.09
Groton 345	0.92   1.13	0.99   1.12	0.88   1.11	0.88   1.11
Tioga 230	0.98   1.05	1.00   1.05	0.98   1.06	0.98   1.06
Wahpeton 115	0.87   1.12	0.97   1.10	0.85   1.10	0.85   1.10
Watertown 345	0.95   1.10	1.01   1.10	0.91   1.10	0.91   1.10
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.67 63200 [JAMSTN2Y] 0.67 63369 [JAMESTN3] 0.67 63269 [JAMSTWN7] 0.69 63270 [LADISH 7] 0.69 63271 [AVIKO 7] 0.69 63272 [JAMESPK7] 0.69 +more	none		
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold			/ 0.133	/ 0.133
Forbes DC Red (DCAR)	326%	478%	507%	507%
K22W (max +dP @ t, d-ang)	22.3@(2.66665,-1.6)	45.2@(2.39166,-16.5)	138.6@(2.56665,-62.4)	132.5@(2.59999,-59.9)
K22W (max -dP @ t, d-ang)	20.8@(0.83333,3.5)	2.7@(0.33333,-0.2)	89.1@(0.24167,7.4)	90.5@(0.23333,7.0)
K22W (max d-ang @ t, dP)	7.2@(1.16666,-1.7)	-18.2@(1.90833,32.2)	-64.9@(2.28333,131.9)	-63.1@(2.29999,126.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	170% / 265%	184% / 287%	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec
B2R at Rugby/L20D at Drayton	999% / 603%	999% / 549%	999% / 550%	999% / 552%
R50M / F3M	717% / 273%	726% / 256%	380% / 146%	397% / 150%
B10T	131%	124%	103%	110%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   1   0 )	( 0   1   0 )	( 0   1   0 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 1   7   2 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )	( 1   4   1 ) / ( 0   0   0 )	( 1   5   1 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   3   0 )	( 0   1   0 ) / ( 1   3   1 )
Shey 115 / Split Rock 115	( 1   5   0 ) / ( 0   0   0 )	( 1   4   0 ) / ( 0   0   0 )	( 1   5   2 ) / ( 0   2   2 )	( 1   5   2 ) / ( 0   2   2 )
<b>Damping Performance</b>				
	N/A	N/A	N/A	N/A

**Appendix C.3 (Cont.): Simulation Summary Tables for Baseline Analysis (With Project G132)**

Case No.	14	15	16	17	18
Case Name	b0d-s709aa.xzqV424-pcs	b0d-s709aa.xzqV424-pct	b0d-s709aa.xzqV424-pys	b0d-s709aa.xzqV424-pyt	b0d-s709aa.xzqV424-au3
Disturbance	pcs	pct	pys	pyt	au3
Prior Outage	None	None	None	None	None
Date/Time	SEP 21 2006 16:05	SEP 21 2006 16:13	SEP 21 2006 16:29	SEP 21 2006 16:21	SEP 22 2006 9:14
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 374	2080 / 374	2080 / 374	2080 / 374	2080 / 374
MHEX / L20D	2175 / 234	2175 / 234	2175 / 234	2175 / 234	2175 / 234
ECL-ARP / PRI-BYN	520 / 718	520 / 718	520 / 718	520 / 718	520 / 718
MWSI / MNEX	1239	1239	1239	1239	1239
D602F / F601C	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611	1821 / 1611
B10T / MH>SPC	163 / 19	163 / 19	163 / 19	163 / 19	163 / 19
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	148 / 151	148 / 151	148 / 151	148 / 151	148 / 151
G82R	-28	-28	-28	-28	-28
Dorsey bipole / CU bipole	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104	3228 / 1104
Dorsey Reserve / Wtrtn SVC	233 / -37	233 / -37	233 / -37	233 / -37	233 / -37
Forbes SVC / MSC	-55 / 600	-55 / 600	-55 / 600	-55 / 600	-55 / 600
Arrowhd-Wstrn/ RCDC	549 / 0	549 / 0	549 / 0	549 / 0	549 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996
Chisago 500/EauClaire 345	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022
Int Falls 115/Badoura 115	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015
Drayton 230/Groton 345	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	217% / 343%	217% / 343%	217% / 343%	217% / 343%	217% / 343%
B2R at Rugby/L20D at Drayton	999% / 865%	999% / 865%	999% / 865%	999% / 865%	999% / 865%
R50M/F3M	869% / 331%	869% / 331%	869% / 331%	869% / 331%	869% / 331%
B10T	335%	335%	335%	335%	335%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.89   0.99	0.95   0.97	0.98   1.01	0.99   1.01	1.00   1.01
Boise 115	1.00   1.07	1.02   1.03	1.00   1.05	1.02   1.04	1.02   1.03
Dorsey 230	1.02   1.09	1.04   1.05	1.03   1.07	1.04   1.05	1.04   1.05
Forbes 230	0.99   1.04	1.00   1.01	1.00   1.06	1.00   1.02	1.00   1.01
Riverton 230	0.99   1.02	1.00   1.02	1.00   1.03	1.01   1.03	1.00   1.02
Coal Creek 230	0.96   1.08	1.02   1.04	0.98   1.08	1.02   1.05	1.02   1.06
Dickinson 345	0.96   1.05	0.98   1.00	0.98   1.04	0.98   1.00	0.98   1.01
Drayton 230	1.01   1.05	1.01   1.02	0.99   1.03	1.01   1.03	1.01   1.02
Groton 345	0.99   1.05	1.02   1.04	1.00   1.04	1.02   1.04	1.01   1.05
Tioga 230	0.98   1.03	1.02   1.03	0.99   1.03	1.02   1.03	1.02   1.03
Wahpeton 115	1.00   1.05	1.02   1.03	1.01   1.04	1.02   1.04	1.01   1.03
Watertown 345	1.01   1.04	1.03   1.04	1.01   1.04	1.03   1.04	1.03   1.04
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold					
Forbes DC Red (DCAR)	152%	325%	152%	355%	479%
K22W (max +dP @ t, d-ang)	5.0@(3.47497,1.9)	0.0@(0.06667,0.0)	8.2@(2.49999,-0.2)	0.0@(0.06667,0.0)	3.4@(2.27499,0.0)
K22W (max -dP @ t, d-ang)	44.0@(0.39166,7.9)	25.7@(2.29166,11.9)	30.6@(1.67500,9.2)	18.8@(1.76666,8.3)	3.6@(0.61666,0.7)
K22W (max d-ang @ t, dP)	24.0@(1.08333,-34.6)	12.3@(19.99972,-17.5)	18.6@(1.07500,-21.8)	8.8@(2.12499,-17.7)	1.2@(0.90000,-0.3)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	168% / 260%	217% / 342%	167% / 257%	217% / 343%	206% / 325%
B2R at Rugby/L20D at Drayton	999% / 598%	999% / 790%	999% / 638%	999% / 794%	999% / 813%
R50M / F3M	636% / 328%	806% / 331%	675% / 303%	840% / 331%	839% / 315%
B10T	149%	289%	171%	287%	295%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)	(0 0 0)
Eau Cl 345 / Park Lk 115	(3 4 2)/(0 3 3)	(3 3 2)/(0 0 0)	(3 4 4)/(0 3 3)	(3 3 3)/(0 0 0)	(3 3 3)/(0 0 0)
Prairie 115 / Ramsey 230	(1 3 2)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)
Roseau 230 / Running 230	(0 1 1)/(1 2 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)	(0 0 0)/(1 1 1)
Shey 115 / Split Rock 115	(1 2 2)/(0 0 0)	(1 1 1)/(0 0 0)	(1 2 2)/(0 0 0)	(1 1 1)/(0 0 0)	(1 1 1)/(0 0 0)
<b>Damping Performance</b>					
	NONE	NONE	NONE	NONE	N/A

**Appendix C.3 (Cont.): Simulation Summary Tables for Baseline Analysis (With Project G132)**

1	<b>Case No.</b>	19	20	21
2	<b>Case Name</b>	b0d-s709aa.xzqV424-au9	b0d-s709aa.xzqV424-ad3	b0d-s709aa.xzqV424-ax3
3	<b>Disturbance</b>	au9	ad3	ax3
4	<b>Prior Outage</b>	None	None	None
5	<b>Date/Time</b>	SEP 21 2006 16:48	SEP 21 2006 17:04	SEP 21 2006 16:56
6	<b>Comments</b>			
7				
8	<b>Steady State Flows</b>			
9	NDEX / EAST BIAS	2080 / 374	2080 / 374	2080 / 374
10	MHEX / L20D	2175 / 234	2175 / 234	2175 / 234
11	ECL-ARP / PRI-BYN	520 / 718	520 / 718	520 / 718
12	MWSI / MNEX	1239	1239	1239
13	D602F / F601C	1821 / 1611	1821 / 1611	1821 / 1611
14	B10T / MH>SPC	163 / 19	163 / 19	163 / 19
15	OH E-W / OH>MH	98 / -196	98 / -196	98 / -196
16	R50M / OH>MP	148 / 151	148 / 151	148 / 151
17	G82R	-28	-28	-28
18	Dorsey bipole / CU bipole	3228 / 1104	3228 / 1104	3228 / 1104
19	Dorsey Reserve / Wtrtn SVC	233 / -37	233 / -37	233 / -37
20	Forbes SVC / MSC	-55 / 600	-55 / 600	-55 / 600
21	Arrowhd-Wstrn/ RCDL	549 / 0	549 / 0	549 / 0
22	<b>Steady State Vltgs</b>			
23	Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
24	Roseau 500/Forbes 500	1.057 / 0.996	1.057 / 0.996	1.057 / 0.996
25	Chisago 500/EauClaire 345	1.002 / 1.022	1.002 / 1.022	1.002 / 1.022
26	Int Falls 115/Badoura 115	1.026 / 1.015	1.026 / 1.015	1.026 / 1.015
27	Drayton 230/Groton 345	1.014 / 1.033	1.014 / 1.033	1.014 / 1.033
28	<b>SS OS Relay Margins</b>			
29	D602F at Forbes/Dorsey	217% / 343%	217% / 343%	217% / 343%
30	B2R at Rugby/L20D at Drayton	999% / 865%	999% / 865%	999% / 865%
31	R50M/F3M	869% / 331%	869% / 331%	869% / 331%
32	B10T	335%	335%	335%
33	<b>Min/MaxTransientVltg</b>			
34	Arrowhd 230	1.00   1.01	0.99   1.03	1.00   1.01
35	Boise 115	1.02   1.03	1.00   1.04	1.02   1.03
36	Dorsey 230	1.04   1.05	1.03   1.06	1.04   1.05
37	Forbes 230	1.00   1.01	0.99   1.02	1.00   1.01
38	Riverton 230	1.00   1.02	0.98   1.05	1.00   1.02
39	Coal Creek 230	1.02   1.05	0.97   1.12	1.02   1.06
40	Dickinson 345	0.99   1.01	0.95   1.04	0.99   1.01
41	Drayton 230	1.01   1.02	0.99   1.09	1.01   1.02
42	Groton 345	1.02   1.04	0.92   1.09	1.01   1.05
43	Tioga 230	1.02   1.03	0.98   1.05	1.02   1.03
44	Wahpeton 115	1.01   1.03	0.97   1.09	1.01   1.03
45	Watertown 345	1.03   1.04	0.97   1.07	1.03   1.04
46	<b>Dynamic Voltage Warnings</b>			
47		none	none	none
48				
49				
50				
51				
52				
53				
54	<b>Worst Case Angle Damping</b>	KING 3 / 62.92%	KING 3 / 69.88%	KING 3 / 62.17%
55	<b>Dorsey SUVP / UdHold</b>			
56	Forbes DC Red (DCAR)	485%	393%	482%
57	K22W (max +dP @ t, d-ang)	2.8@(2.27499,0.0)	15.4@(2.39999,-1.2)	3.7@(2.26666,-0.2)
58	K22W (max -dP @ t, d-ang)	3.1@(0.60833,0.6)	13.2@(0.67500,2.8)	3.3@(0.60833,0.6)
59	K22W (max d-ang @ t, dP)	0.9@(0.89166,-0.4)	4.7@(0.99166,-2.1)	1.0@(0.88333,-0.4)
60	<b>OS Rel Trip / Marg</b>			
61	MH - OH			
62	D602F at Forbes/Dorsey	208% / 329%	178% / 279%	207% / 327%
63	B2R at Rugby/L20D at Drayton	999% / 823%	999% / 685%	999% / 811%
64	R50M / F3M	844% / 318%	758% / 277%	842% / 316%
65	B10T	302%	189%	295%
66	<b>FSCAPS (SS/Unav/Final)</b>			
67	Balta 230	( 0   0   0 )	( 0   1   0 )	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 1   1   1 ) / ( 0   0   0 )	( 1   3   1 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / Split Rock 115	( 1   1   1 ) / ( 0   0   0 )	( 1   4   2 ) / ( 0   0   0 )	( 1   1   1 ) / ( 0   0   0 )
72	<b>Damping Performance</b>	NONE	NONE	NONE

**Appendix C.4: Simulation Summary Tables With GI-0217 and With G132**

Case No.	1	2	3	4	5
Case Name	b1d-s709aa.xzqV424-ag1	b1d-s709aa.xzqV424-ag3	b1d-s709aa.xzqV424-ah3	b1d-s709aa.xzqV424-al1	b1d-s709aa.xzqV424-am1
Disturbance	ag1	ag3	ah3	al1	am1
Prior Outage	None	None	None	None	None
Date/Time	SEP 21 2006 11:22	SEP 21 2006 11:25	SEP 21 2006 10:55	SEP 21 2006 11:31	SEP 21 2006 11:43
Comments					
<b>Steady State Flows</b>					
NDEX / EAST BIAS	2080 / 357	2080 / 357	2080 / 357	2080 / 357	2080 / 357
MHEX / L20D	2175 / 255	2175 / 255	2175 / 255	2175 / 255	2175 / 255
ECL-ARP / PRI-BYN	522 / 717	522 / 717	522 / 717	522 / 717	522 / 717
MWSI / MNEX	1239	1239	1239	1239	1239
D602F / F601C	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595
B10T / MH>SPC	165 / 21	165 / 21	165 / 21	165 / 21	165 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-39	-39	-39	-39	-39
Dorsey bipole / CU bipole	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103
Dorsey Reserve / Wtrtn SVC	246 / -37	246 / -37	246 / -37	246 / -37	246 / -37
Forbes SVC / MSC	-61 / 600	-61 / 600	-61 / 600	-61 / 600	-61 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>					
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032
Drayton 230/Groton 345	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026
<b>SS OS Relay Margins</b>					
D602F at Forbes/Dorsey	222% / 351%	222% / 351%	222% / 351%	222% / 351%	222% / 351%
B2R at Rugby/L20D at Drayton	999% / 781%	999% / 781%	999% / 781%	999% / 781%	999% / 781%
R50M/F3M	880% / 332%	880% / 332%	880% / 332%	880% / 332%	880% / 332%
B10T	340%	340%	340%	340%	340%
<b>Min/MaxTransientVltg</b>					
Arrowhd 230	0.98   1.02	0.97   1.02	0.97   1.02	0.99   1.04	0.99   1.04
Boise 115	1.00   1.04	1.00   1.04	1.00   1.06	1.01   1.06	1.01   1.06
Dorsey 230	1.03   1.06	1.02   1.05	1.02   1.06	1.03   1.07	1.03   1.07
Forbes 230	0.99   1.02	0.99   1.02	0.99   1.03	0.99   1.04	0.99   1.04
Riverton 230	0.97   1.05	0.96   1.04	0.96   1.05	0.99   1.07	0.99   1.07
Coal Creek 230	0.95   1.13	0.95   1.13	0.95   1.13	0.95   1.11	0.95   1.11
Dickinson 345	0.94   1.04	0.94   1.03	0.94   1.04	0.95   1.04	0.95   1.04
Drayton 230	0.97   1.10	0.97   1.09	0.96   1.11	0.97   1.07	0.97   1.08
Groton 345	0.87   1.07	0.86   1.06	0.98   1.10	0.85   1.13	0.86   1.13
Tioga 230	0.99   1.07	0.98   1.07	0.98   1.07	1.00   1.06	1.00   1.06
Wahpeton 115	0.93   1.07	0.91   1.06	0.91   1.07	0.97   1.10	0.96   1.09
Watertown 345	0.95   1.06	0.94   1.06	0.99   1.08	0.94   1.11	0.94   1.11
<b>Dynamic Voltage Warnings</b>					
	none	none	none	none	none
<b>Worst Case Angle Damping</b>					
Dorsey SUVP / UdHold				KING 3 / 53.17%	KING 3 / 53.46%
Forbes DC Red (DCAR)	406%	400%	395%	460%	458%
K22W (max +dP @ t, d-ang)	12.4@(2.68332,2.7)	14.5@(2.67499,1.4)	16.9@(2.73332,1.0)	39.0@(2.87498,-5.8)	39.3@(2.87498,-6.2)
K22W (max -dP @ t, d-ang)	23.5@(0.86666,6.2)	26.3@(0.85833,7.9)	25.8@(0.88333,7.4)	3.6@(0.39166,0.2)	5.0@(0.39166,0.3)
K22W (max d-ang @ t, dP)	9.3@(1.17500,-7.4)	11.1@(1.16666,-10.7)	10.5@(1.19166,-11.5)	-14.8@(2.17499,15.2)	-14.9@(2.17499,16.2)
<b>OS Rel Trip / Marg</b>					
MH - OH					
D602F at Forbes/Dorsey	163% / 252%	158% / 244%	155% / 238%	195% / 307%	195% / 308%
B2R at Rugby/L20D at Drayton	999% / 588%	999% / 575%	999% / 563%	999% / 520%	999% / 515%
R50M / F3M	705% / 267%	688% / 267%	679% / 264%	833% / 255%	831% / 255%
B10T	169%	160%	173%	174%	172%
<b>FSCAPS (SS/Unav/Final)</b>					
Balta 230	(0   3   0)	(0   3   0)	(0   3   0)	(0   2   0)	(0   2   0)
Eau Cl 345 / Park Lk 115	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)	(3   3   3) / (0   0   0)
Prairie 115 / Ramsey 230	(2   9   3) / (0   0   0)	(2   8   3) / (0   0   0)	(2   8   3) / (0   0   0)	(2   7   2) / (0   0   0)	(2   8   2) / (0   0   0)
Roseau 230 / Running 230	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   1   1) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
Shay 115 / Split Rock 115	(2   5   3) / (0   0   0)	(2   5   4) / (0   0   0)	(2   5   4) / (0   0   0)	(2   5   0) / (0   0   0)	(2   5   0) / (0   0   0)
Damping Performance	N/A	N/A	N/A	NONE	NONE

**Appendix C.4 (Cont.) - Simulation Summary Tables With GI-0217 and With G132**

Case No.	6	7	8	9
Case Name	b1d-s709aa.xzqV424-ei2	b1d-s709aa.xzqV424-fd1	b1d-s709aa.xzqV424-fdk	b1d-s709aa.xzqV424-fd3
Disturbance	ei2	fd1	fdk	fd3
Prior Outage	None	None	None	None
Date/Time	SEP 21 2006 10:59	SEP 21 2006 11:02	SEP 21 2006 11:06	SEP 21 2006 11:09
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 357	2080 / 357	2080 / 357	2080 / 357
MHEX / L20D	2175 / 255	2175 / 255	2175 / 255	2175 / 255
ECL-ARP / PRI-BYN	522 / 717	522 / 717	522 / 717	522 / 717
MWSI / MNEX	1239	1239	1239	1239
D602F / F601C	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595
B10T / MH>SPC	165 / 21	165 / 21	165 / 21	165 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-39	-39	-39	-39
Dorsey bipole / CU bipole	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103
Dorsey Reserve / Wtrtn SVC	246 / -37	246 / -37	246 / -37	246 / -37
Forbes SVC / MSC	-61 / 600	-61 / 600	-61 / 600	-61 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032
Drayton 230/Groton 345	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	222% / 351%	222% / 351%	222% / 351%	222% / 351%
B2R at Rugby/L20D at Drayton	999% / 781%	999% / 781%	999% / 781%	999% / 781%
R50M/F3M	880% / 332%	880% / 332%	880% / 332%	880% / 332%
B10T	340%	340%	340%	340%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.05	0.99   1.04	1.01   1.05	0.94   1.03
Boise 115	0.98   1.06	0.99   1.07	1.01   1.04	1.00   1.06
Dorsey 230	1.01   1.07	1.02   1.06	1.03   1.06	1.02   1.06
Forbes 230	0.94   1.02	0.98   1.04	1.00   1.03	0.98   1.03
Riverton 230	0.88   1.07	0.94   1.07	0.99   1.06	0.92   1.06
Coal Creek 230	0.97   1.15	0.96   1.14	0.98   1.11	0.95   1.16
Dickinson 345	0.98   1.05	0.93   1.05	0.96   1.04	0.93   1.05
Drayton 230	0.91   1.12	0.96   1.12	0.99   1.07	0.97   1.10
Groton 345	0.81   1.15	0.88   1.12	0.98   1.11	0.87   1.12
Tioga 230	0.98   1.08	1.00   1.07	1.01   1.06	0.99   1.07
Wahpeton 115	0.81   1.11	0.85   1.10	0.96   1.09	0.84   1.09
Watertown 345	0.87   1.13	0.93   1.10	1.01   1.10	0.92   1.11
<b>Dynamic Voltage Warnings</b>				
		63199 [JAMSTN1Y] 0.66 63200 [JAMSTN2Y] 0.66 63369 [JAMSTN3] 0.66 63271 [AVIKO 7] 0.67 63272 [JAMESPK7] 0.67 63273 [JAMETAP7] 0.67 63274 [JAMSDTN7] 0.67 +more	none	63199 [JAMSTN1Y] 0.67 63200 [JAMSTN2Y] 0.67 63369 [JAMSTN3] 0.67 63272 [JAMESPK7] 0.68 63273 [JAMETAP7] 0.68 63274 [JAMSDTN7] 0.68 63275 [NJAMES 7] 0.68 +more
Worst Case Angle Damping				/ 0.166
Dorsey SUVV / UdHold				
Forbes DC Red (DCAR)	507%	332%	484%	334%
K22W (max +dP @ t, d-ang)	72.9@(3.08331,-26.2)	28.1@(2.84165,-0.9)	45.5@(2.51666,-15.7)	32.7@(2.72499,-2.7)
K22W (max -dP @ t, d-ang)	10.9@(1.13333,-3.4)	25.5@(0.93333,4.6)	2.6@(0.31667,-0.2)	23.8@(0.92500,7.9)
K22W (max d-ang @ t, dP)	-40.6@(2.38332,52.1)	-9.0@(2.18333,-14.4)	-19.6@(1.93333,28.0)	10.6@(1.19166,-11.2)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	119% / 179%	152% / 234%	189% / 295%	162% / 250%
B2R at Rugby/L20D at Drayton	999% / 411%	999% / 524%	999% / 528%	999% / 480%
R50M / F3M	615% / 188%	677% / 244%	739% / 248%	714% / 260%
B10T	62%	133%	136%	103%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   1   0 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 3   3   2 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   3 ) / ( 0   0   0 )	( 2   10   3 ) / ( 0   0   0 )	( 2   4   2 ) / ( 0   0   0 )	( 2   8   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   3   2 )	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   2   1 )
Shey 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   2   2 )	( 2   5   1 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   2   2 )
Damping Performance	N/A	N/A	N/A	N/A

**Appendix C.4 (Cont.) - Simulation Summary Tables With GI-0217 and With G132**

Case No.	10	11	12	13
Case Name	b1d-s709aa.xzqV424-fd4	b1d-s709aa.xzqV424-fdl	b1d-s709aa.xzqV424-nbz	b1d-s709aa.xzqV424-nmz
Disturbance	fd4	fdl	nbz	nmz
Prior Outage	None	None	None	None
Date/Time	SEP 21 2006 11:12	SEP 21 2006 11:15	SEP 21 2006 11:18	SEP 21 2006 14:30
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 357	2080 / 357	2080 / 357	2080 / 357
MHEX / L20D	2175 / 255	2175 / 255	2175 / 255	2175 / 255
ECL-ARP / PRI-BYN	522 / 717	522 / 717	522 / 717	522 / 717
MWSI / MNEX	1239	1239	1239	1239
D602F / F601C	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595
B10T / MH>SPC	165 / 21	165 / 21	165 / 21	165 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-39	-39	-39	-39
Dorsey bipole / CU bipole	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103
Dorsey Reserve / Wtrtn SVC	246 / -37	246 / -37	246 / -37	246 / -37
Forbes SVC / MSC	-61 / 600	-61 / 600	-61 / 600	-61 / 600
Arrowhd-Wstrn/ RCDL	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032
Drayton 230/Groton 345	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	222% / 351%	222% / 351%	222% / 351%	222% / 351%
B2R at Rugby/L20D at Drayton	999% / 781%	999% / 781%	999% / 781%	999% / 781%
R50M/F3M	880% / 332%	880% / 332%	880% / 332%	880% / 332%
B10T	340%	340%	340%	340%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.03	0.97   1.04	0.89   1.09	0.93   1.07
Boise 115	0.99   1.06	1.01   1.05	0.94   1.06	0.94   1.06
Dorsey 230	1.02   1.06	1.03   1.06	1.04   1.20	1.04   1.20
Forbes 230	0.98   1.04	0.99   1.03	0.93   1.08	0.98   1.03
Riverton 230	0.93   1.08	0.99   1.07	0.87   1.07	0.88   1.06
Coal Creek 230	0.97   1.15	0.97   1.11	0.94   1.12	0.95   1.12
Dickinson 345	0.93   1.05	0.95   1.04	0.93   1.07	0.94   1.07
Drayton 230	0.97   1.12	0.98   1.09	0.95   1.12	0.96   1.13
Groton 345	0.89   1.13	0.97   1.12	0.84   1.11	0.84   1.11
Tioga 230	0.99   1.07	1.01   1.05	0.98   1.08	0.98   1.08
Wahpeton 115	0.85   1.10	0.96   1.10	0.82   1.09	0.82   1.09
Watertown 345	0.94   1.11	1.01   1.11	0.89   1.10	0.89   1.10
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.64 63200 [JAMSTN2Y] 0.64 63369 [JAMSTN3] 0.64 63269 [JAMSTWN7] 0.66 63270 [LADISH 7] 0.66 63271 [AVIKO 7] 0.66 63272 [JAMESPK7] 0.66 +more	none		
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold			/ 0.133	/ 0.133
Forbes DC Red (DCAR)	313%	480%	507%	507%
K22W (max +dP @ t, d-ang)	32.8@(2.76665,-1.8)	49.7@(2.49999,-15.5)	142.1@(2.69999,-62.5)	136.5@(2.72499,-59.8)
K22W (max -dP @ t, d-ang)	24.3@(0.88333,4.7)	2.6@(0.32500,-0.2)	88.1@(0.24167,7.3)	89.6@(0.23333,7.0)
K22W (max d-ang @ t, dP)	9.6@(1.25000,-4.1)	-19.6@(1.91666,28.8)	-67.2@(2.39166,124.8)	-64.8@(2.37499,117.6)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	163% / 252%	188% / 294%	0.18333 sec / 0.18333 sec	0.18333 sec / 0.18333 sec
B2R at Rugby/L20D at Drayton	999% / 485%	999% / 479%	999% / 533%	999% / 534%
R50M / F3M	724% / 258%	736% / 256%	366% / 146%	385% / 149%
B10T	111%	116%	104%	112%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   1   0 )	( 0   1   0 )	( 0   2   0 )	( 0   2   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )	( 3   3   1 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   8   2 ) / ( 0   0   0 )	( 2   6   2 ) / ( 0   0   0 )	( 2   7   2 ) / ( 0   0   0 )	( 2   8   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   3   0 )	( 0   1   0 ) / ( 1   3   1 )
Shey 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   0 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   2   2 )
Damping Performance	N/A	N/A	N/A	N/A



**Appendix C.4 (Cont.) - Simulation Summary Tables With GI-0217 and With G132**

1	<b>Case No.</b>	14	15	16	17
2	<b>Case Name</b>	b1d-s709aa.xzqV424-pcs	b1d-s709aa.xzqV424-pct	b1d-s709aa.xzqV424-pys	b1d-s709aa.xzqV424-pyt
3	<b>Disturbance</b>	pcs	pct	pys	pyt
4	<b>Prior Outage</b>	None	None	None	None
5	<b>Date/Time</b>	SEP 21 2006 11:55	SEP 21 2006 12:03	SEP 21 2006 12:19	SEP 21 2006 12:11
6	<b>Comments</b>				
7					
8	<b>Steady State Flows</b>				
9	NDEX / EAST BIAS	2080 / 357	2080 / 357	2080 / 357	2080 / 357
10	MHEX / L20D	2175 / 255	2175 / 255	2175 / 255	2175 / 255
11	ECL-ARP / PRI-BYN	522 / 717	522 / 717	522 / 717	522 / 717
12	MWSI / MNEX	1239	1239	1239	1239
13	D602F / F601C	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595
14	B10T / MH>SPC	165 / 21	165 / 21	165 / 21	165 / 21
15	OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
16	R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
17	G82R	-39	-39	-39	-39
18	Dorsey bipole / CU bipole	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103
19	Dorsey Reserve / Wtrtn SVC	246 / -37	246 / -37	246 / -37	246 / -37
20	Forbes SVC / MSC	-61 / 600	-61 / 600	-61 / 600	-61 / 600
21	Arrowhd-Wstrn/ RCDL	547 / 0	547 / 0	547 / 0	547 / 0
22	<b>Steady State Vltgs</b>				
23	Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
24	Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
25	Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
26	Int Falls 115/Badoura 115	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032
27	Drayton 230/Groton 345	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026
28	<b>SS OS Relay Margins</b>				
29	D602F at Forbes/Dorsey	222% / 351%	222% / 351%	222% / 351%	222% / 351%
30	B2R at Rugby/L20D at Drayton	999% / 781%	999% / 781%	999% / 781%	999% / 781%
31	R50M/F3M	880% / 332%	880% / 332%	880% / 332%	880% / 332%
32	B10T	340%	340%	340%	340%
33	<b>Min/MaxTransientVltg</b>				
34	Arrowhd 230	0.89   1.00	0.95   0.98	0.99   1.02	0.99   1.01
35	Boise 115	1.00   1.07	1.02   1.03	1.01   1.05	1.02   1.04
36	Dorsey 230	1.03   1.09	1.04   1.05	1.03   1.08	1.04   1.05
37	Forbes 230	0.99   1.04	1.00   1.01	0.99   1.06	1.00   1.02
38	Riverton 230	0.99   1.04	1.01   1.03	1.00   1.04	1.02   1.03
39	Coal Creek 230	0.97   1.08	1.02   1.05	0.98   1.07	1.02   1.05
40	Dickinson 345	0.96   1.05	0.98   1.00	0.98   1.04	0.98   1.00
41	Drayton 230	1.00   1.05	1.01   1.03	0.99   1.04	1.01   1.03
42	Groton 345	0.99   1.05	1.02   1.04	0.99   1.05	1.02   1.03
43	Tioga 230	1.00   1.05	1.03   1.04	1.01   1.05	1.03   1.04
44	Wahpeton 115	1.00   1.05	1.01   1.03	1.00   1.04	1.02   1.03
45	Watertown 345	1.01   1.04	1.03   1.04	1.01   1.04	1.03   1.04
46	<b>Dynamic Voltage Warnings</b>				
47		none	none	none	none
48					
49					
50					
51					
52					
53					
54	<b>Worst Case Angle Damping</b>	SHERC3 / 71.72%	SHERC3 / 57.71%	SHERC3 / 74.42%	SHERC3 / 66.22%
55	<b>Dorsey SUVP / UdHold</b>				
56	Forbes DC Red (DCAR)	166%	321%	165%	353%
57	K22W (max +dP @ t, d-ang)	2.4@(2.87498,0.3)	0.0@(0.10000,0.0)	8.7@(2.79998,-1.7)	0.0@(0.10000,0.0)
58	K22W (max -dP @ t, d-ang)	43.4@(0.39166,7.8)	25.9@(2.54999,11.3)	28.0@(1.65833,10.3)	18.9@(1.71666,8.2)
59	K22W (max d-ang @ t, dP)	23.5@(1.10833,-37.8)	12.2@(19.99972,-17.3)	18.2@(1.10000,-23.6)	8.9@(2.07500,-17.0)
60	<b>OS Rel Trip / Marg</b>				
61	MH - OH				
62	D602F at Forbes/Dorsey	182% / 283%	220% / 347%	180% / 278%	222% / 351%
63	B2R at Rugby/L20D at Drayton	999% / 534%	999% / 710%	999% / 578%	999% / 713%
64	R50M / F3M	672% / 332%	812% / 332%	709% / 319%	848% / 332%
65	B10T	141%	289%	162%	289%
66	<b>FSCAPS (SS/Unav/Final)</b>				
67	Balta 230	(0   1   0)	(0   0   0)	(0   0   0)	(0   0   0)
68	Eau Cl 345 / Park Lk 115	(3   4   2) / (0   3   3)	(3   3   2) / (0   0   0)	(3   4   4) / (0   3   3)	(3   3   3) / (0   0   0)
69	Prairie 115 / Ramsey 230	(2   3   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   2   2) / (0   0   0)	(2   2   2) / (0   0   0)
70	Roseau 230 / Running 230	(0   0   0) / (1   2   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)	(0   0   0) / (1   1   1)
71	Shey 115 / Split Rock 115	(2   3   3) / (0   0   0)	(2   2   2) / (0   0   0)	(2   3   3) / (0   0   0)	(2   2   2) / (0   0   0)
72	<b>Damping Performance</b>	NONE	NONE	NONE	NONE

**Appendix C.4 (Cont.) - Simulation Summary Tables With GI-0217 and With G132**

Case No.	18	19	20	21
Case Name	b1d-s709aa.xzqv424-au3	b1d-s709aa.xzqv424-au9	b1d-s709aa.xzqv424-ad3	b1d-s709aa.xzqv424-ax3
Disturbance	au3	au9	ad3	ax3
Prior Outage	None	None	None	None
Date/Time	SEP 21 2006 13:41	SEP 21 2006 13:50	SEP 21 2006 14:07	SEP 21 2006 13:59
Comments				
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 357	2080 / 357	2080 / 357	2080 / 357
MHEX / L20D	2175 / 255	2175 / 255	2175 / 255	2175 / 255
ECL-ARP / PRI-BYN	522 / 717	522 / 717	522 / 717	522 / 717
MWSI / MNEX	1239	1239	1239	1239
D602F / F601C	1811 / 1595	1811 / 1595	1811 / 1595	1811 / 1595
B10T / MH>SPC	165 / 21	165 / 21	165 / 21	165 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-39	-39	-39	-39
Dorsey bipole / CU bipole	3230 / 1103	3230 / 1103	3230 / 1103	3230 / 1103
Dorsey Reserve / Wtrtn SVC	246 / -37	246 / -37	246 / -37	246 / -37
Forbes SVC / MSC	-61 / 600	-61 / 600	-61 / 600	-61 / 600
Arrowhd-Wstrn/ RCD	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032	1.027 / 1.032
Drayton 230/Groton 345	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026	1.015 / 1.026
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	222% / 351%	222% / 351%	222% / 351%	222% / 351%
B2R at Rugby/L20D at Drayton	999% / 781%	999% / 781%	999% / 781%	999% / 781%
R50M/F3M	880% / 332%	880% / 332%	880% / 332%	880% / 332%
B10T	340%	340%	340%	340%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.99   1.04	0.99   1.04	0.98   1.03	1.00   1.02
Boise 115	0.99   1.06	0.99   1.07	1.00   1.05	1.02   1.04
Dorsey 230	0.97   1.07	0.97   1.07	0.99   1.06	1.04   1.05
Forbes 230	0.98   1.02	0.98   1.03	0.98   1.03	1.00   1.02
Riverton 230	0.98   1.05	0.99   1.05	0.98   1.06	1.00   1.03
Coal Creek 230	0.96   1.10	0.97   1.10	0.96   1.12	0.99   1.08
Dickinson 345	0.95   1.04	0.96   1.03	0.95   1.04	0.97   1.02
Drayton 230	0.95   1.08	0.95   1.07	0.94   1.08	0.99   1.03
Groton 345	0.98   1.09	0.98   1.08	0.93   1.09	0.99   1.06
Tioga 230	0.98   1.08	0.98   1.08	0.99   1.07	1.01   1.05
Wahpeton 115	0.96   1.08	0.96   1.07	0.95   1.08	0.99   1.04
Watertown 345	1.01   1.07	1.01   1.07	0.98   1.07	1.01   1.05
<b>Dynamic Voltage Warnings</b>				
	67263 [LTLMISS7] 0.56	67263 [LTLMISS7] 0.63	none	none
	67265 [LTLMISS4] 0.58	67265 [LTLMISS4] 0.65		
	67304 [BAKER 4] 0.59	67304 [BAKER 4] 0.66		
	67305 [BAKER 7] 0.60	67310 [BOWMAN 4] 0.67		
	67310 [BOWMAN 4] 0.61	67348 [HETINGR7] 0.68		
	67348 [HETINGR7] 0.62	67350 [GASCOYN7] 0.68		
	66411 [MI CTYE4] 0.63 +more	67305 [BAKER 7] 0.68 +more		
Worst Case Angle Damping	STANT4 / -44.21%	SHERC3 / -11.72%	KING 3 / 3.61%	ANTEL3 / 61.42%
Dorsey SUVP / UdHold	/ 17.808	/ 17.933	/ 15.483	
Forbes DC Red (DCAR)	421%	424%	393%	442%
K22W (max +dP @ t, d-ang)	52.9@(19.17474,-9.6)	54.6@(19.31640,-10.5)	16.6@(2.64999,-0.1)	8.5@(2.49999,0.5)
K22W (max -dP @ t, d-ang)	14.4@(9.39988,-2.4)	12.9@(3.79164,-2.3)	23.7@(17.05810,0.7)	6.4@(1.91666,-1.8)
K22W (max d-ang @ t, dP)	-19.3@(19.70806,27.0)	-20.6@(19.85806,28.9)	5.5@(1.03333,-3.1)	-2.2@(1.76666,-4.0)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	168% / 256%	165% / 250%	179% / 279%	201% / 317%
B2R at Rugby/L20D at Drayton	999% / 607%	999% / 595%	999% / 620%	999% / 673%
R50M / F3M	728% / 256%	715% / 254%	743% / 276%	825% / 299%
B10T	173%	193%	183%	257%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )	( 0   0   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   1   0 ) / ( 1   2   1 )	( 0   1   1 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shay 115 / Split Rock 115	( 2   5   2 ) / ( 0   0   0 )	( 2   5   3 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )
<b>Damping Performance</b>	NONE	NONE	NONE	NONE

**Appendix C.4 (Cont.) - Simulation Summary Tables With GI-0217 and With G132**

1	<b>Case No.</b>	22
2	<b>Case Name</b>	b1d-s709aa.xzqV424-auj
3	<b>Disturbance</b>	auj
4	<b>Prior Outage</b>	None
5	<b>Date/Time</b>	SEP 21 2006 11:28
6	<b>Comments</b>	
7		
8	<b>Steady State Flows</b>	
9	NDEX / EAST BIAS	2080 / 357
10	MHEX / L20D	2175 / 255
11	ECL-ARP / PRI-BYN	522 / 717
12	MWSI / MNEX	1239
13	D602F / F601C	1811 / 1595
14	B10T / MH>SPC	165 / 21
15	OH E-W / OH>MH	98 / -196
16	R50M / OH>MP	147 / 151
17	G82R	-39
18	Dorsey bipole / CU bipole	3230 / 1103
19	Dorsey Reserve / Wtrtn SVC	246 / -37
20	Forbes SVC / MSC	-61 / 600
21	Arrowhd-Wstrn/ RCDC	547 / 0
22	<b>Steady State Vltgs</b>	
23	Dorsey 500/Dorsey 230	1.029 / 1.045
24	Roseau 500/Forbes 500	1.058 / 0.999
25	Chisago 500/EauClaire 345	1.005 / 1.024
26	Int Falls 115/Badoura 115	1.027 / 1.032
27	Drayton 230/Groton 345	1.015 / 1.026
28	<b>SS OS Relay Margins</b>	
29	D602F at Forbes/Dorsey	222% / 351%
30	B2R at Rugby/L20D at Drayton	999% / 781%
31	R50M/F3M	880% / 332%
32	B10T	340%
33	<b>Min/MaxTransientVltg</b>	
34	Arrowhd 230	1.01   1.03
35	Boise 115	1.01   1.04
36	Dorsey 230	1.04   1.05
37	Forbes 230	1.00   1.02
38	Riverton 230	1.02   1.05
39	Coal Creek 230	1.01   1.09
40	Dickinson 345	0.99   1.03
41	Drayton 230	1.01   1.04
42	Groton 345	1.04   1.09
43	Tioga 230	1.02   1.05
44	Wahpeton 115	1.02   1.06
45	Watertown 345	1.04   1.08
46	<b>Dynamic Voltage Warnings</b>	
47		none
48		
49		
50		
51		
52		
53		
54	<b>Worst Case Angle Damping</b>	
55	Dorsey SUVP / UdHold	
56	Forbes DC Red (DCAR)	500%
57	K22W (max +dP @ t, d-ang)	44.1@(2.14166,-16.3)
58	K22W (max -dP @ t, d-ang)	0.7@(0.24167,0.0)
59	K22W (max d-ang @ t, dP)	-16.5@(2.40832,38.5)
60	<b>OS Rel Trip / Marg</b>	
61	MH - OH	
62	D602F at Forbes/Dorsey	203% / 319%
63	B2R at Rugby/L20D at Drayton	999% / 577%
64	R50M / F3M	850% / 268%
65	B10T	154%
66	<b>FSCAPS (SS/Unav/Final)</b>	
67	Balta 230	( 0   0   0 )
68	Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )
69	Prairie 115 / Ramsey 230	( 2   2   2 ) / ( 0   0   0 )
70	Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )
71	Shey 115 / Split Rock 115	( 2   2   2 ) / ( 0   0   0 )
72	<b>Damping Performance</b>	N/A

**Appendix D – Stability Analysis Results – Sensitivity With  
Proposed Belfield-Hettinger 230 kV Line**

**Appendix D.1: Summary for Case b1e-s709aa.xzqV424.sav  
(G1-0217 with Belfield-Hettinger 230 kV line and Second Belfield 345/230 kV Transformer)**

B1E-S709AA.XZQV424.SAV;SUMMER;OP LD 70%;SYSTEM INTACT  
ND=2080,MH=2175,MW=1238,OHMH=-196,OHMP=151,EWTW=98,BD=166

P O W E R F L O W S U M M A R Y

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NDEX:      2080 MW      ECL-ARP:   522 MW
MHEX:      2175 MW      PRI-BYN:   716 MW
MWSI:      1238 MW      AHD-GPK:   547 MW
                                     NI-WUMS:   151 MW
COOPER S:  1072 MW      WNE-WKS:   515 MW
FTCAL S:   662 MW      GGS:       1518 MW
GRIS-LNC:  700 MW      QC WEST:   -43 MW
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LOAD LEVELS AS PERCENT OF 2009 SUMMER PEAK:  
NORTH DAKOTA (ZONE 90,990) 2267.2 MW, 77.5% OF 2925.0 MW  
NSP (AREA 600) 8431.8 MW, 87.5% OF 9632.0 MW  
MAN HYDRO (AREA 667) 2126.0 MW, 71.7% OF 2964.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	2126/ 268	MH total gross	4725	SPARE	0
Ont. total	22150/ 482	Wpg River	534	SPARE	0
NW	915/ 44	7 Sisters	165	SPARE	0
Sask.	1944/ 85	OH total gross	21779	East Bias	352
MP	1944/ 158	northwest	816	SPC>WAPA (B10T)	166
NSP	8431/ 490	SPC total gross	2241	MH>SPC (3-230)	21
N. Dakota	2267/ 332	MP total gross	2156	MH>SPC (FALLS)	-66
Manitoba	450 MVARs	ND Cfd AC gross	3257	OH>MH @Kenora	-196
Ont. total	13082 MVARs	net	3086	OH>MP @Ft Fran	151
NW	489 MVARs	NSP East gross	1609	OH E>W @Wawa	98
Sask.	453 MVARs	net	1522	OH>East USA	0
MP	493 MVARs	West gross	3010	F601C @Forbes	1596
NSP	1779 MVARs	net	2848	D602F @Dorsey	1814
N. Dakota	445 MVARs	Total net	6720	L20D @Letell	250
		WAPA SD Hydro	1497	R50M @Richer	147
		Pleasant Valley	0	G82R @Glenboro	-36
		LGS/Trimont	99		
		SW MN Wind	830		
		Swing Bus	1041		

Tfms	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	104/ 72%	Stinson	11/ 110	CU (1,2)	1104
Wshell #2 7-7	104/ 72%	Boundary Dam	22/ 166	SQ BU (3,4)	455
Drayton#1 4-7	49/ 35%	Whiteshell	69/ 200	MH Bipole 1	1515
Drayton#2 4-7	62/ 33%	Int Falls	86/ 150	MH Bipole 2	1715
Dorsey #1 2-4	870/ 72%	St. Lawrence	15/ 0	MH (BP1+BP2)	3231
Dorsey #2 2-4	981/ 81%			Miles City E>W	-150
Forbes 2-4	81/ 12%			RCDC (15)	0
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	500	600/ -330	Forbes	500 -59 400/ -450
SCE 1-3G	18.2	3	408	480/ -240	Fargo	13.2 4 20/ -135
SCA 4-6G	18.2	3	408	480/ -240	Watertown	20.0 -48 125/ -86
Total		1318	1560/ -810	Series Caps	Num In Serv	
Margin		242				
				Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors		MVAR	Caps/Reactors		MVAR	Caps/Reactors		MVAR
Balta (FS)	230	0	Arrowhead	230	160	Chisago T 9	34.5	51
Drayton	115	20	Blackberry	230	47	Chisago T 10	34.5	51
Drayton	13.8	-20	Minntac	115	45	Forbes	230	70
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	600
Kohlman Lake	115	240	Roseau Co.(FS)	230	0			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	80	Running react	230	0	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	72	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	80	Richer react	230	0			0
Wilton/Bemidji	115	20	St Vital	110	98			0

Bus Voltages		V,pu	Bus Voltages		V,pu	Bus Voltages		V,kV
Adams	345	1.009	Arrowhead	230	1.010	Whiteshell	110	118.9
Alexandria	115	0.996	Badoura	115	1.034	Kenora	220	248.2
Audubon	115	1.021	Blackberry	230	1.027	Dryden	220	252.0
Bemidji	115	1.010	Boise Cascade	13.8	1.058	Fort Frances	220	247.4
Byron	345	1.025	Boise Cascade	115	1.026	Mackenzie	220	256.7
Chisago Co.	345	1.011	ETCO	115	1.000	Lakehead	220	256.3
Chisago Co.	500	1.005	Forbes	230	1.009	Marathon	220	260.8
Drayton	230	1.012	Forbes	500	0.999	Wawa	220	258.2
Eau Claire	345	1.023	Hubbard	115	1.031	Mississagi	220	250.5
WEST FARIBAULT	115	1.011	Intl Falls	115	1.027	Fort Frances	118	120.4
LaPorte	115	1.017	Minntac	115	1.008	Lakehead	118	122.8
Maple River	230	1.010	Moranville	230	1.017	Birch	118	117.5
Marshall Tap	115	1.022	Riverton	230	1.020	Marathon	118	125.2
Owatonna	161	0.999	Running	230	1.018			0.0
Prairie	115	1.029	Shannon	230	1.025			0.0
Prairie	230	1.019			0.000			0.0
Ramsey	230	1.004	Groton	345	1.028			0.0
Roseau County	230	1.017	Watertown	230	1.030			0.0
Roseau County	500	1.057	Watertown	345	1.034			0.0
Sheyenne	230	1.015			0.000			0.0
Thief R Falls	115	1.010	Dorsey	230	1.045			0.0
Tioga	230	1.038	Dorsey	500	1.029			0.0
Wahpeton	230	1.003			0.000			0.0
Winger	115	1.027			0.000			0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	340%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	699%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	349%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	221%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	332%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1366%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	793%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	877%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

**Appendix D.2: Simulation Summary Tables With GI-0217 + Belfield-Hettinger 230 kV Line +  
Second Belfield 345/230 kV Transformer**

Case No.	1	2	3	4
Case Name	b1e-s709aa.xzqV424-fd3-tb	b1e-s709aa.xzqV424-fd9-tb	b1e-s709aa.xzqV424-au3	b1e-s709aa.xzqV424-au9
Disturbance	fd3-tb	fd9-tb	au3	au9
Prior Outage	None	None	None	None
Date/Time	JAN 06 2007 17:15	JAN 06 2007 17:17	JAN 06 2007 17:23	JAN 06 2007 17:25
Comments	fd3 with delayed	4 cycle version of fd3		
	<b>Sq. Butte HVDC recovery</b>	<b>With delayed Sq. Butte HVDC</b>		
<b>Steady State Flows</b>		<b>recovery</b>		
NDEX / EAST BIAS	2080 / 352	2080 / 352	2080 / 352	2080 / 352
MHEX / L20D	2175 / 250	2175 / 250	2175 / 250	2175 / 250
ECL-ARP / PRI-BYN	522 / 716	522 / 716	522 / 716	522 / 716
MWSI / MNEX	1238	1238	1238	1238
D602F / F601C	1814 / 1596	1814 / 1596	1814 / 1596	1814 / 1596
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-36	-36	-36	-36
Dorsey bipole / CU bipole	3231 / 1104	3231 / 1104	3231 / 1104	3231 / 1104
Dorsey Reserve / Wtrtn SVC	242 / -48	242 / -48	242 / -48	242 / -48
Forbes SVC / MSC	-59 / 600	-59 / 600	-59 / 600	-59 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034
Drayton 230/Groton 345	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 350%	221% / 350%	221% / 350%	221% / 350%
B2R at Rugby/L20D at Drayton	999% / 793%	999% / 793%	999% / 793%	999% / 793%
R50M/F3M	877% / 332%	877% / 332%	877% / 332%	877% / 332%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.94   1.03	0.96   1.03	1.00   1.03	0.99   1.03
Boise 115	0.99   1.07	1.00   1.05	1.01   1.04	1.01   1.04
Dorsey 230	1.01   1.06	1.03   1.06	1.03   1.05	1.03   1.06
Forbes 230	0.98   1.03	0.98   1.03	1.00   1.02	0.99   1.03
Riverton 230	0.91   1.07	0.94   1.07	1.00   1.05	0.99   1.06
Coal Creek 230	0.95   1.16	0.97   1.15	0.98   1.09	0.97   1.10
Dickinson 345	0.92   1.06	0.93   1.05	0.96   1.03	0.95   1.04
Drayton 230	0.95   1.12	0.97   1.09	0.99   1.06	0.98   1.07
Groton 345	0.84   1.14	0.91   1.11	0.99   1.08	0.98   1.09
Tioga 230	0.98   1.07	1.01   1.07	1.01   1.06	1.01   1.07
Wahpeton 115	0.81   1.12	0.88   1.10	0.98   1.07	0.97   1.08
Watertown 345	0.90   1.13	0.95   1.09	1.01   1.06	1.01   1.07
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.62 63200 [JAMSTN2Y] 0.62 63369 [JAMESTN3] 0.63 63270 [LADISH 7] 0.64 63271 [AVIKO 7] 0.64 63272 [JAMESPK7] 0.64 63273 [JAMETAP7] 0.64 +more	none	none	none
<b>Worst Case Angle Damping</b>				
Dorsey SUVV / UdHold	/ 0.166	/ 0.166		
Forbes DC Red (DCAR)	305%	355%	428%	409%
K22W (max +dP @ t, d-ang)	36.5@(2.78332,-1.8)	22.9@(2.66665,-0.5)	11.9@(3.79997,0.8)	15.8@(2.66665,0.3)
K22W (max -dP @ t, d-ang)	29.0@(0.90000,7.5)	19.2@(0.90833,5.8)	10.5@(3.22498,-1.2)	12.1@(4.46663,-1.6)
K22W (max d-ang @ t, dP)	12.8@(1.25000,-12.2)	8.1@(1.17500,-5.5)	-2.2@(1.80000,-2.6)	-2.9@(1.90833,-4.1)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	150% / 231%	173% / 270%	200% / 314%	196% / 309%
B2R at Rugby/L20D at Drayton	999% / 450%	999% / 548%	999% / 696%	999% / 686%
R50M / F3M	678% / 246%	721% / 275%	829% / 290%	816% / 281%
B10T	84%	142%	253%	228%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   2   0 )	( 0   0   0 )	( 0   1   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   12   3 ) / ( 0   0   0 )	( 2   8   3 ) / ( 0   0   0 )	( 2   4   2 ) / ( 0   0   0 )	( 2   5   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   2   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )
Shay 115 / Split Rock 115	( 2   5   1 ) / ( 0   2   2 )	( 2   5   2 ) / ( 0   0   0 )	( 2   3   3 ) / ( 0   0   0 )	( 2   5   3 ) / ( 0   0   0 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix D.2 (Cont.): Simulation Summary Tables With GI-0217 + Belfield-Hettinger 230 kV Line +  
Second Belfield 345/230 kV Transformer**

Case No.	5	6	7	8
Case Name	b1e-s709aa.xzqV424-ad3	b1e-s709aa.xzqV424-ax3	b1e-s709aa.xzqV424-ay3	b1e-s709aa.xzqV424-bl3-tb
Disturbance	ad3	ax3	ay3	bl3-tb
Prior Outage	None	None	None	None
Date/Time	JAN 06 2007 17:29	JAN 06 2007 17:27	JAN 06 2007 23:45	FEB 23 2007 13:36
Comments				Delayed Square Butte HVDC
				Recovery
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 352	2080 / 352	2080 / 352	2080 / 352
MHEX / L20D	2175 / 250	2175 / 250	2175 / 250	2175 / 250
ECL-ARP / PRI-BYN	522 / 716	522 / 716	522 / 716	522 / 716
MWSI / MNEX	1238	1238	1238	1238
D602F / F601C	1814 / 1596	1814 / 1596	1814 / 1596	1814 / 1596
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-36	-36	-36	-36
Dorsey bipole / CU bipole	3231 / 1104	3231 / 1104	3231 / 1104	3231 / 1104
Dorsey Reserve / Wtrtn SVC	242 / -48	242 / -48	242 / -48	242 / -48
Forbes SVC / MSC	-59 / 600	-59 / 600	-59 / 600	-59 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034
Drayton 230/Groton 345	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 350%	221% / 350%	221% / 350%	221% / 350%
B2R at Rugby/L20D at Drayton	999% / 793%	999% / 793%	999% / 793%	999% / 793%
R50M/F3M	877% / 332%	877% / 332%	877% / 332%	877% / 332%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.99   1.03	1.00   1.03	1.00   1.03	0.95   1.03
Boise 115	1.00   1.04	1.01   1.04	1.01   1.04	0.99   1.07
Dorsey 230	1.03   1.06	1.03   1.05	1.03   1.05	1.02   1.07
Forbes 230	0.99   1.03	1.00   1.02	0.99   1.02	0.98   1.04
Riverton 230	0.99   1.06	1.00   1.05	1.00   1.05	0.92   1.07
Coal Creek 230	0.97   1.12	0.98   1.09	0.99   1.10	1.01   1.10
Dickinson 345	0.95   1.04	0.96   1.03	0.97   1.03	0.95   1.03
Drayton 230	0.98   1.09	0.99   1.04	0.99   1.04	0.94   1.13
Groton 345	0.92   1.09	0.99   1.07	0.99   1.07	0.84   1.15
Tioga 230	1.00   1.06	1.01   1.05	1.02   1.06	0.99   1.07
Wahpeton 115	0.96   1.10	0.99   1.06	0.99   1.07	0.84   1.12
Watertown 345	0.98   1.08	1.01   1.06	1.01   1.06	0.90   1.13
<b>Dynamic Voltage Warnings</b>				
	none	none	none	63199 [JAMSTN1Y] 0.69 63200 [JAMSTN2Y] 0.69 63369 [JAMESTN3] 0.69
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold				/ 0.150
Forbes DC Red (DCAR)	388%	424%	434%	323%
K22W (max +dP @ t, d-ang)	16.5@(2.56665,-0.1)	10.4@(2.47499,0.4)	9.4@(2.47499,0.4)	22.3@(2.99165,3.5)
K22W (max -dP @ t, d-ang)	14.7@(0.73333,3.4)	7.2@(1.88333,-2.1)	9.0@(0.73333,1.8)	25.2@(0.88333,4.4)
K22W (max d-ang @ t, dP)	5.3@(1.02500,-2.7)	-2.4@(1.75833,-5.4)	2.9@(0.99166,-1.7)	-11.1@(2.18333,-13.4)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	179% / 279%	196% / 308%	192% / 301%	162% / 252%
B2R at Rugby/L20D at Drayton	999% / 625%	999% / 669%	999% / 681%	999% / 456%
R50M / F3M	757% / 275%	809% / 293%	795% / 290%	698% / 246%
B10T	181%	239%	231%	97%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   1   0 )	( 0   0   0 )	( 0   0   0 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   4   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )	( 2   2   2 ) / ( 0   0   0 )	( 2   11   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   2   1 )
Shay 115 / Split Rock 115	( 2   5   2 ) / ( 0   0   0 )	( 2   3   3 ) / ( 0   0   0 )	( 2   3   3 ) / ( 0   0   0 )	( 2   5   1 ) / ( 0   2   2 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A



**Appendix D.2 (Cont.): Simulation Summary Tables With GI-0217 + Belfield-Hettinger 230 kV Line +  
Second Belfield 345/230 kV Transformer**

Case No.	9	10	11	12
Case Name	b1e-s709aa.xzqV424-bl9-tb	b1e-s709aa.xzqV424-ec3-tb	b1e-s709aa.xzqV424-ecs-tb	b1e-s709aa.xzqV424-ed3-tb
Disturbance	bl9-tb	ec3-tb	ecs-tb	ed3-tb
Prior Outage	None	None	None	None
Date/Time	FEB 23 2007 14:33	FEB 23 2007 13:48	FEB 23 2007 14:36	FEB 23 2007 13:59
Comments	4 cycle version of bl3-tb	Delayed Square Butte HVDC	4 cycle version of ec3-tb	Delayed Square Butte HVDC
		Recovery		Recovery
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 352	2080 / 352	2080 / 352	2080 / 352
MHEX / L20D	2175 / 250	2175 / 250	2175 / 250	2175 / 250
ECL-ARP / PRI-BYN	522 / 716	522 / 716	522 / 716	522 / 716
MWSI / MNEX	1238	1238	1238	1238
D602F / F601C	1814 / 1596	1814 / 1596	1814 / 1596	1814 / 1596
B10T / MH>SPC	166 / 21	166 / 21	166 / 21	166 / 21
OH E-W / OH>MH	98 / -196	98 / -196	98 / -196	98 / -196
R50M / OH>MP	147 / 151	147 / 151	147 / 151	147 / 151
G82R	-36	-36	-36	-36
Dorsey bipole / CU bipole	3231 / 1104	3231 / 1104	3231 / 1104	3231 / 1104
Dorsey Reserve / Wtrtn SVC	242 / -48	242 / -48	242 / -48	242 / -48
Forbes SVC / MSC	-59 / 600	-59 / 600	-59 / 600	-59 / 600
Arrowhd-Wstrn/ RCDC	547 / 0	547 / 0	547 / 0	547 / 0
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045	1.029 / 1.045
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999	1.058 / 0.999
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024	1.005 / 1.024
Int Falls 115/Badoura 115	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034	1.027 / 1.034
Drayton 230/Groton 345	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028	1.012 / 1.028
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 350%	221% / 350%	221% / 350%	221% / 350%
B2R at Rugby/L20D at Drayton	999% / 793%	999% / 793%	999% / 793%	999% / 793%
R50M/F3M	877% / 332%	877% / 332%	877% / 332%	877% / 332%
B10T	341%	341%	341%	341%
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.97   1.03	0.96   1.03	0.97   1.03	0.96   1.03
Boise 115	1.00   1.05	1.00   1.05	1.01   1.05	0.99   1.07
Dorsey 230	1.03   1.06	1.02   1.06	1.03   1.06	1.02   1.07
Forbes 230	0.99   1.03	0.98   1.03	0.99   1.03	0.98   1.04
Riverton 230	0.95   1.06	0.94   1.07	0.96   1.06	0.93   1.07
Coal Creek 230	1.02   1.09	0.92   1.14	0.94   1.14	1.01   1.10
Dickinson 345	0.96   1.02	0.93   1.05	0.93   1.04	0.95   1.03
Drayton 230	0.95   1.10	0.96   1.13	0.98   1.12	0.94   1.12
Groton 345	0.89   1.12	0.89   1.10	0.93   1.08	0.85   1.14
Tioga 230	1.01   1.06	1.00   1.07	1.01   1.06	0.99   1.07
Wahpeton 115	0.89   1.09	0.87   1.10	0.91   1.08	0.85   1.11
Watertown 345	0.94   1.11	0.94   1.09	0.97   1.07	0.91   1.13
<b>Dynamic Voltage Warnings</b>				
	none	63369 [JAMESTN3] 0.68 63200 [JAMSTN2Y] 0.69 63199 [JAMSTN1Y] 0.69		
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.150	/ 0.175	/ 0.175	/ 0.150
Forbes DC Red (DCAR)	362%	377%	405%	325%
K22W (max +dP @ t, d-ang)	16.9@(2.84165,1.4)	29.1@(2.66665,-2.7)	19.7@(2.62499,-0.5)	20.4@(2.97498,4.5)
K22W (max -dP @ t, d-ang)	17.2@(0.77500,1.9)	25.8@(0.73333,4.1)	20.7@(0.68333,2.7)	26.3@(0.89166,4.6)
K22W (max d-ang @ t, dP)	-8.4@(2.09166,-7.4)	9.1@(1.15833,-7.5)	6.7@(1.10833,-4.6)	10.2@(1.27500,-4.5)
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	174% / 270%	168% / 260%	180% / 281%	160% / 248%
B2R at Rugby/L20D at Drayton	999% / 522%	999% / 548%	999% / 623%	999% / 472%
R50M / F3M	709% / 265%	708% / 268%	718% / 277%	701% / 250%
B10T	137%	138%	178%	100%
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )	( 0   3   0 )
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )
Prairie 115 / Ramsey 230	( 2   11   3 ) / ( 0   0   0 )	( 2   9   3 ) / ( 0   0   0 )	( 2   7   3 ) / ( 0   0   0 )	( 2   12   2 ) / ( 0   0   0 )
Roseau 230 / Running 230	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )	( 0   1   0 ) / ( 1   2   1 )
Shay 115 / Split Rock 115	( 2   5   2 ) / ( 0   2   2 )	( 2   5   3 ) / ( 0   2   2 )	( 2   5   3 ) / ( 0   0   0 )	( 2   5   0 ) / ( 0   2   2 )
<b>Damping Performance</b>	N/A	N/A	N/A	N/A

**Appendix D.2 (Cont.): Simulation Summary Tables With GI-0217 + Belfield-Hettinger 230 kV Line +  
Second Belfield 345/230 kV Transformer**

Case No.	13	14	15	16
Case Name	b1e-s709aa.xzqV424-ef3-tb	b1e-s709aa.xzqV424-ef9-tb		
Disturbance	ef3-tb	ef9-tb		
Prior Outage	None	None		
Date/Time	FEB 23 2007 14:09	FEB 23 2007 15:47		
Comments	Delayed Square Butte HVDC	4 cycle version of ef3-tb		
	Recovery			
<b>Steady State Flows</b>				
NDEX / EAST BIAS	2080 / 352	2080 / 352		
MHEX / L20D	2175 / 250	2175 / 250		
ECL-ARP / PRI-BYN	522 / 716	522 / 716		
MWSI / MNEX	1238	1238		
D602F / F601C	1814 / 1596	1814 / 1596		
B10T / MH>SPC	166 / 21	166 / 21		
OH E-W / OH>MH	98 / -196	98 / -196		
R50M / OH>MP	147 / 151	147 / 151		
G82R	-36	-36		
Dorsey bipole / CU bipole	3231 / 1104	3231 / 1104		
Dorsey Reserve / Wtrtn SVC	242 / -48	242 / -48		
Forbes SVC / MSC	-59 / 600	-59 / 600		
Arrowhd-Wstrn/ RCDL	547 / 0	547 / 0		
<b>Steady State Vltgs</b>				
Dorsey 500/Dorsey 230	1.029 / 1.045	1.029 / 1.045		
Roseau 500/Forbes 500	1.058 / 0.999	1.058 / 0.999		
Chisago 500/EauClaire 345	1.005 / 1.024	1.005 / 1.024		
Int Falls 115/Badoura 115	1.027 / 1.034	1.027 / 1.034		
Drayton 230/Groton 345	1.012 / 1.028	1.012 / 1.028		
<b>SS OS Relay Margins</b>				
D602F at Forbes/Dorsey	221% / 350%	221% / 350%		
B2R at Rugby/L20D at Drayton	999% / 793%	999% / 793%		
R50M/F3M	877% / 332%	877% / 332%		
B10T	341%	341%		
<b>Min/MaxTransientVltg</b>				
Arrowhd 230	0.95   1.04	0.96   1.03		
Boise 115	0.99   1.07	1.00   1.06		
Dorsey 230	1.02   1.07	1.02   1.07		
Forbes 230	0.98   1.03	0.99   1.04		
Riverton 230	0.91   1.08	0.93   1.07		
Coal Creek 230	1.01   1.09	1.02   1.09		
Dickinson 345	0.95   1.03	0.96   1.02		
Drayton 230	0.94   1.11	0.95   1.12		
Groton 345	0.75   1.16(1.65)	0.84   1.13		
Tioga 230	0.93   1.07	0.97   1.06		
Wahpeton 115	0.80   1.14	0.86   1.11		
Watertown 345	0.84   1.14	0.90   1.12		
<b>Dynamic Voltage Warnings</b>				
	63199 [JAMSTN1Y] 0.65			
	63200 [JAMSTN2Y] 0.65			
	63369 [JAMESTN3] 0.65			
	63270 [LADISH 7] 0.67			
	63271 [AVIKO 7] 0.67			
	63272 [JAMESPK7] 0.67			
	63273 [JAMETAP7] 0.67 +more			
<b>Worst Case Angle Damping</b>				
Dorsey SUVP / UdHold	/ 0.150	/ 0.150		
Forbes DC Red (DCAR)	312%	348%		
K22W (max +dP @ t, d-ang)	28.6@(3.24164,-0.8)	20.9@(3.10831,1.7)		
K22W (max -dP @ t, d-ang)	32.7@(1.11666,9.8)	23.1@(0.95000,3.8)		
K22W (max d-ang @ t, dP)	17.2@(1.50000,-15.1)	-11.1@(2.27499,0.4)		
<b>OS Rel Trip / Marg</b>				
MH - OH				
D602F at Forbes/Dorsey	159% / 245%	173% / 269%		
B2R at Rugby/L20D at Drayton	999% / 390%	999% / 471%		
R50M / F3M	697% / 246%	730% / 257%		
B10T	52%	107%		
<b>FSCAPS (SS/Unav/Final)</b>				
Balta 230	( 0   3   0 )	( 0   3   0 )		
Eau Cl 345 / Park Lk 115	( 3   3   3 ) / ( 0   0   0 )	( 3   3   3 ) / ( 0   0   0 )		
Prairie 115 / Ramsey 230	( 2   12   3 ) / ( 0   0   0 )	( 2   11   3 ) / ( 0   0   0 )		
Roseau 230 / Running 230	( 0   1   0 ) / ( 1   1   1 )	( 0   0   0 ) / ( 1   1   1 )		
Shey 115 / Split Rock 115	( 2   5   0 ) / ( 0   2   2 )	( 2   5   1 ) / ( 0   2   2 )		
<b>Damping Performance</b>	N/A	N/A		

## **Appendix E – Steady-State Analysis – Case Summaries**

## Appendix E.1: Summary for Case p00-sp15aa.sav (Without GI-0217)

P00-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=727 ,MH=1468 ,MW=295 ,OHMH=0 ,OHMP=150 ,EWTW=-120 ,BD=0

### POWER FLOW SUMMARY

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NDEX:      727 MW      ECL-ARP:   258 MW
MHEX:     1468 MW     PRI-BYN:    37 MW
MWSI:      295 MW     AHD-GPK:   276 MW
                                     NI-WUMS:   295 MW
COOPER S:   312 MW     WNE-WKS:   324 MW
FTCAL S:    195 MW     GGS:       1466 MW
GRIS-LNC:   264 MW     QC WEST:   828 MW
  
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LOAD LEVELS AS PERCENT OF 2015 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 3268.6 MW, 100.5% OF 3251.0 MW  
 NSP (AREA 600) 10963.4 MW, 92.3% OF 11875.0 MW  
 MAN HYDRO (AREA 667) 3043.5 MW, 98.9% OF 3076.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	3043/ 267	MH total gross	4780	SPARE	0
Ont. total	23241/ 566	Wpg River	534	SPARE	0
NW	0/ 0	7 Sisters	165	SPARE	0
Sask.	3084/ 106	OH total gross	23417	East Bias	208
MP	2200/ 107	northwest	0	SPC>WAPA (B10T)	0
NSP	10963/ 307	SPC total gross	3191	MH>SPC (3-230)	63
N. Dakota	3268/ 295	MP total gross	2080	MH>SPC (FALLS)	-63
Manitoba	707 MVARs	ND Cfd AC gross	3277	OH>MH @Kenora	0
Ont. total	13541 MVARs	net	3107	OH>MP @Ft Fran	150
NW	0 MVARs	NSP East gross	2377	OH E>W @Wawa	-120
Sask.	725 MVARs	net	2272	OH>East USA	0
MP	594 MVARs	West gross	2638	F601C @Forbes	846
NSP	1842 MVARs	net	2476	D602F @Dorsey	1150
N. Dakota	654 MVARs	Total net	9274	L20D @Letell	264
		WAPA SD Hydro	0	R50M @Richer	96
		Pleasant Valley	422	G82R @Glenboro	-42
		LGS/Trimont	246		
		SW MN Wind	825		
		Swing Bus	2624		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	43/ 29%	Stinson	-3/ 110	CU (1,2)	1103
Wshell #2 7-7	43/ 29%	Boundary Dam	1/ 0	SQ BU (3,4)	455
Drayton#1 4-7	62/ 44%	Whiteshell	-39/ 0	MH Bipole 1	1406
Drayton#2 4-7	79/ 42%	Int Falls	-39/ 150	MH Bipole 2	1592
Dorsey #1 2-4	537/ 44%	St. Lawrence	16/ 0	MH (BP1+BP2)	2998
Dorsey #2 2-4	625/ 52%			Miles City E>W	-150
Forbes 2-4	145/ 21%			RCDC (15)	-199
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	379	Forbes	500	-19 400/ -450
SCE 1-3G	18.2	3	309	Fargo	13.2	5 20/ -135
SCA 4-6G	18.2	3	309	Watertown	20.0	-27 125/ -86

Total Margin	MVAR	Qmax/ Qmin	Series Caps	Num In Serv
	998	1560/ -810		
	562			
			Roseau	500 2 of 2
			Chisago	500 1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	60	Arrowhead	230 80	Chisago T 9	34.5 25
Drayton 115	40	Blackberry	230 47	Chisago T 10	34.5 25

Drayton	13.8	0	Minntac	115	45	Forbes	230	0
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	300
Kohlman Lake	115	240	Roseau Co.(FS)	230	30			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	120	Running react	230	-20	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	0	Watertown	230	76
Red Rock	115	240						0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	120	Richer react	230	0			0
Wilton/Bemidji	115	43	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.033	Arrowhead	230 1.018	Whiteshell	110 119.1
Alexandria	115 1.030	Badoura	115 1.003	Kenora	220 249.0
Audubon	115 1.008	Blackberry	230 1.031	Dryden	220 252.5
Bemidji	115 1.006	Boise Cascade	13.8 1.028	Fort Frances	220 252.2
Byron	345 1.039	Boise Cascade	115 1.017	Mackenzie	220 253.6
Chisago Co.	345 1.035	ETCO	115 1.012	Lakehead	220 239.7
Chisago Co.	500 1.035	Forbes	230 1.031	Marathon	220 240.8
Drayton	230 1.018	Forbes	500 1.035	Wawa	220 238.2
Eau Claire	345 1.034	Hubbard	115 0.985	Mississagi	220 242.9
WEST FARIBAULT	115 1.025	Intl Falls	115 1.019	Fort Frances	118 120.3
LaPorte	115 0.997	Minntac	115 1.017	Lakehead	118 124.2
Maple River	230 1.010	Moranville	230 1.025	Birch	118 120.4
Marshall Tap	115 1.007	Riverton	230 1.015	Marathon	118 125.6
Owatonna	161 1.002	Running	230 1.020		0.0
Prairie	115 1.035	Shannon	230 1.023		0.0
Prairie	230 1.020		0.000		0.0
Ramsey	230 1.002	Groton	345 1.029		0.0
Roseau County	230 1.027	Watertown	230 1.030		0.0
Roseau County	500 1.063	Watertown	345 1.032		0.0
Sheyenne	230 1.017		0.000		0.0
Thief R Falls	115 1.008	Dorsey	230 1.045		0.0
Tioga	230 1.040	Dorsey	500 1.033		0.0
Wahpeton	230 0.998		0.000		0.0
Winger	115 1.022		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	999%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	999%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	812%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	518%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	330%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1261%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	745%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	1411%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## Appendix E.2: Summary for Case p01-sp15aa.sav (With GI-0217)

P01-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=1166,MH=1471,MW=396,OHMH=0,OHMP=150,EWTW=-120,BD=0

### POWER FLOW SUMMARY

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-----
NDEX:      1166 MW      ECL-ARP:   309 MW
MHEX:      1471 MW      PRI-BYN:    86 MW
MWSI:       396 MW      AHD-GPK:   310 MW
                        NI-WUMS:   289 MW
COOPER S:   395 MW      WNE-WKS:   347 MW
FTCAL S:    246 MW      GGS:       1492 MW
GRIS-LNC:   315 MW      QC WEST:   765 MW
  
```

LOAD LEVELS AS PERCENT OF 2015 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 3268.6 MW, 100.5% OF 3251.0 MW  
 NSP (AREA 600) 10963.4 MW, 92.3% OF 11875.0 MW  
 MAN HYDRO (AREA 667) 3043.5 MW, 98.9% OF 3076.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	3043/ 265	MH total gross	4780	SPARE	0
Ont. total	23241/ 566	Wpg River	534	SPARE	0
NW	0/ 0	7 Sisters	165	SPARE	0
Sask.	3084/ 106	OH total gross	23417	East Bias	253
MP	2200/ 108	northwest	0	SPC>WAPA (B10T)	0
NSP	10963/ 320	SPC total gross	3191	MH>SPC (3-230)	62
N. Dakota	3268/ 353	MP total gross	2080	MH>SPC (FALLS)	-63
Manitoba	707 MVARs	ND Cfd AC gross	3277	OH>MH @Kenora	0
Ont. total	13541 MVARs	net	3107	OH>MP @Ft Fran	150
NW	0 MVARs	NSP East gross	2377	OH E>W @Wawa	-120
Sask.	725 MVARs	net	2272	OH>East USA	0
MP	594 MVARs	West gross	2638	F601C @Forbes	897
NSP	1842 MVARs	net	2476	D602F @Dorsey	1207
N. Dakota	654 MVARs	Total net	9274	L20D @Letell	240
		WAPA SD Hydro	0	R50M @Richer	102
		Pleasant Valley	422	G82R @Glenboro	-79
		LGS/Trimont	246		
		SW MN Wind	825		
		Swing Bus	2728		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	43/ 29%	Stinson	-2/ 110	CU (1,2)	1103
Wshell #2 7-7	42/ 29%	Boundary Dam	10/ 0	SQ BU (3,4)	455
Drayton#1 4-7	60/ 43%	Whiteshell	-31/ 0	MH Bipole 1	1406
Drayton#2 4-7	77/ 41%	Int Falls	-31/ 149	MH Bipole 2	1592
Dorsey #1 2-4	563/ 46%	St. Lawrence	16/ 0	MH (BP1+BP2)	2998
Dorsey #2 2-4	653/ 54%			Miles City E>W	-150
Forbes 2-4	147/ 21%			RCDC (15)	-199
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	385 600/ -330	Forbes	500 24	400/ -450
SCE 1-3G	18.2	3	314 480/ -240	Fargo	13.2 15	20/ -135
SCA 4-6G	18.2	3	314 480/ -240	Watertown	20.0 23	125/ -86
Total		1014	1560/ -810	Series Caps		Num In Serv
Margin		546		Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	60	Arrowhead 230	80	Chisago T 9 34.5	25
Drayton 115	40	Blackberry 230	47	Chisago T 10 34.5	25

Drayton	13.8	0	Minntac	115	45	Forbes	230	0
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	300
Kohlman Lake	115	240	Roseau Co.(FS)	230	30			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	160	Running react	230	-20	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	0	Watertown	230	76
Red Rock	115	240						0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	120	Richer react	230	0			0
Wilton/Bemidji	115	43	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.033	Arrowhead	230 1.014	Whiteshell	110 119.1
Alexandria	115 1.023	Badoura	115 0.997	Kenora	220 249.0
Audubon	115 1.001	Blackberry	230 1.030	Dryden	220 252.5
Bemidji	115 1.005	Boise Cascade	13.8 1.027	Fort Frances	220 252.1
Byron	345 1.039	Boise Cascade	115 1.016	Mackenzie	220 253.5
Chisago Co.	345 1.034	ETCO	115 1.011	Lakehead	220 239.6
Chisago Co.	500 1.034	Forbes	230 1.030	Marathon	220 240.7
Drayton	230 1.030	Forbes	500 1.035	Wawa	220 238.1
Eau Claire	345 1.031	Hubbard	115 0.979	Mississagi	220 242.9
WEST FARIBAULT	115 1.025	Intl Falls	115 1.018	Fort Frances	118 120.2
LaPorte	115 0.994	Minntac	115 1.016	Lakehead	118 124.2
Maple River	230 1.003	Moranville	230 1.023	Birch	118 120.4
Marshall Tap	115 1.006	Riverton	230 1.011	Marathon	118 125.5
Owatonna	161 1.001	Running	230 1.018		0.0
Prairie	115 1.055	Shannon	230 1.022		0.0
Prairie	230 1.033		0.000		0.0
Ramsey	230 0.999	Groton	345 1.020		0.0
Roseau County	230 1.025	Watertown	230 1.030		0.0
Roseau County	500 1.061	Watertown	345 1.029		0.0
Sheyenne	230 1.011		0.000		0.0
Thief R Falls	115 1.016	Dorsey	230 1.045		0.0
Tioga	230 1.040	Dorsey	500 1.032		0.0
Wahpeton	230 0.989		0.000		0.0
Winger	115 1.025		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	N/A		
2) -Tioga (North)	GE OST	SLLP	N/A	999%	
3) -Tioga (Em North)	GE OST	SLLP	N/A		999%
4) D602F-Dorsey	ATP ???	SLINOS	753%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	482%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	330%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	735%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	860%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	1324%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

### Appendix E.3: Summary for Sensitivity Case p0c-sp15aa.sav (Without GI-0217)

POC-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=542,MH=1301,MW=141,OHMH=1,OHMP=150,EWTW=-119,BD=165

#### POWER FLOW SUMMARY

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-----
NDEX:      542 MW      ECL-ARP:  182 MW
MHEX:     1301 MW     PRI-BYN:   -40 MW
MWSI:      141 MW     AHD-GPK:  223 MW
                        NI-WUMS:  306 MW
COOPER S:   131 MW     WNE-WKS:  258 MW
FTCAL S:    117 MW     GGS:      1329 MW
GRIS-LNC:   131 MW     QC WEST:  907 MW
  
```

LOAD LEVELS AS PERCENT OF 2015 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 3268.6 MW, 100.5% OF 3251.0 MW  
 NSP (AREA 600) 10963.4 MW, 92.3% OF 11875.0 MW  
 MAN HYDRO (AREA 667) 3043.5 MW, 98.9% OF 3076.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	3043/ 271	MH total gross	4780	SPARE	0
Ont. total	23241/ 565	Wpg River	534	SPARE	0
NW	0/ 0	7 Sisters	165	SPARE	0
Sask.	3084/ 103	OH total gross	23417	East Bias	168
MP	2200/ 104	northwest	0	SPC>WAPA (B10T)	165
NSP	10963/ 290	SPC total gross	3189	MH>SPC (3-230)	227
N. Dakota	3268/ 295	MP total gross	2080	MH>SPC (FALLS)	-63
Manitoba	707 MVARs	ND Cfd AC gross	3277	OH>MH @Kenora	1
Ont. total	13541 MVARs	net	3107	OH>MP @Ft Fran	150
NW	0 MVARs	NSP East gross	2377	OH E>W @Wawa	-119
Sask.	725 MVARs	net	2272	OH>East USA	0
MP	594 MVARs	West gross	2638	F601C @Forbes	732
NSP	1842 MVARs	net	2476	D602F @Dorsey	1006
N. Dakota	654 MVARs	Total net	9274	L20D @Letell	260
		WAPA SD Hydro	0	R50M @Richer	81
		Pleasant Valley	422	G82R @Glenboro	-46
		LGS/Trimont	246		
		SW MN Wind	825		
		Swing Bus	3663		

Tfms	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	43/ 29%	Stinson	-5/ 110	CU (1,2)	1104
Wshell #2 7-7	43/ 29%	Boundary Dam	37/ 165	SQ BU (3,4)	455
Drayton#1 4-7	61/ 44%	Whiteshell	-56/ -1	MH Bipole 1	1406
Drayton#2 4-7	78/ 42%	Int Falls	-52/ 149	MH Bipole 2	1592
Dorsey #1 2-4	475/ 39%	St. Lawrence	16/ 0	MH (BP1+BP2)	2998
Dorsey #2 2-4	563/ 46%			Miles City E>W	200
Forbes 2-4	134/ 20%			RCDC (15)	199
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	338	Forbes	500	-13
SCE 1-3G	18.2	3	276	Fargo	13.2	-24
SCA 4-6G	18.2	3	276	Watertown	20.0	-45
Total		890	1560/ -810	Series Caps		
Margin		670		Num In Serv		
				Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	60	Arrowhead 230	80	Chisago T 9	34.5
Drayton 115	40	Blackberry 230	47	Chisago T 10	34.5



Drayton	13.8	0	Minntac	115	45	Forbes	230	0
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	300
Kohlman Lake	115	240	Roseau Co.(FS)	230	30			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	120	Running react	230	-20	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	0	Watertown	230	76
Red Rock	115	240						0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	120	Richer react	230	0			0
Wilton/Bemidji	115	43	St Vital	110	98			0

Bus Voltages	V,pu	Bus Voltages	V,pu	Bus Voltages	V,kV
Adams	345 1.033	Arrowhead	230 1.025	Whiteshell	110 119.1
Alexandria	115 1.036	Badoura	115 1.008	Kenora	220 249.1
Audubon	115 1.016	Blackberry	230 1.035	Dryden	220 252.6
Bemidji	115 1.009	Boise Cascade	13.8 1.031	Fort Frances	220 252.5
Byron	345 1.039	Boise Cascade	115 1.020	Mackenzie	220 253.7
Chisago Co.	345 1.040	ETCO	115 1.019	Lakehead	220 239.7
Chisago Co.	500 1.042	Forbes	230 1.040	Marathon	220 240.9
Drayton	230 1.025	Forbes	500 1.046	Wawa	220 238.2
Eau Claire	345 1.037	Hubbard	115 0.991	Mississagi	220 242.9
WEST FARIBAULT	115 1.026	Intl Falls	115 1.022	Fort Frances	118 120.5
LaPorte	115 1.001	Minntac	115 1.024	Lakehead	118 124.2
Maple River	230 1.019	Moranville	230 1.032	Birch	118 120.4
Marshall Tap	115 1.008	Riverton	230 1.019	Marathon	118 125.6
Owatonna	161 1.001	Running	230 1.027		0.0
Prairie	115 1.045	Shannon	230 1.029		0.0
Prairie	230 1.030		0.000		0.0
Ramsey	230 1.011	Groton	345 1.019		0.0
Roseau County	230 1.034	Watertown	230 1.030		0.0
Roseau County	500 1.068	Watertown	345 1.031		0.0
Sheyenne	230 1.025		0.000		0.0
Thief R Falls	115 1.016	Dorsey	230 1.045		0.0
Tioga	230 1.033	Dorsey	500 1.037		0.0
Wahpeton	230 1.005		0.000		0.0
Winger	115 1.029		0.000		0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	340%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	698%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	989%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	635%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	332%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	1231%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	768%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	1716%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## Appendix E.4: Summary for Sensitivity Case p1c-sp15aa.sav (With GI-0217)

PLC-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=993 ,MH=1303 ,MW=248 ,OHMH=0 ,OHMP=150 ,EWTW=-119 ,BD=165

### POWER FLOW SUMMARY

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-----
NDEX:      993 MW      ECL-ARP:  236 MW
MHEX:     1303 MW     PRI-BYN:   11 MW
MWSI:      248 MW     AHD-GPK:  259 MW
                                     NI-WUMS:  299 MW
COOPER S:  224 MW     WNE-WKS:  284 MW
FTCAL S:   172 MW     GGS:      1357 MW
GRIS-LNC:  186 MW     QC WEST:  839 MW
  
```

LOAD LEVELS AS PERCENT OF 2015 SUMMER PEAK:  
 NORTH DAKOTA (ZONE 90,990) 3268.6 MW, 100.5% OF 3251.0 MW  
 NSP (AREA 600) 10963.4 MW, 92.3% OF 11875.0 MW  
 MAN HYDRO (AREA 667) 3043.5 MW, 98.9% OF 3076.0 MW

Load/Losses	MW / MW	Generation	MW	Export	MW
Manitoba	3043/ 269	MH total gross	4780	SPARE	0
Ont. total	23241/ 566	Wpg River	534	SPARE	0
NW	0/ 0	7 Sisters	165	SPARE	0
Sask.	3084/ 103	OH total gross	23417	East Bias	215
MP	2200/ 104	northwest	0	SPC>WAPA (B10T)	165
NSP	10963/ 300	SPC total gross	3189	MH>SPC (3-230)	228
N. Dakota	3268/ 342	MP total gross	2080	MH>SPC (FALLS)	-63
Manitoba	707 MVARs	ND Cfd AC gross	3277	OH>MH @Kenora	0
Ont. total	13541 MVARs	net	3107	OH>MP @Ft Fran	150
NW	0 MVARs	NSP East gross	2377	OH E>W @Wawa	-119
Sask.	725 MVARs	net	2272	OH>East USA	0
MP	594 MVARs	West gross	2638	F601C @Forbes	784
NSP	1842 MVARs	net	2476	D602F @Dorsey	1063
N. Dakota	654 MVARs	Total net	9274	L20D @Letell	235
		WAPA SD Hydro	0	R50M @Richer	87
		Pleasant Valley	422	G82R @Glenboro	-83
		LGS/Trimont	246		
		SW MN Wind	825		
		Swing Bus	3716		

Tfmrs	MVA/ Load	Ph Shifters	Deg/ MW	DC Lines	MW
Wshell #1 7-7	43/ 29%	Stinson	-4/ 110	CU (1,2)	1104
Wshell #2 7-7	43/ 29%	Boundary Dam	45/ 166	SQ BU (3,4)	455
Drayton#1 4-7	60/ 42%	Whiteshell	-46/ 0	MH Bipole 1	1406
Drayton#2 4-7	76/ 41%	Int Falls	-44/ 150	MH Bipole 2	1592
Dorsey #1 2-4	499/ 41%	St. Lawrence	16/ 0	MH (BP1+BP2)	2998
Dorsey #2 2-4	587/ 48%			Miles City E>W	200
Forbes 2-4	136/ 20%			RCDC (15)	199
				Stegall (10)	0

Dorsey SC's	I/S	MVAR	Qmax/ Qmin	SVC's	MVAR	Qmax/ Qmin
MIL 7-9G	17.0	2	347	Forbes	500	-8 400/ -450
SCE 1-3G	18.2	3	283	Fargo	13.2	5 20/ -135
SCA 4-6G	18.2	3	283	Watertown	20.0	-23 125/ -86
Total		913	1560/ -810	Series Caps		Num In Serv
Margin		647				
				Roseau	500	2 of 2
				Chisago	500	1 of 1

Caps/Reactors	MVAR	Caps/Reactors	MVAR	Caps/Reactors	MVAR
Balta (FS) 230	60	Arrowhead	230 80	Chisago T 9	34.5 25

Drayton	115	40	Blackberry	230	47	Chisago T 10	34.5	25
Drayton	13.8	0	Minntac	115	45	Forbes	230	0
Eau Claire(FS)	161	267	Riverton	230	47	Forbes	500	300
Kohlman Lake	115	240	Roseau Co.(FS)	230	30			0
Parkers Lk(FS)	115	0	Running (FS)	230	30	Fargo	115	81
Prairie (FS)	115	160	Running react	230	-20	Watertown	20	20
Ramsey (FS)	230	0	Shannon	230	0	Watertown	230	76
Red Rock	115	240			0			0
Rugby	13.8	-25	Glenboro	230	0			0
Split Rock(FS)	115	0	Laverendrye	110	98			0
Sheyenne (FS)	115	120	Richer react	230	0			0
Wilton/Bemidji	115	43	St Vital	110	98			0

Bus Voltages	V,pu		Bus Voltages	V,pu		Bus Voltages	V,kV	
Adams	345	1.033	Arrowhead	230	1.021	Whiteshell	110	119.1
Alexandria	115	1.030	Badoura	115	1.003	Kenora	220	249.1
Audubon	115	1.009	Blackberry	230	1.034	Dryden	220	252.6
Bemidji	115	1.008	Boise Cascade	13.8	1.030	Fort Frances	220	252.4
Byron	345	1.039	Boise Cascade	115	1.019	Mackenzie	220	253.6
Chisago Co.	345	1.038	ETCO	115	1.016	Lakehead	220	239.7
Chisago Co.	500	1.039	Forbes	230	1.036	Marathon	220	240.9
Drayton	230	1.034	Forbes	500	1.042	Wawa	220	238.2
Eau Claire	345	1.034	Hubbard	115	0.986	Mississagi	220	242.9
WEST FARIBAULT	115	1.026	Intl Falls	115	1.021	Fort Frances	118	120.4
LaPorte	115	0.998	Minntac	115	1.021	Lakehead	118	124.2
Maple River	230	1.008	Moranville	230	1.029	Birch	118	120.4
Marshall Tap	115	1.008	Riverton	230	1.016	Marathon	118	125.6
Owatonna	161	1.001	Running	230	1.024			0.0
Prairie	115	1.062	Shannon	230	1.027			0.0
Prairie	230	1.039			0.000			0.0
Ramsey	230	1.003	Groton	345	1.025			0.0
Roseau County	230	1.031	Watertown	230	1.030			0.0
Roseau County	500	1.066	Watertown	345	1.031			0.0
Sheyenne	230	1.016			0.000			0.0
Thief R Falls	115	1.021	Dorsey	230	1.045			0.0
Tioga	230	1.028	Dorsey	500	1.035			0.0
Wahpeton	230	0.997			0.000			0.0
Winger	115	1.029			0.000			0.0

Steady State Relay Margins (measured from inner blinder)

Relay Location	Manuf/Type	PSS Model	South	North	Em North
1) B10T-Tioga (South)	GE OST	SLLP	334%	N/A	N/A
2) -Tioga (North)	GE OST	SLLP	687%	N/A	N/A
3) -Tioga (Em North)	GE OST	SLLP		N/A	N/A
4) D602F-Dorsey	ATP ???	SLINOS	915%	N/A	N/A
5) -Forbes (Normal)	ATP ???	SLINOS	586%	N/A	N/A
6) -Forbes (Em Nrth)	APT S-PRO	SLINOS		N/A	N/A
8) F3M-Intl Falls	APT S-PRO	SLINOS	331%	N/A	N/A
9) G82R-Rugby	APT	SLINOS	N/A	708%	
10) L20D-Drayton (Normal)	APT, ASEA	SLINOS	887%	N/A	N/A
11) -Drayton (Em Nrth)	ASEA RXZF2	SLINOS		N/A	N/A
12) R50M-Moranville (Norm)	APT, West	SLINOS	1598%	N/A	N/A
13) -Moranville (Em N)	ASEA RXZF2	SLINOS		N/A	N/A

## **Appendix F – Constrained Interface Analysis**

## Appendix F.1: Case p0c (Without GI-0217) vs. p1c (With GI-0217)

\*\*\*\*\* BASE CASE:

P0C-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=542,MH=1301,MW=141,OHMH=1,OHMP=150,EWTW=-119,BD=165

\*\*\*\*\* ERROR: GETTING LINE FLOW 66550 TO 63365 CKT P1 IERR= 1

\*\*\*\*\* ERROR: GETTING LINE FLOW 5634 TO 5601 CKT 1 IERR= 1

\*\*\*\*\* ERROR: GETTING LINE FLOW 66506 TO 67346 CKT 1 IERR= 1

\*\*\*\*\* CHNG CASE:

P1C-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=993,MH=1303,MW=248,OHMH=0,OHMP=150,EWTW=-119,BD=165

\*\*\*\*\* BASE TRANSACTION AMOUNT FOR DF CALCULATION: 500.000

## PTFD INTERFACES ##

64786 COOPER 3 - 59393 ST JOE 3	BASE:	53.1	CHNG:	107.0	DIFF:	101.7%
64786 COOPER 3 - 96039 7FAIRPT	BASE:	78.9	CHNG:	117.0	DIFF:	48.2%

SUBTOTALS FOR: COOPER_S	BASE:	132.0	CHNG:	224.0	DIFF:	69.7%
				DIFF:	92.0	DF: 18.4%

\*\*\*\*\*

60304 EAU CL 3 - 39244 ARP 345	BASE:	182.2	CHNG:	237.0	DIFF:	30.1%
--------------------------------	-------	-------	-------	-------	-------	-------

SUBTOTALS FOR: EAUARP_XCEL	BASE:	182.2	CHNG:	237.0	DIFF:	30.1%
				DIFF:	54.8	DF: 11.0%

\*\*\*\*\*

60101 FORBES 2 - 60198 CHIS-N 2	BASE:	732.6	CHNG:	784.6	DIFF:	7.1%
---------------------------------	-------	-------	-------	-------	-------	------

SUBTOTALS FOR: FORCHS_PTFD	BASE:	732.6	CHNG:	784.6	DIFF:	7.1%
				DIFF:	52.0	DF: 10.4%

\*\*\*\*\*

65351 S3451 3 - 65354 S3454 3	BASE:	29.8	CHNG:	48.8	DIFF:	63.7%
-------------------------------	-------	------	-------	------	-------	-------

65351 S3451 3 - 65359 S3459 3	BASE:	36.2	CHNG:	65.8	DIFF:	81.9%
-------------------------------	-------	------	-------	------	-------	-------

65451 S1251 5 - 65497 S1297 5	BASE:	51.7	CHNG:	57.4	DIFF:	11.1%
-------------------------------	-------	------	-------	------	-------	-------

SUBTOTALS FOR: FTCAL_S	BASE:	117.7	CHNG:	172.1	DIFF:	46.2%
				DIFF:	54.4	DF: 10.9%

\*\*\*\*\*

64832 GENTLMN4 - 64909 N.PLATT4	BASE:	164.2	CHNG:	164.3	DIFF:	0.1%
---------------------------------	-------	-------	-------	-------	-------	------

64832 GENTLMN4 - 64909 N.PLATT4	BASE:	164.7	CHNG:	164.8	DIFF:	0.1%
---------------------------------	-------	-------	-------	-------	-------	------

64832 GENTLMN4 - 64909 N.PLATT4	BASE:	168.3	CHNG:	168.4	DIFF:	0.1%
---------------------------------	-------	-------	-------	-------	-------	------

64831 GENTLMN3 - 64984 SWEET W3	BASE:	260.1	CHNG:	261.1	DIFF:	0.4%
---------------------------------	-------	-------	-------	-------	-------	------

64831 GENTLMN3 - 64984 SWEET W3	BASE:	313.7	CHNG:	314.9	DIFF:	0.4%
---------------------------------	-------	-------	-------	-------	-------	------

64831 GENTLMN3 - 64943 REDWILO3	BASE:	258.8	CHNG:	284.4	DIFF:	9.9%
---------------------------------	-------	-------	-------	-------	-------	------

SUBTOTALS FOR: GGS	BASE:	1329.8	CHNG:	1357.9	DIFF:	2.1%
				DIFF:	28.1	DF: 5.6%

\*\*\*\*\*

64933 PAULINE3 - 64902 MOORE 3	BASE:	-22.6	CHNG:	-4.2	DIFF:	-81.6%
--------------------------------	-------	-------	-------	------	-------	--------

64839 GR ISLD4 - 64780 COLMB.W4	BASE:	124.1	CHNG:	117.9	DIFF:	-4.9%
---------------------------------	-------	-------	-------	-------	-------	-------

66571 GR ISLD3 - 64896 MCCOOL 3	BASE:	29.7	CHNG:	73.0	DIFF:	146.0%
---------------------------------	-------	------	-------	------	-------	--------

SUBTOTALS FOR: GRIS_LNC	BASE:	131.1	CHNG:	186.8	DIFF:	42.4%
				DIFF:	55.6	DF: 11.1%

\*\*\*\*\*

37632 LEECO;BP - 36362 NELSO; B	BASE:	333.6	CHNG:	311.5	DIFF:	-6.6%
---------------------------------	-------	-------	-------	-------	-------	-------

SUBTOTALS FOR: LEECONELS	BASE:	333.6	CHNG:	311.5	DIFF:	-6.6%
				DIFF:	-22.1	DF: -4.4%

```

*****
60175 ROSEAU 4 - 67576 RICHER 4   BASE:   -80.9  CHNG:   -86.1  DIFF:    6.5%
60173 ROSEAUN2 - 67564 DORSEY 2   BASE:  -993.4  CHNG: -1049.3  DIFF:    5.6%
66752 DRAYTON4 - 67557 LETELER4   BASE:  -255.3  CHNG:  -231.7  DIFF:   -9.3%
63379 RUGBY 4 - 67523 GLENBOR4    BASE:    47.4  CHNG:    85.2  DIFF:   79.9%

SUBTOTALS FOR: MHEX_N+           BASE: -1282.2  CHNG: -1281.9  DIFF:    0.0%
                                DIFF:    0.3   DF:    0.1%
*****

67576 RICHER 4 - 60175 ROSEAU 4   BASE:    81.7  CHNG:    87.1  DIFF:    6.6%
67564 DORSEY 2 - 60173 ROSEAUN2   BASE:  1006.4  CHNG:  1063.7  DIFF:    5.7%
67557 LETELER4 - 66752 DRAYTON4   BASE:   260.5  CHNG:   235.9  DIFF:   -9.4%
67523 GLENBOR4 - 63379 RUGBY 4    BASE:   -46.9  CHNG:   -83.7  DIFF:   78.4%

SUBTOTALS FOR: MHEX_S+           BASE:  1301.7  CHNG:  1303.0  DIFF:    0.1%
                                DIFF:    1.3   DF:    0.3%
*****

68613 AUBURNT4 - 67525 RESTON 4   BASE:   -24.5  CHNG:   -26.3  DIFF:    7.3%
68615 YORKTON4 - 67514 ROBLIN 4   BASE:  -119.9  CHNG:  -119.4  DIFF:   -0.4%
68630 EBCAMPB4 - 67515 RALL 4     BASE:   -80.2  CHNG:   -79.5  DIFF:   -0.9%

SUBTOTALS FOR: MH_SPC_E+         BASE:  -224.5  CHNG:  -225.1  DIFF:    0.3%
                                DIFF:   -0.6   DF:   -0.1%
*****

67525 RESTON 4 - 68613 AUBURNT4   BASE:    24.5  CHNG:    26.3  DIFF:    7.3%
67514 ROBLIN 4 - 68615 YORKTON4   BASE:   121.4  CHNG:   120.9  DIFF:   -0.4%
67515 RALL 4 - 68630 EBCAMPB4     BASE:    81.8  CHNG:    81.0  DIFF:   -0.9%

SUBTOTALS FOR: MH_SPC_W+         BASE:   227.7  CHNG:   228.2  DIFF:    0.2%
                                DIFF:    0.5   DF:    0.1%
*****

64095 MNTZUMA3 - 64064 BONDRNT3   BASE:    57.4  CHNG:   -2.5  DIFF: -104.4%

SUBTOTALS FOR: MNTZUMA_W         BASE:    57.4  CHNG:   -2.5  DIFF: -104.4%
                                DIFF:  -60.0   DF: -12.0%
*****

60105 PR ISLD3 - 61950 BYRON 3     BASE:   -40.5  CHNG:    11.7  DIFF: -128.8%
60304 EAU CL 3 - 39244 ARP 345     BASE:   182.2  CHNG:   237.0  DIFF:   30.1%

SUBTOTALS FOR: MWSI              BASE:   141.8  CHNG:   248.6  DIFF:   75.4%
                                DIFF:   106.9   DF:   21.4%
*****

66756 SQBUTTE4 - 63049 STANTON4   BASE:   -50.9  CHNG:   -38.9  DIFF:  -23.5%
66756 SQBUTTE4 - 66751 CENTER 4   BASE:   -28.5  CHNG:   -49.8  DIFF:   74.5%
66756 SQBUTTE4 - 66791 CENTER 3   BASE:    77.7  CHNG:    87.1  DIFF:   12.0%
63041 COAL CR4 - 63042 COAL TP4   BASE:   -17.3  CHNG:   -19.7  DIFF:   13.4%
63041 COAL CR4 - 63049 STANTON4   BASE:  -136.7  CHNG:  -154.1  DIFF:   12.7%
63041 COAL CR4 - 63381 UNDERWD4   BASE:   151.9  CHNG:   171.6  DIFF:   13.0%

SUBTOTALS FOR: NDDC              BASE:    -3.8  CHNG:    -3.9  DIFF:    0.7%
                                DIFF:    0.0   DF:    0.0%
*****

67105 LELAND03 - 66506 FTTHOMP3    BASE:   163.1  CHNG:   233.7  DIFF:   43.3%
67105 LELAND03 - 67160 GROTON 3    BASE:   234.9  CHNG:   301.1  DIFF:   28.2%
67101 ANTELOP3 - 67120 BRDLAND3    BASE:   208.4  CHNG:   276.4  DIFF:   32.6%
63314 BIGSTON4 - 66503 BLAIR 4     BASE:   114.4  CHNG:   125.2  DIFF:    9.4%
66554 MORRIS 4 - 66550 GRANITF4    BASE:   -39.1  CHNG:   -23.2  DIFF: -40.6%
63336 AUDUBON4 - 63053 HUBBARD4    BASE:    88.3  CHNG:   112.5  DIFF:   27.4%
66521 SULLYBT4 - 66519 OAHE 4      BASE:   -49.5  CHNG:   -17.1  DIFF: -65.4%
63052 INMAN 4 - 61611 WINGRIV4     BASE:    80.0  CHNG:   103.0  DIFF:   28.7%
66470 BISON 4 - 66497 MAURINE4     BASE:   -29.7  CHNG:    16.4  DIFF: -155.2%
66716 LAPORTE7 - 61638 AKELEY7    BASE:   -10.9  CHNG:    -1.8  DIFF:  -84.0%
63222 ALEXAND7 - 60144 DGLASCO7    BASE:    23.3  CHNG:    29.0  DIFF:   24.5%

```



SUBTOTALS FOR: BYCHEBYCHE		BASE:	1344.7	CHNG:	1366.6	DIFF:	1.6%
				DIFF:	21.9	DF:	4.4%
*****							
36382	QUAD ; - 34036 ROCK CK3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
64425	DAVNPR5 - 34122 E CALMS5		BASE:	0.0	CHNG:	0.0	DIFF: 999.0%
SUBTOTALS FOR: DAVCALQUARCK		BASE:	0.0	CHNG:	0.0	DIFF:	999.0%
				DIFF:	0.0	DF:	0.0%
*****							
64352	TIFFIN 3 - 34093 ARNOLD 3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
64350	HILLS 3 - 34110 HILLSIE5		BASE:	157.4	CHNG:	143.8	DIFF: -8.7%
SUBTOTALS FOR: HLSXFMTIFARN		BASE:	157.4	CHNG:	143.8	DIFF:	-8.7%
				DIFF:	-13.6	DF:	-2.7%
*****							
57981	LACYGNE7 - 57968 STILWEL7	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
57981	LACYGNE7 - 57965 W.GRDNR7		BASE:	1098.8	CHNG:	1074.9	DIFF: -2.2%
SUBTOTALS FOR: LACWGRLACSTI		BASE:	1098.8	CHNG:	1074.9	DIFF:	-2.2%
				DIFF:	-23.9	DF:	-4.8%
*****							
36310	ELECT; B - 36362 NELSO; B	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
37632	LEECO;BP - 36280 BYRON; B		BASE:	593.8	CHNG:	639.0	DIFF: 7.6%
SUBTOTALS FOR: LEEBYREJNEL		BASE:	593.8	CHNG:	639.0	DIFF:	7.6%
				DIFF:	45.2	DF:	9.0%
*****							
60331	LKFLDXL3 - 60108 WILMART3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
34007	LAKEFLD5 - 34008 FOX LK 5		BASE:	64.0	CHNG:	67.5	DIFF: 5.5%
SUBTOTALS FOR: LKFFOXLKGWLM		BASE:	64.0	CHNG:	67.5	DIFF:	5.5%
				DIFF:	3.5	DF:	0.7%
*****							
36407	WEMPL; R - 39058 PAD 345	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
34028	LORE 5 - 34033 TRK RIV5		BASE:	140.7	CHNG:	136.5	DIFF: -3.0%
SUBTOTALS FOR: LORTRKWEMPAD		BASE:	140.7	CHNG:	136.5	DIFF:	-3.0%
				DIFF:	-4.2	DF:	-0.8%
*****							
39058	PAD 345 - 36407 WEMPL; R	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
36407	WEMPL; R - 36406 WEMPL; B	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
36406	WEMPL; B - 39119 ROE 345	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
39058	PAD 345 - 39059 PAD 138		BASE:	0.0	CHNG:	0.0	DIFF: -204.8%
SUBTOTALS FOR: PADXFMPADROE		BASE:	0.0	CHNG:	0.0	DIFF:	-204.8%
				DIFF:	0.0	DF:	0.0%
*****							
64095	MNTZUMA3 - 64064 BONDRNT3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0	
-----							
34185	POWESHK5 - 34191 REASNOR5		BASE:	53.9	CHNG:	31.0	DIFF: -42.5%
SUBTOTALS FOR: POWREAMTZBON		BASE:	53.9	CHNG:	31.0	DIFF:	-42.5%
				DIFF:	-22.9	DF:	-4.6%
*****							



65351 S3451	3	-	63875 RAUN	3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
65426 S1226	5	-	64987 TEKAMAH5			BASE:	101.3	CHNG:	79.5 DIFF: -21.5%
-----									
SUBTOTALS FOR: S1226TEKAMAH						BASE:	101.3	CHNG:	79.5 DIFF: -21.5%
								DIFF:	-21.8 DF: -4.4%
*****									
36382 QUAD ;		-	64405 SUB 91	3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
34029 SALEM	3	-	34030 SALEM N5			BASE:	341.8	CHNG:	326.5 DIFF: -4.5%
-----									
SUBTOTALS FOR: SALXFMQUADAV						BASE:	341.8	CHNG:	326.5 DIFF: -4.5%
								DIFF:	-15.3 DF: -3.1%
*****									
36407 WEMPL; R		-	39058 PAD 345		*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
34029 SALEM	3	-	34030 SALEM N5			BASE:	315.3	CHNG:	302.5 DIFF: -4.1%
-----									
SUBTOTALS FOR: SALXFMWEMPAD						BASE:	315.3	CHNG:	302.5 DIFF: -4.1%
								DIFF:	-12.8 DF: -2.6%
*****									
63875 RAUN	3	-	34006 LAKEFLD3		*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
66563 SPENCER5		-	34137 TRIBOJI5			BASE:	-17.9	CHNG:	-28.0 DIFF: 56.2%
-----									
SUBTOTALS FOR: SPETRILAKRAU						BASE:	-17.9	CHNG:	-28.0 DIFF: 56.2%
								DIFF:	-10.1 DF: -2.0%
*****									
56873 SUMMIT	6	-	56872 EMCPHER6		*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
57374 SPHILPJ3		-	57438 WMCIPHER3			BASE:	-1.8	CHNG:	-3.5 DIFF: 88.8%
57374 SPHILPJ3		-	57438 WMCIPHER3			BASE:	-1.6	CHNG:	-3.6 DIFF: 124.0%
-----									
SUBTOTALS FOR: SPHWMCSUMEMC						BASE:	-3.4	CHNG:	-7.0 DIFF: 105.2%
								DIFF:	-3.6 DF: -0.7%
*****									

## Appendix F.2: Case p0c (Without GI-0217) vs. p1e (With GI-0217 & Belfield-Hettinger 230 kV line and Belfield 345/230 kV transformer #2)

\*\*\*\*\* BASE CASE:

P0C-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=542,MH=1301,MW=141,OHMH=1,OHMP=150,EWTW=-119,BD=165

\*\*\*\*\* ERROR: GETTING LINE FLOW 66550 TO 63365 CKT P1 IERR= 1  
 \*\*\*\*\* ERROR: GETTING LINE FLOW 5634 TO 5601 CKT 1 IERR= 1  
 \*\*\*\*\* ERROR: GETTING LINE FLOW 66506 TO 67346 CKT 1 IERR= 1

\*\*\*\*\* CHNG CASE:

P1E-SP15AA.SAV;SUMMER;PK LD;SYSTEM INTACT :  
 ND=1008,MH=1301,MW=247,OHMH=1,OHMP=150,EWTW=-119,BD=167

\*\*\*\*\* BASE TRANSACTION AMOUNT FOR DF CALCULATION: 500.000

## PTFD INTERFACES ##

64786 COOPER 3 - 59393 ST JOE 3 BASE: 53.1 CHNG: 109.7 DIFF: 106.8%  
 64786 COOPER 3 - 96039 7FAIRPT BASE: 78.9 CHNG: 118.9 DIFF: 50.6%

SUBTOTALS FOR: COOPER\_S BASE: 132.0 CHNG: 228.6 DIFF: 73.2%  
 DIFF: 96.6 DF: 19.3%

60304 EAU CL 3 - 39244 ARP 345 BASE: 182.2 CHNG: 237.0 DIFF: 30.1%

SUBTOTALS FOR: EAUARP\_\_XCEL BASE: 182.2 CHNG: 237.0 DIFF: 30.1%  
 DIFF: 54.8 DF: 11.0%

60101 FORBES 2 - 60198 CHIS-N 2 BASE: 732.6 CHNG: 781.2 DIFF: 6.6%

SUBTOTALS FOR: FORCHS\_PTFD BASE: 732.6 CHNG: 781.2 DIFF: 6.6%  
 DIFF: 48.6 DF: 9.7%

65351 S3451 3 - 65354 S3454 3 BASE: 29.8 CHNG: 47.7 DIFF: 59.8%  
 65351 S3451 3 - 65359 S3459 3 BASE: 36.2 CHNG: 65.6 DIFF: 81.4%  
 65451 S1251 5 - 65497 S1297 5 BASE: 51.7 CHNG: 57.4 DIFF: 11.0%

SUBTOTALS FOR: FTCAL\_S BASE: 117.7 CHNG: 170.7 DIFF: 45.0%  
 DIFF: 53.0 DF: 10.6%

64832 GENTLMN4 - 64909 N.PLATT4 BASE: 164.2 CHNG: 165.2 DIFF: 0.6%  
 64832 GENTLMN4 - 64909 N.PLATT4 BASE: 164.7 CHNG: 165.7 DIFF: 0.6%  
 64832 GENTLMN4 - 64909 N.PLATT4 BASE: 168.3 CHNG: 169.3 DIFF: 0.6%  
 64831 GENTLMN3 - 64984 SWEET W3 BASE: 260.1 CHNG: 265.8 DIFF: 2.2%  
 64831 GENTLMN3 - 64984 SWEET W3 BASE: 313.7 CHNG: 320.7 DIFF: 2.2%  
 64831 GENTLMN3 - 64943 REDWILO3 BASE: 258.8 CHNG: 288.7 DIFF: 11.5%

SUBTOTALS FOR: GGS BASE: 1329.8 CHNG: 1375.4 DIFF: 3.4%  
 DIFF: 45.7 DF: 9.1%

64933 PAULINE3 - 64902 MOORE 3 BASE: -22.6 CHNG: 0.5 DIFF: -102.4%  
 64839 GR ISLD4 - 64780 COLMB.W4 BASE: 124.1 CHNG: 119.3 DIFF: -3.8%  
 66571 GR ISLD3 - 64896 MCCOOL 3 BASE: 29.7 CHNG: 78.6 DIFF: 164.9%

SUBTOTALS FOR: GRIS\_LNC BASE: 131.1 CHNG: 198.5 DIFF: 51.3%  
 DIFF: 67.3 DF: 13.5%

37632 LEECO;BP - 36362 NELSO; B BASE: 333.6 CHNG: 310.4 DIFF: -6.9%

SUBTOTALS FOR: LEECONELS		BASE:	333.6	CHNG:	310.4	DIFF:	-6.9%
				DIFF:	-23.2	DF:	-4.6%
*****							
60175	ROSEAU 4 - 67576 RICHER 4	BASE:	-80.9	CHNG:	-85.8	DIFF:	6.1%
60173	ROSEAU2 - 67564 DORSEY 2	BASE:	-993.4	CHNG:	-1045.7	DIFF:	5.3%
66752	DRAYTON4 - 67557 LETELER4	BASE:	-255.3	CHNG:	-232.5	DIFF:	-8.9%
63379	RUGBY 4 - 67523 GLENBOR4	BASE:	47.4	CHNG:	83.3	DIFF:	75.9%
SUBTOTALS FOR: MHEX_N+		BASE:	-1282.2	CHNG:	-1280.7	DIFF:	-0.1%
				DIFF:	1.5	DF:	0.3%
*****							
67576	RICHER 4 - 60175 ROSEAU 4	BASE:	81.7	CHNG:	86.7	DIFF:	6.1%
67564	DORSEY 2 - 60173 ROSEAU2	BASE:	1006.4	CHNG:	1060.1	DIFF:	5.3%
67557	LETELER4 - 66752 DRAYTON4	BASE:	260.5	CHNG:	236.7	DIFF:	-9.1%
67523	GLENBOR4 - 63379 RUGBY 4	BASE:	-46.9	CHNG:	-81.8	DIFF:	74.5%
SUBTOTALS FOR: MHEX_S+		BASE:	1301.7	CHNG:	1301.7	DIFF:	0.0%
				DIFF:	0.0	DF:	0.0%
*****							
68613	AUBURNT4 - 67525 RESTON 4	BASE:	-24.5	CHNG:	-27.0	DIFF:	10.4%
68615	YORKTON4 - 67514 ROBLIN 4	BASE:	-119.9	CHNG:	-119.8	DIFF:	-0.1%
68630	EBCAMPB4 - 67515 RALL 4	BASE:	-80.2	CHNG:	-79.8	DIFF:	-0.5%
SUBTOTALS FOR: MH_SPC_E+		BASE:	-224.5	CHNG:	-226.6	DIFF:	0.9%
				DIFF:	-2.1	DF:	-0.4%
*****							
67525	RESTON 4 - 68613 AUBURNT4	BASE:	24.5	CHNG:	27.1	DIFF:	10.4%
67514	ROBLIN 4 - 68615 YORKTON4	BASE:	121.4	CHNG:	121.2	DIFF:	-0.1%
67515	RALL 4 - 68630 EBCAMPB4	BASE:	81.8	CHNG:	81.4	DIFF:	-0.5%
SUBTOTALS FOR: MH_SPC_W+		BASE:	227.7	CHNG:	229.7	DIFF:	0.9%
				DIFF:	2.0	DF:	0.4%
*****							
64095	MNTZUMA3 - 64064 BONDRNT3	BASE:	57.4	CHNG:	-5.9	DIFF:	-110.3%
SUBTOTALS FOR: MNTZUMA_W		BASE:	57.4	CHNG:	-5.9	DIFF:	-110.3%
				DIFF:	-63.3	DF:	-12.7%
*****							
60105	PR ISLD3 - 61950 BYRON 3	BASE:	-40.5	CHNG:	10.2	DIFF:	-125.2%
60304	EAU CL 3 - 39244 ARP 345	BASE:	182.2	CHNG:	237.0	DIFF:	30.1%
SUBTOTALS FOR: MWSI		BASE:	141.8	CHNG:	247.2	DIFF:	74.4%
				DIFF:	105.4	DF:	21.1%
*****							
66756	SQBUTTE4 - 63049 STANTON4	BASE:	-50.9	CHNG:	-35.1	DIFF:	-30.9%
66756	SQBUTTE4 - 66751 CENTER 4	BASE:	-28.5	CHNG:	-51.2	DIFF:	79.2%
66756	SQBUTTE4 - 66791 CENTER 3	BASE:	77.7	CHNG:	84.6	DIFF:	8.8%
63041	COAL CR4 - 63042 COAL TP4	BASE:	-17.3	CHNG:	-19.5	DIFF:	12.6%
63041	COAL CR4 - 63049 STANTON4	BASE:	-136.7	CHNG:	-153.0	DIFF:	11.9%
63041	COAL CR4 - 63381 UNDERWD4	BASE:	151.9	CHNG:	170.4	DIFF:	12.2%
SUBTOTALS FOR: NDDC		BASE:	-3.8	CHNG:	-3.8	DIFF:	0.6%
				DIFF:	0.0	DF:	0.0%
*****							
67105	LELANDO3 - 66506 FTTHOMP3	BASE:	163.1	CHNG:	219.4	DIFF:	34.5%
67105	LELANDO3 - 67160 GROTON 3	BASE:	234.9	CHNG:	292.9	DIFF:	24.7%
67101	ANTELOP3 - 67120 BRDLAND3	BASE:	208.4	CHNG:	264.1	DIFF:	26.7%
63314	BIGSTON4 - 66503 BLAIR 4	BASE:	114.4	CHNG:	123.7	DIFF:	8.2%
66554	MORRIS 4 - 66550 GRANITF4	BASE:	-39.1	CHNG:	-24.4	DIFF:	-37.5%
63336	AUDUBON4 - 63053 HUBBARD4	BASE:	88.3	CHNG:	111.7	DIFF:	26.5%
66521	SULLYBT4 - 66519 OAHE 4	BASE:	-49.5	CHNG:	-26.6	DIFF:	-46.2%
63052	INMAN 4 - 61611 WINGRIV4	BASE:	80.0	CHNG:	102.5	DIFF:	28.0%



36280	BYRON; B	-	36288	CHERR; B	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
36281	BYRON; R	-	36289	CHERR; R		BASE:	1344.7	CHNG:	1367.2
						DIFF:			1.7%
-----									
SUBTOTALS FOR: BYCHEBYCHE						BASE:	1344.7	CHNG:	1367.2
						DIFF:	22.4	DF:	4.5%
*****									
36382	QUAD ;	-	34036	ROCK CK3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
64425	DAVNPR5	-	34122	E CALMS5		BASE:	0.0	CHNG:	0.0
						DIFF:			999.0%
-----									
SUBTOTALS FOR: DAVCALQUARCK						BASE:	0.0	CHNG:	0.0
						DIFF:	0.0	DF:	0.0%
*****									
64352	TIFFIN 3	-	34093	ARNOLD 3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
64350	HILLS 3	-	34110	HILLSIE5		BASE:	157.4	CHNG:	143.8
						DIFF:			-8.7%
-----									
SUBTOTALS FOR: HLSXFMTIFARN						BASE:	157.4	CHNG:	143.8
						DIFF:	-13.6	DF:	-2.7%
*****									
57981	LACYGNE7	-	57968	STILWEL7	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
57981	LACYGNE7	-	57965	W.GRDNR7		BASE:	1098.8	CHNG:	1072.5
						DIFF:			-2.4%
-----									
SUBTOTALS FOR: LACWGRLACSTI						BASE:	1098.8	CHNG:	1072.5
						DIFF:	-26.2	DF:	-5.2%
*****									
36310	ELECT; B	-	36362	NELSO; B	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
37632	LEECO;BP	-	36280	BYRON; B		BASE:	593.8	CHNG:	640.7
						DIFF:			7.9%
-----									
SUBTOTALS FOR: LEEBYREJNEL						BASE:	593.8	CHNG:	640.7
						DIFF:	46.8	DF:	9.4%
*****									
60331	LKFLDXL3	-	60108	WILMART3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
34007	LAKEFLD5	-	34008	FOX LK 5		BASE:	64.0	CHNG:	67.9
						DIFF:			6.1%
-----									
SUBTOTALS FOR: LKFFOXLKGLWM						BASE:	64.0	CHNG:	67.9
						DIFF:	3.9	DF:	0.8%
*****									
36407	WEMPL; R	-	39058	PAD 345	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
34028	LORE 5	-	34033	TRK RIV5		BASE:	140.7	CHNG:	136.7
						DIFF:			-2.8%
-----									
SUBTOTALS FOR: LORTRKWEMPAD						BASE:	140.7	CHNG:	136.7
						DIFF:	-4.0	DF:	-0.8%
*****									
39058	PAD 345	-	36407	WEMPL; R	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
36407	WEMPL; R	-	36406	WEMPL; B	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
36406	WEMPL; B	-	39119	ROE 345	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
39058	PAD 345	-	39059	PAD 138		BASE:	0.0	CHNG:	0.0
						DIFF:			-590.1%
-----									
SUBTOTALS FOR: PADXFMPADROE						BASE:	0.0	CHNG:	0.0
						DIFF:	0.0	DF:	0.0%
*****									
64095	MNTZUMA3	-	64064	BONDRNT3	*CONTINGENCY*	BASE:	0.0	CHNG:	0.0
-----									
34185	POWESHK5	-	34191	REASNOR5		BASE:	53.9	CHNG:	29.9
						DIFF:			-44.6%
-----									
SUBTOTALS FOR: POWREAMTZBON						BASE:	53.9	CHNG:	29.9
						DIFF:			-44.6%

```

DIFF: -24.0 DF: -4.8%
*****
65351 S3451 3 - 63875 RAUN 3 *CONTINGENCY* BASE: 0.0 CHNG: 0.0
-----
65426 S1226 5 - 64987 TEKAMAH5 BASE: 101.3 CHNG: 79.8 DIFF: -21.2%
SUBTOTALS FOR: S1226TEKAMAH BASE: 101.3 CHNG: 79.8 DIFF: -21.2%
DIFF: -21.5 DF: -4.3%
*****
36382 QUAD ; - 64405 SUB 91 3 *CONTINGENCY* BASE: 0.0 CHNG: 0.0
-----
34029 SALEM 3 - 34030 SALEM N5 BASE: 341.8 CHNG: 326.3 DIFF: -4.5%
SUBTOTALS FOR: SALXFMQUADAV BASE: 341.8 CHNG: 326.3 DIFF: -4.5%
DIFF: -15.5 DF: -3.1%
*****
36407 WEMPL; R - 39058 PAD 345 *CONTINGENCY* BASE: 0.0 CHNG: 0.0
-----
34029 SALEM 3 - 34030 SALEM N5 BASE: 315.3 CHNG: 302.4 DIFF: -4.1%
SUBTOTALS FOR: SALXFMWEMPAD BASE: 315.3 CHNG: 302.4 DIFF: -4.1%
DIFF: -12.9 DF: -2.6%
*****
63875 RAUN 3 - 34006 LAKEFLD3 *CONTINGENCY* BASE: 0.0 CHNG: 0.0
-----
66563 SPENCER5 - 34137 TRIBOJI5 BASE: -17.9 CHNG: -27.0 DIFF: 50.7%
SUBTOTALS FOR: SPETRILAKRAU BASE: -17.9 CHNG: -27.0 DIFF: 50.7%
DIFF: -9.1 DF: -1.8%
*****
56873 SUMMIT 6 - 56872 EMCIPHER6 *CONTINGENCY* BASE: 0.0 CHNG: 0.0
-----
57374 SPHILPJ3 - 57438 WMCIPHER3 BASE: -1.8 CHNG: -4.0 DIFF: 117.5%
57374 SPHILPJ3 - 57438 WMCIPHER3 BASE: -1.6 CHNG: -4.2 DIFF: 163.9%
SUBTOTALS FOR: SPHWMCSUMEMC BASE: -3.4 CHNG: -8.2 DIFF: 139.0%
DIFF: -4.8 DF: -1.0%
*****

```

**Appendix G – Data Files for Steady-State Analysis  
(i.e., Data Files used for GRE Contingency Program)**

## **Appendix G.1: Command File for Defining Monitored Elements & Contingencies (File make-belfield.idv)**

```
TEXT This PSS/E 29.4 command file generates a monitored element list and a
TEXT contingency list for steady-state analysis.
TEXT Inputs:
TEXT 1. Power flow case.
TEXT 2. Subsystem list for defining contingencies.
TEXT 3. Subsystem list for monitoring branches and buses.
TEXT 4. Switching procedure files: belfield-switch.assign & belfield-switch.proc
TEXT Outputs:
TEXT 1. File belfield-line.input: List of monitored branches.
TEXT 2. File belfield-bus.input: List of monitored buses.
TEXT 3. File belfield-cont.lines: List of contingencies.
TEXT

odev
2
make-belfield.tsc
pdev
2
make-belfield.tsc
exec contingency
plc-spl5aa
1 /* contingency generator
3 /* define subsystem by area
652 626 618 608 600
0 /* zero levels away
115 /* min voltage for contingencies
belfield-switch.assign
belfield-cont.lines
2 /* input file generator
3 /* by area
652 626 618 608 600 667
0
110 /* min kV for monitoring
belfield-line.input
belfield-bus.input
3 /* test input files
n /* do not test with equipment ratings
belfield-cont.lines
belfield-switch.proc

TEXT *** End make file ***
odev
1
pdev
1
```



## Appendix G.2: Command File for Performing System Intact Analysis (File *run-belfield-intact.idv*)

```
TEXT *** MAIN IDEV FILE FOR SYSTEM INTACT ANALYSIS ***
pdev
2
run-belfield-intact.tsc
odev
2
run-belfield-intact.tsc

TEXT ***** Run contingency program *****
exec contingency
plc-spl5aa
4 /* single contingency
100 /* itmxn
c
90 /* system intact line overload threshold
d
90 /* system intact tfr overload threshold
e
90 /* contingency case undervoltage threshold
g
90 /* contingency case line overload threshold
h
90 /* contingency case tfr overload threshold

a /* use rate a
15 /* max number of criteria violations
n /* no automap printing
null-cont.lines
belfield-switch.proc
belfield-line.input
belfield-bus.input
solve.cont
plc-spl5aa-intact
Y /* yes run contingencies

TEXT *** END ***
odev
1
pdev
1
```

**Note:** File “*null-cont.lines*” is a null contingency file containing a single “dummy” contingency specification as shown below (this specification models a remote contingency in the TVA system):

```
19623 19280      0 '1' SW0      2MANISRD69.0-2MELTON 69.0
```

**Note:** File “*solve.cont*” is a solving routine file. It must contain 3 lines of input per solve activity (FDNS OPT and FNSL OPT are activities to be used). Entry is as follows and an FNSL OPT must be done for a final tolerance flag to be achieved.

```
FDNS OPT
1,,1
0
FNSL OPT
1,,1
0
```

### **Appendix G.3: Command File for Performing N-1 Contingency Analysis (File run-belfield.idv)**

```
TEXT *** MAIN IDEV FILE FOR CONTINGENCY ANALYSIS ***
pdev
2
run-belfield.tsc
odev
2
run-belfield.tsc

TEXT ***** Run contingency program *****
exec contingency
plc-spl5aa
4 /* single contingency
100 /* itmxn
c
90 /* system intact line overload threshold
d
90 /* system intact tfr overload threshold
e
90 /* contingency case undervoltage threshold
g
90 /* contingency case line overload threshold
h
70 /* contingency case tfr overload threshold

c /* use rate c
15 /* max number of criteria violations
n /* no automap printing
belfield-cont.lines
belfield-switch.proc
belfield-line.input
belfield-bus.input
solve.cont

Y /* yes run contingencies

TEXT *** END ***
odev
1
pdev
1
```

## Appendix G.4: Switching Procedure Files (Files *belfield-switch.assign* & *belfield-switch.proc*)

### File *belfield-switch.assign*:

```
66199 66208 0 '1' SW1
66199 66444 0 '1' SW1
66199 66445 0 '1' SW1
66200 66201 0 '1' SW2
66200 66437 0 '1' SW2
66200 66443 0 '1' SW2
66207 66208 0 '1' SW3
66207 66444 0 '1' SW3
66207 66445 0 '1' SW3
66210 66211 0 '1' SW4
66210 66403 0 '1' SW4
66210 66404 0 '1' SW4
66216 66217 0 '1' SW5
66216 66411 0 '1' SW5
66216 66412 0 '1' SW5
66220 66221 0 '1' SW6 SW301 / Loss of Belfield 1st xfr w/o & with loss of 2nd xfr
66220 66424 0 '1' SW6 SW301
66220 66425 0 '1' SW6 SW301
66231 66232 0 '1' SW7
66231 66523 0 '1' SW7
66231 66524 0 '1' SW7
66233 66234 0 '1' SW8
66234 66523 0 '1' SW8
66234 66524 0 '1' SW8
66236 66237 0 '1' SW9
66236 66529 0 '1' SW9
66236 66530 0 '1' SW9
66238 66530 0 '1' SW10
66238 66531 0 '1' SW10
66238 66239 0 '1' SW10
66240 66241 0 '1' SW11
66241 66530 0 '1' SW11
66241 66531 0 '1' SW11
66246 66247 0 '1' SW12
66246 66480 0 '1' SW12
66246 66497 0 '1' SW12
66266 66267 0 '1' SW13
66266 66484 0 '1' SW13
66266 66485 0 '1' SW13
66272 66273 0 '1' SW14
66272 66506 0 '1' SW14
66272 66507 0 '1' SW14
66274 66275 0 '1' SW15
66275 66506 0 '1' SW15
66275 66507 0 '1' SW15
66280 66281 0 '1' SW16
66280 66514 0 '1' SW16
66280 66515 0 '1' SW16
66282 66283 0 '1' SW17
66283 66514 0 '1' SW17
66283 66515 0 '1' SW17
66292 66293 0 '1' SW18
66292 66537 0 '1' SW18
66292 66538 0 '1' SW18
66296 66297 0 '1' SW19
66296 66550 0 '1' SW19
66296 66551 0 '1' SW19
63188 66759 0 '1' SW20
63188 63167 0 '1' SW20
63188 66923 0 '1' SW20
66303 66304 0 '1' SW21
66303 66564 0 '1' SW21
```

66303	66565	0	'1'	SW21
66305	66306	0	'1'	SW22
66306	66564	0	'1'	SW22
66306	66565	0	'1'	SW22
66307	66308	0	'1'	SW23
66307	66565	0	'1'	SW23
66307	66566	0	'1'	SW23
66309	66310	0	'1'	SW24
66309	66565	0	'1'	SW24
66309	66566	0	'1'	SW24
66434	66440	0	'1'	SW25
66435	66440	0	'1'	SW25
66436	66440	0	'1'	SW25
66434	66446	0	'1'	SW26
66435	66446	0	'1'	SW26
66436	66446	0	'1'	SW26
67105	67201	0	'1'	SW27
67106	67201	0	'1'	SW27
67105	67202	0	'1'	SW28
67106	67202	0	'1'	SW28
67108	67208	0	'1'	SW29
67155	67208	0	'1'	SW29
67120	67204	0	'1'	SW30
67204	67205	0	'1'	SW30
67133	67209	0	'1'	SW31
67209	67210	0	'1'	SW31
67168	67209	0	'1'	SW31
67135	67207	0	'1'	SW32
67206	67207	0	'1'	SW32
67167	67207	0	'1'	SW32
67160	67203	0	'1'	SW33
67161	67203	0	'1'	SW33
66512	67203	0	'1'	SW33
67182	67211	0	'1'	SW34
67183	67211	0	'1'	SW34
66212	66213	0	'1'	SW35
66212	66214	0	'1'	SW35
66212	66407	0	'1'	SW35
66226	66227	0	'1'	SW36
66226	66229	0	'1'	SW36
66226	66505	0	'1'	SW36
66227	66228	0	'1'	SW36
66253	66254	0	'1'	SW37
66253	66255	0	'1'	SW37
66253	66502	0	'1'	SW37
66255	66256	0	'1'	SW37
66261	66262	0	'1'	SW38
66261	66479	0	'1'	SW38
66707	66772	0	'1'	SW39
66777	66772	0	'1'	SW39
67503	66772	0	'1'	SW39
65009	65046	0	'1'	SW40
65010	65046	0	'1'	SW40
65011	65046	0	'1'	SW40
66571	66313	0	'1'	SW41
64839	66313	0	'1'	SW41
66314	66313	0	'1'	SW41
66571	66315	0	'1'	SW42
64839	66315	0	'1'	SW42
66316	66315	0	'1'	SW42
66754	60133	0	'1'	SW0 SW100
66754	63329	0	'1'	SW0 SW100
66712	60141	0	'1'	SW0 SW101
66712	60141	0	'2'	SW0 SW101
60134	60135	0	'2'	SW0 SW102
66761	60134	0	'1'	SW0 SW102
66761	60135	0	'1'	SW0 SW102
60135	60137	0	'1'	SW0 SW102
60135	60137	0	'1'	SW0 SW103
60135	66761	0	'1'	SW0 SW103
66761	60134	0	'1'	SW0 SW103

67104 67108 0 '1' SWO SW104  
67104 67385 0 '1' SWO SW104  
66431 63267 0 '1' SWO SW105  
63267 63268 0 '1' SWO SW105  
63267 63265 0 '1' SWO SW105  
63265 63266 0 '1' SWO SW105  
63265 66720 0 '1' SWO SW105  
66720 63264 0 '1' SWO SW105  
63264 66709 0 '1' SWO SW105  
66709 66784 0 '1' SWO SW105  
66784 63164 0 '1' SWO SW105  
66784 66800 0 '1' SWO SW105  
66426 66441 0 '1' SWO SW106  
66426 66456 0 '1' SWO SW106  
66456 67106 0 '1' SWO SW106  
66426 66441 0 '1' SWO SW107  
66441 67106 0 '1' SWO SW107  
66426 66456 0 '1' SWO SW108  
66456 67106 0 '1' SWO SW108  
67310 67265 0 '1' SWO SW109  
67265 67304 0 '1' SWO SW109  
67265 67263 0 '1' SWO SW109  
63041 63042 0 '1' SWO SW110  
63042 63049 0 '1' SWO SW110  
63042 63044 0 '1' SWO SW110  
63041 63042 0 '1' SWO SW111  
63042 63049 0 '1' SWO SW111  
63042 63044 0 '1' SWO SW111  
63041 63049 0 '1' SWO SW111  
66436 66707 0 '1' SWO SW112  
66707 66430 0 '1' SWO SW112  
66430 66443 0 '1' SWO SW112  
66772 66707 0 '1' SWO SW112  
66772 66777 0 '1' SWO SW112  
66772 67053 0 '1' SWO SW112  
66437 66759 0 '1' SWO SW113  
66444 66759 0 '1' SWO SW113  
66759 63188 0 '1' SWO SW113  
63188 66923 0 '1' SWO SW113  
63188 63167 0 '1' SWO SW113  
63358 63369 0 '1' SWO SW114  
66792 63358 0 '1' SWO SW114  
63358 63198 0 '1' SWO SW114  
63198 63258 0 '1' SWO SW114  
63198 63158 0 '1' SWO SW114  
66792 63189 0 '1' SWO SW114  
63189 66754 0 '1' SWO SW114  
63189 63359 0 '1' SWO SW114  
63190 66754 0 '1' SWO SW114  
66792 63190 0 '1' SWO SW114  
63190 63360 0 '1' SWO SW114  
63363 63327 0 '1' SWO SW115  
63363 63362 0 '1' SWO SW115  
67326 63362 0 '1' SWO SW115  
63362 63162 0 '1' SWO SW115  
63363 63193 0 '1' SWO SW115  
63193 63163 0 '1' SWO SW115  
63193 63263 0 '1' SWO SW115  
66755 63047 0 '1' SWO SW116  
63056 63047 0 '1' SWO SW116  
63266 63047 0 '1' SWO SW116  
63044 63056 0 '1' SWO SW117  
63042 63044 0 '1' SWO SW117  
63044 60140 0 '1' SWO SW117  
66752 66787 0 '1' SWO SW118  
66705 66787 0 '1' SWO SW118  
66763 66787 0 '1' SWO SW118  
66752 66788 0 '1' SWO SW119  
66705 66788 0 '1' SWO SW119  
66762 66788 0 '1' SWO SW119  
63325 63327 0 '1' SWO SW120

63314	63325	0	'1'	SW0	SW120
63325	63125	0	'1'	SW0	SW120
66555	63219	0	'1'	SW0	SW121
63219	63223	0	'1'	SW0	SW121
66705	63255	0	'1'	SW0	SW122
63255	63256	0	'1'	SW0	SW122
63255	66718	0	'1'	SW0	SW122
63255	66714	0	'1'	SW0	SW122
63255	63155	0	'1'	SW0	SW122
63255	63155	0	'2'	SW0	SW122
63256	63356	0	'1'	SW0	SW122
63256	63356	0	'2'	SW0	SW122
63255	63155	0	'1'	SW0	SW123
63255	63155	0	'2'	SW0	SW123
63255	66718	0	'1'	SW0	SW124
66718	66708	0	'1'	SW0	SW124
66708	63254	0	'1'	SW0	SW124
63254	66713	0	'1'	SW0	SW124
66708	66785	0	'1'	SW0	SW124
66785	66838	0	'1'	SW0	SW124
66785	63156	0	'1'	SW0	SW124
63254	63354	0	'1'	SW0	SW124
66713	63253	0	'1'	SW0	SW125
63253	63251	0	'1'	SW0	SW125
63251	63252	0	'1'	SW0	SW125
63251	63238	0	'1'	SW0	SW125
63253	63353	0	'1'	SW0	SW125
63253	63353	0	'2'	SW0	SW125
66706	66722	0	'1'	SW0	SW126
66722	66714	0	'1'	SW0	SW126
66714	63255	0	'1'	SW0	SW126
66722	63284	0	'1'	SW0	SW126
63284	66724	0	'1'	SW0	SW126
66724	66725	0	'1'	SW0	SW126
66725	66726	0	'1'	SW0	SW126
66706	66722	0	'1'	SW0	SW127
66706	63249	0	'1'	SW0	SW127
63214	63213	0	'1'	SW0	SW128
63213	63212	0	'1'	SW0	SW128
63212	63211	0	'1'	SW0	SW128
63212	63210	0	'1'	SW0	SW128
63213	63113	0	'1'	SW0	SW128
63215	63216	0	'1'	SW0	SW129
63214	63215	0	'1'	SW0	SW129
63249	63250	0	'1'	SW0	SW130
63250	63238	0	'1'	SW0	SW130
63250	63150	0	'1'	SW0	SW130
63223	63233	0	'1'	SW0	SW131
63233	63234	0	'1'	SW0	SW131
63233	63232	0	'1'	SW0	SW131
63232	62532	0	'1'	SW0	SW131
63234	62528	0	'1'	SW0	SW131
62528	62533	0	'1'	SW0	SW131
62533	62529	0	'1'	SW0	SW131
63236	62529	0	'1'	SW0	SW131
62528	63310	0	'1'	SW0	SW131
62528	63310	0	'2'	SW0	SW131
62529	62530	0	'1'	SW0	SW131
63331	63329	0	'1'	SW0	SW132
66754	63329	0	'1'	SW0	SW132
63329	63191	0	'1'	SW0	SW132
63191	63229	0	'1'	SW0	SW132
63191	63129	0	'1'	SW0	SW132
63327	63303	0	'1'	SW0	SW133
63327	63329	0	'1'	SW0	SW133
63329	63201	0	'1'	SW0	SW133
63201	63229	0	'1'	SW0	SW133
63201	63129	0	'1'	SW0	SW133
62425	62427	0	'1'	SW0	SW134
62425	62005	0	'1'	SW0	SW134
62425	62005	0	'1'	SW0	SW135

60357 62005 0 '1' SW0 SW135  
62005 62006 0 '1' SW0 SW135  
62006 62001 0 '1' SW0 SW135  
63041 63042 0 '1' SW0 SW136  
63042 63049 0 '1' SW0 SW136  
63042 63044 0 '1' SW0 SW136  
63041 63042 0 '1' SW0 SW137  
63042 63049 0 '1' SW0 SW137  
63042 63044 0 '1' SW0 SW137  
63041 63049 0 '1' SW0 SW137  
63216 62003 0 '1' SW0 SW138  
66555 62003 0 '1' SW0 SW138  
62003 62004 0 '1' SW0 SW138  
66555 63218 0 '1' SW0 SW139  
63218 62002 0 '1' SW0 SW139  
62002 62001 0 '1' SW0 SW139  
62001 62013 0 '1' SW0 SW139  
62001 62006 0 '1' SW0 SW139  
63331 63051 0 '1' SW0 SW140  
63051 63052 0 '1' SW0 SW140  
63051 63309 0 '1' SW0 SW140  
63052 61611 0 '1' SW0 SW141  
63052 63051 0 '1' SW0 SW141  
63052 62531 0 '1' SW0 SW141  
60126 60130 0 '1' SW0 SW200  
60130 66537 0 '1' SW0 SW200  
60126 60131 0 '1' SW0 SW200  
60131 66564 0 '1' SW0 SW200  
60129 60117 0 '1' SW0 SW201  
60129 60132 0 '1' SW0 SW201  
60126 60286 0 'P1' SW0 SW202  
60126 60131 0 '1' SW0 SW202  
60131 66564 0 '1' SW0 SW202  
66503 66530 0 '1' SW0 SW203  
66530 66550 0 '1' SW0 SW203  
66530 66550 0 '1' SW0 SW204  
66503 66550 0 '1' SW0 SW204  
66600 66601 0 '1' SW0 SW205  
66600 66520 0 '1' SW0 SW205  
66600 66489 0 '1' SW0 SW205  
66602 66601 0 '1' SW0 SW206  
66602 66489 0 '1' SW0 SW206  
67411 66515 0 '1' SW0 SW207  
67411 67403 0 '1' SW0 SW207  
67411 67404 0 '1' SW0 SW207  
66504 66531 0 '1' SW0 SW208  
66529 66537 0 '1' SW0 SW208  
66507 66509 0 '1' SW0 SW209  
66507 66516 0 '1' SW0 SW209  
66509 66516 0 '1' SW0 SW209  
66507 66523 0 '1' SW0 SW210  
66507 67122 0 '1' SW0 SW210  
66513 67122 0 '1' SW0 SW210  
67122 67123 0 '1' SW0 SW210  
66507 66514 0 '1' SW0 SW211  
66507 66514 0 '2' SW0 SW211  
66507 66519 0 '1' SW0 SW212  
66507 66519 0 '2' SW0 SW212  
66507 66519 0 '3' SW0 SW213  
66507 66519 0 '4' SW0 SW213  
66509 66565 0 '1' SW0 SW214  
66509 66526 0 '1' SW0 SW214  
66526 66536 0 '1' SW0 SW214  
66398 66526 0 '1' SW0 SW214  
66509 66565 0 '1' SW0 SW215  
66536 66565 0 '1' SW0 SW215  
66509 66526 0 '1' SW0 SW216  
66398 66526 0 '1' SW0 SW216  
66526 66536 0 '1' SW0 SW216  
66514 66530 0 '1' SW0 SW217  
66514 66530 0 '2' SW0 SW217

66484 66488 0 '1' SW0 SW218  
66488 66519 0 '1' SW0 SW218  
66486 66488 0 '1' SW0 SW218  
64984 66571 0 '1' SW0 SW219  
66506 66571 0 '1' SW0 SW219  
64896 66571 0 '1' SW0 SW220  
66506 66571 0 '1' SW0 SW220  
66550 63050 0 '1' SW0 SW220  
63050 62427 0 '1' SW0 SW220  
66551 66508 0 '1' SW0 SW222  
66552 66508 0 '1' SW0 SW222  
60371 66508 0 '1' SW0 SW222  
66550 66554 0 '1' SW0 SW223  
66554 66555 0 '1' SW0 SW223  
66553 66554 0 '1' SW0 SW223  
66550 60147 0 '1' SW0 SW224  
60147 60148 0 '5' SW0 SW224  
66550 60150 0 '1' SW0 SW225  
60148 60149 0 '6' SW0 SW225  
60150 63054 0 '1' SW0 SW225  
60149 60150 0 '1' SW0 SW225  
63054 60742 0 '1' SW0 SW225  
66560 34047 0 '1' SW0 SW226  
66603 34047 0 '1' SW0 SW226  
34048 34047 0 '1' SW0 SW226  
67316 66791 0 '1' SW0 SW227 / Coyote - Center 345 without and with trip of Coyote unit  
60101 60198 0 '1' SW600  
60197 60198 0 '1' SW600  
60101 60174 0 '1' SW601  
60173 60174 0 '1' SW601  
60173 67564 0 '1' SW601  
66752 66755 0 '1' SW602  
66752 67557 0 '1' SW602  
60175 66757 0 '1' SW603  
60175 67576 0 '1' SW603  
61627 66753 0 '1' SW603  
66753 66757 0 '1' SW603  
67557 67559 0 '1' SW604  
67526 67575 0 '1' SW605  
67560 67576 0 '1' SW606  
67523 63379 0 '1' SW607  
67523 67524 0 '1' SW607  
67523 67526 0 '1' SW607  
63056 63379 0 '1' SW607  
60186 60199 0 '1' SW608  
60199 60221 0 '1' SW608  
67564 67566 0 '1' SW609  
67564 67598 0 '1' SW609  
63345 63186 0 '1' SW0 SW809  
63186 63343 0 '1' SW0 SW809  
66758 63345 0 '1' SW0 SW809  
60133 60336 0 '1' SW0 SW887  
60133 60134 0 '5' SW0 SW887  
63336 63136 0 '1' SW0 SW887  
63336 63053 0 '1' SW0 SW936 SW887  
63053 61641 0 '1' SW0 SW936  
63281 63245 0 '1' SW0 SW947 SW948  
63246 63245 0 '1' SW0 SW948  
63245 66776 0 '1' SW0 SW948  
66776 66968 0 '1' SW0 SW948  
66776 63145 0 '1' SW0 SW948  
63245 63186 0 '1' SW0 SW948 SW809  
66330 66331 0 '2' SW300 SW301 / Loss of Belfield 345-230 2nd xfr without and with loss of 1st xfr  
66330 66424 0 '2' SW300 SW301  
66330 66425 0 '2' SW300 SW301  
66417 66418 0 '1' SW0 SW302 / Loss of Dickinson 230-115 2nd xfr without and with loss of 1st  
xfr  
66417 66418 0 '2' SW0 SW302





	LINESW	66292	WHITE__T	66293	WHITE9_1	1	0
	LINESW	66292	WHITE__T	66537	WHITE__3	1	0
	LINESW	66292	WHITE__T	66538	WHITE__7	1	0
SW19	3						
	LINESW	66296	GRANITFT	66297	GRANITF9	1	0
	LINESW	66296	GRANITFT	66550	GRANITF4	1	0
	LINESW	66296	GRANITFT	66551	GRANITF7	1	0
SW20	3						
	LINESW	63188	PICKERTY	66759	PICKERT4	1	0
	LINESW	63188	PICKERTY	63167	PICKERT9	1	0
	LINESW	63188	PICKERTY	66923	PICKERT8	1	0
SW21	3						
	LINESW	66303	SIOUXC1T	66304	SIOUXC19	1	0
	LINESW	66303	SIOUXC1T	66564	SIOUXCY3	1	0
	LINESW	66303	SIOUXC1T	66565	SIOUXCY4	1	0
SW22	3						
	LINESW	66305	SIOUXC29	66306	SIOUXC2T	1	0
	LINESW	66306	SIOUXC2T	66564	SIOUXCY3	1	0
	LINESW	66306	SIOUXC2T	66565	SIOUXCY4	1	0
SW23	3						
	LINESW	66307	SIOUXC3T	66308	SIOUXC39	1	0
	LINESW	66307	SIOUXC3T	66565	SIOUXCY4	1	0
	LINESW	66307	SIOUXC3T	66566	SIOUXCY5	1	0
SW24	3						
	LINESW	66309	SIOUXC4T	66310	SIOUXC49	1	0
	LINESW	66309	SIOUXC4T	66565	SIOUXCY4	1	0
	LINESW	66309	SIOUXC4T	66566	SIOUXCY5	1	0
SW25	3						
	LINESW	66434	FARGOSVC	66440	FARGOM14	1	0
	LINESW	66435	FARGO__4	66440	FARGOM14	1	0
	LINESW	66436	FARGO__7	66440	FARGOM14	1	0
SW26	3						
	LINESW	66434	FARGOSVC	66446	FARGOM24	1	0
	LINESW	66435	FARGO__4	66446	FARGOM24	1	0
	LINESW	66436	FARGO__7	66446	FARGOM24	1	0
SW27	2						
	LINESW	67105	LELANDO3	67201	LELND1TY	1	0
	LINESW	67106	LELANDO4	67201	LELND1TY	1	0
SW28	2						
	LINESW	67105	LELANDO3	67202	LELND2TY	1	0
	LINESW	67106	LELANDO4	67202	LELND2TY	1	0
SW29	2						
	LINESW	67108	LOGAN__4	67208	LOGAN_TY	1	0
	LINESW	67155	LOGAN__7	67208	LOGAN_TY	1	0
SW30	2						
	LINESW	67120	BRDLAND3	67204	BRDLNDTY	1	0
	LINESW	67204	BRDLNDTY	67205	BRDLAND4	1	0
SW31	3						
	LINESW	67133	SIDNEY_3	67209	SIDNEYTY	1	0
	LINESW	67209	SIDNEYTY	67210	SIDXFMR4	1	0
	LINESW	67168	SIDNEY_M	67209	SIDNEYTY	1	0
SW32	3						
	LINESW	67135	STEGALL3	67207	STEGALTY	1	0
	LINESW	67206	STGXFMR4	67207	STEGALTY	1	0
	LINESW	67167	STEGALLM	67207	STEGALTY	1	0
SW33	3						
	LINESW	67160	GROTON_3	67203	GROTONTY	1	0
	LINESW	67161	GROTON_9	67203	GROTONTY	1	0
	LINESW	66512	GROTON_7	67203	GROTONTY	1	0
SW34	2						
	LINESW	67182	CHAR.CK7	67211	CHARCKTY	1	0
	LINESW	67183	CHAR.CK3	67211	CHARCKTY	1	0
SW35	3						
	LINESW	66212	FALLON_T	66213	FALLON_8	1	0
	LINESW	66212	FALLON_T	66214	FALLON_9	1	0
	LINESW	66212	FALLON_T	66407	FALLON_7	1	0
SW36	4						
	LINESW	66226	FLANDRUT	66227	FLANDR19	1	0
	LINESW	66226	FLANDRUT	66229	FLANDRU8	1	0
	LINESW	66226	FLANDRUT	66505	FLANDRU7	1	0
	LINESW	66227	FLANDR19	66228	FLANDRU9	1	0

SW37	4								
	LINESW	66253	BERSFRDT	66254	BERSFRD8	1	0		
	LINESW	66253	BERSFRDT	66255	BERSFR19	1	0		
	LINESW	66253	BERSFRDT	66502	BERSFRD7	1	0		
	LINESW	66255	BERSFR19	66256	BERSFRD9	1	0		
SW38	2								
	LINESW	66261	MARTIN19	66262	MARTIN_9	1	0		
	LINESW	66261	MARTIN19	66479	MARTIN_7	1	0		
SW39	3								
	LINESW	66707	CALEDON7	66772	CALEDONT	1	0		
	LINESW	66777	CALEDON9	66772	CALEDONT	1	0		
	LINESW	67503	CALEDON8	66772	CALEDONT	1	0		
SW40	3								
	LINESW	65009	WAYSIDE4	65046	WAYSID_Y	1	0		
	LINESW	65010	WAYSIDE7	65046	WAYSID_Y	1	0		
	LINESW	65011	WAYSIDE9	65046	WAYSID_Y	1	0		
SW41	3								
	LINESW	66571	GR_ISLD3	66313	GR_ISL1T	1	0		
	LINESW	64839	GR_ISLD4	66313	GR_ISL1T	1	0		
	LINESW	66314	GR_ISL19	66313	GR_ISL1T	1	0		
SW42	3								
	LINESW	66571	GR_ISLD3	66315	GR_ISL2T	1	0		
	LINESW	64839	GR_ISLD4	66315	GR_ISL2T	1	0		
	LINESW	66316	GR_ISL29	66315	GR_ISL2T	1	0		
SW100	2								
	LINESW	66754	MAPLE_R4	60133	SHEYNNE4	1	0		
	LINESW	66754	MAPLE_R4	63329	WAHPETN4	1	0		
SW101	2								
	LINESW	66712	PRAIRIE7	60141	NORDIC_7	1	0		
	LINESW	66712	PRAIRIE7	60141	NORDIC_7	2	0		
SW102	4								
	LINESW	60134	SHEYNNE7	60135	CASS_CO7	2	0		
	LINESW	66761	MODEROW7	60134	SHEYNNE7	1	0		
	LINESW	66761	MODEROW7	60135	CASS_CO7	1	0		
	LINESW	60135	CASS_CO7	60137	REDRIVR7	1	0		
SW103	3								
	LINESW	60135	CASS_CO7	60137	REDRIVR7	1	0		
	LINESW	60135	CASS_CO7	66761	MODEROW7	1	0		
	LINESW	66761	MODEROW7	60134	SHEYNNE7	1	0		
SW104	2								
	LINESW	67104	TIOGA4_4	67108	LOGAN_4	1	0		
	LINESW	67104	TIOGA4_4	67385	TIOGA4_7	1	0		
SW105	10								
	LINESW	66431	DEVILSL7	63267	DEVIL_J7	1	0		
	LINESW	63267	DEVIL_J7	63268	DEVIL_S7	1	0		
	LINESW	63267	DEVIL_J7	63265	DEVILSE7	1	0		
	LINESW	63265	DEVILSE7	63266	RAMSEY_7	1	0		
	LINESW	63265	DEVILSE7	66720	SWEETWA7	1	0		
	LINESW	66720	SWEETWA7	63264	LOMA_JT7	1	0		
	LINESW	63264	LOMA_JT7	66709	LANGDON7	1	0		
	LINESW	66709	LANGDON7	66784	LANGDONT	1	0		
	LINESW	66784	LANGDONT	63164	LANGDON9	1	0		
	LINESW	66784	LANGDONT	66800	LANGDON8	1	0		
SW106	4								
	LINESW	66426	BISMAR4	67283	WILTTAP4	1	0		
	LINESW	67283	WILTTAP4	66441	GARRISN4	1	0		
	LINESW	66426	BISMAR4	66456	WASHBRN4	1	0		
	LINESW	66456	WASHBRN4	67106	LELANDO4	1	0		
SW107	3								
	LINESW	66426	BISMAR4	67283	WILTTAP4	1	0		
	LINESW	67283	WILTTAP4	66441	GARRISN4	1	0		
	LINESW	66441	GARRISN4	67106	LELANDO4	1	0		
SW108	2								
	LINESW	66426	BISMAR4	66456	WASHBRN4	1	0		
	LINESW	66456	WASHBRN4	67106	LELANDO4	1	0		
SW109	3								
	LINESW	67310	BOWMAN_4	67265	LTLMISS4	1	0		
	LINESW	67265	LTLMISS4	67304	BAKER_4	1	0		
	LINESW	67265	LTLMISS4	67263	LTLMISS7	1	0		
SW110	3								
	LINESW	63041	COAL_CR4	63042	COAL_TP4	1	0		

	LINESW	63042	COAL_TP4	63049	STANTON4	1	0
	LINESW	63042	STANTON4	63044	MCHENRY4	1	0
SW111	4						
	LINESW	63041	COAL_CR4	63042	COAL_TP4	1	0
	LINESW	63042	COAL_TP4	63049	STANTON4	1	0
	LINESW	63042	COAL_TP4	63044	MCHENRY4	1	0
	LINESW	63041	COAL_CR4	63049	STANTON4	1	0
SW112	6						
	LINESW	66436	FARGO_7	66707	CALEDON7	1	0
	LINESW	66707	CALEDON7	66430	EGF_IND7	1	0
	LINESW	66430	EGF_IND7	66443	GRNDFKS7	1	0
	LINESW	66772	CALEDONT	66707	CALEDON7	1	0
	LINESW	66772	CALEDONT	66777	CALEDON9	1	0
	LINESW	66772	CALEDONT	67053	CALEDON8	1	0
SW113	5						
	LINESW	66437	GRNDFKS4	66759	PICKERT4	1	0
	LINESW	66444	JAMESTN4	66759	PICKERT4	1	0
	LINESW	66759	PICKERT4	63188	PICKERTY	1	0
	LINESW	63188	PICKTERY	66923	PICKERT8	1	0
	LINESW	63188	PICKTERY	63167	PICKERT9	1	0
SW114	11						
	LINESW	63358	BUFFALO3	63369	JAMESTN3	1	0
	LINESW	66792	MAPLE_R3	63358	BUFFALO3	1	0
	LINESW	63358	BUFFALO3	63198	BUFFALOY	1	0
	LINESW	63198	BUFFALOY	63258	BUFFALO7	1	0
	LINESW	63198	BUFFALOY	63158	BUFFALO9	1	0
	LINESW	66792	MAPLE_R3	63189	MAPLER1Y	1	0
	LINESW	63189	MAPLER1Y	66754	MAPLE_R4	1	0
	LINESW	63189	MAPLER1Y	63359	MAPLER19	1	0
	LINESW	63190	MAPLER2Y	66754	MAPLE_R4	1	0
	LINESW	66792	MAPLE_R3	63190	MAPLER2Y	1	0
	LINESW	63190	MAPLER2Y	63360	MAPLER29	1	0
SW115	7						
	LINESW	63363	FORMAN_4	63327	HANKSON4	1	0
	LINESW	63363	FORMAN_4	63362	OAKES_4	1	0
	LINESW	67326	ELLENDL4	63362	OAKES_4	1	0
	LINESW	63362	OAKES_4	63162	OAKES_9	1	0
	LINESW	63363	FORMAN_4	63193	FORMAN_Y	1	0
	LINESW	63193	FORMAN_Y	63163	FORMN_9	1	0
	LINESW	63193	FORMAN_Y	63263	FORMN_7	1	0
SW116	3						
	LINESW	66755	PRAIRIE4	63047	RAMSEY_4	1	0
	LINESW	63056	BALTA_4	63047	RAMSEY_4	1	0
	LINESW	63266	RAMSEY_7	63047	RAMSEY_4	1	0
SW117	3						
	LINESW	63044	MCHENRY4	63056	BALTA_4	1	0
	LINESW	63042	COAL_TP4	63044	MCHENRY4	1	0
	LINESW	63044	MCHENRY4	60140	MCHENRY7	1	0
SW118	3						
	LINESW	66752	DRAYTON4	66787	DRAYTO1T	1	0
	LINESW	66705	DRAYTON7	66787	DRAYTO1T	1	0
	LINESW	66763	DRAYTO19	66787	DRAYTO1T	1	0
SW119	3						
	LINESW	66752	DRAYTON4	66788	DRAYTO2T	1	0
	LINESW	66705	DRAYTON7	66788	DRAYTO2T	1	0
	LINESW	66762	DRAYTO29	66788	DRAYTO2T	1	0
SW120	3						
	LINESW	63325	BROWNSV4	63327	HANKSON4	1	0
	LINESW	63314	BIGSTON4	63325	BROWNSV4	1	0
	LINESW	63325	BROWNSV4	63125	BROWNSV9	1	0
SW121	2						
	LINESW	66555	MORRIS_7	63219	GRANTCO7	1	0
	LINESW	63219	GRANTCO7	63223	HOOT_LK7	1	0
SW122	8						
	LINESW	66705	DRAYTON7	63255	DONALDS7	1	0
	LINESW	63255	DONALDS7	63256	DONDPIP7	1	0
	LINESW	63255	DONALDS7	66718	HALMA_7	1	0
	LINESW	63255	DONALDS7	66714	WARSAW_7	1	0
	LINESW	63255	DONALDS7	63155	DONALDS9	1	0
	LINESW	63255	DONALDS7	63155	DONALDS9	2	0
	LINESW	63256	DONDPIP7	63356	DON PIP9	1	0

	LINESW	63256	DONDPIP7	63356	DON PIP9	2	0	
SW123	2	LINESW	63255	DONALDS7	63155	DONALDS9	1	0
	LINESW	63255	DONALDS7	63155	DONALDS9	2	0	
SW124	8	LINESW	63255	DONALDS7	66718	HALMA_7	1	0
	LINESW	66718	HALMA_7	66708	KARLSTA7	1	0	
	LINESW	66708	KARLSTA7	63254	VIKING_7	1	0	
	LINESW	63254	VIKING_7	66713	TRFALLS7	1	0	
	LINESW	66708	KARLSTA7	66785	KARLSTAT	1	0	
	LINESW	66785	KARLSTAT	66838	KARLSTA8	1	0	
	LINESW	66785	KARLSTAT	63156	KARLSTD9	1	0	
	LINESW	63254	VIKING_7	63354	VIK_PIP9	1	0	
SW125	6	LINESW	66713	TRFALLS7	63253	PLUMPIP7	1	0
	LINESW	63253	PLUMPIP7	63251	PLUMTAP7	1	0	
	LINESW	63251	PLUMTAP7	63252	PLUMMER7	1	0	
	LINESW	63251	PLUMTAP7	63238	WINGER_7	1	0	
	LINESW	63253	PLUMPIP7	63353	PLUMPIP9	1	0	
	LINESW	63253	PLUMPIP7	63353	PLUMPIP9	2	0	
SW126	7	LINESW	66706	FALCONR7	66722	OSLO_7	1	0
	LINESW	66722	OSLO_7	66714	WARSAW_7	1	0	
	LINESW	66714	WARSAW7	63255	DONALDS7	1	0	
	LINESW	66722	OSLO_7	63284	OSLO_TN7	1	0	
	LINESW	63284	OSLO_TN7	66724	ALVARAD7	1	0	
	LINESW	66724	ALVARAD7	66725	WARREN_7	1	0	
	LINESW	66725	WARREN_7	66726	ANDERNW7	1	0	
SW127	2	LINESW	66706	FALCONR7	66722	OSLO_7	1	0
	LINESW	66706	FALCONR7	63249	CRKSTON7	1	0	
SW128	5	LINESW	63214	BIGSTON7	63213	MARIETT7	1	0
	LINESW	63213	MARIETT7	63212	BURR_7	1	0	
	LINESW	63212	BURR_7	63211	CANBY_7	1	0	
	LINESW	63212	BURR_7	63210	TORONTO7	1	0	
	LINESW	63213	MARIETT7	63113	MARIETT9	1	0	
SW129	2	LINESW	63215	HIWY12_7	63216	ORTONVL7	1	0
	LINESW	63214	BIGSTON7	63215	HIWY12_7	1	0	
SW130	3	LINESW	63249	CRKSTON7	63250	FERTILE7	1	0
	LINESW	63250	FERTILE7	63238	WINGER_7	1	0	
	LINESW	63250	FERTILE7	63150	FERTILE9	1	0	
SW131	11	LINESW	63223	HOOT_LK7	63233	EDGETAP7	1	0
	LINESW	63233	EDGETAP7	63234	HOOTLK3G	1	0	
	LINESW	63233	EDGETAP7	63232	EDGETWN7	1	0	
	LINESW	63232	EDGETWN7	62532	FERGUS_7	1	0	
	LINESW	63234	PEL_RPD7	62528	TAMARAC7	1	0	
	LINESW	62528	TAMARAC7	62533	CORMRNT7	1	0	
	LINESW	62533	CORMRNT7	62529	CMRTJCT7	1	0	
	LINESW	63236	AUDUBON7	62529	CMRTJCT7	1	0	
	LINESW	62528	TAMARAC7	63310	TAMARAC9	1	0	
	LINESW	62528	TAMARAC7	63310	TAMARAC9	2	0	
	LINESW	62529	CMRTJCT7	62530	FRAEE_7	1	0	
SW132	5	LINESW	63331	FERGSFL4	63329	WAHPETN4	1	0
	LINESW	66754	MAPLE_R4	63329	WAHPETN4	1	0	
	LINESW	63329	WAHPETN4	63191	WAHPET1Y	1	0	
	LINESW	63191	WAHPET1Y	63229	WAHPETN7	1	0	
	LINESW	63191	WAHPET1Y	63129	WAHPETN9	1	0	
SW133	5	LINESW	63327	HANKSON4	63303	HANKSON9	1	0
	LINESW	63327	HANKSON4	63329	WAHPETN4	1	0	
	LINESW	63329	WAHPETN4	63201	WAHPET2Y	1	0	
	LINESW	63201	WAHPET2Y	63229	WAHPETN7	1	0	
	LINESW	63201	WAHPET2Y	63129	WAHPETN9	1	0	
SW134	2	LINESW	62425	WILLMAR7	62427	WILLMAR8	1	0
	LINESW	62425	WILLMAR7	62005	KERKHOT7	1	0	

SW135	4								
	LINESW	62425	WILLMAR7	62005	KERKHOT7	1	0		
	LINESW	60357	MAYNARD7	62005	KERKHOT7	1	0		
	LINESW	62005	KERKHOT7	62006	KERKHO_7	1	0		
	LINESW	62006	KERKHO_7	62001	BENSON_7	1	0		
SW136	3								
	LINESW	63041	COAL_CR4	63042	COAL_TP4	1	0		
	LINESW	63042	COAL_TP4	63049	STANTON4	1	0		
	LINESW	63042	COAL_TP4	63044	MCHENRY4	1	0		
SW137	4								
	LINESW	63041	COAL_CR4	63042	COAL_TP4	1	0		
	LINESW	63042	COAL_TP4	63049	STANTON4	1	0		
	LINESW	63042	COAL_TP4	63044	MCHENRY4	1	0		
	LINESW	63041	COAL_CR4	63049	STANTON4	1	0		
SW138	3								
	LINESW	63216	ORTONVL7	62003	JOHNJCT7	1	0		
	LINESW	66555	MORRIS_7	62003	JOHNJCT7	1	0		
	LINESW	62003	JOHNJCT7	62004	GRACEV_7	1	0		
SW139	5								
	LINESW	66555	MORRIS_7	63218	MOROTP_7	1	0		
	LINESW	63218	MOROTP_7	62002	WALDEN_7	1	0		
	LINESW	62002	WALDEN_7	62001	BENSON_7	1	0		
	LINESW	62001	BENSON_7	62013	BENSON_9	1	0		
	LINESW	62001	BENSON_7	62006	KERKHO_7	1	0		
SW140	3								
	LINESW	63331	FERGSFL4	63051	HENNING4	1	0		
	LINESW	63051	HENNING4	63052	INMAN_4	1	0		
	LINESW	63051	HENNING4	63309	HENNING9	1	0		
SW141	3								
	LINESW	63052	INMAN_4	61611	WINGRIV4	1	0		
	LINESW	63052	INMAN_4	63051	HENNING4	1	0		
	LINESW	63052	INMAN_4	62531	INMAN_7	1	0		
SW200	4								
	LINESW	60126	SPLT_RK3	60130	SPLTRTA3	1	0		
	LINESW	60130	SPLTRTA3	66537	WHITE_3	1	0		
	LINESW	60126	SPLT_RK3	60131	SPLTRTB3	1	0		
	LINESW	60131	SPLTRTB3	66564	SOUXCY3	1	0		
SW201	2								
	LINESW	60129	SPLT_RK7	60117	CHERRC7	1	0		
	LINESW	60129	SPLT_RK7	60132	WSX_FLS7	1	0		
SW203	2								
	LINESW	66503	BLAIR_4	66530	WATERTN4	1	0		
	LINESW	66530	WATERTN4	66550	GRANITF4	1	0		
SW204	2								
	LINESW	66530	WATERTN4	66550	GRANITF4	1	0		
	LINESW	66503	BLAIR_4	66550	GRANITF4	1	0		
SW205	3								
	LINESW	66600	ASHTAP_7	66601	ASH_ST_7	1	0		
	LINESW	66600	ASHTAP_7	66520	OAHE_7	1	0		
	LINESW	66600	ASHTAP_7	66489	PIERRE_7	1	0		
SW206	2								
	LINESW	66602	EVANSST7	66601	ASH_ST_7	1	0		
	LINESW	66602	EVANSST7	66489	PIERRE_7	1	0		
SW207	3								
	LINESW	67411	BTAP_WP7	66515	HURON_7	1	0		
	LINESW	67411	BTAP_WP7	67403	REDFLD_7	1	0		
	LINESW	67411	BTAP_WP7	67404	HURONWP7	1	0		
SW208	2								
	LINESW	66504	BROOKNG7	66531	WATERTN7	1	0		
	LINESW	66529	WATERTN3	66537	WHITE_3	1	0		
SW209	3								
	LINESW	66507	FTTHOMP4	66509	FTRANDL4	1	0		
	LINESW	66507	FTTHOMP4	66516	LAKPLAT4	1	0		
	LINESW	66509	FTRANDL4	66516	LAKPLAT4	1	0		
SW210	4								
	LINESW	66507	FTTHOMP4	66523	SIOUXFL4	1	0		
	LINESW	66507	FTTHOMP4	67122	STORLA_4	1	0		
	LINESW	66513	HANLON_4	67122	STORLA_4	1	0		
	LINESW	67122	STORLA_4	67123	STORLA_7	1	0		
SW211	2								
	LINESW	66507	FTTHOMP4	66514	HURON_4	1	0		

	LINESW	66507	FTTHOMP4	66514	HURON_4	2	0
SW212	2						
	LINESW	66507	FTTHOMP4	66519	OAHE_4	1	0
	LINESW	66507	FTTHOMP4	66519	OAHE_4	2	0
SW213	2						
	LINESW	66507	FTTHOMP4	66519	OAHE_4	3	0
	LINESW	66507	FTTHOMP4	66519	OAHE_4	4	0
SW214	4						
	LINESW	66509	FTRANL4	66565	SIOUXCY4	1	0
	LINESW	66509	FTRANL4	66526	UTICAJC4	1	0
	LINESW	66526	UTICAJC4	66536	RASMUSN4	1	0
	LINESW	66398	VFODNES4	66526	UTICAJC4	1	0
SW215	2						
	LINESW	66509	FTRANL4	66565	SIOUXCY4	1	0
	LINESW	66536	RASMUSN4	66565	SIOUXCY4	1	0
SW216	3						
	LINESW	66509	FTRANL4	66526	UTICAJC4	1	0
	LINESW	66398	VFODNES4	66526	UTICAJC4	1	0
	LINESW	66526	UTICAJC4	66536	RASMUSN4	1	0
SW217	2						
	LINESW	66514	HURON_4	66530	WATERTN4	1	0
	LINESW	66514	HURON_4	66530	WATERTN4	2	0
SW218	3						
	LINESW	66484	NUNDRWD4	66488	PHILTAP4	1	0
	LINESW	66488	PHILTAP4	66519	OAHE_4	1	0
	LINESW	66486	PHILIP_4	66488	PHILTAP4	1	0
SW219	2						
	LINESW	64984	SWEET_W3	66571	GR ISLD3	1	0
	LINESW	66506	FTTHOMP3	66571	GR ISLD3	1	0
SW220	2						
	LINESW	64896	MCCOL_3	66571	GR_ISLD3	1	0
	LINESW	66506	FTTHOMP3	66571	GR_ISLD3	1	0
SW221	2						
	LINESW	66550	GRANITF4	63050	WILLMAR4	1	0
	LINESW	63050	WILLMAR4	62427	WILLMAR8	1	0
SW222	3						
	LINESW	66551	GRANITF7	66508	S3_7	1	0
	LINESW	66552	MARS_ER7	66508	S3_7	1	0
	LINESW	60371	ERIE_RD7	66508	S3_7	1	0
SW223	3						
	LINESW	66550	GRANITF4	66554	MORRIS_4	1	0
	LINESW	66554	MORRIS_4	66555	MORRIS_7	1	0
	LINESW	66553	MOORHED4	66554	MORRIS_4	1	0
SW224	2						
	LINESW	66550	GRANITF4	60147	MINVALY4	1	0
	LINESW	60147	MINVALY4	60148	MINVALY7	5	0
SW225	5						
	LINESW	66550	GRANITF4	60150	MNVLTAP4	1	0
	LINESW	60148	MINVALY7	60149	MINVALT4	6	0
	LINESW	60150	MNVLTAP4	63054	PANTHER4	1	0
	LINESW	60149	MINVALT4	60150	MNVLTAP4	1	0
	LINESW	63054	PANTHER4	60742	PANTHER8	1	0
SW226	3						
	LINESW	66560	CRESTON5	34047	ANTA_TP5	1	0
	LINESW	66603	EXIRA_5	34047	ANTA_TP5	1	0
	LINESW	34048	ANITA_5	34047	ANTA_TP5	1	0
SW227	1						
LINESW	67316	COYOTE3345	67315	COYOTE1G24.0		1	0
SW300	3						
	LINESW	66330	BELFELDT	66331	BELFELD9	2	0
	LINESW	66330	BELFELDT	66424	BELFELD3	2	0
	LINESW	66330	BELFELDT	66425	BELFELD4	2	0
SW301	6						
	LINESW	66220	BELFELDT	66221	BELFELD9	1	0
	LINESW	66220	BELFELDT	66424	BELFELD3	1	0
	LINESW	66220	BELFELDT	66425	BELFELD4	1	0
	LINESW	66330	BELFELDT	66331	BELFELD9	2	0
	LINESW	66330	BELFELDT	66424	BELFELD3	2	0
	LINESW	66330	BELFELDT	66425	BELFELD4	2	0
SW302	2						
	LINESW	66417	DICKNSN4	66418	DKSN-ND7	1	0

	LINESW	66417	DICKNSN4	66418	DKSN-ND7	2	0
SW500	4						
	LINESW	66571	GR_ISLD3	66313	GR_ISL1T	1	0
	LINESW	64839	GR_ISLD4	66313	GR_ISL1T	1	0
	LINESW	66314	GR_ISL19	66313	GR_ISL1T	1	0
	LINESW	66571	GR_ISLD3	64896	MCPOOL_3	1	0
SW501	4						
	LINESW	66571	GR_ISLD3	64984	SWEET_W3	1	0
	LINESW	66571	GR_ISLD3	66315	GR_ISL2T	1	0
	LINESW	64839	GR_ISLD4	66315	GR_ISL2T	1	0
	LINESW	66316	GR_ISL29	66315	GR_ISL2T	1	0
SW502	3						
	LINESW	66571	GR_ISLD3	66506	FTTHOMP3	1	0
	LINESW	66275	FTTHMP2T	66507	FTTHOMP4	1	0
	LINESW	66275	FTTHMP2T	66274	FTTHMP29	1	0
SW503	3						
	LINESW	66571	GR_ISLD3	66506	FTTHOMP3	1	0
	LINESW	66272	FTTHMP1T	66507	FTTHOMP4	1	0
	LINESW	66272	FTTHMP1T	66273	FTTHMP19	1	0
SW600	4						
SPECSW	MHSOUTH500						
LINESW	60197	CHIS_CO2500	60198	CHIS-N_2500	1	0	
LINESW	60198	CHIS-N_2500	60101	FORBES_2500	1	0	
CAP-SW	60100	FORBESCA2	1	1.05	1.019	0	
SW601	4						
SPECSW	MHNORTH500						
LINESW	60173	ROSEAUN2500	60174	ROSEAUS2500	1	0	
LINESW	60174	ROSEAUS2500	60101	FORBES_2500	1	0	
CAP-SW	60100	FORBESCA2	1	1.05	1.019	0	
SW602	1						
SPECSW	MHL20D						
SW603	1						
SPECSW	MHR50M						
SW604	1						
SPECSW	MHY51L						
SW605	1						
SPECSW	MHS60L						
SW606	1						
SPECSW	MHR49R						
SW607	1						
SPECSW	MHG82R						
SW608	1						
SPECSW	CHISAGO345						
SW609	1						
SPECSW	DORSEY500-230SW806						
SW809	4	DUPLICATE					
LINESW	63345	WILTON_4	63186	WILTON_Y	1	0	
LINESW	63186	WILTON_Y	63245	WILTON_7	1	0	
LINESW	63186	WILTON_Y	63343	WILTON19	1	0	
LINESW	66758	WINGER_4	63345	WILTON_4	1	0	
SW887	4	DUPLICATE					
LINESW	60133	SHEYNNE4	63336	AUDUBON4	1	0	
LINESW	63336	AUDUBON4	63053	HUBBARD4	1	0	
LINESW	60133	SHEYNNE4	60134	SHEYNNE7	5	0	
LINESW	63336	AUDUBON4	63136	AUDUBON9	1	0	
SW936	2	DUPLICATE					
LINESW	63336	AUDUBON4	63053	HUBBARD4	1	0	
LINESW	63053	HUBBARD4	61641	HUBBARD7	1	0	
SW947	3	DUPLICATE					
LINESW	63285	SOLWAY_7	63281	LH_PIPE7	1	0	
LINESW	63281	LH_PIPE7	63280	WLTN_TP7	1	0	
LINESW	63281	LH_PIPE7	63245	WILTON_7	1	0	
SW948	6	DUPLICATE					
LINESW	63246	BEMIDJI7	63245	WILTON_7	1	0	
LINESW	63245	WILTON_7	63281	LH_PIPE7	1	0	
LINESW	63245	WILTON_7	66776	WILTON_T	1	0	
LINESW	66776	WILTON_T	66968	WILTON_8	1	0	
LINESW	66776	WILTON_T	63145	WILTON_9	1	0	
LINESW	63245	WILTON_7	63186	WILTON_Y	1	0	



## **Appendix H – Power Flow & Stability Data for GI-0217 Unit**



## Appendix H.2: GI-0217 Stability Data

REPORT FOR ALL MODELS

BUS 67349 [BELF500G19.000] MODELS

\*\* GENROU \*\* BUS X-- NAME --X BASEKV MC C O N S S T A T E S  
 67349 BELF500G 19.000 1 138718-138731 51763-51768

MBASE Z S O R C E X T R A N GENTAP  
 733.0 0.00340+J 0.27440 0.00000+J 0.00000 1.00000

T'D0 T''D0 T'Q0 T''Q0 H DAMP XD XQ X'D X'Q X''D XL  
 5.19 0.025 0.58 0.250 4.00 0.00 2.3535 2.3078 0.3644 0.5039 0.2744 0.2120

S(1.0) S(1.2)  
 0.0950 0.3800

\*\* EXST1 \*\* BUS X-- NAME --X BASEKV MC C O N S S T A T E S  
 67349 BELF500G 19.000 1 138732-138743 51769-51772

TR VIMAX VIMIN TC TB KA TA  
 0.000 0.170 -0.170 1.000 8.000 250.0 0.020

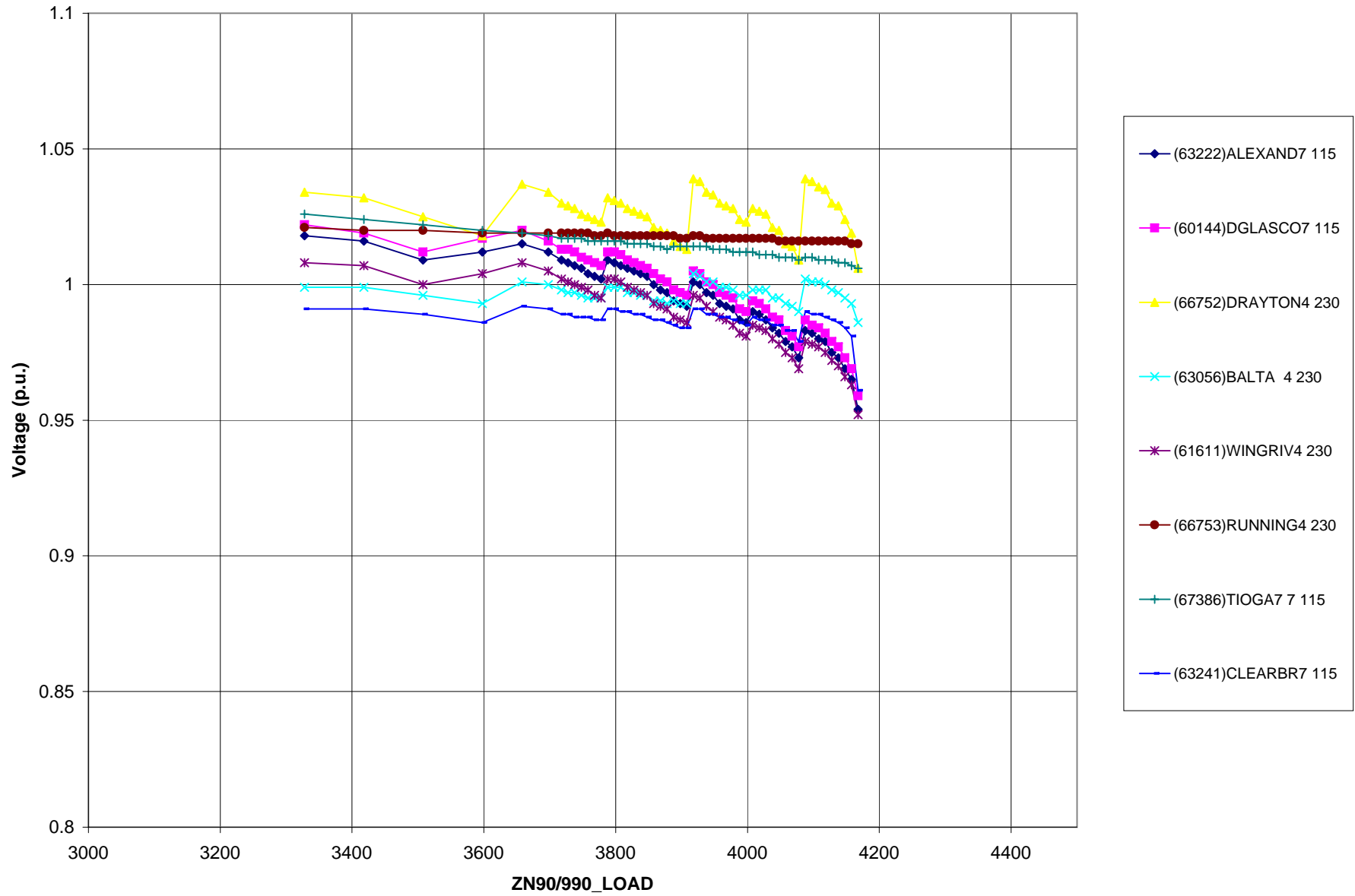
VRMAX VRMIN KC KF TF  
 5.641 -5.077 0.107 0.000 0.500

\*\* TGOV1 \*\* BUS X-- NAME --X BASEKV MC C O N S S T A T E S VAR  
 67349 BELF500G 19.000 1 138744-138750 51773-51774 12787

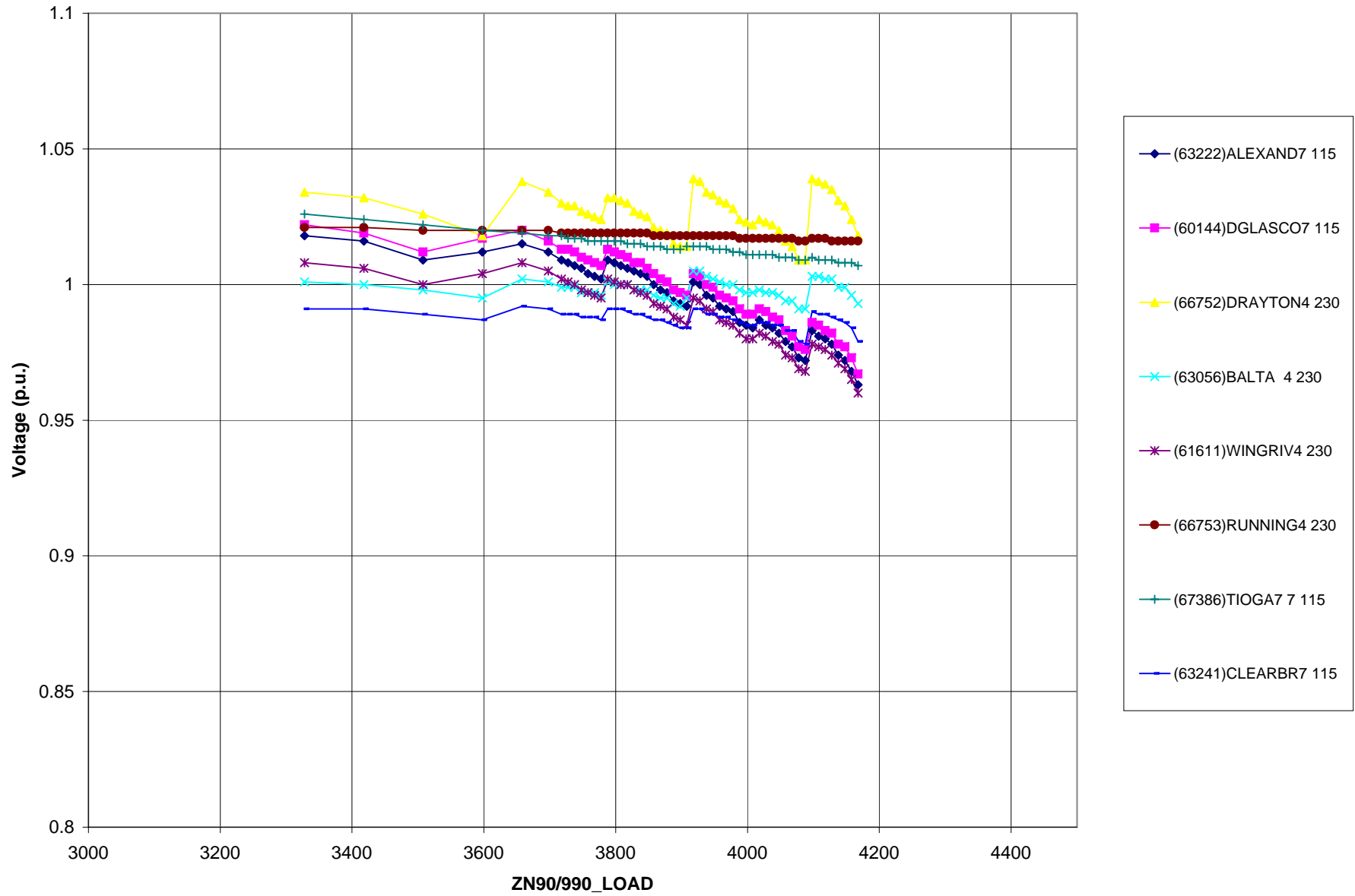
R T1 VMAX VMIN T2 T3 DT  
 0.050 0.500 0.850 0.000 2.100 7.000 0.000

**Appendix I – Voltage Stability Analysis – PV Curves**

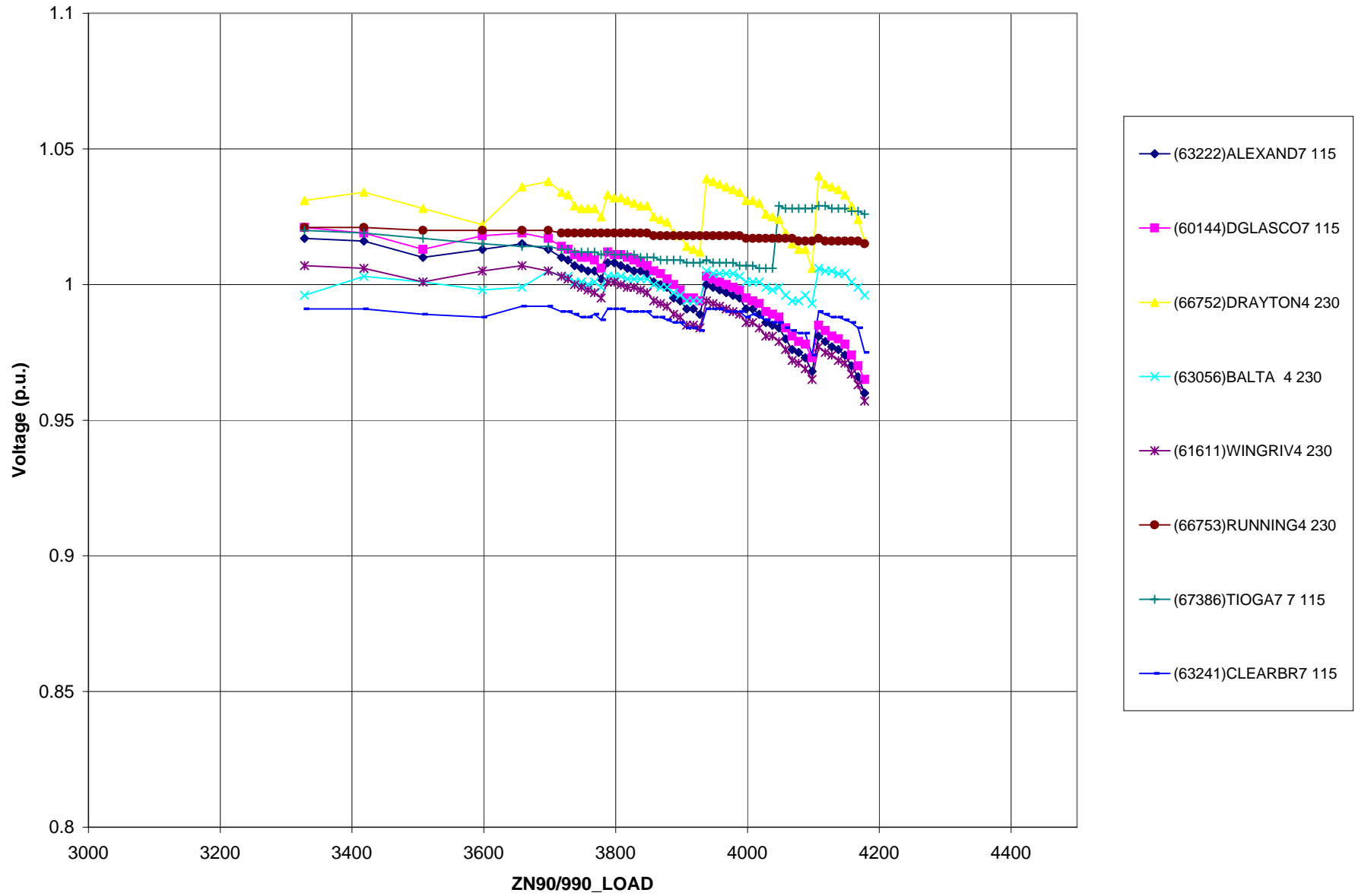
### P-V Analysis (Case nrt-wp06aa with CEN-JMS Outage)



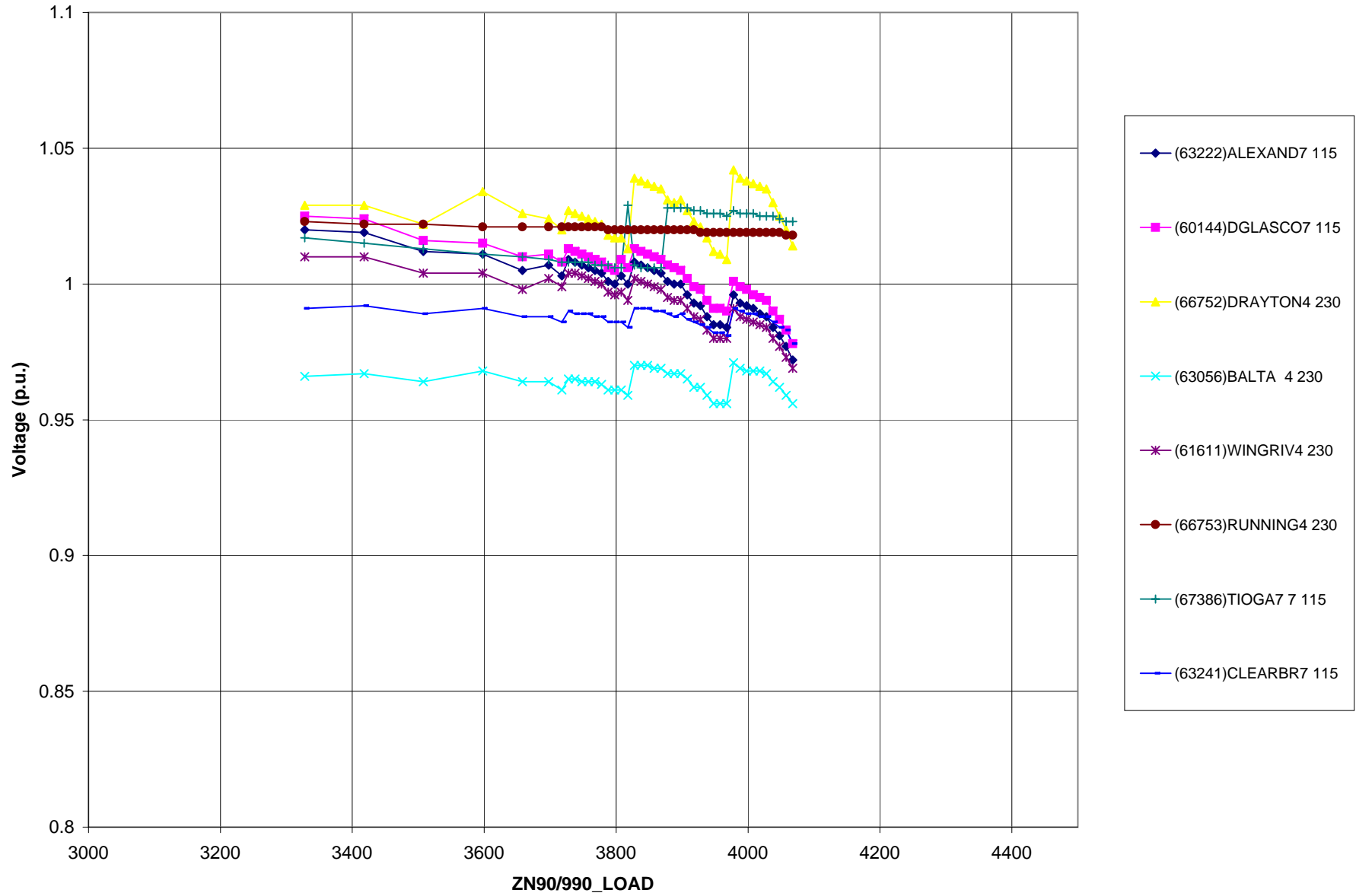
### P-V Analysis (Case urn-wp06aa.9N60410 with CEN-JMS Outage)



### P-V Analysis (Case unb-wp06aa.9N70410 with CEN-JMS Outage)

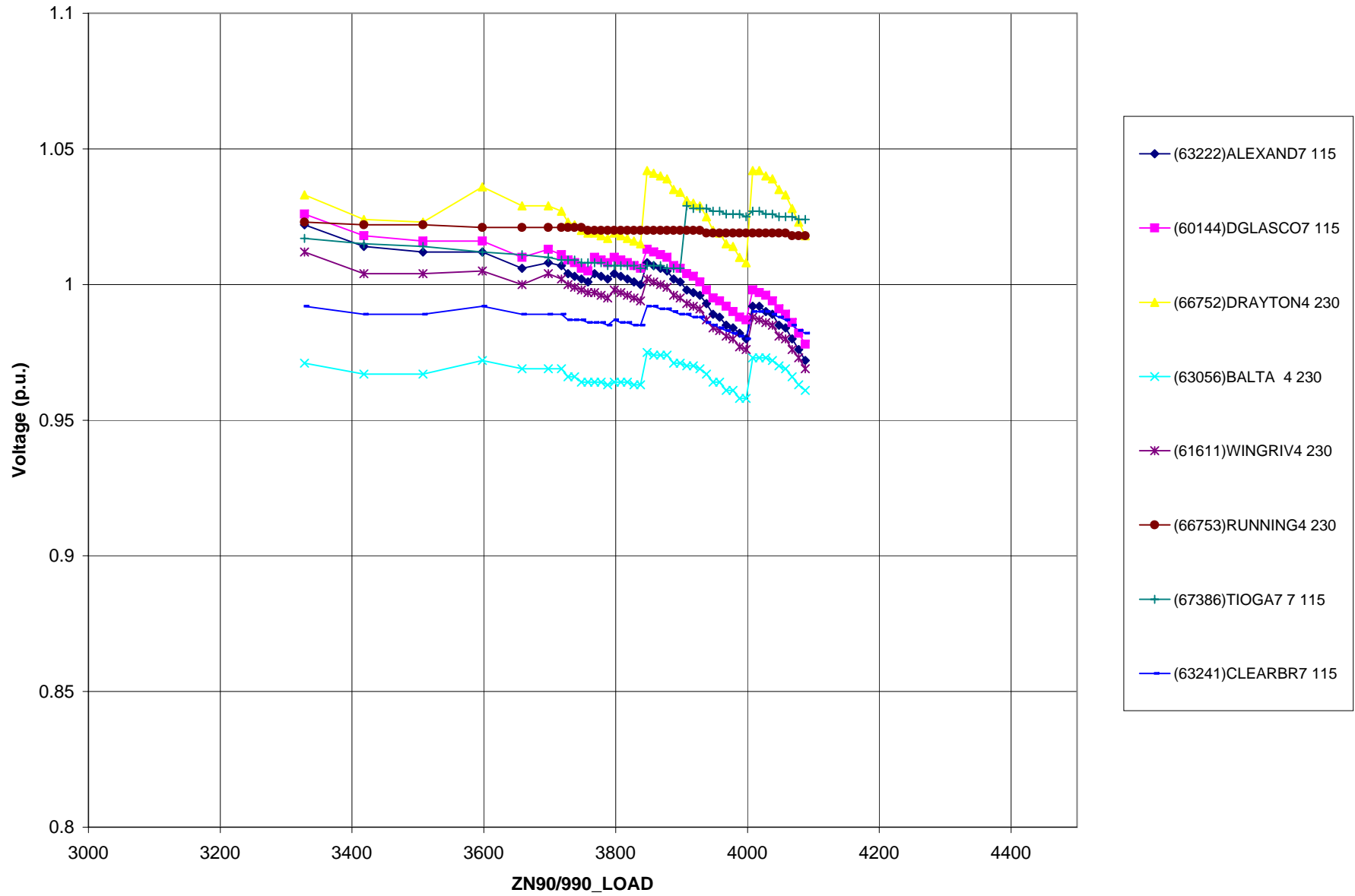


### P-V Analysis (Case ub2-wp06aa.fN90410 with CEN-JMS Outage)





### P-V Analysis (Case ub3-wp06aa.fN90410 with CEN-JMS Outage)



**Appendix J – Rate A Screening for N-1 Contingency Analysis  
– Summer Peak Cases**

**Appendix J.1: Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1c (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
60133 SHEYNNE4 230 66435 FARGO 4 230 1	391.0	96.2	376.3	106.4	416.2	10.2	39.9	0.07978	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		92.1	360.2	102.6	401.2	10.5	41.0	0.08200	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		90.7	354.7	100.7	393.8	10.0	39.1	0.07824	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		90.6	354.1	100.5	393.1	9.9	38.9	0.07786	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
60138 SOURIS 7 115 60139 MALLARD7 115 1	112.0	105.1	117.7	118.0	132.2	12.9	14.4	0.02882	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 66452 RUGBY 7 115 1	80.0	95.0	76.0	112.9	90.3	17.9	14.3	0.02862	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 67155 LOGAN 7 115 1	159.0	114.1	181.4	129.8	206.4	15.7	25.1	0.05010	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
		95.5	151.8	106.6	169.4	11.1	17.7	0.03532	66442 GARRISN7 115 66449 MAX 7 115 1	
		94.4	150.1	105.5	167.7	11.1	17.6	0.03528	60139 MALLARD7 115 66449 MAX 7 115 1	
		88.4	140.5	100.7	160.1	12.3	19.6	0.03914	63041 COAL CR4 230 63042 COAL TP4 230 1	SW110
		88.4	140.5	100.7	160.1	12.3	19.6	0.03914	63042 COAL TP4 230 63044 MCHENRY4 230 1	SW110
		88.4	140.5	100.7	160.1	12.3	19.6	0.03914	63042 COAL TP4 230 63049 STANTON4 230 1	SW110
60140 MCHENRY7 115 63082 MCHENRY1.00 1	84.0	126.9	106.6	148.7	124.9	21.8	18.3	0.03662	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60305 EAU CLA5 161 61200 PRESTOT5 161 1	268.0	118.7	318.1	123.1	330.0	4.4	11.9	0.02388	60186 AS KING3 345 60304 EAU CL 3 345 1	
60317 WHT 14 5 161 61200 PRESTOT5 161 1	272.0	117.6	319.9	122.0	331.7	4.4	11.9	0.02370	60186 AS KING3 345 60304 EAU CL 3 345 1	
63044 MCHENRY4 230 63082 MCHENRY1.00 1	84.0	135.4	113.8	156.3	131.3	20.9	17.6	0.03510	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
63189 MAPLER1Y 345 66754 MAPLE R4 230 1	336.0	115.2	387.0	128.6	432.0	13.4	45.1	0.09014	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		115.2	387.0	128.6	432.1	13.4	45.1	0.09014	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63189 MAPLER1Y 345 66792 MAPLE R3 345 1	336.0	118.3	397.4	132.1	443.7	13.8	46.3	0.09254	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		118.3	397.5	132.1	443.8	13.8	46.3	0.09254	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66754 MAPLE R4 230 1	336.0	115.2	387.0	128.6	432.0	13.4	45.1	0.09014	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		115.2	387.0	128.6	432.1	13.4	45.1	0.09014	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66792 MAPLE R3 345 1	336.0	118.3	397.4	132.1	443.7	13.8	46.3	0.09254	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		118.3	397.5	132.1	443.8	13.8	46.3	0.09254	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63195 BIGSTONY 230 63214 BIGSTON7 115 1	233.0	117.5	273.8	122.9	286.3	5.4	12.6	0.02510	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63195 BIGSTONY 230 63314 BIGSTON4 230 1	233.0	117.5	273.8	122.9	286.3	5.4	12.6	0.02512	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63245 WILTON 7 115 63246 BEMIDJI7 115 1	120.0	88.9	106.6	100.4	120.5	11.5	13.8	0.02768	61641 HUBBARD7 115 63053 HUBBARD4 230 1	SW936

**Appendix J.1 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1c (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		89.3	107.2	100.1	120.1	10.8	12.9	0.02578	60133 SHEYNN4 230 63336 AUDUBON4 230 1	
63327 HANKSON4 230 63329 WAHPETN4 230 1	320.0	100.4	321.2	105.3	337.0	4.9	15.8	0.03150	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		99.7	318.9	104.5	334.4	4.8	15.5	0.03090	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		98.7	315.8	104.3	333.7	5.6	17.9	0.03572	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		99.0	316.7	103.4	330.8	4.4	14.1	0.02826	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	0.0	0.0	195.8	489.4	195.8	489.4	0.97884	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		97.6	243.9	175.4	438.5	77.8	194.6	0.38926	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		97.6	243.9	175.4	438.5	77.8	194.6	0.38926	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		102.2	255.4	173.1	432.8	70.9	177.4	0.35474	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		102.2	255.4	173.1	432.8	70.9	177.4	0.35474	66456 WASHBRN4 230 67106 LELAND4 230 1	SW106
		89.8	224.6	162.7	406.6	72.9	182.0	0.36406	66514 HURON 4 230 67205 BRDLAND4 230 1	
		89.8	224.6	162.7	406.6	72.9	182.0	0.36406	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		89.8	224.6	162.7	406.6	72.9	182.0	0.36406	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		89.8	224.6	162.7	406.6	72.9	182.0	0.36406	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		91.5	228.9	162.1	405.2	70.6	176.3	0.35264	66426 BISMAR4 230 66456 WASHBRN4 230 1	
		91.6	228.9	162.1	405.3	70.5	176.4	0.35276	66456 WASHBRN4 230 67106 LELAND4 230 1	
		87.9	219.8	159.7	399.2	71.8	179.4	0.35878	67105 LELAND3 345 67160 GROTON 3 345 1	
		90.5	226.3	159.4	398.5	68.9	172.2	0.34442	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		89.6	224.0	159.2	397.9	69.6	173.9	0.34784	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		90.6	226.5	158.5	396.2	67.9	169.7	0.33944	66484 NUNDRWD4 230 66488 PHILTPA4 230 1	SW218
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	0.0	0.0	195.8	489.4	195.8	489.4	0.97884	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		98.6	246.6	175.8	439.4	77.2	192.8	0.38560	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		98.6	246.6	175.8	439.4	77.2	192.8	0.38560	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		102.2	255.4	173.3	433.2	71.1	177.8	0.35556	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		102.2	255.4	173.3	433.2	71.1	177.8	0.35556	66456 WASHBRN4 230 67106 LELAND4 230 1	SW106
		90.9	227.3	162.8	407.1	71.9	179.8	0.35960	66514 HURON 4 230 67205 BRDLAND4 230 1	
		90.9	227.3	162.8	407.1	71.9	179.8	0.35958	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		90.9	227.3	162.8	407.1	71.9	179.8	0.35960	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		90.9	227.3	162.8	407.1	71.9	179.8	0.35960	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		92.8	231.9	162.5	406.1	69.7	174.2	0.34838	66456 WASHBRN4 230 67106 LELAND4 230 1	
		92.7	231.8	162.4	405.9	69.7	174.1	0.34818	66426 BISMAR4 230 66456 WASHBRN4 230 1	
		87.9	219.8	159.8	399.6	71.9	179.8	0.35962	67105 LELAND3 345 67160 GROTON 3 345 1	
		90.6	226.6	159.5	398.8	68.9	172.2	0.34440	66404 DAWSONC7 115 67356 LEWIS 7 115 1	
		90.5	226.3	159.4	398.5	68.9	172.2	0.34442	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
		87.2	218.1	158.5	396.1	71.3	178.0	0.35608	66506 FTTHOMP3 345 67105 LELAND3 345 1	
66403 DAWSONC4 230 66411 MI CTYE4 230 1	200.0	104.8	209.7	118.3	236.7	13.5	27.0	0.05398	66404 DAWSONC7 115 67332 GLENDCT7 115 1	
		102.1	204.2	114.7	229.4	12.6	25.2	0.05044	66404 DAWSONC7 115 66407 FALLON 7 115 1	
		99.1	198.2	113.3	226.7	14.2	28.4	0.05684	66210 DAWSONCT 230 66403 DAWSONC4 230 1	SW4

**Appendix J.1 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1c (With GI-0217)**

MONITORED ELEMENT	RATE A MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		99.1	198.2	113.3	226.7	14.2	28.4	0.05684	66210 DAWSONCT 230 66404 DAWSONC7 115 1	SW4
		98.5	197.0	112.0	224.0	13.5	27.0	0.05394	67305 BAKER 7 115 67332 GLENDCT7 115 1	
		99.2	198.4	111.8	223.5	12.6	25.2	0.05034	66216 MICTYE1T 230 66411 MI CTYE4 230 1	SW5
		99.2	198.4	111.8	223.5	12.6	25.2	0.05034	66216 MICTYE1T 230 66412 MI CTYE7 115 1	SW5
		98.4	196.8	111.0	221.9	12.6	25.1	0.05022	66407 FALLON 7 115 66412 MI CTYE7 115 1	
		96.4	192.9	109.8	219.6	13.4	26.7	0.05346	66417 DICKNSN4 230 66425 BELFELD4 230 1	
		96.4	192.9	109.8	219.5	13.4	26.7	0.05332	66418 DKSND7 115 67370 N ENGLN7 115 1	
		100.3	200.6	109.6	219.2	9.3	18.6	0.03720	66484 NUNDRWD4 230 66488 PHILTAP4 230 1	SW218
		100.3	200.6	109.6	219.2	9.3	18.6	0.03720	66486 PHILIP 4 230 66488 PHILTAP4 230 1	SW218
		100.3	200.6	109.6	219.2	9.3	18.6	0.03720	66488 PHILTAP4 230 66519 OAHE 4 230 1	SW218
66404 DAWSONC7 115 67356 LEWIS 7 115 1	80.0	125.1	100.1	142.0	113.6	16.9	13.6	0.02714	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		117.8	94.2	134.3	107.4	16.5	13.2	0.02638	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		95.1	76.1	123.9	99.1	28.8	23.0	0.04596	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		95.1	76.1	123.9	99.1	28.8	23.0	0.04596	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
66408 WATFORD7 115 67182 CHAR.CK7 115 1	80.0	69.9	55.9	104.3	83.4	34.4	27.5	0.05500	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		69.9	55.9	104.3	83.4	34.4	27.5	0.05500	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		80.1	64.1	101.2	81.0	21.1	16.9	0.03378	66413 MEDORA 4 230 66425 BELFELD4 230 1	
66417 DICKNSN4 230 66418 DKSND7 115 1	100.0	103.0	103.0	149.4	149.4	46.4	46.4	0.09278	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		99.2	99.2	145.6	145.6	46.4	46.4	0.09286	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		28.2	28.2	129.4	129.5	101.2	101.3	0.20250	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		65.4	65.4	127.2	127.2	61.8	61.8	0.12356	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		74.1	74.1	125.0	125.0	50.9	50.9	0.10176	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		104.9	104.9	124.9	124.9	20.0	20.0	0.04000	67318 COYOTE 7 115 67320 DICKSWH7 115 1	
		76.0	76.0	119.3	119.3	43.3	43.4	0.08676	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		76.0	76.0	119.3	119.3	43.3	43.4	0.08676	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		98.2	98.2	118.3	118.3	20.1	20.1	0.04020	66418 DKSND7 115 67320 DICKSWH7 115 1	
		83.2	83.2	118.2	118.2	35.0	35.0	0.07002	66484 NUNDRWD4 230 66488 PHILTAP4 230 1	SW218
		83.2	83.2	118.2	118.2	35.0	35.0	0.07002	66486 PHILIP 4 230 66488 PHILTAP4 230 1	SW218
		83.2	83.2	118.2	118.2	35.0	35.0	0.07002	66488 PHILTAP4 230 66519 OAHE 4 230 1	SW218
		80.5	80.5	117.0	117.0	36.5	36.5	0.07304	66488 PHILTAP4 230 66519 OAHE 4 230 1	
		74.6	74.6	114.5	114.5	39.9	39.9	0.07984	66756 SQBUTTE4 230 66791 CENTER 3 345 1	
66417 DICKNSN4 230 66425 BELFELD4 230 1	239.0	39.2	93.6	115.5	276.1	76.3	182.5	0.36492	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		49.3	117.9	112.3	268.4	63.0	150.5	0.30108	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		47.2	112.7	109.9	262.6	62.7	149.9	0.29982	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		47.3	113.2	106.3	254.0	59.0	140.8	0.28166	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		47.3	113.2	106.3	254.0	59.0	140.8	0.28166	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
66418 DKSND7 115 67370 N ENGLN7 115 1	112.5	82.7	93.1	103.1	116.0	20.4	22.9	0.04584	66413 MEDORA 4 230 66425 BELFELD4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	239.0	0.0	0.0	202.6	484.3	202.6	484.3	0.96850	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		0.0	0.0	202.6	484.3	202.6	484.3	0.96850	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		66.4	158.7	110.5	264.0	44.1	105.3	0.21058	66417 DICKNSN4 230 66425 BELFELD4 230 1	
66426 BISMARCK4 230 66456 WASHBRN4 230 1	320.0	85.8	274.4	101.3	324.1	15.5	49.7	0.09944	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		85.8	274.4	101.3	324.1	15.5	49.7	0.09944	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6

**Appendix J.1 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1c (With GI-0217)**

MONITORED ELEMENT	RATE MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		WITH GI-0217 (Case p1c-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
66426 BISMARK4 230 67296 WARD 4 230 1	320.0	83.7	267.9	103.4	330.7	19.7	62.8	0.12558	66426 BISMARK4 230 66456 WASHBRN4 230 1	SW106
		83.7	267.9	103.4	330.7	19.7	62.8	0.12558	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
66442 GARRISN7 115 67113 VOLTAIR7 115 1	109.0	95.5	104.1	106.1	115.6	10.6	11.6	0.02310	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
66442 GARRISN7 115 67308 BEULAH 7 115 1	120.0	83.5	100.2	104.9	125.9	21.4	25.7	0.05140	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66451 RICHLND7 115 67356 LEWIS 7 115 1	79.7	102.1	81.4	120.7	96.2	18.6	14.8	0.02960	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		94.7	75.4	112.3	89.4	17.6	14.0	0.02804	66403 DAWSONC4 230 66413 MEDORA 4 230 1	
		70.6	56.2	101.6	80.9	31.0	24.7	0.04942	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		70.6	56.2	101.6	80.9	31.0	24.7	0.04942	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
66456 WASHBRN4 230 67106 LELANDO4 230 1	319.0	86.1	274.8	101.7	324.5	15.6	49.7	0.09944	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		86.1	274.8	101.7	324.5	15.6	49.7	0.09944	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		92.3	294.6	99.2	316.5	6.9	21.9	0.04378	66426 BISMARK4 230 67283 WILTTAP4 230 1	
		92.4	294.7	99.2	316.5	6.8	21.9	0.04372	66441 GARRISN4 230 67283 WILTTAP4 230 1	
66756 SQBUTTE4 230 66791 CENTER 3 345 1	336.0	109.8	369.1	121.3	407.4	11.5	38.4	0.07672	66791 CENTER 3 345 67316 COYOTE 3 345 1	
		101.1	339.9	112.1	376.7	11.0	36.8	0.07362	66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67105 LELANDO3 345 67201 LELND1TY 345 1	250.0	112.7	281.7	134.8	337.0	22.1	55.3	0.11062	67105 LELANDO3 345 67202 LELND2TY 345 1	SW28
		112.7	281.7	134.8	337.0	22.1	55.3	0.11062	67106 LELANDO4 230 67202 LELND2TY 345 1	SW28
67106 LELANDO4 230 67201 LELND1TY 345 1	250.0	109.9	274.6	131.4	328.6	21.5	53.9	0.10784	67105 LELANDO3 345 67202 LELND2TY 345 1	SW28
		109.9	274.6	131.4	328.6	21.5	53.9	0.10784	67106 LELANDO4 230 67202 LELND2TY 345 1	SW28
67108 LOGAN 4 230 67208 LOGAN TY 230 1	200.0	90.1	180.2	99.8	199.7	9.7	19.4	0.03888	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
67296 WARD 4 230 67342 HESKETT4 230 1	320.0	83.8	268.0	103.4	330.8	19.6	62.8	0.12554	66426 BISMARK4 230 66456 WASHBRN4 230 1	SW106
		83.8	268.0	103.4	330.8	19.6	62.8	0.12554	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	290.2	294.3	305.7	310.0	15.5	15.8	0.03150	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	128.9	113.4	144.1	126.8	15.2	13.4	0.02676	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67380 STANLEY7 115 67385 TIOGA4 7 115 1	61.6	88.0	54.2	106.3	65.5	18.3	11.3	0.02258	67104 TIOGA4 4 230 67108 LOGAN 4 230 1	

**Appendix J.2: Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1e (With GI-0217 and Injection Related Network Upgrades)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
60133 SHEYNNE4 230 66435 FARGO 4 230 1	391.0	90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		92.1	360.2	104.3	407.9	12.2	47.6	0.09522	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		90.7	354.7	107.4	419.8	16.7	65.1	0.13010	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		90.6	354.1	106.9	418.1	16.3	64.0	0.12790	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		96.2	376.3	109.2	427.0	13.0	50.7	0.10138	63369 JAMESTN3 345 66791 CENTER 3 345 1	
60138 SOURIS 7 115 60139 MALLARD7 115 1	112.0	105.1	117.7	117.2	131.2	12.1	13.5	0.02694	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 66452 RUGBY 7 115 1	80.0	95.0	76.0	111.7	89.4	16.7	13.4	0.02682	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60139 MALLARD7 115 67155 LOGAN 7 115 1	159.0	94.4	150.1	105.0	166.9	10.6	16.8	0.03368	60139 MALLARD7 115 66449 MAX 7 115 1	
		88.4	140.5	100.1	159.1	11.7	18.6	0.03722	63041 COAL CR4 230 63042 COAL TP4 230 1	SW110
		114.1	181.4	128.9	204.9	14.8	23.6	0.04716	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
		88.4	140.5	100.1	159.1	11.7	18.6	0.03722	63042 COAL TP4 230 63044 MCHENRY4 230 1	SW110
		88.4	140.5	100.1	159.1	11.7	18.6	0.03722	63042 COAL TP4 230 63049 STANTON4 230 1	SW110
		95.5	151.8	106.1	168.6	10.6	16.9	0.03372	66442 GARRISN7 115 66449 MAX 7 115 1	
60140 MCHENRY7 115 63082 MCHENRY1.00 1	84.0	126.9	106.6	147.3	123.7	20.4	17.1	0.03424	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
60305 EAU CLA5 161 61200 PRESTOT5 161 1	268.0	118.7	318.1	123.1	330.0	4.4	12.0	0.02392	60186 AS KING3 345 60304 EAU CL 3 345 1	
60317 WHT 14 5 161 61200 PRESTOT5 161 1	272.0	117.6	319.9	122.0	331.8	4.4	11.9	0.02374	60186 AS KING3 345 60304 EAU CL 3 345 1	
63044 MCHENRY4 230 63082 MCHENRY1.00 1	84.0	135.4	113.8	155.0	130.2	19.6	16.4	0.03286	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
63189 MAPLER1Y 345 66754 MAPLE R4 230 1	336.0	115.2	387.0	127.8	429.4	12.6	42.5	0.08494	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		115.2	387.0	127.8	429.5	12.6	42.5	0.08494	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63189 MAPLER1Y 345 66792 MAPLE R3 345 1	336.0	118.3	397.4	131.3	441.0	13.0	43.6	0.08720	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		118.3	397.5	131.3	441.1	13.0	43.6	0.08722	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66754 MAPLE R4 230 1	336.0	115.2	387.0	127.8	429.4	12.6	42.5	0.08494	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		115.2	387.0	127.8	429.5	12.6	42.5	0.08494	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66792 MAPLE R3 345 1	336.0	118.3	397.4	131.3	441.0	13.0	43.6	0.08720	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		118.3	397.5	131.3	441.1	13.0	43.6	0.08722	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63195 BIGSTONY 230 63214 BIGSTON7 115 1	233.0	117.5	273.8	122.5	285.4	5.0	11.6	0.02320	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63195 BIGSTONY 230 63314 BIGSTON4 230 1	233.0	117.5	273.8	122.5	285.4	5.0	11.6	0.02320	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63245 WILTON 7 115 63246 BEMIDJI7 115 1	120.0	88.9	106.6	99.9	119.9	11.0	13.3	0.02654	61641 HUBBARD7 115 63053 HUBBARD4 230 1	SW936

NA = Contingency or Monitored Facility Not Applicable.  
Network upgrades in Case p1e-sp15aa.sav: Belfield 345/230 kV transformer #2 + Belfield-Hettinger 230 kV line.

**Appendix J.2 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1e (With GI-0217 and Injection Related Network Upgrades)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
63327 HANKSON4 230 63329 WAHPETN4 230 1	320.0	98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		99.7	318.9	108.2	346.4	8.5	27.5	0.05498	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		99.0	316.7	115.0	368.1	16.0	51.4	0.10286	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		98.7	315.8	114.1	365.2	15.4	49.4	0.09884	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		100.4	321.2	109.6	350.6	9.2	29.4	0.05878	63369 JAMESTN3 345 66791 CENTER 3 345 1	
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	NA	NA	168.9	422.2	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW300
		NA	NA	168.9	422.2	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW300
		97.6	243.9	102.9	257.3	5.3	13.4	0.02672	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		97.6	243.9	102.9	257.3	5.3	13.4	0.02672	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	NA	NA	170.0	424.9	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW300
		NA	NA	170.0	424.9	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW300
		98.6	246.6	103.9	259.8	5.3	13.2	0.02638	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		98.6	246.6	103.9	259.8	5.3	13.2	0.02638	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
66330 BELFELDT 345 66424 BELFELD3 345 2	250.0	NA	NA	168.9	422.2	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		NA	NA	168.9	422.2	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		NA	NA	103.7	259.1	NA	NA	NA	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		NA	NA	103.7	259.1	NA	NA	NA	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		NA	NA	102.9	257.3	NA	NA	NA	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		NA	NA	102.9	257.3	NA	NA	NA	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
66330 BELFELDT 345 66425 BELFELD4 230 2	250.0	NA	NA	168.9	422.2	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		NA	NA	168.9	422.2	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		NA	NA	103.7	259.1	NA	NA	NA	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		NA	NA	103.7	259.1	NA	NA	NA	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		NA	NA	102.9	257.3	NA	NA	NA	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		NA	NA	102.9	257.3	NA	NA	NA	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
66404 DAWSONC7 115 66407 FALLON 7 115 1	80.0	57.6	46.1	121.9	97.5	64.3	51.4	0.10288	66403 DAWSONC4 230 66411 MI CTYE4 230 1	
66404 DAWSONC7 115 67356 LEWIS 7 115 1	80.0	NA	NA	123.2	98.6	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	123.2	98.6	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	123.2	98.6	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		NA	NA	123.2	98.6	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66407 FALLON 7 115 66412 MI CTYE7 115 1	80.0	45.7	36.6	109.9	87.9	64.2	51.3	0.10264	66403 DAWSONC4 230 66411 MI CTYE4 230 1	
66408 WATFORD7 115 67182 CHAR.CK7 115 1	80.0	NA	NA	103.9	83.2	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	103.9	83.2	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	103.9	83.2	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301

NA = Contingency or Monitored Facility Not Applicable.  
Network upgrades in Case p1e-sp15aa.sav: Belfield 345/230 kV transformer #2 + Belfield-Hettinger 230 kV line.



**Appendix J.2 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case p0c (Without GI-0217) vs. Case p1e (With GI-0217 and Injection Related Network Upgrades)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case p0c-sp15aa)		GI-0217 + UPGRADES (Case p1e-sp15aa)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		NA	NA	103.9	83.2	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66417 DICKNSN4 230 66418 DKSND7 115 1	100.0	NA	NA	111.9	111.9	NA	NA	NA	66425 BELFELD4 230 67347 HETINGR4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	239.0	NA	NA	202.6	484.3	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	202.6	484.3	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	202.6	484.3	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		NA	NA	202.6	484.3	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66426 BISMAR4 230 66456 WASHBRN4 230 1	320.0	NA	NA	102.4	327.8	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	102.4	327.8	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	102.4	327.8	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		NA	NA	102.4	327.8	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66426 BISMAR4 230 67296 WARD 4 230 1	320.0	83.7	267.9	101.3	324.3	17.6	56.3	0.11266	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		83.7	267.9	101.3	324.3	17.6	56.3	0.11266	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
66442 GARRISN7 115 67113 VOLTAIR7 115 1	109.0	95.5	104.1	105.3	114.8	9.8	10.7	0.02134	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
66442 GARRISN7 115 67308 BEULAH 7 115 1	120.0	83.5	100.2	104.6	125.5	21.1	25.3	0.05060	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66451 RICHLND7 115 67356 LEWIS 7 115 1	79.7	NA	NA	100.8	80.3	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	100.8	80.3	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	100.8	80.3	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		NA	NA	100.8	80.3	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66456 WASHBRN4 230 67106 LELAND04 230 1	319.0	NA	NA	102.9	328.2	NA	NA	NA	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301
		NA	NA	102.9	328.2	NA	NA	NA	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		NA	NA	102.9	328.2	NA	NA	NA	66330 BELFELDT 345 66424 BELFELD3 345 2	SW301
		NA	NA	102.9	328.2	NA	NA	NA	66330 BELFELDT 345 66425 BELFELD4 230 2	SW301
66756 SQBUTTE4 230 66791 CENTER 3 345 1	336.0	109.8	369.1	120.4	404.5	10.6	35.4	0.07086	66791 CENTER 3 345 67316 COYOTE 3 345 1	
		101.1	339.9	111.4	374.2	10.3	34.4	0.06876	66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67105 LELAND03 345 67201 LELND1TY 345 1	250.0	112.7	281.7	126.3	315.9	13.6	34.2	0.06836	67105 LELAND03 345 67202 LELND2TY 345 1	SW28
		112.7	281.7	126.3	315.9	13.6	34.2	0.06836	67106 LELAND04 230 67202 LELND2TY 345 1	SW28
67106 LELAND04 230 67201 LELND1TY 345 1	250.0	109.9	274.6	123.2	308.0	13.3	33.3	0.06664	67105 LELAND03 345 67202 LELND2TY 345 1	SW28
		109.9	274.6	123.2	308.0	13.3	33.3	0.06664	67106 LELAND04 230 67202 LELND2TY 345 1	SW28
67296 WARD 4 230 67342 HESKETT4 230 1	320.0	83.8	268.0	101.4	324.3	17.6	56.3	0.11262	66426 BISMAR4 230 66456 WASHBRN4 230 1	SW106
		83.8	268.0	101.4	324.3	17.6	56.3	0.11262	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	290.2	294.3	311.9	316.3	21.7	22.0	0.04394	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	128.9	113.4	143.4	126.2	14.5	12.8	0.02558	66791 CENTER 3 345 67316 COYOTE 3 345 1	
67380 STANLEY7 115 67385 TIOGA4 7 115 1	61.6	88.0	54.2	108.1	66.6	20.1	12.4	0.02484	67104 TIOGA4 4 230 67108 LOGAN 4 230 1	

NA = Contingency or Monitored Facility Not Applicable.  
Network upgrades in Case p1e-sp15aa.sav: Belfield 345/230 kV transformer #2 + Belfield-Hettinger 230 kV line.

**Appendix K – System Intact and N-1 Contingency Analysis  
– Summer Off-Peak Cases (Sensitivity Cases with Prior-Queued  
Project G132 Included)**

Case *b0d-s709aa.xzqV424.sav (b0d)*. Without the GI-0217 Plant.

vs.

Case *b1d-s709aa.xzqV424.sav (b1d)*. With the GI-0217 Plant.

**Table K.1: Significantly Affected Facilities - System Intact Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF
		LOADING	CURRENT	LOADING	CURRENT	%	MVA	
		%	MVA	%	MVA			
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	31.3	78.2	106.4	265.9	75.1	187.7	0.37546
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	33.1	82.7	107.5	268.7	74.4	186.0	0.37202
66411 MI CTYE4 230 67304 BAKER 4 230 1	160.0	92.7	148.4	109.2	174.8	16.5	26.5	0.05290
67263 LTLMISS7 115 67265 LTLMISS4 230 1	100.0	77.3	77.3	100.0	100.0	22.7	22.7	0.04546
67326 ELLENDL4 230 67390 G132 230 1	239.0	113.9	272.3	121.0	289.3	7.1	17.0	0.03398

**Table K.2: Significantly Affected Bus Voltages - System Intact Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

SUBSTATION # NAME	VOLTAGE (%) WITHOUT GI-0217	VOLTAGE (%) WITH GI-0217	CHANGE %
63358 BUFFALO3 345	95.63	94.89	0.74
63369 JAMESTN3 345	96.15	94.90	1.25
67263 LTLMISS7 115	97.26	94.07	3.19

**Table K.3: Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
60126 SPLT RK3 345 60130 SPLTRTA3 345 1	717.0	104.9	752.2	107.4	769.9	2.5	17.7	0.03546	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
		99.7	714.9	102.5	735.0	2.8	20.0	0.04002	66503 BLAIR 4 230 66530 WATERTN4 230 1	SW203
		99.7	714.9	102.5	735.0	2.8	20.0	0.04002	66530 WATERTN4 230 66550 GRANITF4 230 1	SW203
		101.0	723.9	102.4	734.2	1.4	10.3	0.02064	66507 FTTHOMP4 230 66523 SIOUXFL4 230 1	SW210
		101.0	723.9	102.4	734.2	1.4	10.3	0.02064	66507 FTTHOMP4 230 67122 STORLA 4 230 1	SW210
		101.0	723.9	102.4	734.2	1.4	10.3	0.02064	66513 HANLON 4 230 67122 STORLA 4 230 1	SW210
		101.0	723.9	102.4	734.2	1.4	10.3	0.02064	67122 STORLA 4 230 67123 STORLA 7 115 1	SW210
60133 SHEYNNE4 230 66435 FARGO 4 230 1	391.0	91.2	356.4	106.3	415.5	15.1	59.1	0.11812	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		89.0	348.0	100.9	394.6	11.9	46.6	0.09310	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		88.6	346.6	100.3	392.0	11.7	45.4	0.09088	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		88.5	346.4	100.0	391.1	11.5	44.7	0.08944	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
60140 MCHENRY7 115 63082 MCHENRY1.00 1	84.0	101.8	85.5	117.3	98.6	15.5	13.1	0.02618	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
62005 KERKHOT7 115 62006 KERKHO 7 115 1	44.9	78.1	35.1	100.7	45.2	22.6	10.2	0.02032	63218 MOROTP 7 115 66555 MORRIS 7 115 1	
63044 MCHENRY4 230 63082 MCHENRY1.00 1	84.0	109.7	92.2	124.5	104.5	14.8	12.4	0.02472	63041 COAL CR4 230 63049 STANTON4 230 1	SW111
63189 MAPLER1Y 345 66754 MAPLE R4 230 1	336.0	120.9	406.3	132.2	444.3	11.3	38.0	0.07596	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		120.9	406.4	132.2	444.4	11.3	38.0	0.07596	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63189 MAPLER1Y 345 66792 MAPLE R3 345 1	336.0	124.2	417.3	135.8	456.3	11.6	39.0	0.07800	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	
		124.2	417.4	135.8	456.4	11.6	39.0	0.07800	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66754 MAPLE R4 230 1	336.0	120.9	406.3	132.2	444.3	11.3	38.0	0.07596	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		120.9	406.4	132.2	444.4	11.3	38.0	0.07596	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63190 MAPLER2Y 345 66792 MAPLE R3 345 1	336.0	124.2	417.3	135.8	456.3	11.6	39.0	0.07800	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	
		124.2	417.4	135.8	456.4	11.6	39.0	0.07800	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	
63195 BIGSTONY 230 63214 BIGSTON7 115 1	233.0	110.2	256.8	116.3	270.9	6.1	14.2	0.02836	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63195 BIGSTONY 230 63314 BIGSTON4 230 1	233.0	110.2	256.8	116.3	270.9	6.1	14.2	0.02838	66503 BLAIR 4 230 66550 GRANITF4 230 1	SW204
63362 OAKES 4 230 67326 ELLENDL4 230 1	240.0	110.1	264.3	126.1	302.7	16.0	38.3	0.07668	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114

**Table K.3 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		109.3	262.3	121.2	291.0	11.9	28.7	0.05736	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		109.2	262.2	121.1	290.6	11.9	28.4	0.05678	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		109.1	261.9	120.9	290.1	11.8	28.2	0.05644	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		103.3	247.9	110.8	266.0	7.5	18.1	0.03614	67326 ELLENDL4 230 67327 ELLENDL7 115 1	
		100.5	241.1	110.2	264.4	9.7	23.3	0.04660	66529 WATERTN3 345 67160 GROTON 3 345 1	
		102.6	246.3	109.8	263.5	7.2	17.2	0.03444	67327 ELLENDL7 115 67401 ABDNJCT7 115 1	
		95.4	228.9	105.6	253.4	10.2	24.5	0.04898	66503 BLAIR 4 230 66530 WATERTN4 230 1	SW203
66220 BELFELDT 345 66424 BELFELD3 345 1	250.0	0.0	0.0	196.4	490.9	196.4	490.9	0.98182	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		0.0	0.0	142.0	355.0	142.0	355.0	0.71004	67101 ANTELOP3 345 67183 CHAR.CK3 345 1	
		48.8	122.0	126.6	316.5	77.8	194.5	0.38900	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		48.8	122.0	126.6	316.5	77.8	194.5	0.38900	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		46.4	116.1	124.7	311.7	78.3	195.6	0.39122	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		46.4	116.1	124.6	311.5	78.2	195.4	0.39086	66514 HURON 4 230 67205 BRDLAND4 230 1	
		46.4	116.1	124.6	311.5	78.2	195.4	0.39086	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		46.4	116.1	124.6	311.5	78.2	195.4	0.39086	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		34.3	85.8	120.9	302.2	86.6	216.4	0.43284	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		34.3	85.8	120.9	302.2	86.6	216.4	0.43284	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		43.6	109.1	120.5	301.2	76.9	192.1	0.38424	67105 LELAND03 345 67160 GROTON 3 345 1	
		42.8	106.9	119.5	298.8	76.7	191.9	0.38372	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		39.5	98.8	116.4	291.0	76.9	192.2	0.38438	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		39.5	98.7	116.3	290.8	76.8	192.1	0.38424	66456 WASHBRN4 230 67106 LELAND04 230 1	
		38.9	97.2	114.3	285.8	75.4	188.6	0.37710	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66220 BELFELDT 345 66425 BELFELD4 230 1	250.0	0.0	0.0	196.9	492.1	196.9	492.1	0.98426	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		0.0	0.0	142.8	357.0	142.8	357.0	0.71392	67101 ANTELOP3 345 67183 CHAR.CK3 345 1	
		50.3	125.7	127.4	318.5	77.1	192.8	0.38562	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		50.3	125.7	127.4	318.5	77.1	192.8	0.38562	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		47.4	118.5	125.4	313.4	78.0	194.9	0.38986	66514 HURON 4 230 67205 BRDLAND4 230 1	
		47.4	118.5	125.4	313.6	78.0	195.1	0.39022	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		47.4	118.5	125.4	313.4	78.0	194.9	0.38986	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		47.4	118.5	125.4	313.4	78.0	194.9	0.38986	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		36.1	90.2	122.0	305.0	85.9	214.7	0.42942	67182 CHAR.CK7 115 67211 CHARCKTY 345 1	SW34
		36.1	90.2	122.0	305.0	85.9	214.7	0.42942	67183 CHAR.CK3 345 67211 CHARCKTY 345 1	SW34
		44.5	111.2	121.3	303.2	76.8	192.0	0.38402	67105 LELAND03 345 67160 GROTON 3 345 1	
		43.6	108.9	120.3	300.7	76.7	191.9	0.38370	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		41.1	102.9	117.4	293.6	76.3	190.8	0.38150	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		41.1	102.7	117.4	293.4	76.3	190.8	0.38156	66456 WASHBRN4 230 67106 LELAND04 230 1	
		39.8	99.5	115.2	288.1	75.4	188.7	0.37732	66403 DAWSONC4 230 66405 FTPECK 4 230 1	
66404 DAWSONC7 115 67332 GLENDCT7 115 1	112.5	115.8	130.3	143.0	160.8	27.2	30.5	0.06100	66411 MI CTYE4 230 67304 BAKER 4 230 1	
66411 MI CTYE4 230 67304 BAKER 4 230 1	160.0	118.2	189.2	141.1	225.8	22.9	36.6	0.07326	66404 DAWSONC7 115 67332 GLENDCT7 115 1	
		112.4	179.8	133.1	213.0	20.7	33.2	0.06632	67305 BAKER 7 115 67332 GLENDCT7 115 1	
		99.7	159.5	127.1	203.3	27.4	43.8	0.08768	66417 DICKNSN4 230 66425 BELFELD4 230 1	
		103.0	164.7	122.7	196.3	19.7	31.6	0.06314	66418 DKSND7 115 67370 N ENGLN7 115 1	
		102.4	163.9	122.0	195.2	19.6	31.4	0.06270	67348 HETINGR7 115 67370 N ENGLN7 115 1	

**Table K.3 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		100.8	161.3	119.6	191.4	18.8	30.2	0.06036	67347 HETINGR4 230 67348 HETINGR7 115 1	
		101.4	162.2	119.5	191.2	18.1	29.0	0.05806	66506 FTTHOMP3 345 67105 LELANDO3 345 1	
		98.0	156.7	118.9	190.3	20.9	33.5	0.06708	66417 DICKNSN4 230 66418 DKSND7 115 1	
		98.1	156.9	118.9	190.3	20.8	33.3	0.06668	66417 DICKNSN4 230 66418 DKSND7 115 1	SW302
		100.2	160.3	118.8	190.0	18.6	29.7	0.05940	66514 HURON 4 230 67205 BRDLAND4 230 1	
		100.2	160.3	118.8	190.0	18.6	29.7	0.05940	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		100.2	160.3	118.8	190.0	18.6	29.7	0.05940	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		100.2	160.3	118.7	190.0	18.5	29.7	0.05936	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		89.9	143.9	118.0	188.7	28.1	44.8	0.08966	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		98.7	158.0	117.3	187.8	18.6	29.8	0.05958	66210 DAWSONCT 230 66403 DAWSONC4 230 1	SW4
66417 DICKNSN4 230 66418 DKSND7 115 1	100.0									
		103.2	103.2	146.4	146.4	43.2	43.2	0.08638	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		33.6	33.6	142.1	142.1	108.5	108.5	0.21690	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		88.6	88.6	138.1	138.1	49.5	49.5	0.09898	67265 LTLMISS4 230 67304 BAKER 4 230 1	SW109
		88.6	88.6	138.1	138.1	49.5	49.5	0.09898	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	SW109
		79.7	79.8	128.4	128.5	48.7	48.7	0.09740	66411 MI CTYE4 230 67304 BAKER 4 230 1	
		80.7	80.7	128.1	128.1	47.4	47.4	0.09478	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	
		58.9	58.9	125.5	125.5	66.6	66.6	0.13316	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		74.4	74.4	120.2	120.2	45.8	45.8	0.09162	67310 BOWMAN 4 230 67347 HETINGR4 230 1	
		37.3	37.3	112.8	112.8	75.5	75.5	0.15094	67101 ANTELOP3 345 67183 CHAR.CK3 345 1	
		61.2	61.2	107.4	107.4	46.2	46.2	0.09234	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		61.2	61.2	107.3	107.3	46.1	46.1	0.09226	66514 HURON 4 230 67205 BRDLAND4 230 1	
		61.2	61.2	107.3	107.3	46.1	46.1	0.09226	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		61.2	61.2	107.3	107.3	46.1	46.1	0.09226	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		60.4	60.4	105.6	105.6	45.2	45.1	0.09024	66506 FTTHOMP3 345 67105 LELANDO3 345 1	
		47.6	47.6	104.9	104.9	57.3	57.3	0.11452	66413 MEDORA 4 230 66425 BELFELD4 230 1	
66417 DICKNSN4 230 66425 BELFELD4 230 1	239.0									
		14.2	33.9	160.5	383.6	146.3	349.7	0.69944	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
		14.1	33.7	125.2	299.2	111.1	265.5	0.53106	67101 ANTELOP3 345 67183 CHAR.CK3 345 1	
		64.6	154.3	124.9	298.6	60.3	144.3	0.28866	67265 LTLMISS4 230 67304 BAKER 4 230 1	SW109
		64.6	154.3	124.9	298.6	60.3	144.3	0.28866	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	SW109
		67.3	160.8	124.8	298.2	57.5	137.4	0.27478	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		56.5	134.9	115.4	275.7	58.9	140.8	0.28152	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		56.5	134.9	115.4	275.7	58.9	140.8	0.28152	66456 WASHBRN4 230 67106 LELANDO4 230 1	SW106
		53.4	127.6	112.5	268.9	59.1	141.4	0.28274	66411 MI CTYE4 230 67304 BAKER 4 230 1	
		54.4	130.0	112.4	268.5	58.0	138.6	0.27716	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	
		51.0	121.8	108.0	258.1	57.0	136.3	0.27252	67310 BOWMAN 4 230 67347 HETINGR4 230 1	
		48.8	116.7	106.9	255.4	58.1	138.8	0.27752	67101 ANTELOP3 345 67120 BRDLAND3 345 1	
		48.8	116.7	106.8	255.3	58.0	138.6	0.27724	66514 HURON 4 230 67205 BRDLAND4 230 1	
		48.8	116.7	106.8	255.3	58.0	138.6	0.27724	67120 BRDLAND3 345 67204 BRDLNDTY 345 1	SW30
		48.8	116.7	106.8	255.3	58.0	138.6	0.27724	67204 BRDLNDTY 345 67205 BRDLAND4 230 1	SW30
		46.0	110.0	104.0	248.6	58.0	138.6	0.27716	66426 BISMARCK4 230 66456 WASHBRN4 230 1	
		46.6	111.5	104.0	248.6	57.4	137.1	0.27420	67105 LELANDO3 345 67160 GROTON 3 345 1	
66417 DICKNSN4 230 67342 HESKETT4 230 1	240.0									
		6.4	15.4	102.1	245.1	95.7	229.7	0.45930	66424 BELFELD3 345 67183 CHAR.CK3 345 1	
66418 DKSND7 115 67370 N ENGLN7 115 1	112.5									
		93.9	105.7	111.1	125.0	17.2	19.3	0.03858	67265 LTLMISS4 230 67304 BAKER 4 230 1	
66424 BELFELD3 345 67183 CHAR.CK3 345 1	239.0									
		0.0	0.0	202.7	484.5	202.7	484.5	0.96898	66220 BELFELDT 345 66424 BELFELD3 345 1	SW301

**Table K.3 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
		0.0	0.0	202.7	484.5	202.7	484.5	0.96898	66220 BELFELDT 345 66424 BELFELD3 345 1	SW6
		0.0	0.0	202.7	484.5	202.7	484.5	0.96898	66220 BELFELDT 345 66425 BELFELD4 230 1	SW301
		0.0	0.0	202.7	484.5	202.7	484.5	0.96898	66220 BELFELDT 345 66425 BELFELD4 230 1	SW6
		10.3	24.6	164.5	393.2	154.2	368.6	0.73716	66417 DICKNSN4 230 66425 BELFELD4 230 1	
		24.5	58.5	127.5	304.8	103.0	246.3	0.49264	66417 DICKNSN4 230 67342 HESKETT4 230 1	
		21.1	50.4	114.5	273.7	93.4	223.3	0.44650	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		21.1	50.4	113.2	270.5	92.1	220.1	0.44018	67265 LTLMISS4 230 67304 BAKER 4 230 1	SW109
		27.4	65.5	113.2	270.5	85.8	205.0	0.40998	67265 LTLMISS4 230 67310 BOWMAN 4 230 1	SW109
		20.0	47.9	111.0	265.4	91.0	217.5	0.43498	66470 BISON 4 230 67347 HETINGR4 230 1	
		20.8	49.7	110.3	263.6	89.5	213.9	0.42774	66470 BISON 4 230 66497 MAURINE4 230 1	
		27.5	65.7	108.5	259.2	81.0	193.5	0.38706	66417 DICKNSN4 230 66418 DKSND7 115 1	
		27.5	65.7	108.5	259.2	81.0	193.5	0.38706	66417 DICKNSN4 230 66418 DKSND7 115 1	SW302
		35.8	85.6	103.9	248.2	68.1	162.7	0.32536	66413 MEDORA 4 230 66425 BELFELD4 230 1	
		26.4	63.1	103.8	248.0	77.4	184.9	0.36976	66411 MI CTYE4 230 67304 BAKER 4 230 1	
66426 BISMARCK4 230 67342 HESKETT4 230 1	320.0									
		101.9	326.2	121.9	389.9	20.0	63.7	0.12740	66426 BISMARCK4 230 66456 WASHBRN4 230 1	SW106
		101.9	326.2	121.9	389.9	20.0	63.7	0.12740	66456 WASHBRN4 230 67106 LELAND04 230 1	SW106
		89.1	285.3	105.3	337.0	16.2	51.8	0.10350	67326 ELLENDL4 230 67390 G132 230 1	
		86.6	277.0	105.1	336.2	18.5	59.2	0.11848	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		83.7	267.8	101.1	323.5	17.4	55.6	0.11122	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		83.6	267.5	101.0	323.1	17.4	55.7	0.11130	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		83.2	266.2	100.5	321.5	17.3	55.3	0.11052	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
66442 GARRISN7 115 67308 BEULAH 7 115 1	120.0									
		92.9	111.5	112.6	135.1	19.7	23.6	0.04726	66791 CENTER 3 345 67316 COYOTE 3 345 1	
66514 HURON 4 230 67205 BRDLAND4 230 1	400.0									
		109.8	439.0	118.3	473.1	8.5	34.1	0.06826	67105 LELAND03 345 67160 GROTON 3 345 1	
		108.3	433.3	117.0	468.1	8.7	34.8	0.06954	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		95.5	381.8	107.2	428.7	11.7	46.9	0.09378	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		96.7	386.6	106.1	424.2	9.4	37.6	0.07520	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		96.6	386.4	106.0	424.2	9.4	37.8	0.07554	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		96.2	384.8	104.7	418.8	8.5	34.0	0.06798	66529 WATERTN3 345 67160 GROTON 3 345 1	
		93.7	374.8	102.1	408.6	8.4	33.7	0.06746	67326 ELLENDL4 230 67390 G132 230 1	
66756 SQBUTTE4 230 66791 CENTER 3 345 1	336.0									
		110.9	372.5	124.1	417.1	13.2	44.5	0.08908	66791 CENTER 3 345 67316 COYOTE 3 345 1	



**Table K.3 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH
		LOADING	CURRENT	LOADING	CURRENT	%	MVA			
		%	MVA	%	MVA					
66791 CENTER 3 345 67316 COYOTE 3 345 1	478.0	101.8	342.1	114.5	384.8	12.7	42.7	0.08542	66791 CENTER 3 345 67316 COYOTE 3 345 1	SW227
67101 ANTELOP3 345 67120 BRDLAND3 345 1	478.0	91.1	435.4	100.2	479.1	9.1	43.7	0.08740	66756 SQBUTTE4 230 66791 CENTER 3 345 1	
67120 BRDLAND3 345 67204 BRDLNDTY 345 1	400.0	91.8	439.0	102.9	491.8	11.1	52.8	0.10560	67105 LELAND03 345 67160 GROTON 3 345 1	
		90.7	433.3	102.2	488.6	11.5	55.3	0.11050	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		109.8	439.0	118.3	473.1	8.5	34.1	0.06826	67105 LELAND03 345 67160 GROTON 3 345 1	
		108.3	433.3	117.0	468.1	8.7	34.8	0.06954	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		95.5	381.8	107.2	428.7	11.7	46.9	0.09378	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		96.7	386.6	106.1	424.2	9.4	37.6	0.07520	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		96.6	386.4	106.0	424.2	9.4	37.8	0.07554	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		96.2	384.8	104.7	418.8	8.5	34.0	0.06798	66529 WATERTN3 345 67160 GROTON 3 345 1	
		93.7	374.8	102.1	408.6	8.4	33.7	0.06746	67326 ELLENDL4 230 67390 G132 230 1	
67204 BRDLNDTY 345 67205 BRDLAND4 230 1	400.0	109.8	439.0	118.3	473.1	8.5	34.1	0.06826	67105 LELAND03 345 67160 GROTON 3 345 1	
		108.3	433.3	117.0	468.1	8.7	34.8	0.06954	66506 FTTHOMP3 345 67105 LELAND03 345 1	
		95.5	381.8	107.2	428.7	11.7	46.9	0.09378	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114
		96.8	387.3	106.4	425.7	9.6	38.4	0.07670	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114
		96.7	386.6	106.1	424.2	9.4	37.6	0.07520	63358 BUFFALO3 345 66792 MAPLE R3 345 1	
		96.6	386.4	106.0	424.2	9.4	37.8	0.07554	63358 BUFFALO3 345 63369 JAMESTN3 345 1	
		96.2	384.8	104.7	418.8	8.5	34.0	0.06798	66529 WATERTN3 345 67160 GROTON 3 345 1	
		93.7	374.8	102.1	408.6	8.4	33.7	0.06746	67326 ELLENDL4 230 67390 G132 230 1	
67263 LTLMISS7 115 67265 LTLMISS4 230 1	100.0	87.4	87.4	153.0	153.0	65.6	65.6	0.13110	67265 LTLMISS4 230 67304 BAKER 4 230 1	
		83.4	83.5	123.9	123.9	40.5	40.5	0.08096	66411 MI CTYE4 230 67304 BAKER 4 230 1	
		78.9	78.9	103.2	103.2	24.3	24.3	0.04860	63369 JAMESTN3 345 66791 CENTER 3 345 1	
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63189 MAPLER1Y 345 66754 MAPLE R4 230 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63189 MAPLER1Y 345 66792 MAPLE R3 345 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63190 MAPLER2Y 345 66754 MAPLE R4 230 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63190 MAPLER2Y 345 66792 MAPLE R3 345 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63198 BUFFALOY 345 63258 BUFFALO7 115 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63198 BUFFALOY 345 63358 BUFFALO3 345 1	SW114
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63358 BUFFALO3 345 63369 JAMESTN3 345 1	SW114

**Table K.3 (Cont.): Significantly Affected Facilities - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

MONITORED ELEMENT	RATEA MVA	WITHOUT GI-0217 (Case b0d)		WITH GI-0217 (Case b1d)		CHANGE		TDF	CONTINGENCY	SWITCH	
		LOADING	CURRENT	LOADING	CURRENT	%	MVA				
		%	MVA	%	MVA						
		78.8	78.8	102.9	102.9	24.1	24.2	0.04834	63358 BUFFALO3 345 66792 MAPLE R3 345 1	SW114	
		78.7	78.7	102.8	102.8	24.1	24.1	0.04818	63358 BUFFALO3 345 63369 JAMESTN3 345 1		
		78.7	78.7	102.8	102.8	24.1	24.1	0.04814	63358 BUFFALO3 345 66792 MAPLE R3 345 1		
		77.7	77.7	101.7	101.7	24.0	24.0	0.04798	67304 BAKER 4 230 67305 BAKER 7 115 1		
		78.0	78.0	101.3	101.3	23.3	23.3	0.04656	66417 DICKNSN4 230 66425 BELFELD4 230 1		
67265 LTLMISS4 230 67304 BAKER 4 230 1	216.1	77.0	166.4	100.0	216.1	23.0	49.7	0.09948	66417 DICKNSN4 230 66425 BELFELD4 230 1		
67305 BAKER 7 115 67332 GLENDCT7 115 1	112.5	104.2	117.2	131.2	147.6	27.0	30.3	0.06066	66411 MI CTYE4 230 67304 BAKER 4 230 1		
67306 BISM DT7 115 67309 BISEXP 7 115 1	67.8	81.1	55.0	103.1	69.9	22.0	14.9	0.02972	67365 MANDANS7 115 67367 MANDANW7 115 1		
		81.0	54.9	103.0	69.8	22.0	14.9	0.02972	67343 HESKETT7 115 67367 MANDANW7 115 1		
67308 BEULAH 7 115 67318 COYOTE 7 115 1	101.4	302.3	306.5	317.0	321.4	14.7	14.9	0.02988	66791 CENTER 3 345 67316 COYOTE 3 345 1		
67308 BEULAH 7 115 67343 HESKETT7 115 1	88.0	137.7	121.2	153.3	134.9	15.6	13.8	0.02756	66791 CENTER 3 345 67316 COYOTE 3 345 1		
67309 BISEXP 7 115 67329 ESTBMRK7 115 1	67.8	94.2	63.8	119.6	81.1	25.4	17.2	0.03446	67365 MANDANS7 115 67367 MANDANW7 115 1		
		94.1	63.8	119.5	81.0	25.4	17.2	0.03446	67343 HESKETT7 115 67367 MANDANW7 115 1		
67326 ELLENDL4 230 67390 G132 230 1	239.0	134.4	321.3	149.9	358.3	15.5	37.0	0.07390	63369 JAMESTN3 345 66791 CENTER 3 345 1	SW114	
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63189 MAPLER1Y 345 66754 MAPLE R4 230 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63189 MAPLER1Y 345 66792 MAPLE R3 345 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63190 MAPLER2Y 345 66754 MAPLE R4 230 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63190 MAPLER2Y 345 66792 MAPLE R3 345 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63198 BUFFALOY 345 63258 BUFFALO7 115 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63198 BUFFALOY 345 63358 BUFFALO3 345 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63358 BUFFALO3 345 63369 JAMESTN3 345 1		
		134.9	322.4	146.3	349.6	11.4	27.2	0.05442	63358 BUFFALO3 345 66792 MAPLE R3 345 1		
		134.7	321.9	145.8	348.6	11.1	26.8	0.05350	63358 BUFFALO3 345 63369 JAMESTN3 345 1		
		134.6	321.8	145.8	348.5	11.2	26.8	0.05350	63358 BUFFALO3 345 66792 MAPLE R3 345 1		
		131.3	313.9	140.3	335.3	9.0	21.4	0.04276	67105 LELAND03 345 67160 GROTON 3 345 1		
		123.6	295.5	133.2	318.3	9.6	22.8	0.04558	66514 HURON 4 230 67205 BRDLAND4 230 1		
67347 HETINGR4 230 67348 HETINGR7 115 1	100.0	89.6	89.6	110.5	110.5	20.9	20.9	0.04182	67265 LTLMISS4 230 67304 BAKER 4 230 1		
67348 HETINGR7 115 67370 N ENGLN7 115 1	112.5	91.5	103.0	108.1	121.6	16.6	18.6	0.03722	67265 LTLMISS4 230 67304 BAKER 4 230 1		

**Table K.4: Significantly Affected Bus Voltages - N-1 Contingency Conditions  
Case b0d (Without GI-0217) vs. Case b1d (With GI-0217)**

SUBSTATION # NAME	VOLTAGE (%)	VOLTAGE (%)	CHANGE %	CONTINGENCY PERFORMED			SWITCH
	WITHOUT GI-0217	WITH GI-0217		FROM	TO	CKT	
62752 MLTN TP7 115	91.46	89.10	2.36	67452 ALEXSS	115 67453 ALEXSWM	115 1	
62753 MILTONA7 115	91.43	89.05	2.38	67452 ALEXSS	115 67453 ALEXSWM	115 1	
63336 AUDUBON4 230	90.52	88.52	2.00	60133 SHEYNNE4 230	60134 SHEYNNE7 115	5	SW887
63358 BUFFALO3 345	98.64 97.82	89.00 89.80	9.64 8.02	63358 BUFFALO3 345	63369 JAMESTN3 345	1	
66470 BISON 4 230	96.92	80.51	16.41	67265 LTLMISS4 230	67304 BAKER 4 230	1	
66480 MAURINE7 115	99.47	89.02	10.45	67265 LTLMISS4 230	67304 BAKER 4 230	1	
66497 MAURINE4 230	99.12	87.10	12.02	67265 LTLMISS4 230	67304 BAKER 4 230	1	
66792 MAPLE R3 345	98.39 89.16 96.91	88.78 87.36 89.11	9.61 1.80 7.80	63358 BUFFALO3 345	63369 JAMESTN3 345	1	
67263 LTLMISS7 115	90.06 85.95	75.90 48.23	14.16 37.72	66411 MI CTYE4 230	67304 BAKER 4 230	1	
67265 LTLMISS4 230	93.20 89.27	80.81 55.38	12.39 33.89	66411 MI CTYE4 230	67304 BAKER 4 230	1	
67310 BOWMAN 4 230	95.80 92.08	85.46 68.07	10.34 24.01	66411 MI CTYE4 230	67304 BAKER 4 230	1	
67347 HETINGR4 230	97.71 94.40	89.35 74.13	8.36 20.27	66411 MI CTYE4 230	67304 BAKER 4 230	1	
67348 HETINGR7 115	94.95	75.55	19.40	67265 LTLMISS4 230	67304 BAKER 4 230	1	
67350 GASCOYN7 115	95.04	75.61	19.43	67265 LTLMISS4 230	67304 BAKER 4 230	1	
67370 N ENGLN7 115	95.58	85.24	10.34	67265 LTLMISS4 230	67304 BAKER 4 230	1	
67453 ALEXSWM 115	89.99	87.17	2.82	67452 ALEXSS	115 67453 ALEXSWM	115 1	
67454 ALEXPLDM 115	90.14	87.37	2.77	67452 ALEXSS	115 67453 ALEXSWM	115 1	
67461 ALEXSOUM 115	90.06	87.27	2.79	67452 ALEXSS	115 67453 ALEXSWM	115 1	