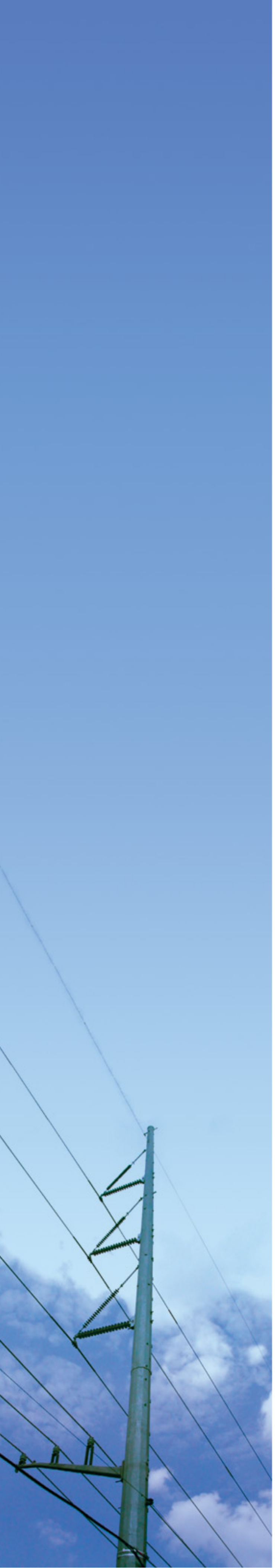


Preliminary Interconnection System Impact Study for Generation Interconnection Requests

Southwest Power Pool
Engineering Department
Tariff Studies – Generation Interconnection

(PISIS-2009-001 Study)
February 2010
Re-Posted March 12, 2010

SPP RESTRICTED

Preliminary Interconnection System Impact Study for Generation Interconnection Requests

Southwest Power Pool
Engineering Department
Tariff Studies – Generation Interconnection

(PISIS-2009-001 Study)
February 2010
Re-Posted March 12, 2010

Date	Rev.	Comment
2/26/2010	0	Report Issued
3/12/2010	1	Revised Total Costs and Appendix E,F,G. Added Stability Studies for Groups 1, 2, 3, 8, 11, 15.

Executive Summary

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Preliminary Interconnection System Impact Study (PISIS) for certain generation interconnection requests in the SPP Generation Interconnection Queue. These interconnection requests have been clustered together for the following Impact Study. The customers will be referred to in this study as the PISIS-2009-001 Interconnection Customers. This Impact Study analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling 7,951 MW of new generation which would be located within the transmission systems of American Electric Power West (AEPW), Midwest Energy Inc. (MIDW), Missouri Public Service (MIPU), Mid-Kansas Electric Power LLC (MKEC), Nebraska Public Power District (NPPD), Oklahoma Gas and Electric (OKGE), Southwestern Public Service (SPS), Sunflower Electric Power Corporation (SUNC), Westar Energy (WERE). The various generation interconnection requests have differing proposed in-service dates[1]. The generation interconnection requests included in this PISIS are listed in Appendix A by their queue number, amount, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

Power flow analysis has indicated that for the powerflow cases studied, 7,951 MW of nameplate generation may be interconnected with transmission system reinforcements within the SPP transmission system. Dynamic Stability Analysis has determined the need for reactive compensation in accordance with Order No. 661-A for wind farm interconnection requests and those requirements are listed for each interconnection request within the contents of this report.

The dynamic stability analysis has determined that the transmission system will remain stable with the assigned Network Upgrades and Interconnection Facilities to the PISIS. Further analysis will be necessary for request GEN-2008-022 for use of the G.E. 2.5 MW wind turbines.

The total estimated minimum cost for interconnecting the PISIS-2009-001 interconnection customers is $1,224,100,000. These costs are shown in Appendix E and F. Interconnection Service to PISIS-2009-001 interconnection customers is also contingent upon higher queued customers paying for certain required network upgrades. The in service date for the PISIS customers will be deferred until the construction of these network upgrades can be completed.

These costs do not include the Interconnection Customer Interconnection Facilities as defined by the SPP Open Access Transmission Tariff (OATT). This cost does not include additional network constraints in the SPP transmission system that were identified are shown in Appendix H.

Network Constraints listed in Appendix H are in the local area of the new generation when this generation is injected throughout the SPP footprint for the Energy Resource (ER) Interconnection Request. Additional Network constraints will have to be verified with a Transmission Service Request (TSR) and associated studies. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

[1] The generation interconnection requests in-service dates will need to be deferred based on the required lead time for the Network Upgrades necessary. The Interconnection Customer's that proceed to the Facility Study will be provided a new in-service date based on the completion of the Facility Study.

The required interconnection costs listed in Appendix E, F, and G do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT.

Based on the SPP Tariff Attachment O, transmission facilities that are part of the SPP Transmission Expansion Plan (STEP) including Sponsored Economic Upgrades or the Balanced Portfolio that may be approved by the SPP Board of Directors will receive notifications to construct. These projects will then be considered construction pending projects and would not be assignable to the Impact Cluster Study Generation Interconnection Requests.

Table of Contents

Introduction

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Preliminary Interconnection System Impact Study (PISIS) for certain generation interconnection requests in the SPP Generation Interconnection Queue. These interconnection requests have been clustered together for the following Impact Study. The customers will be referred to in this study as the PISIS-2009-001 Interconnection Customers. This Impact Study analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling 7,951 MW of new generation which would be located within the transmission systems of American Electric Power West (AEPW), Midwest Energy Inc. (MIDW), Missouri Public Service (MIPU), Mid-Kansas Electric Power LLC (MKEC), Nebraska Public Power District (NPPD), Oklahoma Gas and Electric (OKGE), Southwestern Public Service (SPS), Sunflower Electric Power Corporation (SUNC), Westar Energy (WERE). The various generation interconnection requests have differing proposed in-service dates[2]. The generation interconnection requests included in this Impact Cluster Study are listed in Appendix A by their queue number, amount, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

The primary objective of this Preliminary Interconnection System Impact Study is to identify the system constraints associated with connecting the generation to the area transmission system. The Impact and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other Direct Assignment Facilities needed to accept power into the grid at each specific interconnection receipt point.

Model Development

Interconnection Requests Included in the PISIS-2009-001 Study

SPP has included all interconnection requests that submitted a Preliminary Interconnection System Impact Study request no later than September 30, 2009 and were subsequently accepted by Southwest Power Pool under the terms of the Large Generation Interconnection Procedures (LGIP) that became effective June 2, 2009.

The interconnection requests that are included in this study are listed in Appendix A.

Previous Queued Projects

The previous queued projects included in this study are listed in Appendix B. In addition to the Base Case Upgrades, the previous queued projects and associated upgrades were assumed to be in-service and added to the Base Case models. These projects were dispatched as Energy Resources with equal distribution across the SPP footprint.

[2] The generation interconnection requests in-service dates will need to be deferred based on the required lead time for the Network Upgrades necessary. The Interconnection Customer's that proceed to the Facility Study will be provided a new in-service date based on the completion of the Facility Study.

Development of Base Cases

Powerflow - The 2009 series Transmission Service Request (TSR) Models 2010 spring and 2014 summer and winter peak scenario 0 peak cases were used for this study. After the 2010 spring and the 2014 summer and winter peak cases were developed, each of the control areas' resources were then re-dispatched using current dispatch orders.

Stability – The 2009 series SPP Model Development Working Group (MDWG) Models 2009 winter and 2010 summer were used for this study.

Base Case Upgrades

The following facilities are part of the SPP Transmission Expansion Plan or the Balanced Portfolio. These facilities have been approved or are in construction stages and were assumed to be in-service at the time of dispatch and added to the base case models. The PISIS-2009-001 Customers have no potential cost for the below listed projects. <u>However, the PISIS-2009-001 Customers Generation Facilities in service dates may need to be delayed until the completion of the following upgrades.</u> If for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the PISIS customers.

- Hitchland 345/230/115kV upgrades to be built by SPS for 2010/2011 in-service[3].
- Hitchland – Pringle 230kV line
- Hitchland – Moore County 230kV line
- Hitchland – Ochiltree 230kV line
- Hitchland – Texas County 115kV line
- Hitchland – Hansford County 115kV line
- Hitchland – Sherman County Tap 115kV line
- Valliant – Hugo – Sunnyside 345kV – assigned to Aggregate Study AG3-2006 Customers for 2011 in-service
- Wichita – Reno County – Summit 345kV to be built by WERE for 2011 in-service[4].
- Rose Hill – Sooner 345kV to be built by WERE/OKGE for 2010 in-service.
- Tuco – Woodward 345kV line approved by the SPP Board of Directors as part of the Balanced Portfolio and issued an NTC in June, 2009
- Spearville – Knoll- Axtell 345kV line approved by the SPP Board of Directors as part of the Balanced Portfolio and issued an NTC in June, 2009

Contingent Upgrades

The following facilities do not yet have approval. These facilities have been assigned to higher queued interconnection customers. These facilities have been included in the models for the PISIS-2009-001 study and are assumed to be in service. <u>The PISIS-2009-001 Customers at this time do not have responsibility for these facilities but may later be assigned the cost of these facilities if higher queued customers terminate their LGIA or withdraw from the interconnection queue. The PISIS-</u>

[3] Approved 230kV upgrades are based on SPP 2007 STEP. Upgrades may need to be re-evaluated in the system impact study.

[4] Approved based on an order of the Kansas Corporation Commission issued in Docket no. 07-WSEE-715-MIS

2009-001 Customer Generation Facilities in service dates may need to be delayed until the completion of the following upgrades.

- Finney – Holcomb 345kV ckt #2 line assigned to GEN-2006-044 interconnection customer. This customer is currently in suspension[5].
- Hitchland – Woodward 345kV line assigned to GEN-2006-049 interconnection customer for in service date yet to be determined
- Stevens County – Gray County 345kV line assigned to 1st Cluster Interconnection Customers
- Central Plains – Setab 115kV transmission line assigned to GEN-2007-013 interconnection customer.
- Spearville – Comanche 345kV line assigned to 1st Cluster Interconnection Customers
- Comanche – Wichita 345kV line assigned to 1st Cluster Interconnection Customers
- Comanche – Woodward 345kV line assigned to 1st Cluster Interconnection Customers
- Conway – Wheeler County 345kV line assigned to 1st Cluster Interconnection Customers
- Wheeler County 345/230/13.2kV autotransformer assigned to 1st Cluster Interconnection Customers
- Wheeler County – Anadarko 345kV line assigned to 1st Cluster Interconnection Customers
- Conway 345/115kV autotransformer assigned to 1st Cluster Interconnection Customers
- Grassland 230/115kV autotransformer #2 assigned to 1st Cluster Interconnection Customers (100% to GEN-2008-016)
- Various other upgrades as listed in Appendix F

Potential Upgrades Not in the Base Case

Any potential upgrades that do not have a Notification to Construct (NTC) have not been included in the base case. These upgrades include any identified in the SPP Extra-High Voltage (EHV) overlay plan or any other SPP planning study other than the upgrades listed above in the previous sections.

Regional Groupings

The interconnection requests listed in Appendix A were grouped together in twelve different regional groups based on geographical and electrical impacts. These groupings are shown in Appendix C.

To determine interconnection impacts, twelve different dispatch variations of the spring base case models were developed to accommodate the regional groupings.

Powerflow - For each group, the various wind generating plants were modeled at 80% nameplate of maximum generation. The wind generating plants in the other areas were modeled at 20% nameplate of maximum generation. This process created twelve different scenarios with each group being studied at 80% nameplate rating. These projects were dispatched as Energy Resources with equal distribution across the SPP footprint. This method allowed for the identification of network constraints that were common to the regional groupings that could then in turn have the mitigating upgrade cost allocated throughout the entire cluster. Each interconnection request was also modeled separately at 100% nameplate for certain analyses.

[5] Based on Facility Study Posting November 2008

Peaking units were not dispatched in the 2010 spring model. To study peaking units' impacts, the 2014 summer and winter peak model was chosen and peaking units were modeled at 100% of the nameplate rating and wind generating facilities were modeled at 10% of the nameplate rating.

Stability - For each group, all interconnection requests (wind and non-wind) were modeled at 100% nameplate of maximum generation in both winter and summer seasonal models. The wind interconnection requests in the other areas were modeled at 20% nameplate of maximum generation while fossil units were modeled at 100% in the other areas. This process created twelve different scenarios with each group being studied at 100% nameplate rating. These projects were dispatched as Energy Resources with equal distribution across the SPP footprint.

Identification of Network Constraints

The initial set of network constraints were found by using PTI MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels mentioned above. These constraints were then screened to determine if any of the generation interconnection requests had at least a 20% Distribution Factor (DF) upon the constraint. Constraints that measured at least a 20% DF from at least one interconnection request were considered for mitigation.

Determination of Cost Allocated Network Upgrades

Cost Allocated Network Upgrades of wind generation interconnection requests were determined using the 2010 spring model. Cost Allocated Network Upgrades of peaking units was determined using the 2014 summer peak model. Once a determination of the required Network Upgrades was made, a powerflow model of the 2010 spring case was developed with all cost allocated Network Upgrades in-service. A MUST FCITC analysis was performed to determine the Power Transfer Distribution Factors (PTDF), defined as a distribution factor with system impact conditions that each generation interconnection request had on each new upgrade. The impact each generation interconnection request had on each upgrade project was weighted by the size of each request. Finally the costs due by each request for a particular project were then determined by allocating the portion of each request's impact over the impact of all affecting requests.

For example, assume that there are three Generation Interconnection requests, X, Y, and Z that are responsible for the costs of Upgrade Project '1'. Given that their respective PTDF for the project have been determined, the cost allocation for Generation Interconnection request 'X' for Upgrade Project 1 is found by the following set of steps and formulas:

- Determine an Impact Factor on a given project for all responsible GI requests:

  Request X Impact Factor on Upgrade Project 1 = PTDF(%)(X) * MW(X) = X1

  Request Y Impact Factor on Upgrade Project 1 = PTDF(%)(Y) * MW(Y) = Y1

Request Z Impact Factor on Upgrade Project 1 = PTDF(%)(Z) * MW(Z) = Z1

- Determine each request's Allocation of Cost for that particular project:

$$\text{Request X's Project 1 Cost Allocation (\$)} = \frac{\text{Network Upgrade Project 1 Cost(\$)} * \text{X1}}{\text{X1} + \text{Y1} + \text{Z1}}$$

- Repeat previous for each responsible GI request for each Project

The cost allocation of each needed Network Upgrade is determined by the size of each request and its impact on the given project. This allows for the most efficient and reasonable mechanism for sharing the costs of upgrades.

Credits for Amounts Advanced for Network Upgrades

Interconnection Customer shall be entitled to credits in accordance with Attachment Z1 of the SPP Tariff for any Network Upgrades including any tax gross-up or any other tax-related payments associated with the Network Upgrades, and not refunded to the Interconnection Customer.

Interconnection Facilities

The requirement to interconnect the 7,951 MW of generation into the existing and proposed transmission systems in the affected areas of the SPP transmission footprint consist of the necessary cost allocated shared facilities listed in Appendix G by upgrade. Interconnection Facilities specific to each generation interconnection request are listed in Appendix E and F.

Other Network Constraints in the AEPW, MIDW, MIPU, MKEC, NPPD, OKGE, SPS, SUNC, AND WERE transmission systems that were identified are shown in Appendix H. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

A preliminary one-line drawing for each generation interconnection request are listed in Appendix D. Figure 1 depicts the major transmission line Network Upgrades needed to support the interconnection of the generation amounts requested in this study.

Powerflow

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) Criteria states that:

"The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable NERC Reliability Standards for transmission planning. All MDWG power flow models shall be tested to verify compliance with the System Performance Standards from NERC Table 1 – Category A."

The ACCC function of PSS/E was used to simulate single contingencies in portions or all of the modeled control areas of American Electric Power West (AEPW), Empire District Electric (EMDE), Grand River Dam Authority (GRDA), Kansas City Power & Light (KCPL), Midwest Energy (MIDW), MIPU, MKEC, Nebraska Public Power District (NPPD), OG&E Electric Services (OKGE), Omaha Public Power District (OPPD), Southwest Public Service (SPS), Sunflower Electric (SUNC), Westar Energy (WERE), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the "more probable" contingency testing criteria mandated by NERC and the SPP criteria.

Powerflow Analysis

A powerflow analysis was conducted for each Interconnection Customer's facility using modified versions of the 2010 spring peak and the 2014 summer and winter peak models. The output of the Interconnection Customer's facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection Request. The available seasonal models used were through the 2014 Summer Peak.

This analysis was conducted assuming that previous queued requests in the immediate area of these interconnect requests were in-service. The analysis of each Customer's project indicates that additional criteria violations will occur on the AEPW, MIDW, OKGE, SPS, SUNC, SWPA, MKEC, WERE, AND WFEC transmission systems under steady state and contingency conditions in the peak seasons.

Cluster Group 1 (Woodward Area)

The Woodward area contained approximately 500 MW of new interconnection requests in addition to the 3,053 MW of prior queued interconnection requests. The constraint in the area was the Northwest – Tatonga 345kV line which overloaded for an outage of Woodward – Comanche 345kV. To mitigate this constraint, a single 345kV circuit from Woodward – Woodring was added.

Cluster Group 2 (Hitchland Area)

The Hitchland area contained 1,458 MW of interconnection request in addition to the 2,482 MW of previous queued generation interconnection requests. The major constraints consisted of overloads on 345kV, 230kV, and 115kV lines in the Hitchland area. In addition, voltage collapse was observed for the outage of the Hitchland – Stevens 345kV line and outage of the Hitchland-Woodward 345kV line. To mitigate these constraints, a second circuit from Hitchland – GEN-2008-047 – Woodward 345kV line and a 345kV line from Spearville – Reno County was added. Also, due to the point of interconnection change for GEN-2008-060 and GEN-2008-122 in Group 3,a 345kV Spearville – Reno County line was added. In addition, the Ochiltree – Cole 115kV line was rebuilt.

Cluster Group 3 (Spearville Area)

The Spearville area contained 1,380 MW of interconnection requests and 2,333 MW of previous queued interconnection requests. Several constraints were observed on the 115kV, 138kV, and 345kV lines in the Spearville area. To mitigate these constraints the St. John – Ninnescah – Pratt 115kV line and the Harper – Milan Tap – Clearwater – Gill Energy Center 138kV line will need to be rebuilt. Also, a 345kV line from Pratt – Medicine Lodge and a 345kV line from Spearville – Reno was added. The point of interconnection for GEN-2008-060 and GEN-2008-122 were moved to the proposed Spearville – Reno 345kV line due to the overloads that were caused on the Spearville-Mullergren and Mullergren – Circle 230kv lines. Finally, several new autotransformers will need to be installed in the area.

Cluster Group 4 (Mingo Area)

The Mingo/NW Kansas group had 588 MW in addition to the 924 MW of previously queued generation in the area. The major constraints in this area were noticed along the Syracuse – Williamson – Fletcher 115kV line. To mitigate the constraints, the Syracuse – Williamson – Fletcher line will need to be rebuilt and a second 115kV Syracuse – Williamson – Fletcher line will need to be built.

Cluster Group 5 (Amarillo Area)

The Amarillo group had 62.1 MW of interconnection requests in addition to the 2,879 MW of previously queued interconnection requests in this area. The major constraint in the Amarillo area was the Vega – Wildorado – SW 2749 69kV line. In order to mitigate the constraint, the Vega – Wildorado – SW 2749 69kV line will need to be rebuilt.

Cluster Group 6 (New Mexico & South Panhandle Area)

The South Panhandle group had 1,662 MW of interconnection requests in addition to the 1,468 MW of previously queued interconnection requests in this area. Because of the lack of 345kV infrastructure in the area, several issues were noticed on the 230kV system. Certain 345kV lines had to be added to obtain a solution for a starting point to begin analysis. Two of the many constraints noticed were the Plant X – Tuco 230kV double circuit and the Tolk Station East – Tuco 230kV line. In order to mitigate the issues noticed in the area, the following 345kV upgrades will need to be built: GEN-2008-022 Tap – Tuco 345kV line, GEN-2005-015 Tap – Lawton Eastside 345kV line, Potter County – Frio Draw 345kV line, Frio Draw – GEN-2007-043 Tap 345kV line, Potter County – Conway 345kV line, and Frio Draw 345/230 Interchange. In addition, the following lines will need to be rebuilt: Woodrow – Lynn County – Grassland 115kV single circuit and Plant X – Tuco 230kV double circuit. Also, terminal equipment on the Lawton Eastside – Sunnyside 345kV line and the Cimarron – GEN-2007-043 Tap 345kV line will need to be replaced.

Cluster Group 7 (Southwestern Oklahoma Area)

This group had 361 MW of interconnection requests in addition to the 1,838 MW of previous queued generation in the area. Several constraints were observed on the lower voltage system in this area. To mitigate the constraints in the area a second Washita – Anadarko 138kV line will be needed. Also, the terminal equipment on the Lake Creek – Carter 69kV and the Washita – GEN-2008-037 Tap 138kV line will need to be replaced. The GEN-2009-030 interconnection request, which had requested interconnection into the WFEC Weatherford substation, proved to be infeasible due to the size of the request (200MW), the size of the transmission lines in the area (143MVA), and the large amounts of prior queued generation in the area (GEN-2007-032 at 150MW and the existing Weatherford wind farm at 147MW). Therefore, the point of interconnection for GEN-2009-030 was moved to the Midpoint – Anadarko 345kV line.

Cluster Group 8 (South Central Kansas Area)
This group had 450 MW of interconnection requests in addition to the 2,253 MW of previous queued generation in the area. No new constraints were found in this area.

Cluster Group 9 (Northeast Nebraska Area)
This group had 150 MW of interconnection requests in addition to the 598 MW of previous queued generation in the area. No new constraints were found in this area.

Cluster Group 10 (North Nebraska Area)
No Group 10 powerflow analysis.

Cluster Group 11 (North Kansas Area)
This group had 151 MW of interconnection requests in addition to the 976 MW of previous queued generation in the area. The major constraint in this area was the Smoky Hills – Summit 230kV line. In order to mitigate these constraints the following upgrades are needed: build Smoky Hills 345kV bus and Smoky Hills 345/230kV autotransformer. The terminal equipment of the constrained line (Smoky Hills – Summit 230kV line) will need to be upgraded. Also, the point of interconnection for GEN-2008-061 will need to be moved to the Smoky Hills 345kV bus.

Cluster Group 12 (Northwest Arkansas Area)
No Group 12 powerflow analysis.

Cluster Group 13 (Northwest Missouri Area)
This group had 150 MW of interconnection requests in addition to the 2,186 MW of previous queued generation in the area. No new constraints were found in this area.

Cluster Group 14 (South Central Oklahoma Area)
This group had 549 MW of interconnection requests in addition to the 0 MW of previous queued generation in the area. No new constraints were found in this area.

Cluster Group 15 (Southwest Nebraska Area)
This group had 490 MW of interconnection requests in addition to the 0 MW of previous queued generation in the area. The only constraint in the area was the Hastings City – Hasting 115kV line. To mitigate the constraint, the equipment will on the Hastings City – Hasting 115kV line and the Guide Rock – Superior 115kV line will need to be rerated.

Stability Analysis

A stability analysis was conducted for each Interconnection Customer's facility using modified versions of the 2010 winter peak and the 2010 summer peak models. The stability analysis was conducted with all upgrades in service that were identified in the powerflow analysis. For each group, the interconnection requests were studied at 100% nameplate output while the other groups were dispatched at 20% output for wind requests and 100% output for fossil requests. The exception to this practice was that Groups 9 and 10 were combined at the request of Transmission Owner. These two groupings were studied together because despite the large geographic area of the two groupings, there are limited transmission paths that the two groups share. The output of the Interconnection Customer's facility was offset in each model by a reduction in output of existing online SPP generation. The following synopsis is included for each group. The entire stability study for each group can be found in the Appendices.

Cluster Group 1 (Woodward Area)

The Group 1 stability study was conducted by S&C Electric Company. The full report is available in the appendices. The Woodward stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Woodward area will have power factor requirements as denoted in the study.

With the power factor requirements and all network upgrades in service, all interconnection request in Group 1 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

The Group 1 study consists of the following projects

- **GEN-2008-044** – Vestas V90 1.8 MW – 199.8 MW – Interconnection at the 345 kV Tatonga Substation.
- **GEN-2008-045** – Vestas V90 1.8 MW – 300.6 MW – Interconnection at the 345 kV Woodward District Station.

It was seen that to maintain a stable transmission system, that generators interconnecting at Tatonga 345kV substation will be required to maintain a 1.01 pu voltage schedule. It was determined that all interconnection requests in the Woodward area (with all upgrades in service) will have a power factor requirements ranging from 99% lagging (supplying vars) to 97% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system. These power factor results are considered preliminary at this stage due to the large amount of generation being studied. For this study, the Woodward 345kV bus has five 345kV lines over 100 miles long connected into the bus resulting in large amounts of charging causing high voltages. Changes in the configuration of the system will result in different power factor configurations for the interconnection request.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 1 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 2 (Hitchland Area)

The Group 2 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The Hitchland stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Hitchland area will have power factor requirements as denoted in the study.

The Group 2 study consists of the following projects –

Request	Size	Wind Turbine Model	Reactive Capability of Wind Farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2008-028	360	GE 1.5MW	118.324	-118.324	Hitchland 345kV (#523097)
GEN-2008-047	300	GE 1.5MW	98.6	-98.6	Hitchland – Woodward 345kV (523097-515375)
GEN-2008-062	100.8	Vestas V90 1.8MW	0	0	Cole 115kV (523120)
GEN-2008-108	198	Vestas V90 1.8MW	0	0	Potter – Moore County 230kV (523959 – 523309)
GEN-2008-110	300	GE 1.5MW	98.6	-98.6	Hitchland 345kV (#523097)
GEN-2009-018	200.1	Siemens SMK203 2.3MW	96.912	-96.912	Hitchland – Moore County 230kV (523095 - 523309)

It was determined that all interconnection requests in the Hitchland area will have a power factor requirements ranging from 96% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 2 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 3 (Spearville Area)

The Group 3 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The Spearville stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Spearville area will have power factor requirements as denoted in the study.

The Group 3 study consists of the following projects –

Request	Size (MW)	Wind Turbine Model	Reactive Capability of Wind Farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2007-019	375	GE 1.5MW	123.2	-123.2	Tap Lamar – Finney 345kV

GEN-2008-059	100.8	Vestas V90 1.8MW	0 (*)	0 (*)	Tap Sawyer – Medicine Lodge 115kV
GEN-2008-060	300	Vestas V90 1.8MW	0 (*)	0 (*)	Tap Spearville – Reno 345kV
GEN-2008-087	299	Siemens SMK203 2.3MW	169.4	-169.4	Spearville 345kV
GEN-2008-122	95	GE 1.5MW	31.1	-31.1	Tap Spearville – Reno 345kV
GEN-2009-003	200	Suzlon S88	0	0	Pratt 115kV

It was determined that all interconnection requests in the Spearville area will have a power factor requirements ranging from 96% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system. For GEN-2009-003, the Suzlon wind turbines exhibited oscillations that were controllable due to the SVC that is currently assigned to interconnection request GEN-2006-022. If GEN-2006-022 withdraws from the queue, an SVC may be necessary for the interconnection of GEN-2009-003.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 3 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 4 (Mingo Area)

The Group 4 stability study was conducted by AMEC Earth and Environmental (AMEC). The full report is available in the appendices. The Mingo stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Mingo area will have power factor requirements as denoted in the study.

The Group 4 study consists of the following projects –

- GEN-2008-066. 120 MW wind farm (80 General Electric 1.5 MW turbines) connected to the Sunflower Electric Power Corporation (SUNC) Syracuse 115 kV bus.

- GEN-2009-022. 467.5 MW wind farm (187 General Electric 2.5 MW turbines) connected to the SUNC Mingo – Red Willow 345 kV line.

With the power factor requirements and all network upgrades in service, all interconnection request in Group 4 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 5 (Amarillo Area)

The Group 5 stability study was conducted by Black & Veatch. The full report is available in the appendices. The Amarillo stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Amarillo area will have power factor requirements as denoted in the study.

The Group 5 study consists of the following project –

GEN-2008-088: 62.1 MW wind farm (27 Siemens SMK 2.3 MW turbines) connected to the Vega 69 kV bus.

With the power factor requirements and all network upgrades in service, all interconnection request in Group 5 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 6 (New Mexico/South Panhandle Area)

The Group 6 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The New Mexico/South Panhandle stability analysis revealed no stability issues with the study requests with the exception of a possible modeling issue as described below. It was determined that all interconnection requests in the New Mexico/South Panhandle area will have power factor requirements as denoted in the study.

The Group 6 study consists of the following projects –

Request	Size	Wind Turbine Model	Point of Interconnection
GEN-2008-022	860	GE 2.5MW	Tolk (#525549) – Eddy (#527802) 345kV (#571226)
GEN-2008-050	201	Vestas V90 3.0MW	Tolk (#525549) – Eddy (#527802) 345kV
GEN-2008-058	200.1	Siemens SMK203 2.3MW	Roosevelt (#524909) 230kV
GEN-2008-064	200.1	Siemens SMK203 2.3MW	Oasis (#524875) 230kV
GEN-2008-083	99	Vestas V90 1.8MW	Grassland 115kV(526676)
GEN-2008-085	100.5	GE 1.5MW	Tolk (525531) – Lamb County (#525637)

Various stability issues were encountered in this area due to the volume and magnitude of the generation requested to be interconnected. In particular, numerical modeling issues were discovered in the analysis of the GEN-2008-022 project, which is requested at 860MW. The GEN-2008-022 project requested the use of General Electric 2.5MW turbines, which is a newer model. Whether from actual transmission problems or from purely numerical issues with the GE turbine model it was determined that the 860MW amount could not be interconnected at the point of interconnection requested. At SPP's direction, PTI then ran the simulation assuming GE 1.5 MW turbine units and the system was found to be stable with all network upgrades in service. The Customer can continue the request for GE 1.5MW turbines or the Customer may request an additional analysis to be performed on the GE 2.5MW units. If the Customer wishes to continue with the GE 2.5MW units, SPP will work with PTI and GE to determine the needs of the interconnection request

It was determined that all interconnection requests (with the required upgrades in service) in the New Mexico / South Panhandle area will have a power factor requirements ranging from 99% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 6 (with the exception of GEN-2008-022 using GE 2.5 MW wind turbines) will meet FERC Order #661A low voltage ride through (LVRT) requirements. If the GEN-2008-022 project uses GE 1.5MW turbines, it will be able to meet FERC Order #661A low voltage ride through requirements.

Cluster Group 7 (Southwest Oklahoma)

The Group 7 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The Southwest Oklahoma stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Southwest Oklahoma area will have power factor requirements as denoted in the study.

The Group 7 study consists of the following projects –

Request	Size (MW)	Model	Reactive Capability of Wind Farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2007-049	59.4	Vestas V90 1.8MW	0*	0*	Carter Junction 69kV
GEN-2008-037	100.8	Vestas V90 1.8MW	0*	0*	Blucan1 - Washita 138kV
GEN-2009-030	201	GE 1.5MW	66	-66	Anadarko – Midpoint 345kV line

It was determined that all interconnection requests in the southwest Oklahoma area will have a power factor requirements ranging from 99% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 7 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 8 (South Central Kansas / North Central Oklahoma)

The Group 8 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The South Central Kansas/North Central Oklahoma stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the South Central Kansas/North Central Oklahoma area will have power factor requirements as denoted in the study.

The Group 8 study consists of the following projects –

Request	Size (MW)	Model	Reactive capability of wind farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2008-071	151.2	Vestas V90 1.8MW	0*	0*	Newkirk (514759) 138kV
GEN-2008-098	100.8	Vestas V90 1.8MW	0*	0*	Tap Wolf Creek– LaCygne 345kV line
GEN-2009-005	200.1	Siemens SMK203 2.3MW	118.72	-118.72	Tap Emporia – Swissvale 345kV line

It was determined that all interconnection requests in the North central Oklahoma / South Central Kansas area will have a power factor requirements ranging from 95% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system. The GEN-2008-071 request is shown as having a leading requirement, but will also need capacitors because of low voltage under certain conditions.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 8 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 9 (Northeast Nebraska)

The Group 9 stability study was conducted by ABB Consulting (ABB). The entire study is available in the appendices. The Northeast Nebraska stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the northeast Nebraska will have power factor requirements as denoted in the study.

The Group 9 study consists of the following projects –

Request	Size	Wind Turbine Technology	Point of Interconnection	County
GEN-2006-044N02	150	GE 1.5 MW	Tap Columbus (640133) – Ft Randall (652509) 230kV. Bus # 570886	Madison, Nebraska

With the power factor requirements and all network upgrades in service, all interconnection request in Group 9 will meet FERC Order #661A low voltage ride through (LVRT) requirements

Cluster Group 10 (North Nebraska)

No Group 10 stability study.

Cluster Group 11 (North Kansas)

The Group 11 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The Nebraska stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the Nebraska area will have power factor requirements as denoted in the study.

The Group 11 study consists of the following projects –

Request	Size (MW)	Model	Reactive Capability of Wind Farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2008-061	149.4	Vestas V90 1.8 MW	0(*)	0(*)	Smoky Hills 345kV

It was determined that all interconnection requests in the North Kansas area will have a power factor requirements ranging from 98% lagging (supplying vars) to 95% leading (absorbing vars) as measured at the point of interconnection in accordance with FERC Order #661A in order to maintain a reliable and stable system.

With the power factor requirements (and associated reactive power equipment) and all network upgrades in service, all interconnection request in Group 11 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 12 (Northwest Arkansas)

No group 12 stability study

Cluster Group 13 (Northwest Missouri)

The Group 13 stability analysis was conducted by Excel Engineering (Excel). The entire report is available in the appendices. The Northwest Missouri stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the north Kansas area will have power factor requirements as denoted in the study.

The Group 13 study consists of the following projects –

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2009-031	149.5	Siemens SMK203 2.3MW	St Joseph (541199) – Cooper (640139) 345kV

With the power factor requirements and all network upgrades in service, all interconnection request in Group 13 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 14 (South Central Oklahoma)

The Group 14 stability analysis was conducted by Pterra. The entire report is available in the appendices. The South Central Oklahoma stability analysis revealed no stability issues with the study requests. It was determined that all interconnection requests in the south central Oklahoma area will have power factor requirements as denoted in the study.

The Group 14 study consists of the following projects –

Project#	Request	Size	Wind Turbine Model	Point of Interconnection
1	GEN-2008-033	100.8	Vestas V90 1.8MW	Tap Jollyville – Arbuckle 138kV
2	GEN-2008-034	100.8	Vestas V90 1.8MW	Tap Jollyville – Arbuckle 138kV
3	GEN-2008-046	349.2	Vestas V90 1.8MW	Sunnyside 345kV

With the power factor requirements and all network upgrades in service, all interconnection request in Group 14 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 15 (Southwest Nebraska)

The Group 15 stability study was conducted by Power Technologies Inc (PTI). The full report is available in the appendices. The Southwest Nebraska stability analysis revealed no stability issues with the study requests under system in tact and (n-1) conditions. At the request of the Transmission Owner, additional prior outage conditions were evaluated. It was found that for a prior outage of the GEN-2008-121N01 wind farm – Moore 345kV line, the wind farm will be limited to approximately 295MW.

It was determined that all interconnection requests in the Southwest Nebraska area will have power factor requirements as denoted in the study.

The Group 15 study consists of the following projects –

Request	Size (MW)	Model	Reactive Capability of Wind Farm		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
GEN-2008-121N01	401.4	Vestas V90 1.8MW	0	0	Pauline (640312) – Moore (640277) 345kV	572120
GEN-2008-123N	89.7	Siemens SMK203 2.3 MW	53.22	-53.22	Pauline (640312) – Guide Rock (640206)	572050

With the power factor requirements and all network upgrades in service, all interconnection request in Group 15 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Conclusion

The minimum cost of interconnecting all of the interconnection requests included in this Impact Cluster Study is estimated at $1,224,100,000 for the Allocated Network Upgrades and Transmission Owner Interconnection Facilities are listed in Appendix E, F, and G These costs do not include the cost of upgrades of other transmission facilities listed in Appendix H which are Network Constraints.

These interconnection costs do not include any cost of Network Upgrades determined to be required by short circuit analysis. The required interconnection costs listed in Appendices E, and F, and G and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request (TSR) through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP Open Access Transmission Tariff (OATT).

Appendix

A: Generation Interconnection Requests Considered for Impact Study

Request	Amount	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date
GEN-2006-044N02	150	NPPD	Tap Ft Randle-Columbus 230kV	Tap Ft Randle-Columbus 230kV	1/1/2010
GEN-2007-019	375	SPS	Tap Lamar - Finney 345kV	Tap Lamar - Finney 345kV	8/30/2009
GEN-2007-049	60	WFEC	Carter Junction 69kV	Carter Junction 69kV	12/31/2009
GEN-2008-022	860	SPS	Tap Eddy County - GEN-2007-034 345kV	Tap Eddy County - GEN-2007-034 345kV	9/1/2011
GEN-2008-028	360	SPS	Hitchland 345kV	Hitchland 345kV	12/31/2012
GEN-2008-033	100	OKGE	Tap Arbuckle - Jollyville 138kV	Tap Arbuckle - Jollyville 138kV	12/31/2010
GEN-2008-034	100	OKGE	Tap Arbuckle - Jollyville 138kV	Tap Arbuckle - Jollyville 138kV	12/31/2010
GEN-2008-037	100	WFEC	Tap Washita - Blue Canyon Tap 138kV	Tap Washita - Blue Canyon Tap 138kV	11/30/2011
GEN-2008-044	199.8	OKGE	Tatonga 345kV	Tatonga 345kV	12/1/2010
GEN-2008-045	300	OKGE	Woodward 345kV	Woodward 345kV	12/1/2010
GEN-2008-046	349.2	OKGE	Sunnyside 345kV	Sunnyside 345kV	12/1/2010
GEN-2008-047	300	SPS	Tap Hitchland - Woodward 345kV	Tap Hitchland - Woodward 345kV	12/31/2012
GEN-2008-050	201	SPS	Tap Eddy County - GEN-2007-034 345kV	Tap Eddy County - GEN-2007-034 345kV	12/31/2010
GEN-2008-058	201	SPS	Roosevelt N 230kV	Roosevelt N 230kV	11/1/2010
GEN-2008-059	100.8	SUNC	Tap Sawyer – Medicine Lodge 115kV	Tap Sawyer – Medicine Lodge 115kV	12/1/2010
GEN-2008-060	300	SUNC	Tap Mullergren – Spearville 230kV	Tap Spearville – Reno 345kV^	12/1/2010
GEN-2008-061	151.2	MIDW	Smoky Hills Tap 230kV	^Smoky Hills 345kV	12/1/2010
GEN-2008-062	100	SPS	Cole 115kV	Cole 115kV	12/1/2010
GEN-2008-064	201	SPS	Oasis 230kV	Oasis 230kV	10/10/2010
GEN-2008-066	120	SUNC	Syracuse 115kV	Syracuse 115kV	8/30/2010
GEN-2008-071	150	OKGE	Newkirk 138kV	Newkirk 138kV	11/1/2010
GEN-2008-083	99	SPS	Southland 69kV	Grassland 115kV	6/1/2010
GEN-2008-085	100	SPS	Tap Lamb Co – Tolk W 230kV	Tap Lamb Co – Tolk W 230kV	12/31/2011
GEN-2008-087	300	SUNC	Spearville 345kV	Spearville 345kV	12/1/2012
GEN-2008-088	62.1	SPS	Vega 69kV	Vega 69kV	12/1/2011
GEN-2008-098	100	WERE	Tap Lacygne – Wolf Creek 345kV	Tap Lacygne – Wolf Creek 345kV	12/31/2011
GEN-2008-108	198	SPS	Tap Moore Co – Potter Co 230kV	Tap Moore Co – Potter Co 230kV	10/1/2012
GEN-2008-110	300	SPS	Hitchland 345kV	Hitchland 345kV	7/31/2011
GEN-2008-121N01	400	NPPD	Tap Moore – Pauline 345kV	Tap Moore – Pauline 345kV	
GEN-2008-122	105	SUNC	Tap Mullergren – Spearville 115kV	Tap Spearville - Reno 345kV^	12/31/2011
GEN-2008-123N	90	NPPD	Tap Guide – Pauline 115kV	Tap Guide – Pauline 115kV	
GEN-2009-003	199.5	SUNC	Pratt 115kV	^Pratt 345kV	12/1/2010
GEN-2009-005	200.1	WERE	Tap Emporia EC – Swissvale 345kV	Tap Emporia EC – Swissvale 345kV	12/1/2010
GEN-2009-018	200.1	SPS	Tap Moore Co – Hitchland 230kV	Tap Moore Co – Hitchland 230kV	12/31/2011
GEN-2009-022	467.5	SUNC	Tap Red Willow – Mingo 345kV	Tap Red Willow – Mingo 345kV	1/1/2011
GEN-2009-030	201	WFEC	Weatherford 138kV	Tap Midpoint – Anadarko 345kV	7/1/2012
GEN-2009-031	149.5	MIPU	Tap St. Joseph – Cooper 345kV	Tap St. Joseph – Cooper 345kV	10/31/2011
GROUPED TOTAL	**7,950.8**				

***** Planned Facility

^ Proposed Facility

******* Electrically Remote Interconnection Requests

B: Prior Queued Interconnection Requests

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2001-014	96	WFEC	Fort Supply 138kV	On-Line
GEN-2001-026	74	WFEC	Washita 138kV	On-Line
GEN-2001-033	180	SPS	San Juan Mesa Tap 230kV	On-Line
GEN-2001-036	80	SPS	Caprock Tap 115kV	On-Line
GEN-2001-037	100	OKGE	Windfarm Switching 138kV	On-Line
GEN-2001-039A	105	MKEC	Greensburg - Judson-Large 115kV	On Schedule for 2011
GEN-2001-039M	100	SUNC	Leoti – City Services 115kV	On-Line
GEN-2002-004	200	WERE	Latham 345kV	On-Line
GEN-2002-005	120	WFEC	Morewood - Elk City 138kV	On-Line
GEN-2002-006	150	SPS	Texas County 115kV	IA Executed/On Schedule 12/31/2010
GEN-2002-008	240	SPS	*Hitchland 345kV	On-Line at 120MW
GEN-2002-009	80	SPS	Hansford County 115kV	On-Line
GEN-2002-022	240	SPS	Bushland 230kV	On-Line at 160MW
GEN-2002-025A	150	MKEC	Spearville 230kV	On-Line at 100MW
GEN-2003-005	100	WFEC	Anadarko - Paradise 138kV	On Line
GEN-2003-006A	200	MKEC	Elm Creek 230kV	On-Line
GEN-2003-013	198	SPS	*Hitchland - Finney 345kV	On Schedule for 2012
GEN-2003-019	250	MIDW	Smoky Hills Tap 230kV	On-Line
GEN-2003-020	160	SPS	Martin 115kV	On-Line at 80MW
GEN-2003-021N	75	NPPD	Ainsworth Wind Tap	On-Line
GEN-2003-022	120	AEPW	Washita 138kV	On-Line
GEN-2004-003	240	SPS	Conway 115kV	On Suspension
GEN-2004-005N	30	NPPD	St. Francis 115kV	IA Pending
GEN-2004-010	300	WERE	Latham 345kV	On Suspension
GEN-2004-014	155	MKEC	Spearville 230kV	On Schedule for 2011
GEN-2004-020	27	AEPW	Washita 138kV	On-Line
GEN-2005-005	18	OKGE	Windfarm Tap 138kV	pending
GEN-2005-008	120	OKGE	Woodward 138kV	On-Line
GEN-2005-010	160	SPS	Roosevelt County - Tolk West 230kV (Single Ckt Tap)	On Suspension
GEN-2005-012	250	SUNC	Spearville 345kV	IA Executed/On Schedule 10/1/2011
GEN-2005-013	201	WERE	Tap Latham - Neosho	On Schedule 2011
GEN-2005-015	150	SPS	Tuco - Oklaunion 345kV	On Suspension
GEN-2005-016	150	WFEC	Tap Latham - Neosho	On Schedule 2012
GEN-2005-017	340	SPS	*Hitchland - Potter County 345kV	On Suspension
GEN-2005-021	86	SPS	Kirby 115kV	On Suspension
GEN-2006-002	150	AEPW	Grapevine - Elk City 230kV	On Suspension
GEN-2006-006	206	MKEC	Spearville 230kV	Under Study (ICS-2008-001)
GEN-2006-014	300	MIPU	Tap Maryville – Clarinda 161kV	On Schedule 2011
GEN-2006-017	300	MIPU	Tap Maryville – Clarinda 161kV	On Suspension
GEN-2006-018	170	SPS	Tuco 230kV	IA Executed/On Schedule 6/1/2010
GEN-2006-020	18.9	SPS	DWS Frisco Tap	IA Executed/On Schedule 12/31/2010
GEN-2006-020N	42	NPPD	Bloomfield 115kV	1/1/2009
GEN-2006-021	101	WPEK	Flat Ridge Tap 138kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2006-022	150	WPEK	Ninnescah Tap 115kV	On Suspension
GEN-2006-024	20	WFEC	South Buffalo Tap 69kV	On-Line
GEN-2006-031	75	MIDW	Knoll 115kV	On-Line
GEN-2006-032	200	MIDW	South Hays 230kV	On Schedule for 2012
GEN-2006-034	81	SUNC	Kanarado - Sharon Springs 115kV	On Suspension
GEN-2006-035	225	AEPW	Grapevine - Elk City 230kV	On Suspension
GEN-2006-038N005	80	NPPD	Broken Bow 115kV	IA Pending
GEN-2006-038N019	80	NPPD	Petersburg 115kV	IA Pending
GEN-2006-037N	100.5	NPPD	Valentine 115 kV	Under Study (DISIS-2009-001)
GEN-2006-037N1	75	NPPD	Broken Bow 115kV	Under Study (DISIS-2009-001)
GEN-2006-039	400	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV	On Suspension
GEN-2006-040	108	SUNC	Mingo 115kV	On Suspension
GEN-2006-043	99	AEPW	Grapevine - Elk City 230kV	On-Line
GEN-2006-044	370	SPS	*Hitchland 345kV	On Suspension
GEN-2006-044N	40.5	NPPD	Tap Neligh – Petersburg 115kV	Under Study (DISIS-2009-001)
GEN-2006-045	240	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV	On Suspension
GEN-2006-046	131	OKGE	Dewey 138kV	On Schedule for 2010
GEN-2006-047	240	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV	On Schedule for 2013
GEN-2006-049	400	SPS	*Hitchland - Finney 345kV	IA Pending
GEN-2007-002	160	SPS	Grapevine 115kV	On Suspension
GEN-2007-005	200	SPS	Pringle 115kV	Under Study (ICS-2008-001)
GEN-2007-006	160	OKGE	Roman Nose 138kV	On Suspension
GEN-2007-008	300	SPS	Grapevine EHV 230kV	Under Study (ICS-2008-001)
GEN-2007-011	135	SUNC	Syracuse 115kV	On Suspension
GEN-2007-011N06	75	NPPD	Tap Neligh – Petersburg 115kV	Under Study (DISIS-2009-001)
GEN-2007-011N08	81	NPPD	Bloomfield 115kV	On-Line
GEN-2007-011N09	75	NPPD	Bloomfield 115kV	Under Study (DISIS-2009-001)
GEN-2007-013	99	SUNC	Selkirk 115kV	IA Pending
GEN-2007-015	135	WERE	Tap Humboldt – Kelly 161kV	IA Pending
GEN-2007-017	101	MIPU	Tap Maryville – Clarinda 161kV	On Schedule 2010
GEN-2007-021	201	OKGE	*Tatonga 345kV	Under Study (ICS-2008-001)
GEN-2007-025	300	WERE	Tap Woodring – Wichita 345kV	Under Study (ICS-2008-001)
GEN-2007-032	150	WFEC	Tap Clinton Junction – Clinton 138kV	Under Study (ICS-2008-001)
GEN-2007-034	150	SPS	Tap Eddy – Tolk 345kV	Under Study (ICS-2008-001)
GEN-2007-038	200	SUNC	Spearville 345kV	Under Study (ICS-2008-001)
GEN-2007-040	200	SUNC	Tap Holcomb – Spearville 345kV	Under Study (DISIS-2009-001)
GEN-2007-043	300	AEPW	Tap Lawton Eastside – Cimarron 345kV	Under Study (ICS-2008-001)
GEN-2007-044	300	OKGE	*Tatonga 345kV	Under Study (ICS-2008-001)

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2007-045	171	SPS	Conway 115kV	Under Study (ICS-2008-001)
GEN-2007-046	200	SPS	*Hitchland 115kV	Under Study (ICS-2008-001)
GEN-2007-048	400	SPS	Tap Amarillo South – Swisher 230kV	Under Study (ICS-2008-001)
GEN-2007-050	171	OKGE	*Woodward 138kV	Under Study (ICS-2008-001)
GEN-2007-051	200	WFEC	Mooreland 138kV	Under Study (ICS-2008-001)
GEN-2007-052	150	WFEC	Anadarko 138kV	Under Study (ICS-2008-001)
GEN-2007-053	110	MIPU	Tap Maryville – Clarinda 161kV	Under Study (ICS-2008-001)
GEN-2007-057	35	SPS	Moore County East 115kV	Under Study (ICS-2008-001)
GEN-2007-062**	765	OKGE	*Woodward 345kV	Under Study (ICS-2008-001)
GEN-2008-003	101	OKGE	*Woodward EHV 138kV	Under Study (ICS-2008-001)
GEN-2008-008	60	SPS	Graham 115kV	Under Study (ICS-2008-001)
GEN-2008-009	60	SPS	San Juan Mesa Tap 230kV	Under Study (ICS-2008-001)
GEN-2008-013	300	OKGE	Tap Woodring – Wichita 345kV	Under Study (ICS-2008-001)
GEN-2008-014	150	SPS	Tap Tuco – Oklaunion 345kV	Under Study (ICS-2008-001)
GEN-2008-016	248	SPS	Grassland 230kV	Under Study (ICS-2008-001)
GEN-2008-017	300	SUNC	Setab 345kV	Under Study (ICS-2008-001)
GEN-2008-018	405	SUNC	Finney 345kV	Under Study (ICS-2008-001)
GEN-2008-019**	300	OKGE	*Tatonga 345kV	Under Study (ICS-2008-001)
GEN-2008-021	42	WERE	Wolf Creek 345kV	Under Study (DISIS-2009-001)
GEN-2008-023	150	AEPW	Hobart Junction 138kV	Under Study (DISIS-2009-001)
GEN-2008-025	101.2	SUNC	Ruleton 115kV	Under Study (DISIS-2009-001)
GEN-2008-029	250.5	OKGE	Woodward EHV 138kV	Under Study (DISIS-2009-001)
GEN-2008-038	150	AEPW	Tap Shidler – West Pawhuska 138kV	Under Study (DISIS-2009-001)
GEN-2008-051	322	SPS	Potter 345kV	Under Study (DISIS-2009-001)
GEN-2008-079	100.5	MKEC	Tap Judson Large – Cudahy 115kV	Under Study (DISIS-2009-001)
GEN-2008-086N02	200	NPPD	Tap Ft. Randall – Columbus 230kV	Under Study (DISIS-2009-001)
GEN-2008-092	201	MIDW	Knoll 115kV	Under Study (DISIS-2009-001)
GEN-2008-119O	60	OPPD	Tap Humboldt – Kelly 161kV	IA Pending
GEN-2008-124	200.1	MKEK	Spearville 230kV	Under Study (DISIS-2009-001)
GEN-2008-127	200.1	WERE	Tap Sooner – Rose Hill 345kV	Under Study (DISIS-2009-001)
GEN-2008-129	80	MIPU	Pleasant Hill 161kV	Under Study (DISIS-2009-001)

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2009-006	60	AEPW	SE Fayetteville 161kV	Under Study (DISIS-2009-001)
GEN-2009-011	50	SUNC	Tap Plainville – Phillipsburg 115kV	Under Study (DISIS-2009-001)
GEN-2009-016	140	MKEC	Falcon Road 138kV	Under Study (DISIS-2009-001)
GEN-2009-017	60	SPS	Tap Pembrook – Stiles 138kV	Under Study (DISIS-2009-001)
GEN-2009-025	60	OKGE	Kay Coop	Under Study (DISIS-2009-001)
Broken Bow	8.3	NPPD	Broken Bow 115kV	On-Line
Ord	13.9	NPPD	Ord 115kV	On-Line
Stuart	2.1	NPPD	Stuart 115kV	On-Line
Genoa	4	NPPD	Genoa 115kV	On-Line
AECI-1	400	AECI	Tap Cooper – Fairport 345kV	Under Study
AECI-2	99	AECI	Lathrop 161kV	Under Study
AECI-3	201	AECI	Osborn 161kV	Under Study
AECI-4	150	AECI	Tap Fairfax 138kV	Under Study
AECI-5	100	AECI	Maryville 161kV	Under Study
AECI-6	200	AECI	Tap Fairfax 138kV	
AECI-7	300	AECI	Maryville 161kV	
Llano Estacado	80	SPS	Llano Wind Farm Tap 115kV	On-Line
Distribution Wind	90	SPS	DUMAS_19ST 115kV	On-Line
			Etter 115kV	On-Line
			Sherman 115kV	On-Line
			Spearman 115kV	On-Line
			Texas County 115kV	On-Line
Blue Canyon II	153	WFEC	Washita 138kV (GEN-2003-004)	On-Line
			Washita 138kV (GEN-2004-023)	On-Line
			Washita 138kV (GEN-2005-003)	On-Line
Montezuma	110	MKEC	Haggard 115kV	On-Line
GROUPED TOTAL	**21,434.6**			

***** Planned Facility

C: Study Groupings

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2001-014	96	WFEC	Fort Supply 138kV
	GEN-2001-037	100	OKGE	Windfarm Switching 138kV
	GEN-2002-005	120	WFEC	Tap Morewood - Elk City 138kV
	GEN-2005-005	18	OKGE	Windfarm Tap 138kV
	GEN-2005-008	120	OKGE	Woodward 138kV
	GEN-2006-024	20	WFEC	South Buffalo Tap 69kV
	GEN-2006-046	131	OKGE	Dewey 138kV
	GEN-2007-006	160	OKGE	Roman Nose 138kV
	GEN-2007-021	201	OKGE	*Tatonga 345kV
	GEN-2007-044	300	OKGE	*Tatonga 345kV
	GEN-2007-050	171	OKGE	*Woodward 138kV
	GEN-2007-051	200	WFEC	Mooreland 138kV
	GEN-2007-062	765	OKGE	*Woodward 345kV
	GEN-2008-003	101	OKGE	*Woodward EHV 138kV
	GEN-2008-019	300	OKGE	*Tatonga 345kV
	GEN-2008-029	250.5	OKGE	WOODWARD EHV 138kV
	PRIOR QUEUED SUBTOTAL	**3,053.5**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Woodward	GEN-2008-044	199.8	OKGE	Tatonga 345kV
	GEN-2008-045	300	OKGE	Woodward 345kV
	WOODWARD SUBTOTAL	**499.8**		
	AREA SUBTOTAL	**3,553.3**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	SPS Distribution	90	SPS	Various
	GEN-2002-006	150	SPS	Texas County 115kV
	GEN-2002-008	240	SPS	*Hitchland 345kV
	GEN-2002-009	80	SPS	Hansford County 115kV
	GEN-2003-013	198	SPS	*Tap Hitchland - Finney 345kV
	GEN-2003-020	160	SPS	Martin 115kV
	GEN-2005-017	340	SPS	*Tap Hitchland - Potter County 345kV
	GEN-2006-020	18.9	SPS	DWS Frisco Tap
	GEN-2006-044	370	SPS	*Hitchland 345kV
	GEN-2006-049	400	SPS	*Tap Hitchland - Finney 345kV
	GEN-2007-005	200	SPS	Pringle 115kV
	GEN-2007-046	200	SPS	*Hitchland 115kV
	GEN-2007-057	35	SPS	Moore County East 115kV
	PRIOR QUEUED SUBTOTAL	**2,481.9**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Hitchland	GEN-2008-028	360	SPS	Hitchland 345kV
	GEN-2008-047	300	SPS	Tap Hitchland-Woodward 345kV
	GEN-2008-062	100	SPS	Cole 115kV
	GEN-2008-108	198	SPS	Tap Moore Co-Potter Co 230kV
	GEN-2008-110	300	SPS	Hitchland 345kV
	GEN-2009-018	200.1	SPS	Tap Moore Co-Hitchland 230kV
	WOODWARD SUBTOTAL	**1,458.1**		
	AREA SUBTOTAL	**3,940**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	Montezuma	110	MKEC	Haggard 115kV
	GEN-2001-039A	105	WPEK	Tap Greensburg - Judson-Large 115kV
	GEN-2002-025A	150	WPEK	Spearville 230kV
	GEN-2004-014	155	MIDW	Spearville 230kV
	GEN-2005-012	250	WPEK	Spearville 345kV
	GEN-2006-006	206	MKEC	Spearville 230kV
	GEN-2006-021	101	WPEK	Flat Ridge Tap 138kV
	GEN-2006-022	150	WPEK	Ninnescah Tap 115kV
	GEN-2007-038	200	SUNC	Spearville 345kV
	GEN-2007-040	200	SUNC	Tap Holcomb – Spearville 345kV
	GEN-2008-018	405	SUNC	Finney 345kV
	GEN-2008-079	100.5	MKEC	Tap Judson Large – Cudahy 115kV
	GEN-2008-124	200.1	SUNC	Spearville 345kV
	PRIOR QUEUED SUBTOTAL	**2,332.6**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Spearville	GEN-2007-019	375	SPS	Tap Lamar-Finney 345kV
	GEN-2008-059	100.8	SUNC	Tap Pratt-Medicine Lodge 115kV
	GEN-2008-060	300	SUNC	Tap Spearville – Reno 345kV
	GEN-2008-087	300	SUNC	Spearville 345kV
	GEN-2008-122	105	SUNC	Tap Spearville - Reno 345kV
	GEN-2009-003	199.5	SUNC	Pratt 345kV
	SPEARVILLE SUBTOTAL	**1,380.3**		
	AREA SUBTOTAL	**3,712.9**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2001-039M	100	SUNC	Tap Leoti - City Services 115kV
	GEN-2006-034	81	SUNC	Tap Kanarado - Sharon Springs 115kV
	GEN-2006-040	108	SUNC	Mingo 115kV
	GEN-2007-011	135	SUNC	Syracuse 115kV
	GEN-2007-013	99	SUNC	Selkirk 115kV
	GEN-2008-017	300	SUNC	Setab 345kV
	GEN-2008-025	101.2	SUNC	Ruleton 115kV
	PRIOR QUEUED SUBTOTAL	**924.2**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Mingo	GEN-2008-066	120	SUNC	Syracuse 115kV
	GEN-2009-022	467.5	SUNC	Tap Red Willow-Mingo 345kV
	MINGO/NW KANSAS SUBTOTAL	**587.5**		
	AREA SUBTOTAL	**1,511.7**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	Llano Estacado	80	SPS	Llano Estacado Tap 115kV
	GEN-2002-022	240	SPS	Bushland 230kV
	GEN-2004-003	240	SPS	Conway 115kV
	GEN-2005-021	86	SPS	Kirby 115kV
	GEN-2006-039	400	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV
	GEN-2006-045	240	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV
	GEN-2006-047	240	SPS	Tap and Tie both Potter County - Plant X 230kV and Bushland - Deaf Smith 230kV
	GEN-2007-002	160	SPS	Grapevine 115kV
	GEN-2007-008	300	SPS	Grapevine EHV 230kV
	GEN-2007-045	171	SPS	Conway 115kV
	GEN-2007-048	400	SPS	Tap Amarillo South – Swisher 230kV
	GEN-2008-051	322	SPS	Potter 345kV
	PRIOR QUEUED SUBTOTAL	**2,879**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Amarillo	GEN-2008-088	62.1	SPS	Vega 69kV
	AMARILLO SUBTOTAL	**62.1**		
	AREA SUBTOTAL	**3,014**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2001-033	180	SPS	San Juan Mesa Tap 230kV
	GEN-2001-036	80	SPS	Norton 115kV
	GEN-2005-010	160	SPS	Tap Roosevelt County - Tolk West 230kV (Single Ckt Tap)
	GEN-2005-015	150	SPS	Tap TUCO - Oklaunion 345kV
	GEN-2006-018	170	SPS	Tuco 230kV
	GEN-2007-034	150	SPS	Tap Eddy – Tolk 345kV
	GEN-2008-008	60	SPS	Graham 115kV
	GEN-2008-009	60	SPS	San Juan Mesa Tap 230kV
	GEN-2008-014	150	SPS	Tap Tuco – Oklaunion 345kV
	GEN-2008-016	248	SPS	Grassland 230kV
	GEN-2009-017	60	SPS	Tap Pembrook – Stiles 138kV
	PRIOR QUEUED SUBTOTAL	**1,468**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
S Pandle	GEN-2008-022	860	SPS	Tap Eddy – Tolk 345kV
	GEN-2008-050	201	SPS	Tap Eddy – Tolk 345kV
	GEN-2008-058	201	SPS	Roosevelt N 230kV
	GEN-2008-064	201	SPS	Oasis 230kV
	GEN-2008-083	99	SPS	Grassland 115kV
	GEN-2008-085	100	SPS	Tap Lamb Co-Tolk W 230kV
	SOUTH PANHANDLE/NM SUBTOTAL	**1,662**		
	AREA SUBTOTAL	**3,130**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2001-026	74	WFEC	Washita 138kV
	GEN-2003-004	101	WFEC	Washita 138kV
	GEN-2003-005	100	WFEC	Anadarko - Paradise 138kV
	GEN-2003-022	120	AEPW	Washita 138kV
	GEN-2004-020	27	AEPW	Washita 138kV
	GEN-2004-023	21	WFEC	Washita 138kV
	GEN-2005-003	31	WFEC	Washita 138kV
	GEN-2006-002	150	AEPW	Grapevine - Elk City 230kV
	GEN-2006-035	225	AEPW	Grapevine - Elk City 230kV
	GEN-2006-043	99	AEPW	Grapevine - Elk City 230kV
	GEN-2007-032	150	WFEC	Tap Clinton Junction – Clinton 138kV
	GEN-2007-043	300	AEPW	Tap Lawton Eastside – Cimarron 345kV
	GEN-2007-052	150	WFEC	Anadarko 138kV
	GEN-2008-023	150	AEPW	Hobart Junction 138kV
	GEN-2009-016	140.3	AEPW	Falcon Road 138kV
	PRIOR QUEUED SUBTOTAL	**1,838.3**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
SW Oklahoma	GEN-2007-049	60	WFEC	Carter Junction 69kV
	GEN-2008-037	100	WFEC	Tap Washita-Blue Canyon Tap 138kV
	GEN-2009-030	201	WFEC	Tap Midpoint – Anadarko 345kV
	SW OKLAHOMA SUBTOTAL	**361**		
	AREA SUBTOTAL	**2,199.3**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	AECI-4	150	AECI	Tap Fairfax – Fairfax Tap 138kV
	AECI-6	200	AECI	Tap Fairfax – Fairfax Tap 138kV
	GEN-2002-004	200	WERE	Latham 345kV
	GEN-2004-010	300	WERE	Latham 345kV
	GEN-2005-013	201	WERE	Tap Latham - Neosho
	GEN-2005-016	150	WFEC	Tap Latham - Neosho
	GEN-2007-025	300	WERE	Tap Woodring – Wichita 345kV
	GEN-2008-013	300	OKGE	Tap Woodring – Wichita 345kV
	GEN-2008-021	42	WERE	Wolf Creek 345kV
	GEN-2008-038	150	AEPW	Tap Shidler – West Pawhuska 138kV
	GEN-2008-127	200.1	WERE	Tap Sooner – Rose Hill 345kV
	GEN-2009-025	60	OKGE	Kay Coop 69kV
	PRIOR QUEUED SUBTOTAL	**2,253.1**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
South Central Kansas	GEN-2008-071	150	OKGE	Newkirk 138kV
	GEN-2008-098	100	WERE	Tap Lacygne-Wolf Creek 345kV
	GEN-2009-005	200.1	WERE	Tap Emporia EC-Swissvale 345kV
SOUTH CENTRAL KANSAS SUBTOTAL		**450.1**		
	AREA SUBTOTAL	**2,703.2**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	Genoa	4	NPPD	Genoa 115kV
	GEN-2006-020N	42	NPPD	Bloomfield 115kV
	GEN-2006-038N019	80	NPPD	Petersburg 115kV
	GEN-2006-044N	40.5	NPPD	Tap Neligh – Petersburg 115kV
	GEN-2007-011N06	75	NPPD	Tap Neligh – Petersburg 115kV
	GEN-2007-011N08	81	NPPD	Bloomfield 115kV
	GEN-2007-011N09	75	NPPD	Bloomfield 115kV
	GEN-2008-086N02	200	NPPD	Tap Ft. Randall - Columbus
	PRIOR QUEUED SUBTOTAL	**597.5**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
NE Nebraska	GEN-2006-044N02	150	NPPD	Ft Randle-Columbus 230kV
	NE NEBRASKA SUBTOTAL	**150**		
	AREA SUBTOTAL	**747.5**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	Broken Bow	8.3	NPPD	Broken Bow 115kV
	Ord	13.9	NPPD	Bloomfield 115kV
	Stuart	2.1	NPPD	Petersburg 115kV
	GEN-2003-021N	75	NPPD	Ainsworth Wind Tap 115kV
	GEN-2004-005N	30	NPPD	St. Francis 115kV
	GEN-2006-037N	100.5	NPPD	Valentine 115kV
	GEN-2006-037N1	75	NPPD	Broken Bow 115kV
	GEN-2006-038N05	80	NPPD	Broken Bow 115kV
	PRIOR QUEUED SUBTOTAL	**384.8**		
	NORTH NEBRASKA AREA SUBTOTAL	**384.8**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2003-006A-E	100	EMDE	Elm Creek 230kV
	GEN-2003-006A-W	100	WERE	Elm Creek 230kV
	GEN-2003-019	250	MIDW	Smoky Hills Tap 230kV
	GEN-2006-031	75	MIDW	Knoll 115kV
	GEN-2006-032	200	MIDW	South Hays 230kV
	GEN-2008-092	201	MIDW	Knoll 115kV
	GEN-2009-011	50	MKEC	Tap Plainville – Phillipsburg 115kV
	PRIOR QUEUED SUBTOTAL	**976**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
North Kansas	GEN-2008-061	151.2	MIDW	Smoky Hills 345kV
	NORTH KANSAS SUBTOTAL	**151.2**		
	AREA SUBTOTAL	**1,127.2**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	GEN-2009-006	60	AEPW	SE Fayetteville 161kV
PRIOR QUEUED SUBTOTAL		60		
NW ARKANSAS AREA SUBTOTAL		60		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Prior Queued	AECI-1	400	AECI	Tap Cooper – Fairport 345kV
	AECI-2	99	AECI	Lathrop 161kV
	AECI-3	201	AECI	Osborn 161kV
	AECI-5	100	AECI	Maryville 161kV
	AECI-7	300	AECI	Maryville 161kV
	GEN-2006-014	300	MIPU	Tap Maryville – Clarinda 161kV
	GEN-2006-017	300	MIPU	Tap Maryville – Clarinda 161kV
	GEN-2007-015	135	WERE	Tap Humboldt – Kelly 161kV
	GEN-2007-017	101	MIPU	Tap Maryville – Clarinda 161kV
	GEN-2007-053	110	MIPU	Tap Maryville – Clarinda 161kV
	GEN-2008-119O	60	OPPD	Tap Humboldt – Kelly 161kV
	GEN-2008-129	80	MIPU	Pleasant Hill 161kV
PRIOR QUEUED SUBTOTAL		2,186		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Northwest Missouri	GEN-2009-031	149.5	MIPU	Tap St. Joseph-Cooper 345kV
NORTHWEST MISSOURI SUBTOTAL		149.5		
AREA SUBTOTAL		2,335.5		

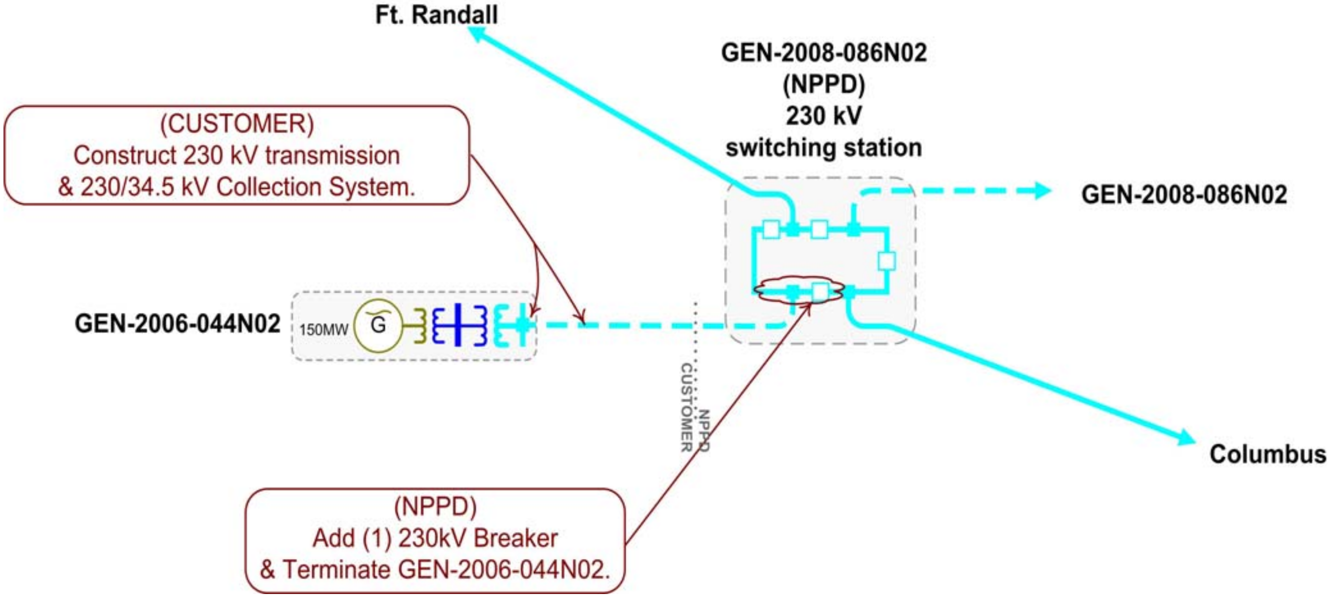
Cluster	Request	Amount	Area	Proposed Point of Interconnection
South Central Oklahoma	GEN-2008-033	100	OKGE	Tap Arbuckle – Jollyville 138kV
	GEN-2008-034	100	OKGE	Tap Arbuckle – Jollyville 138kV
	GEN-2008-046	349.2	OKGE	Sunnyside 345kV
SOUTH CENTRAL OKLAHOMA SUBTOTAL		549.2		
AREA SUBTOTAL		549.2		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
Southwest Nebraska	GEN-2008-121N01	400	NPPD	Tap Moore – Pauline 345kV
	GEN-2008-123N	90	NPPD	Tap Guide – Pauline 115kV
SOUTHWEST NEBRASKA SUBTOTAL		490		
AREA SUBTOTAL		490		
***CLUSTERED TOTAL (w/o PRIOR QUEUED)		7,950.8		
***CLUSTERED TOTAL (w/PRIOR QUEUED)		29,385.4		

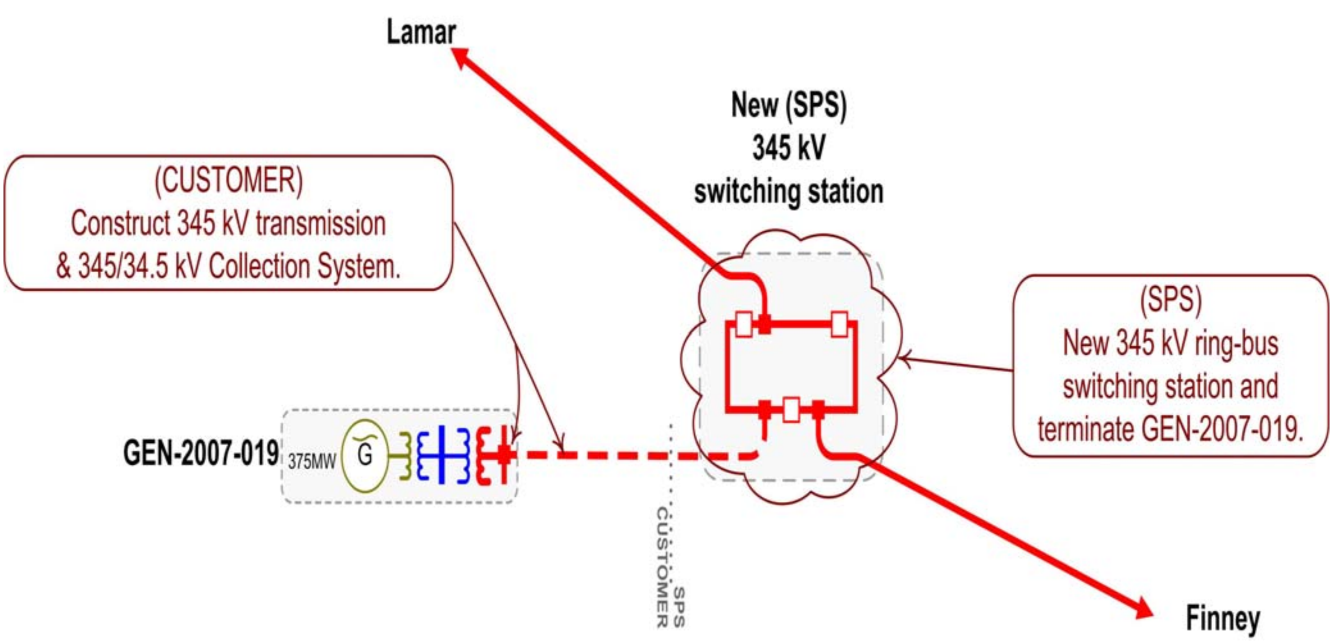
***** Planned Facility
^ Proposed Facility
****** Alternate requests - counted as one request for study purpose
*** Electrically Remote Interconnection Requests included in total

D: Proposed Point of Interconnection One line Diagrams

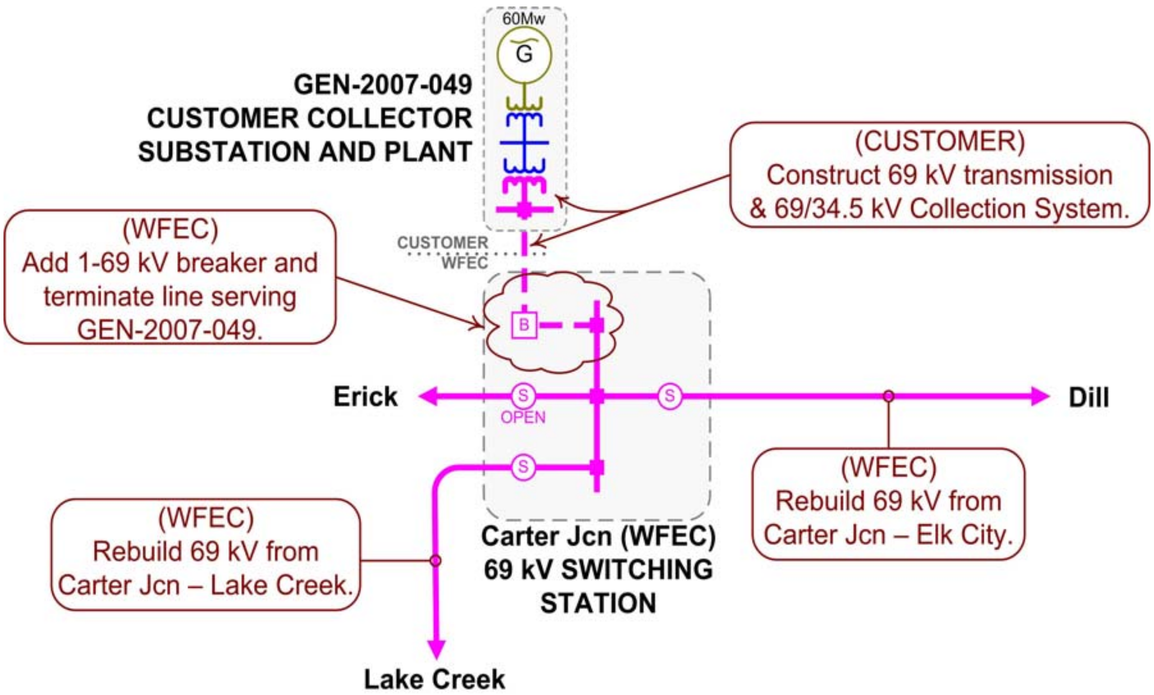
GEN-2006-044N02



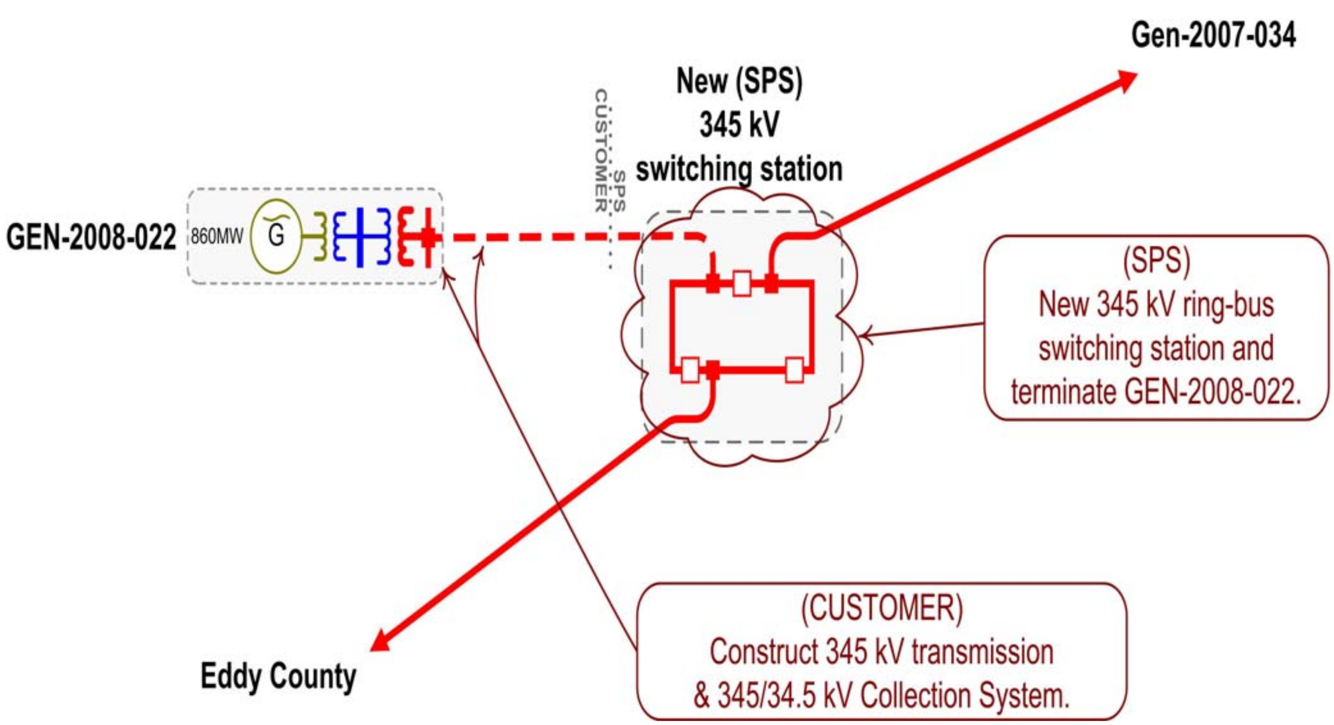
GEN-2007-019



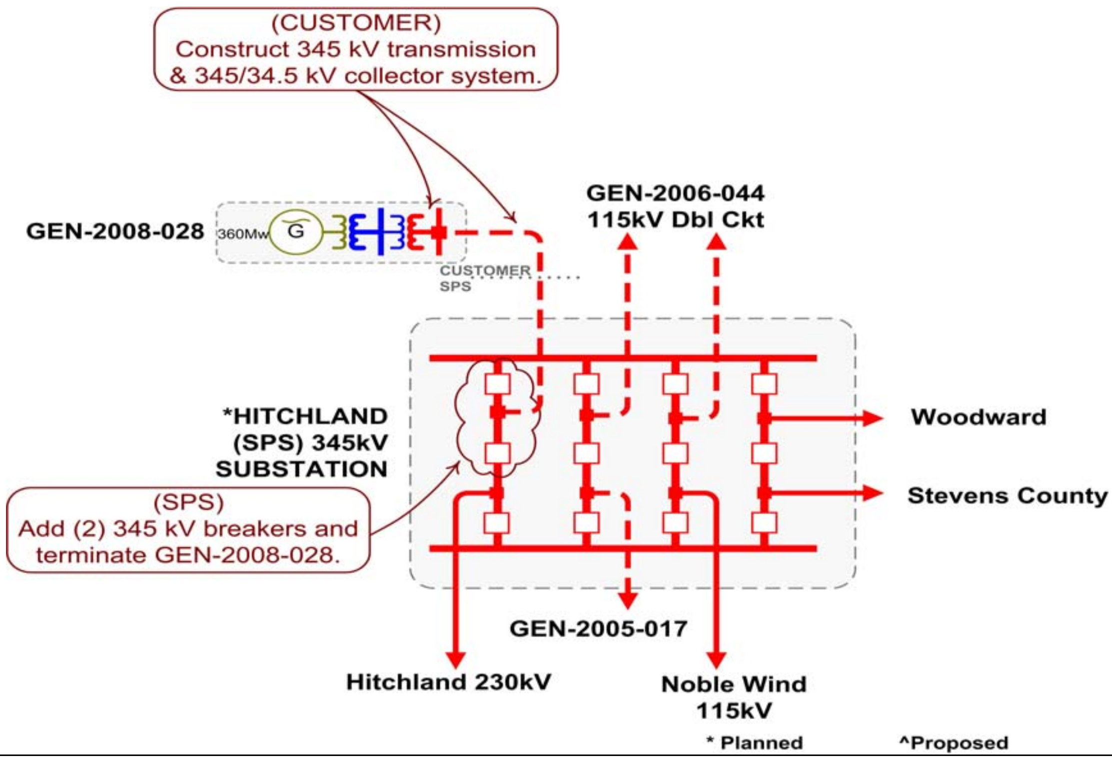
GEN-2007-049



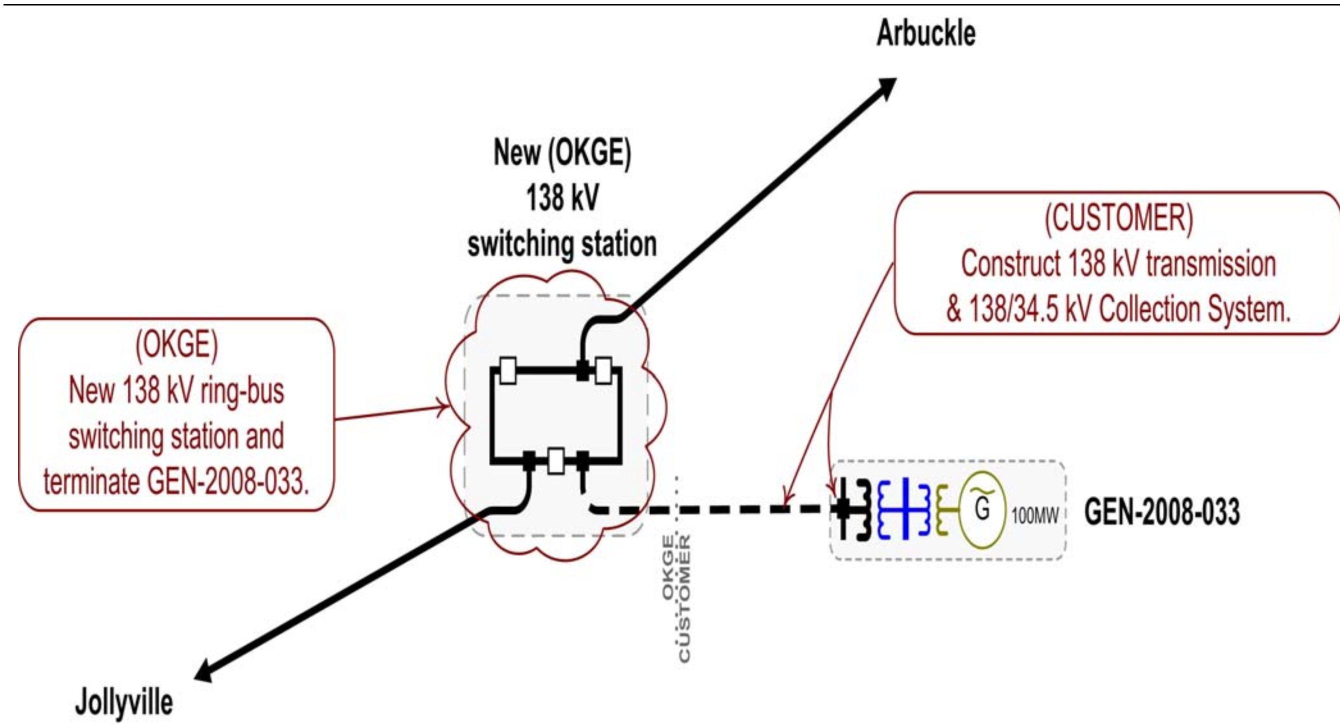
GEN-2008-022



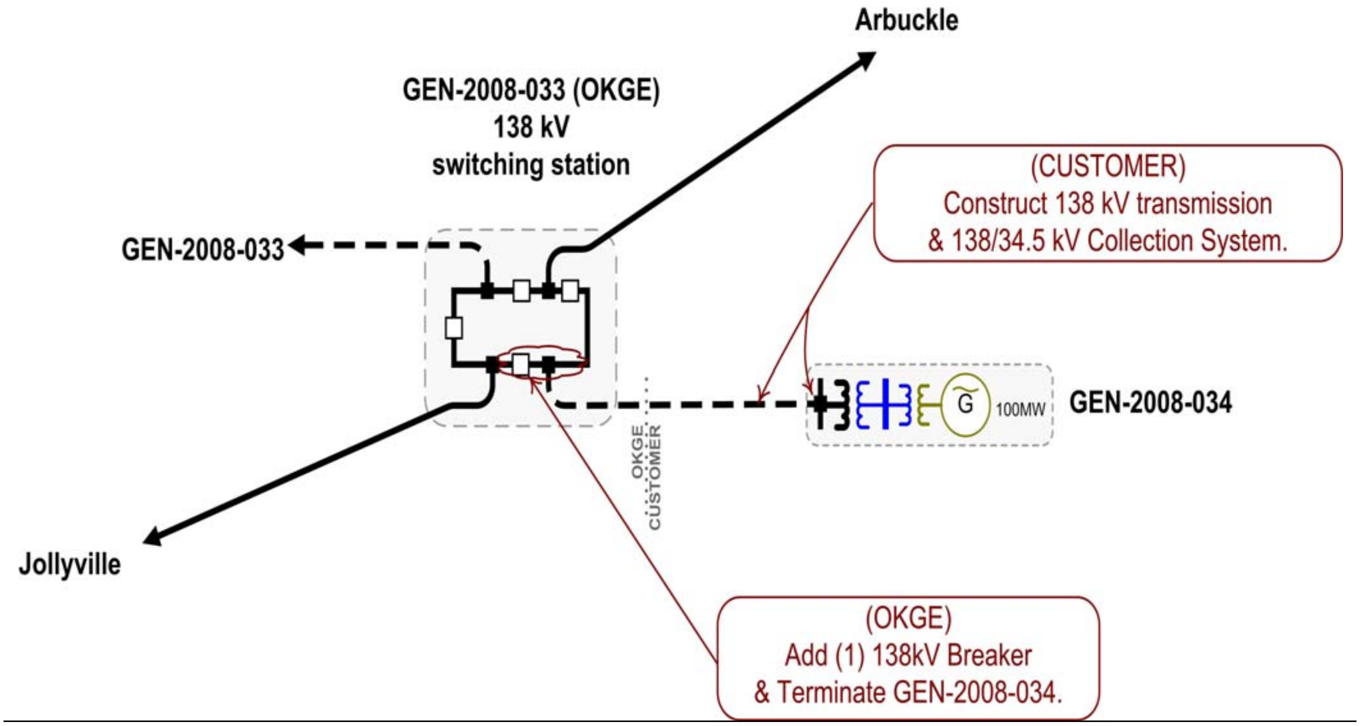
GEN-2008-028



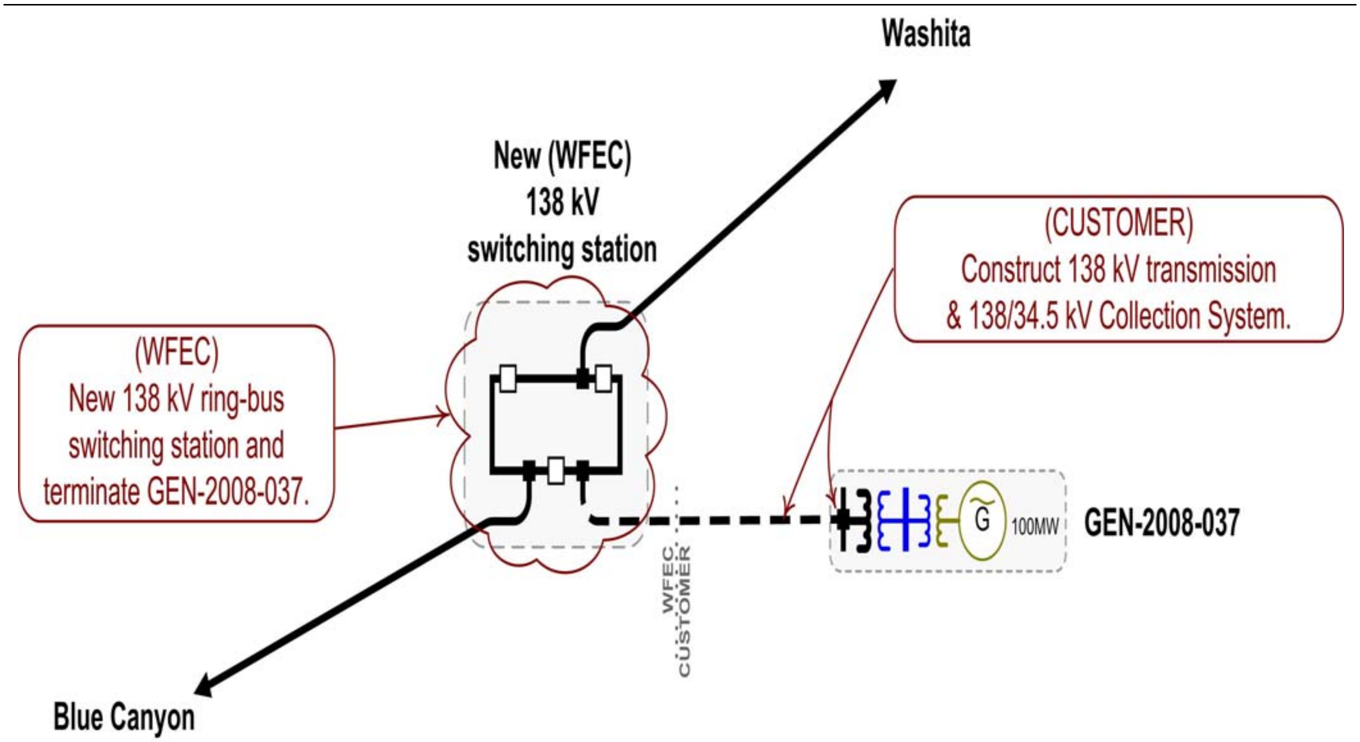
GEN-2008-033



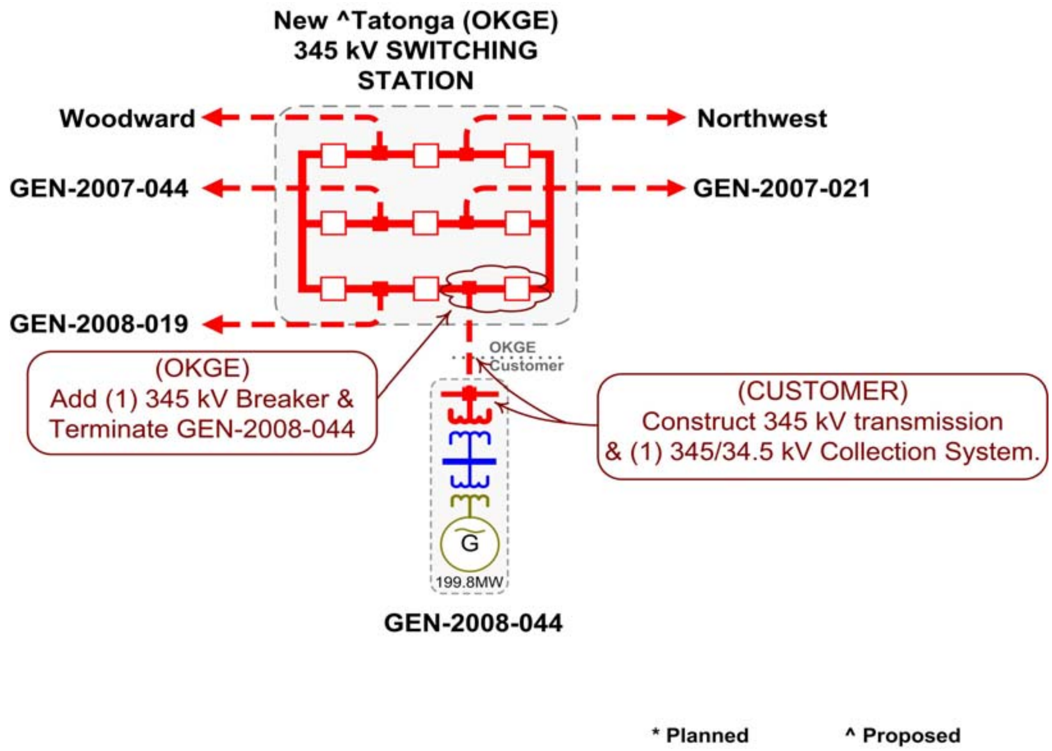
GEN-2008-034



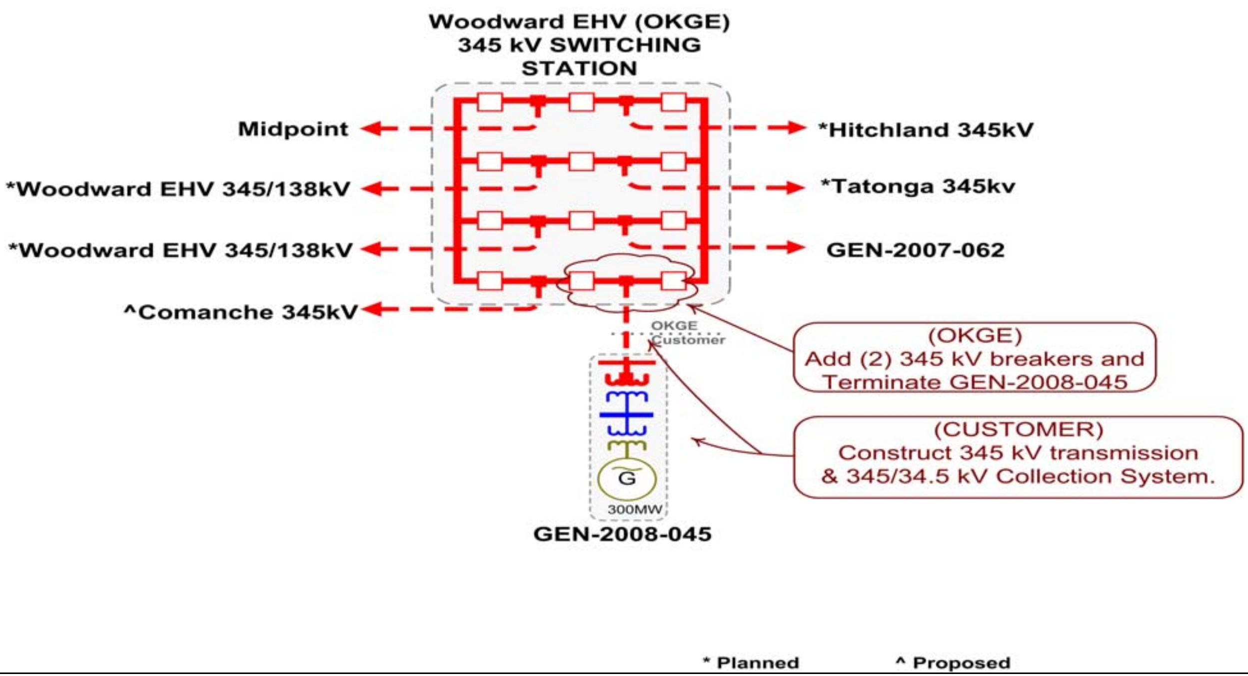
GEN-2008-037



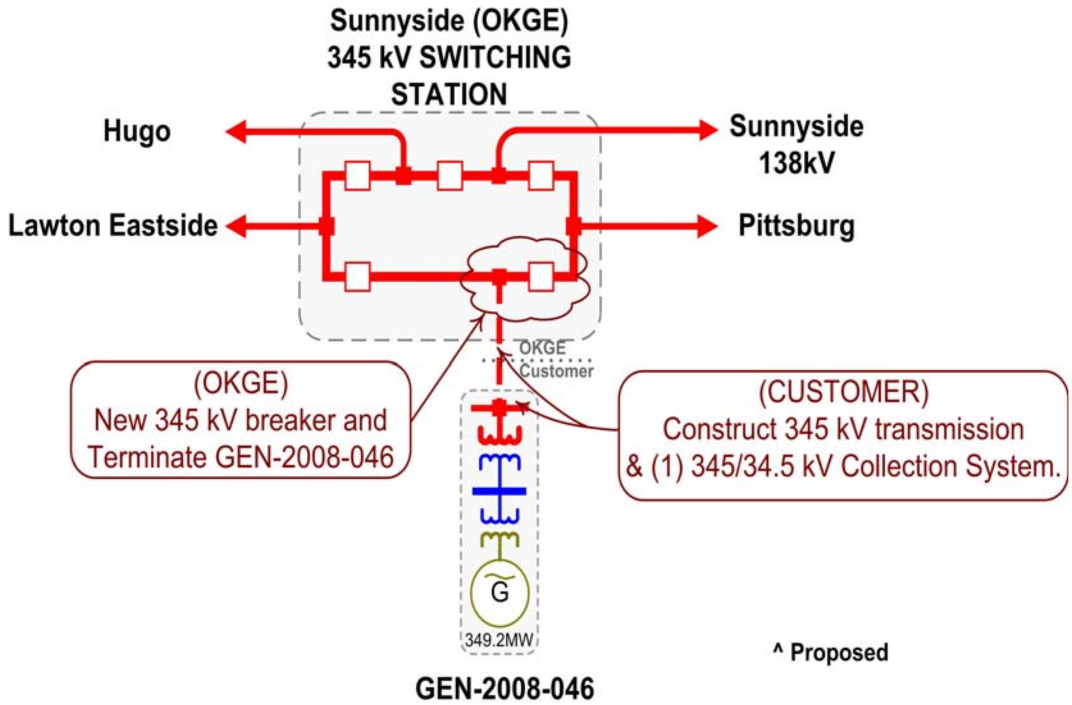
GEN-2008-044



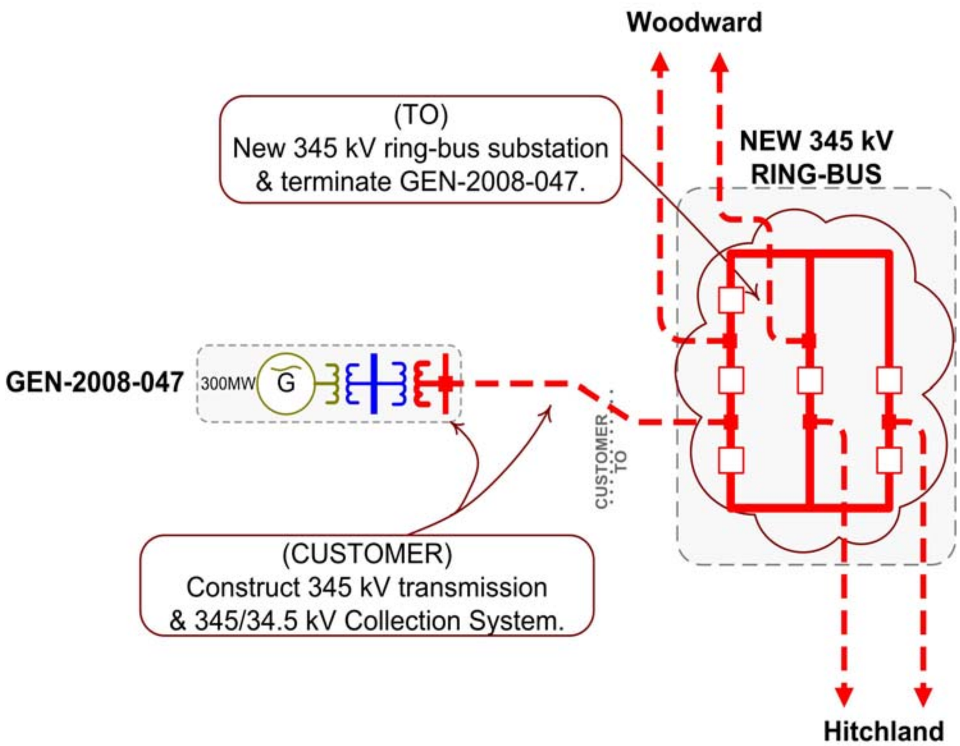
GEN-2008-045



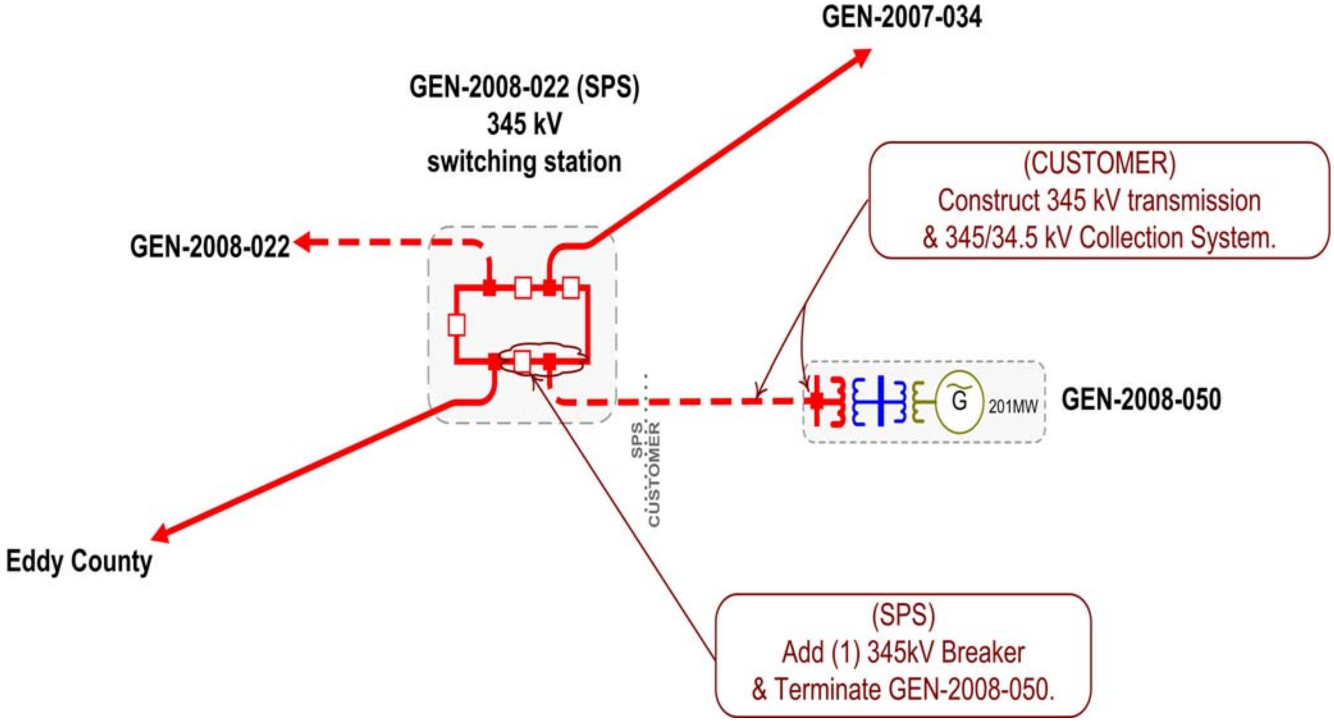
GEN-2008-046



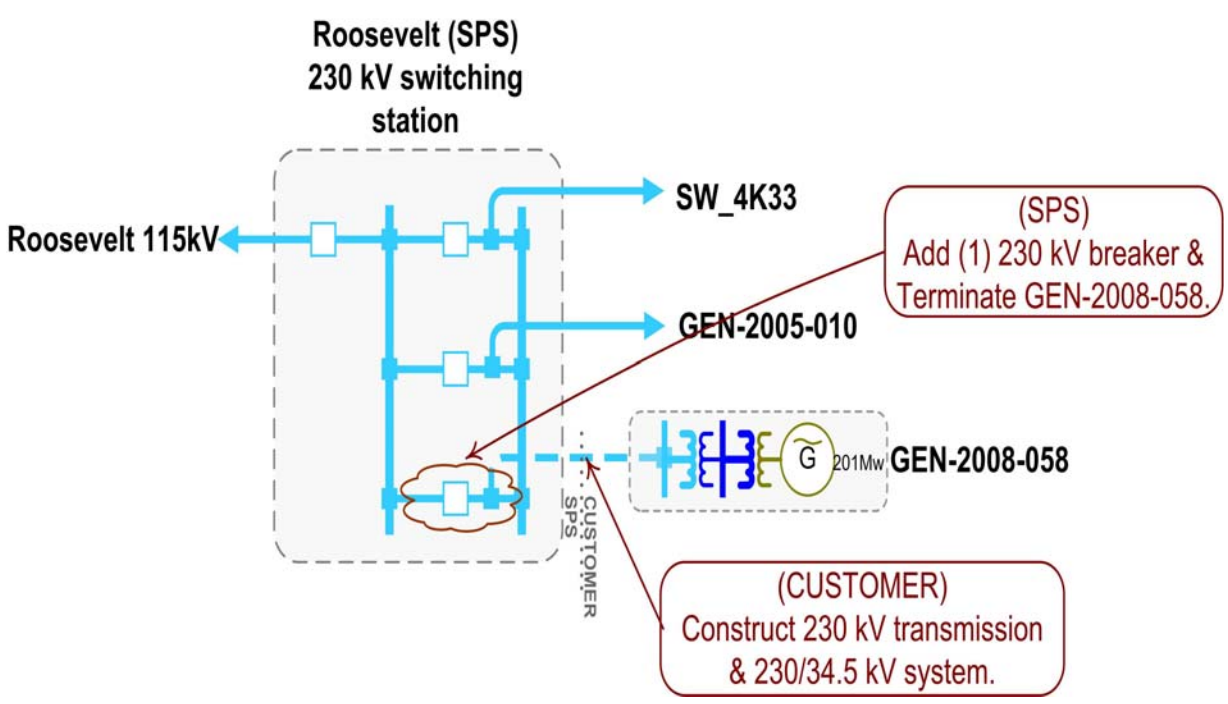
GEN-2008-047



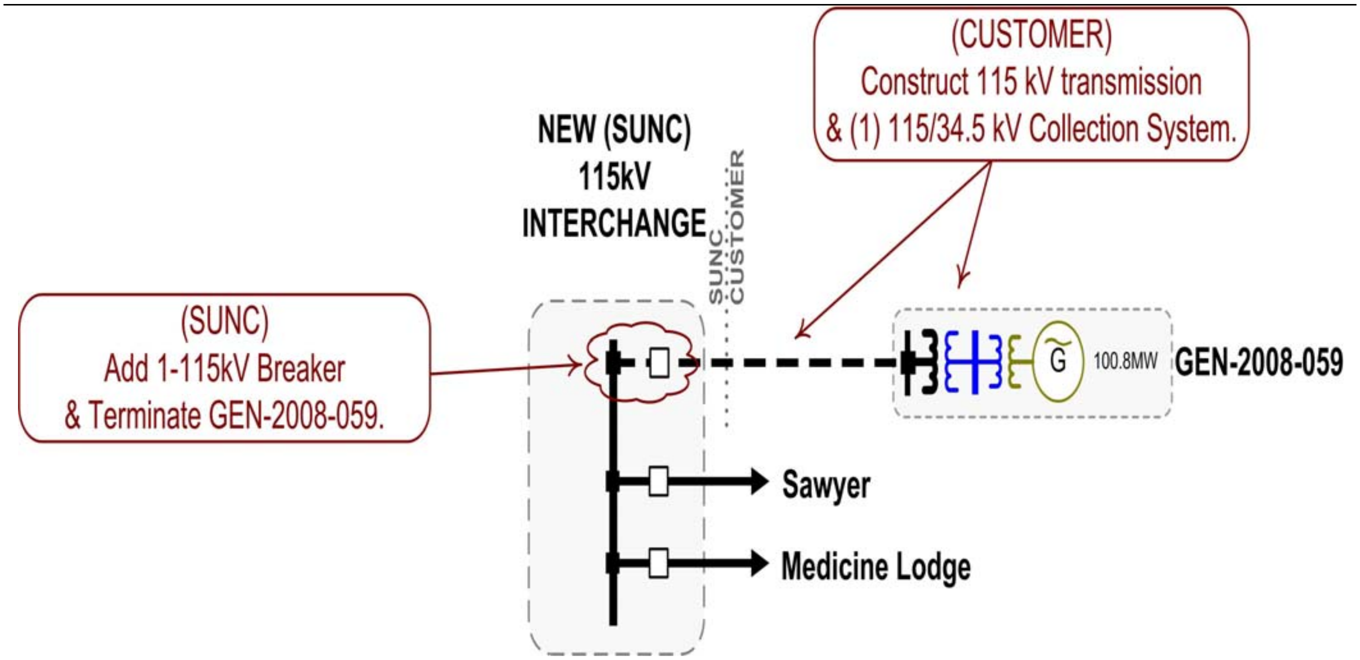
GEN-2008-050



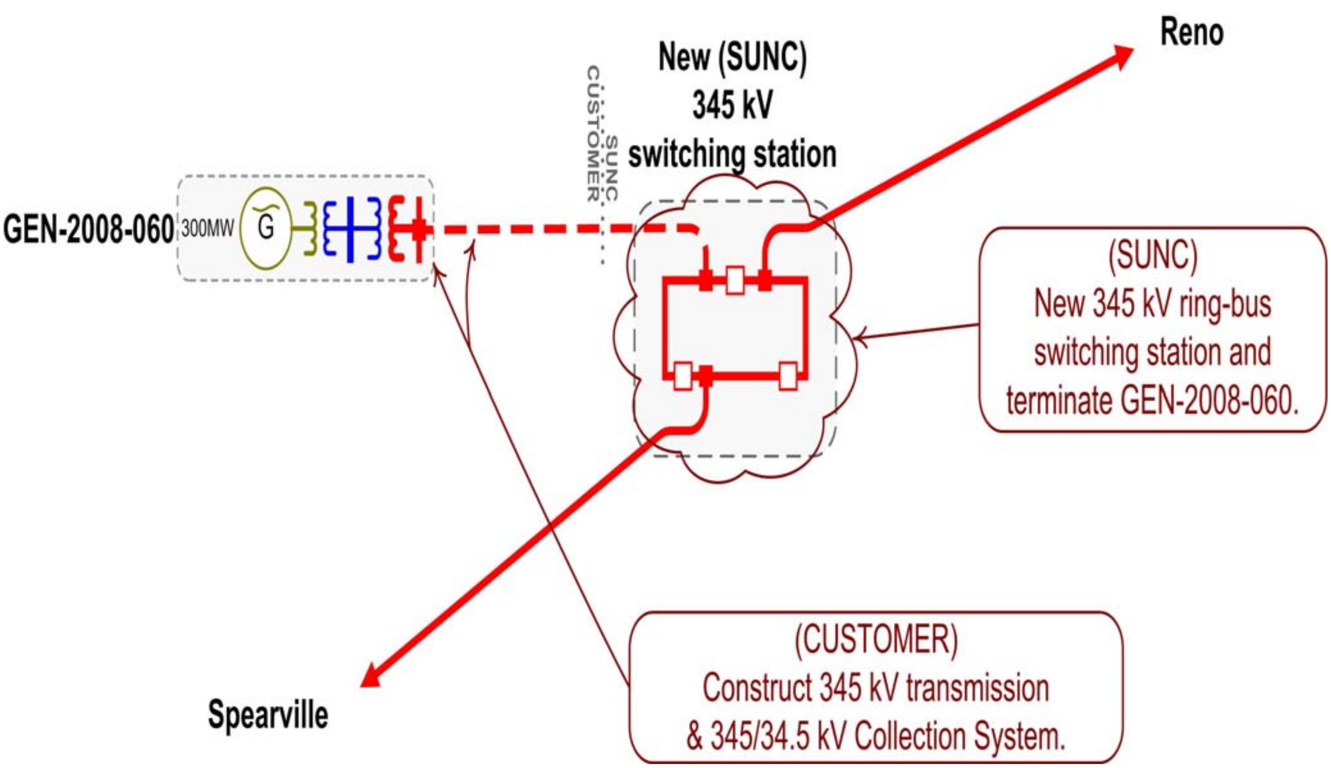
GEN-2008-058



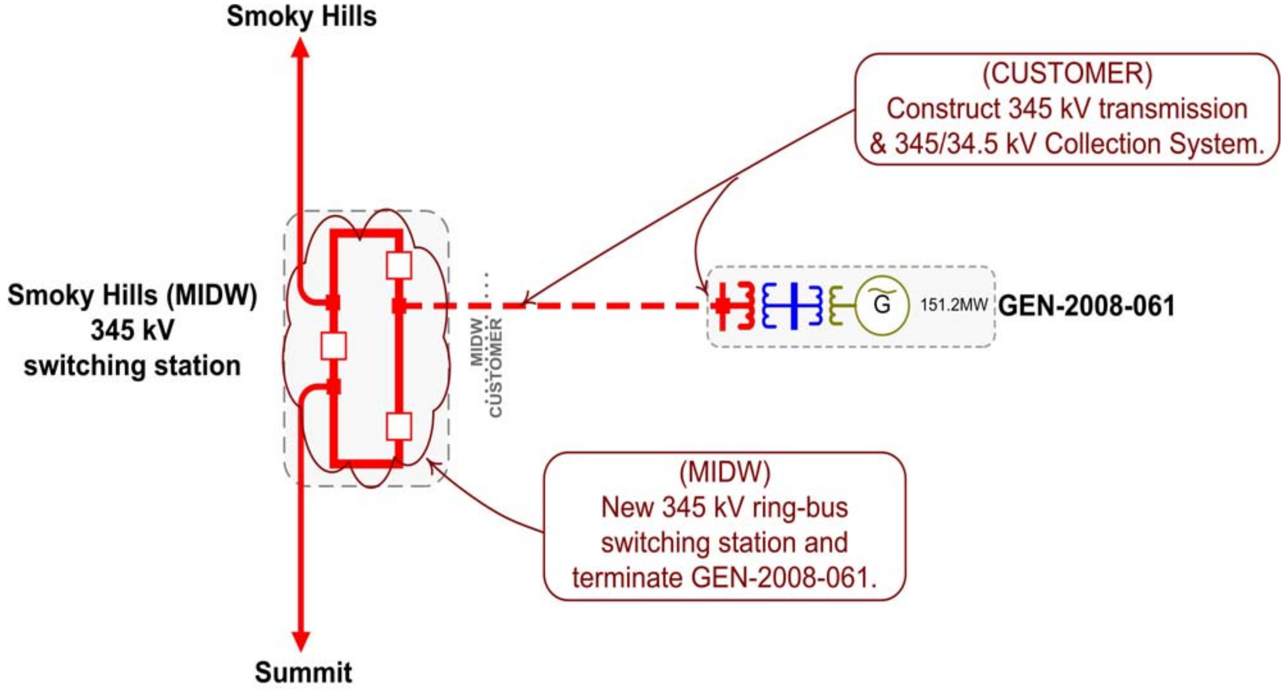
GEN-2008-059



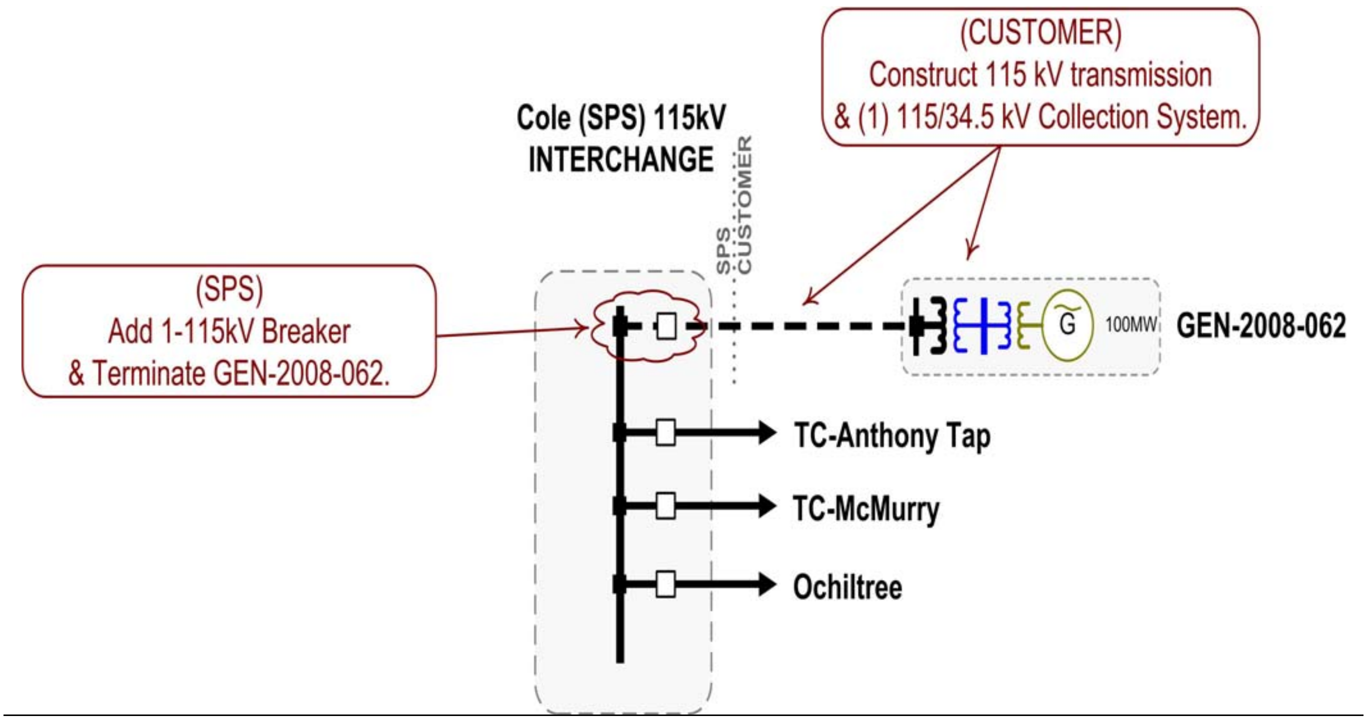
GEN-2008-060



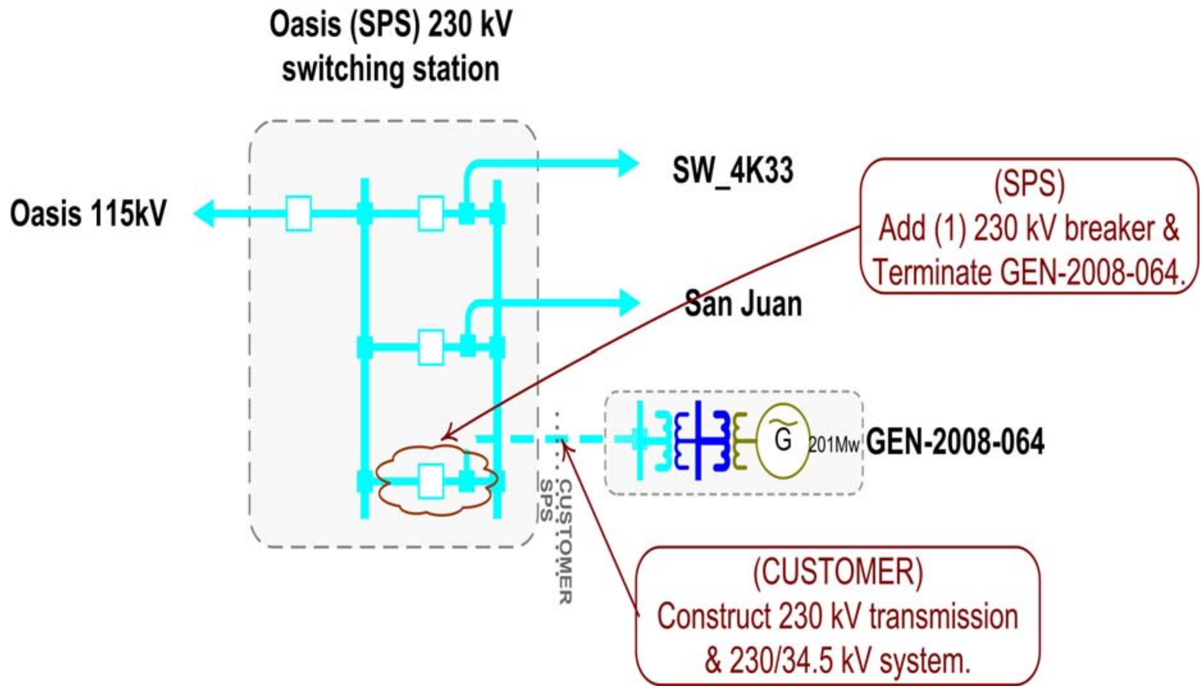
GEN-2008-061



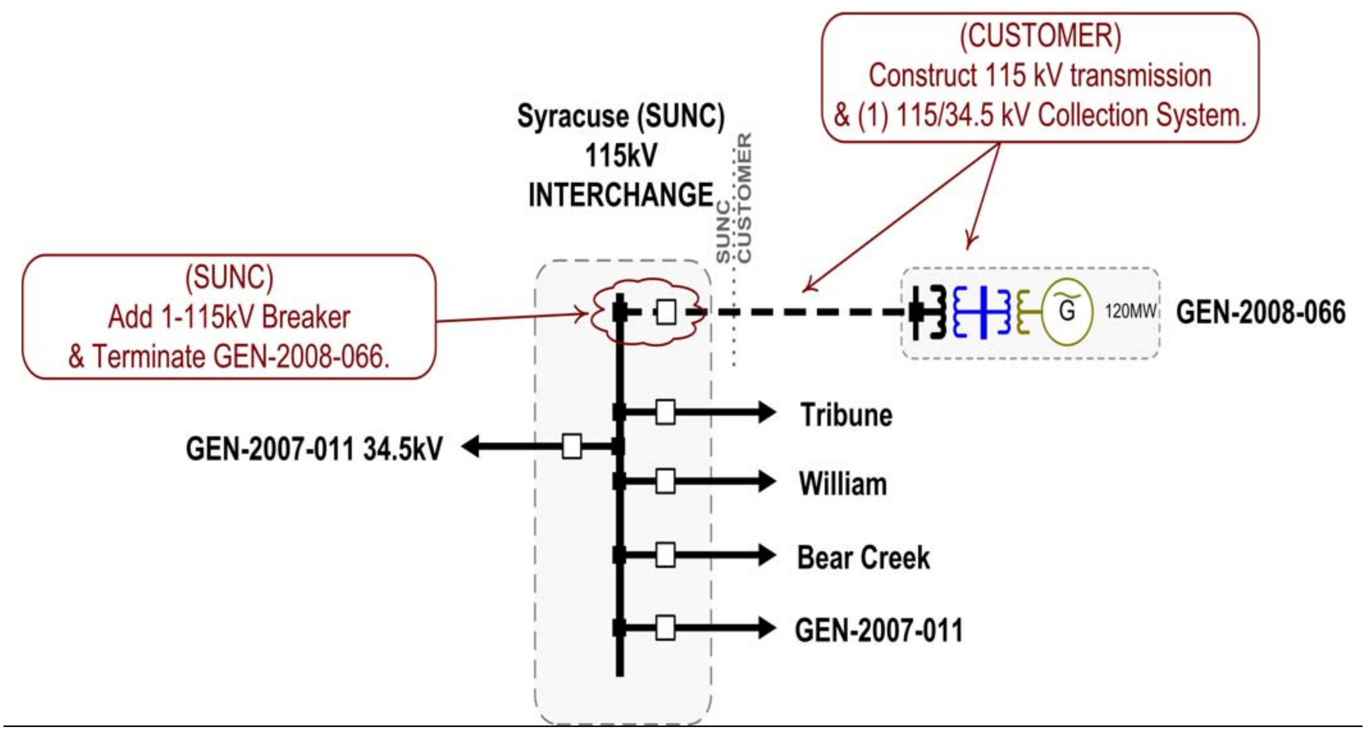
GEN-2008-062



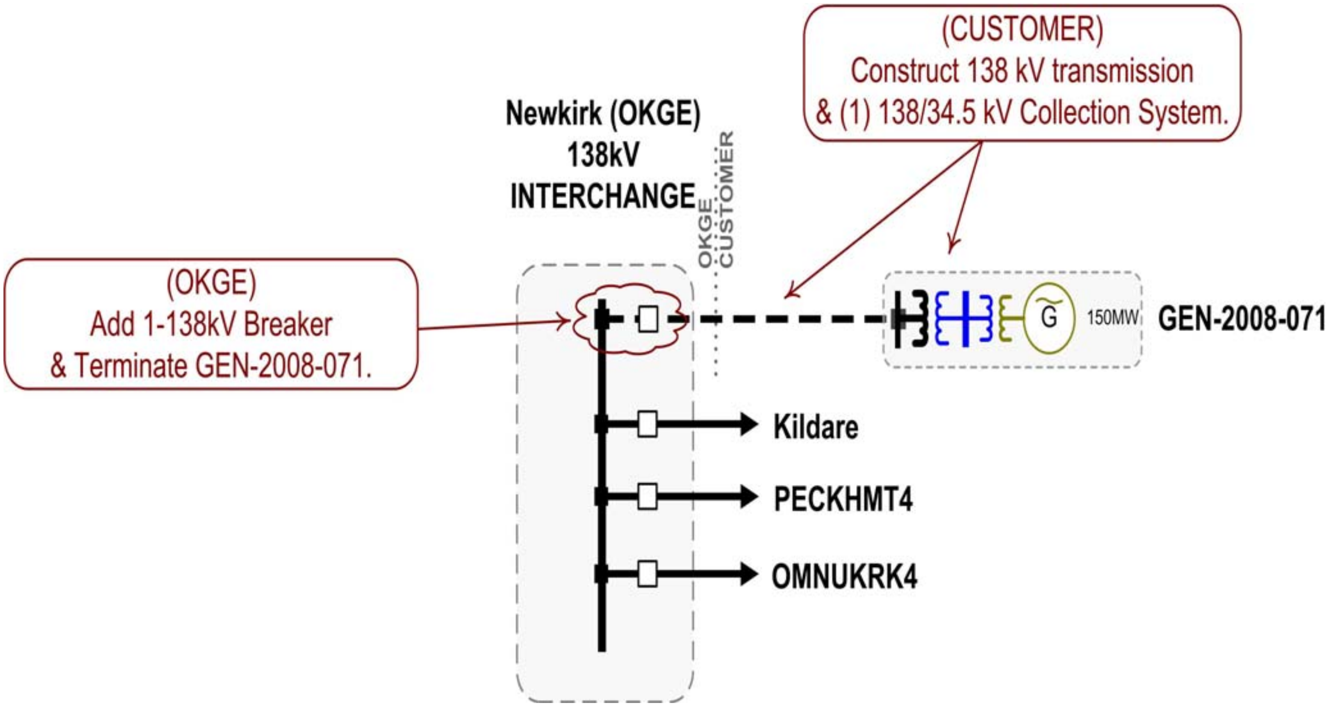
GEN-2008-064



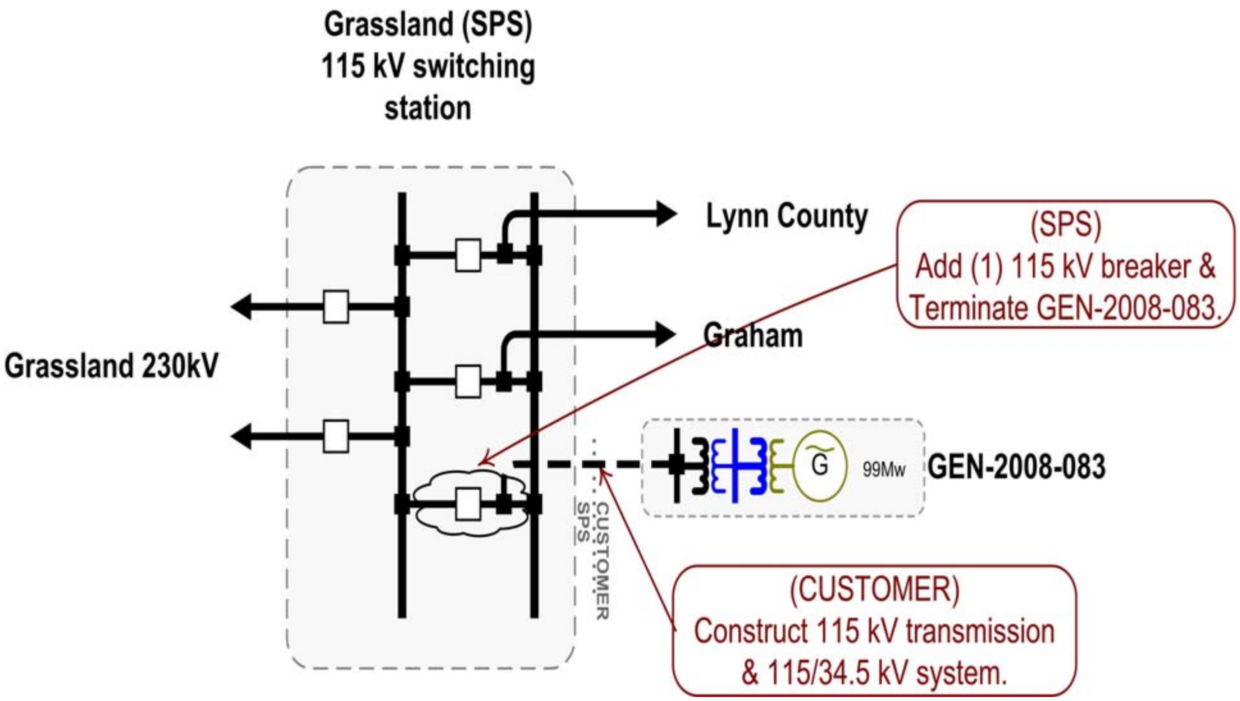
GEN-2008-066



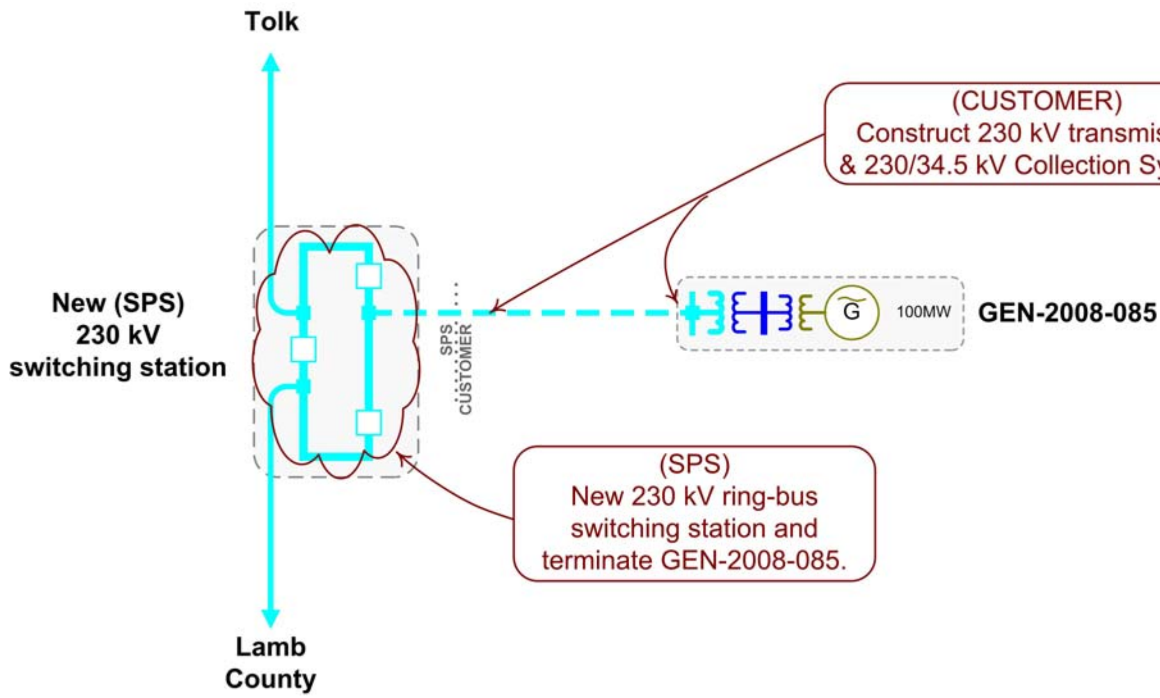
GEN-2008-071



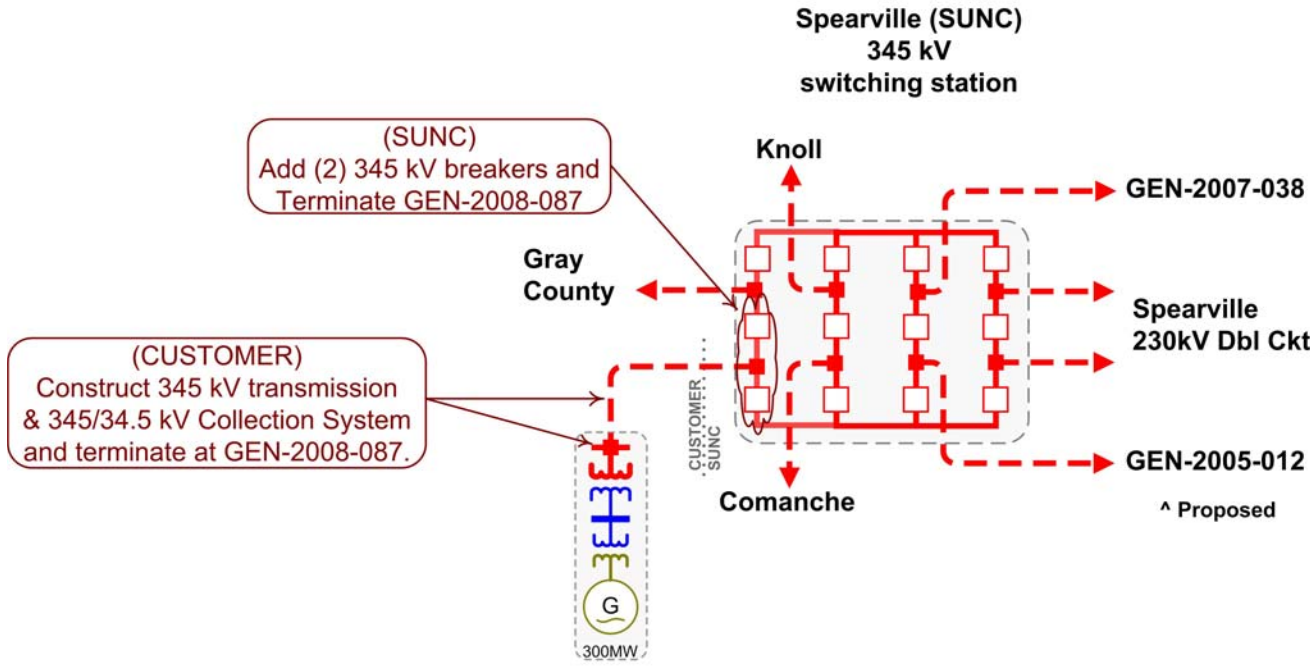
GEN-2008-083



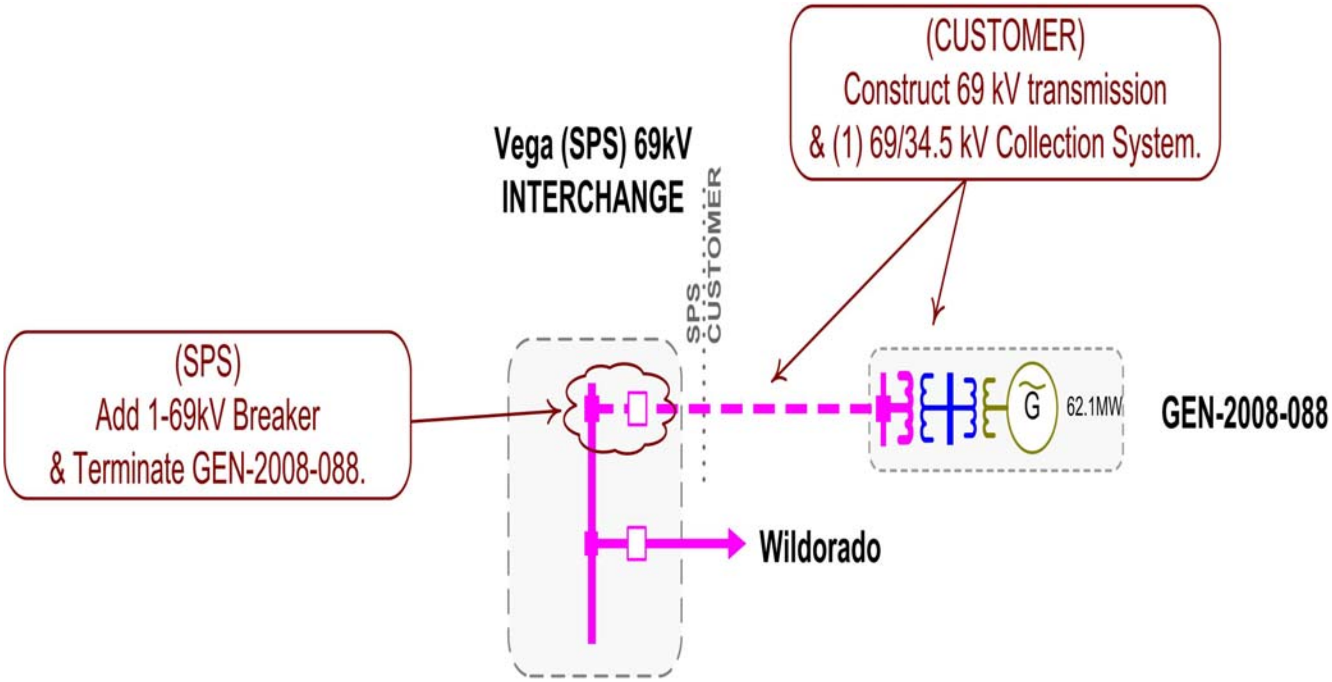
GEN-2008-085



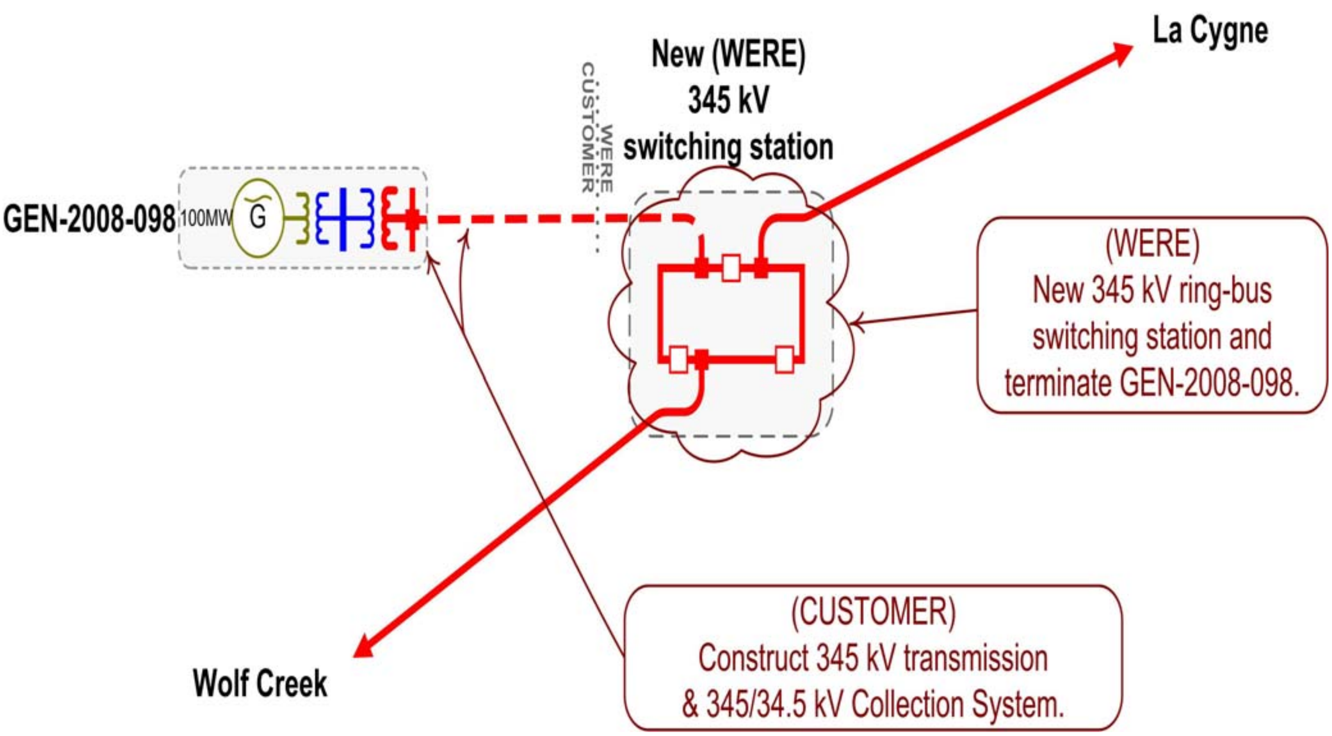
GEN-2008-087



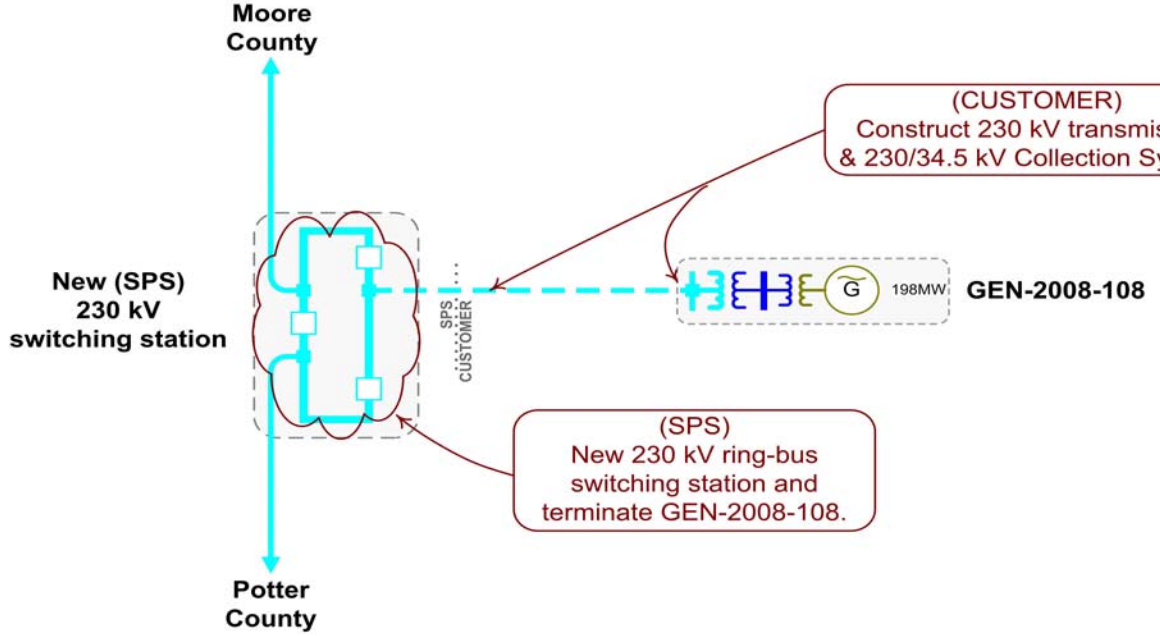
GEN-2008-088



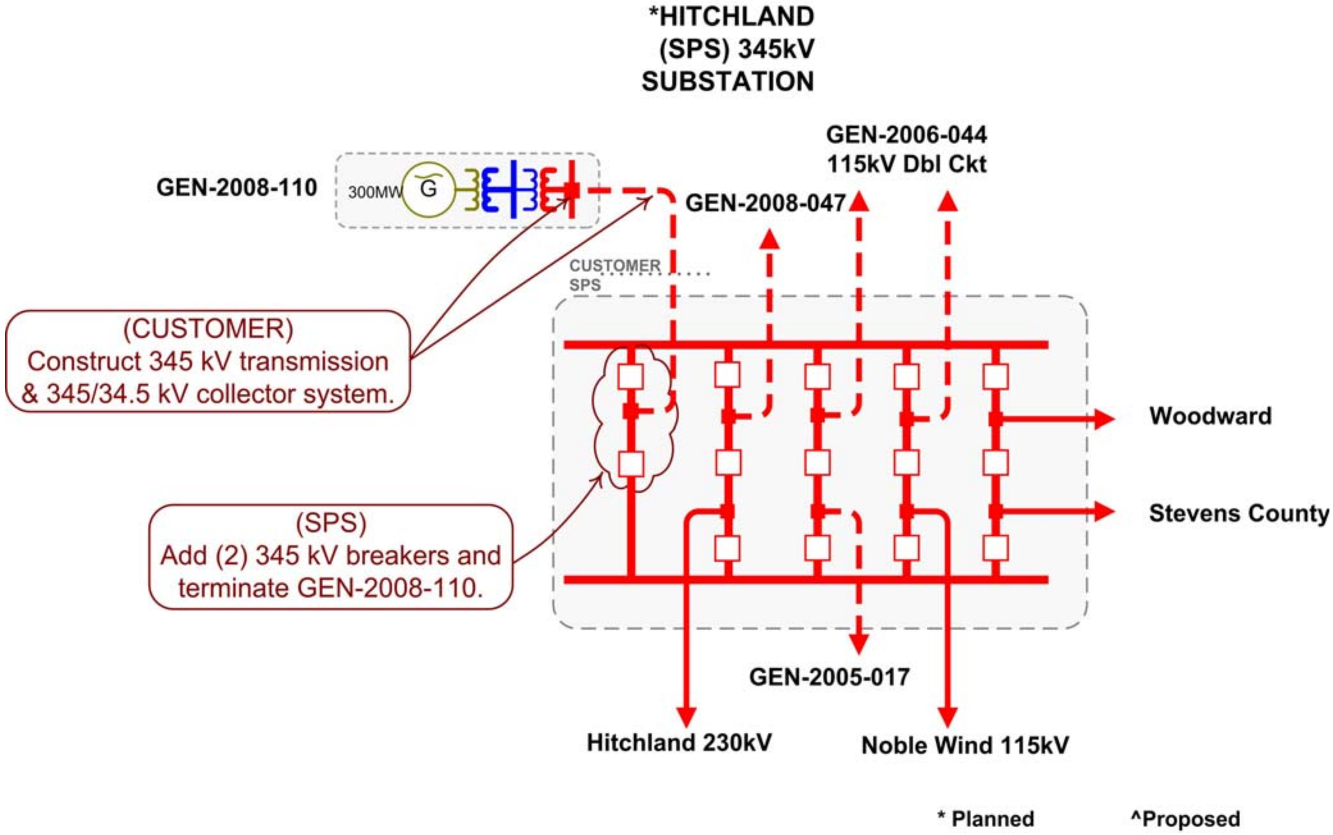
GEN-2008-098



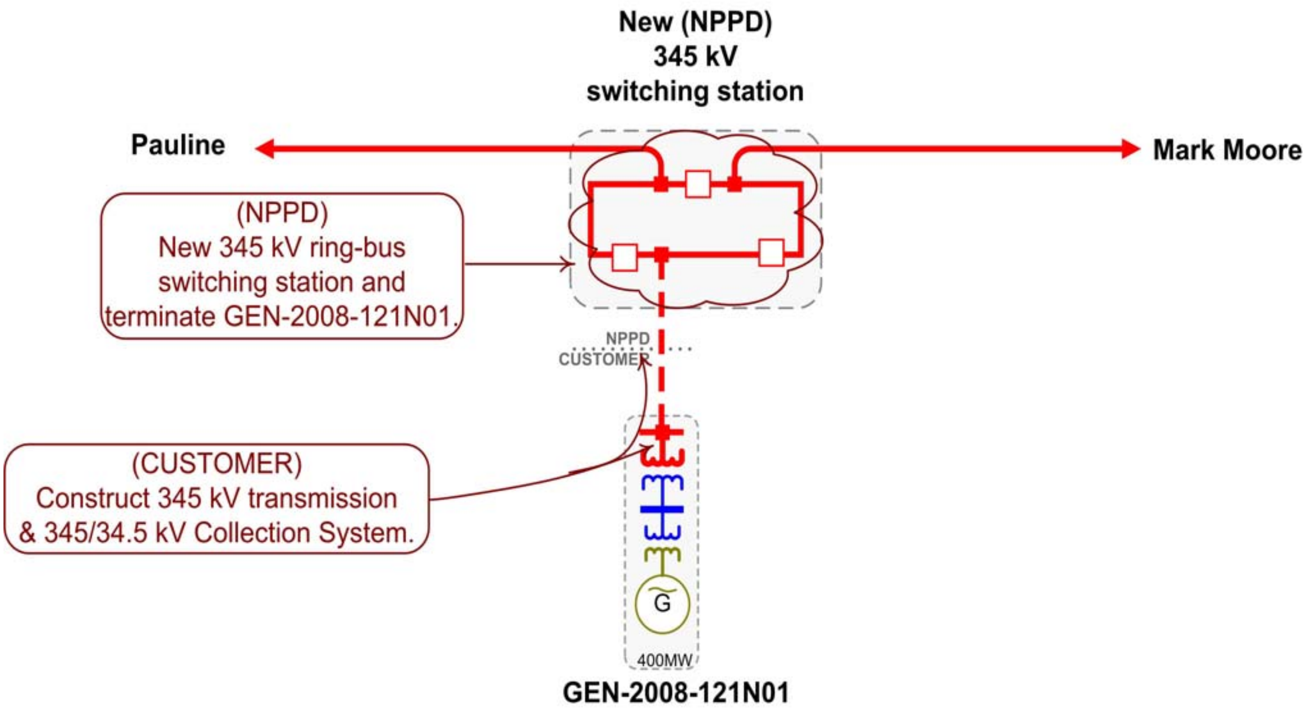
GEN-2008-108



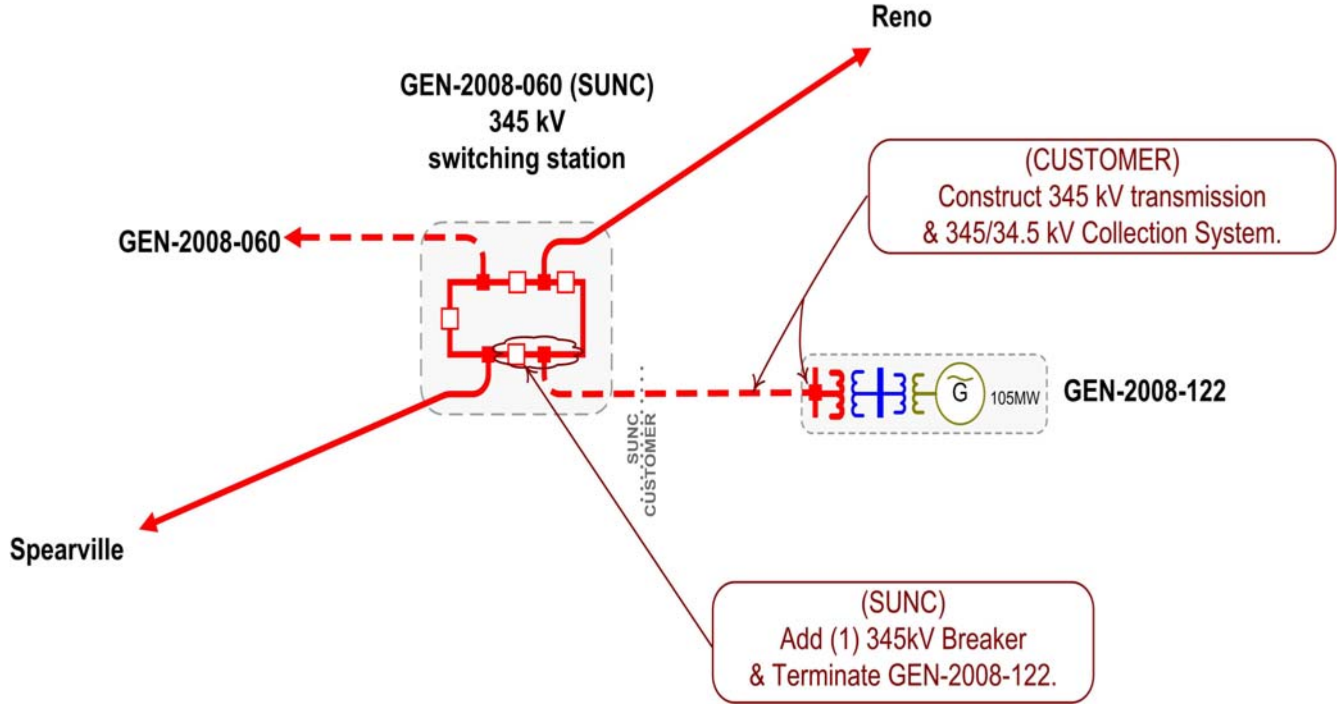
GEN-2008-110



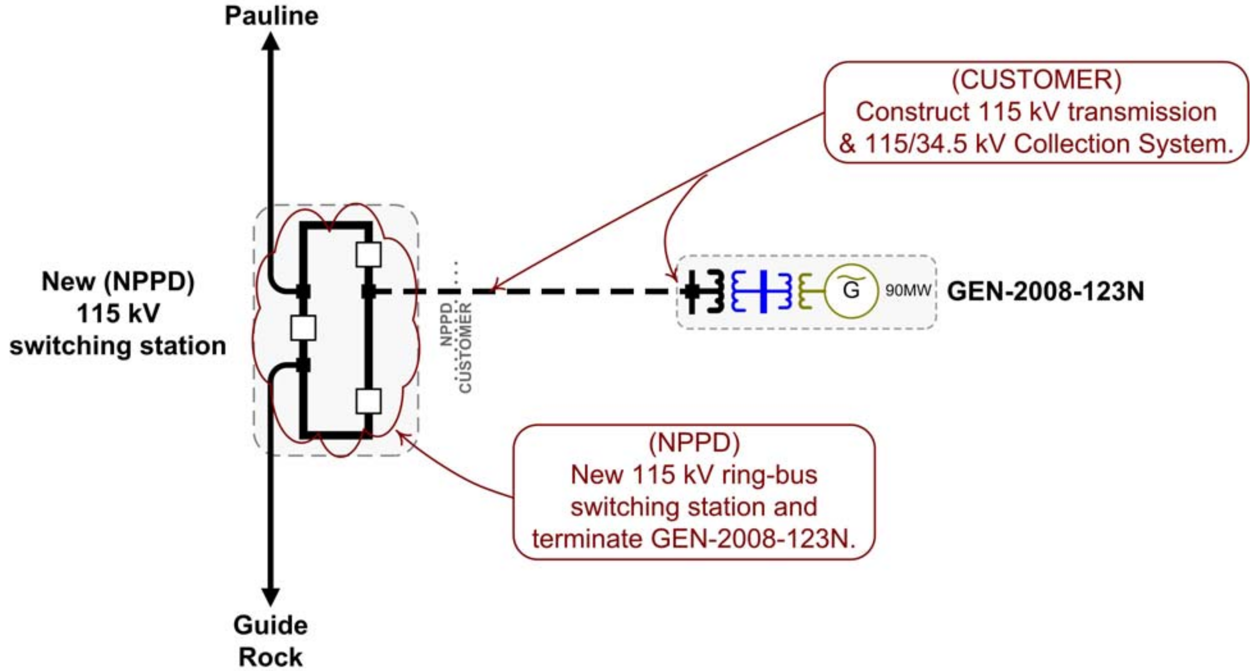
GEN-2008-121N01


New (NPPD)
345 kV
switching station
Pauline
Mark Moore
(NPPD)
New 345 kV ring-bus
switching station and
terminate GEN-2008-121N01.
NPPD
CUSTOMER
(CUSTOMER)
Construct 345 kV transmission
& 345/34.5 kV Collection System.
G
400MW
GEN-2008-121N01

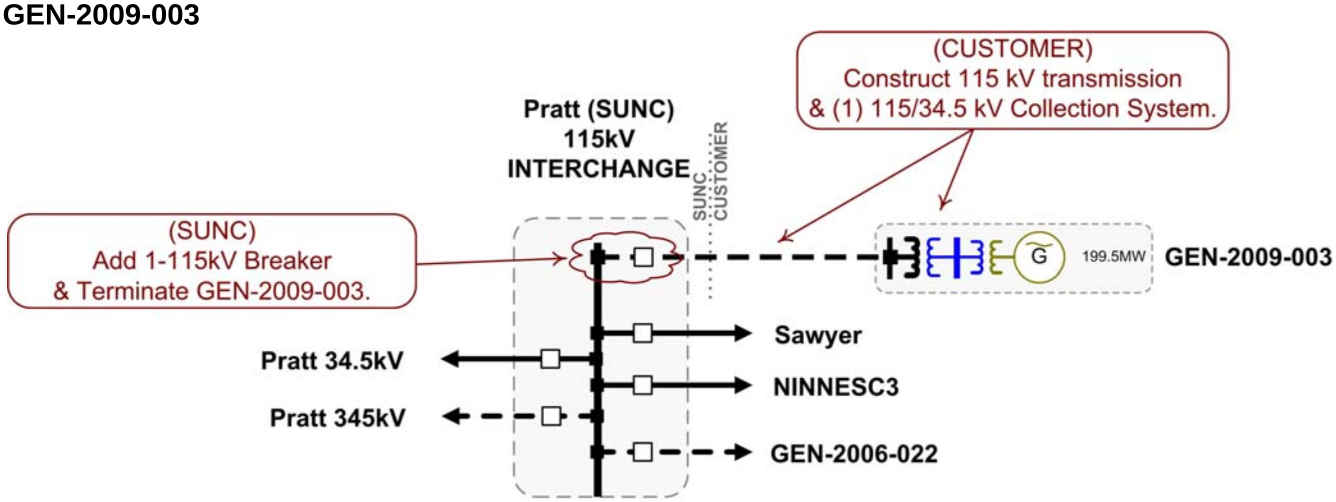
GEN-2008-122


Reno
GEN-2008-060 (SUNC)
345 kV
switching station
GEN-2008-060
(CUSTOMER)
Construct 345 kV transmission
& 345/34.5 kV Collection System.
G
105MW
GEN-2008-122
SUNC
CUSTOMER
Spearville
(SUNC)
Add (1) 345kV Breaker
& Terminate GEN-2008-122.

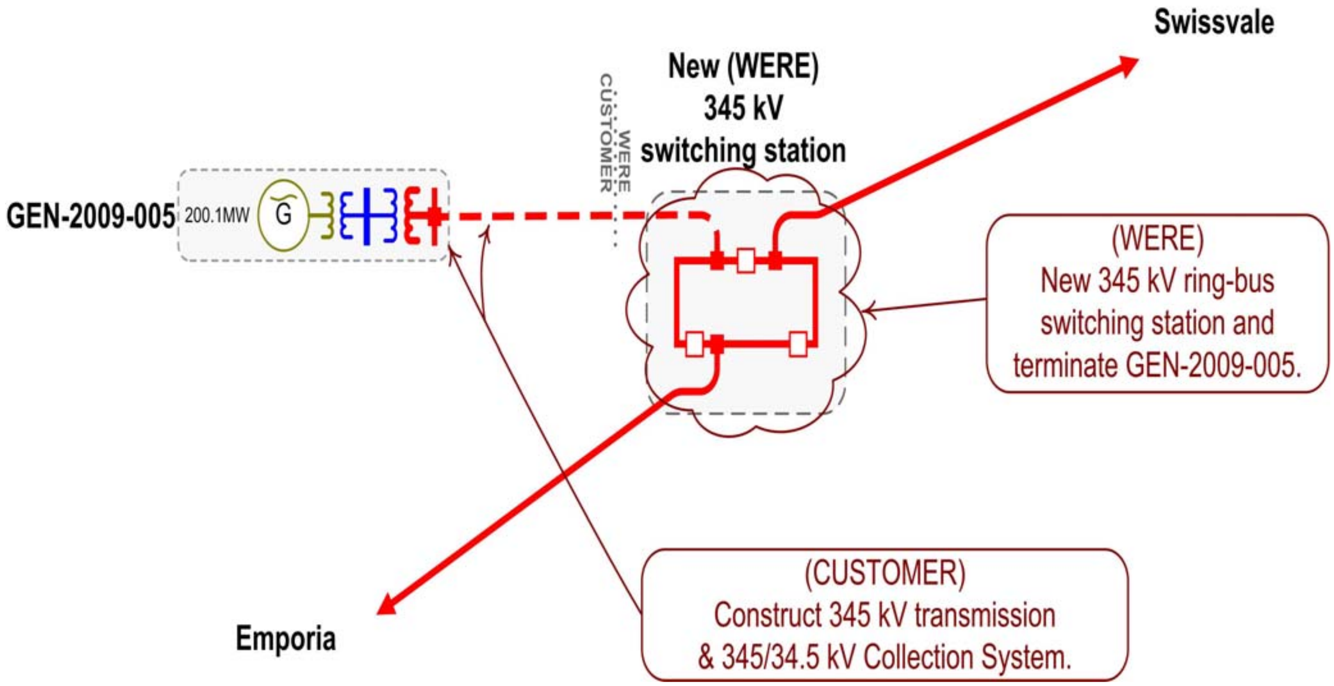
GEN-2008-123N



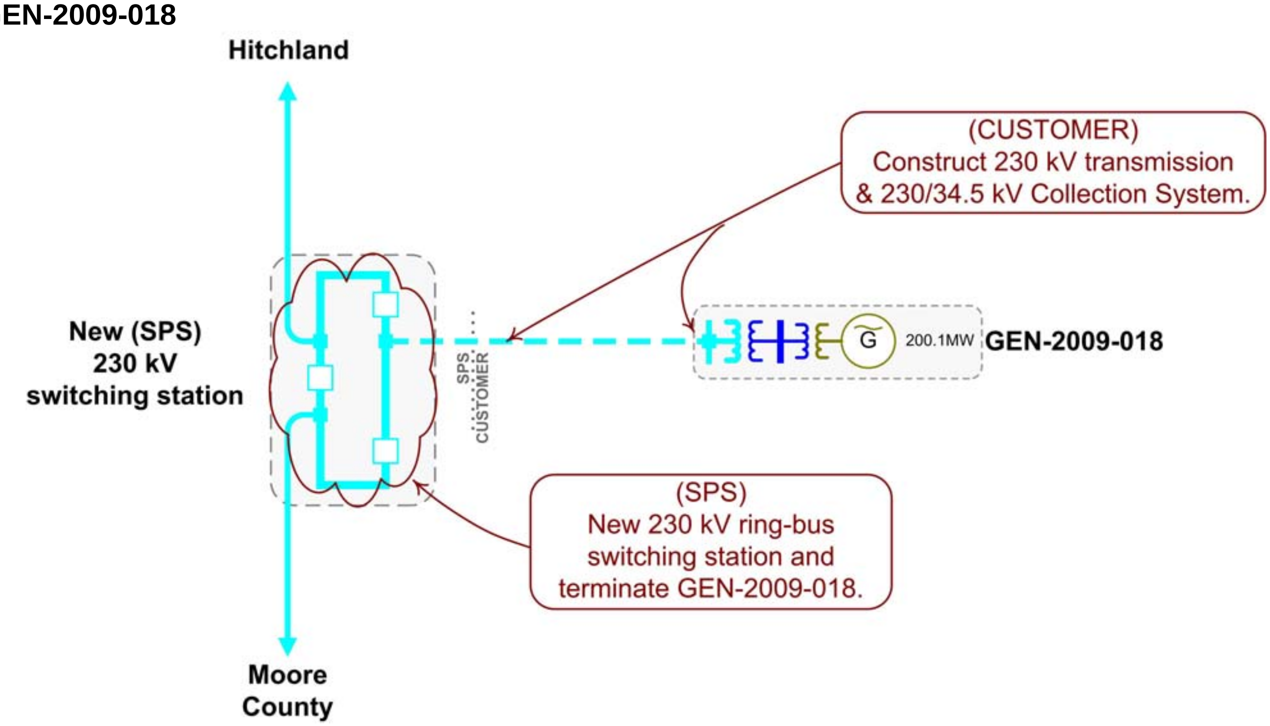
GEN-2009-003



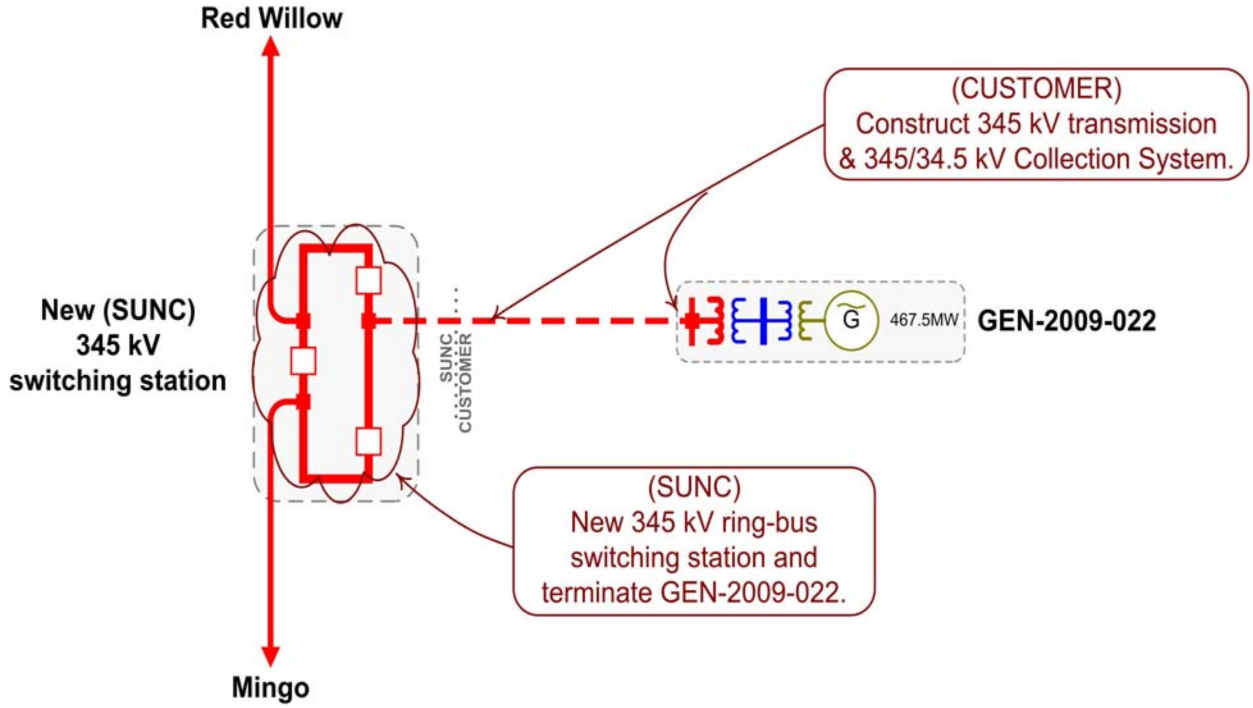
GEN-2009-005



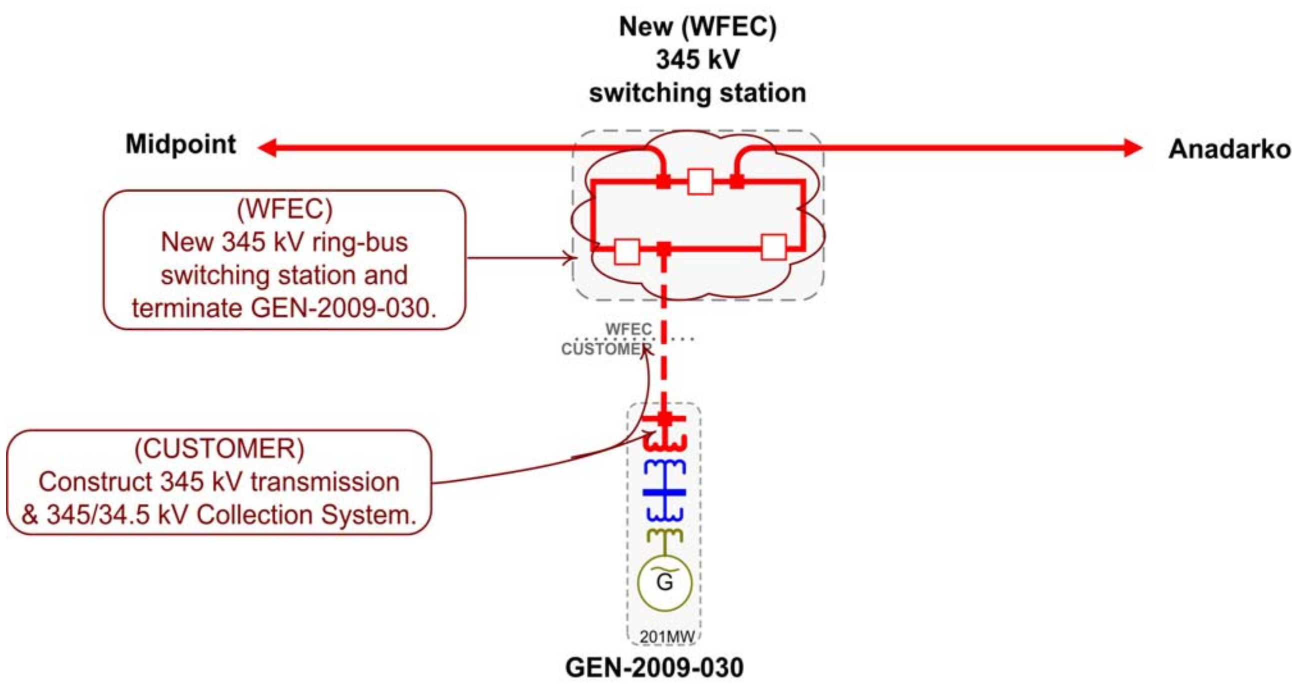
GEN-2009-018



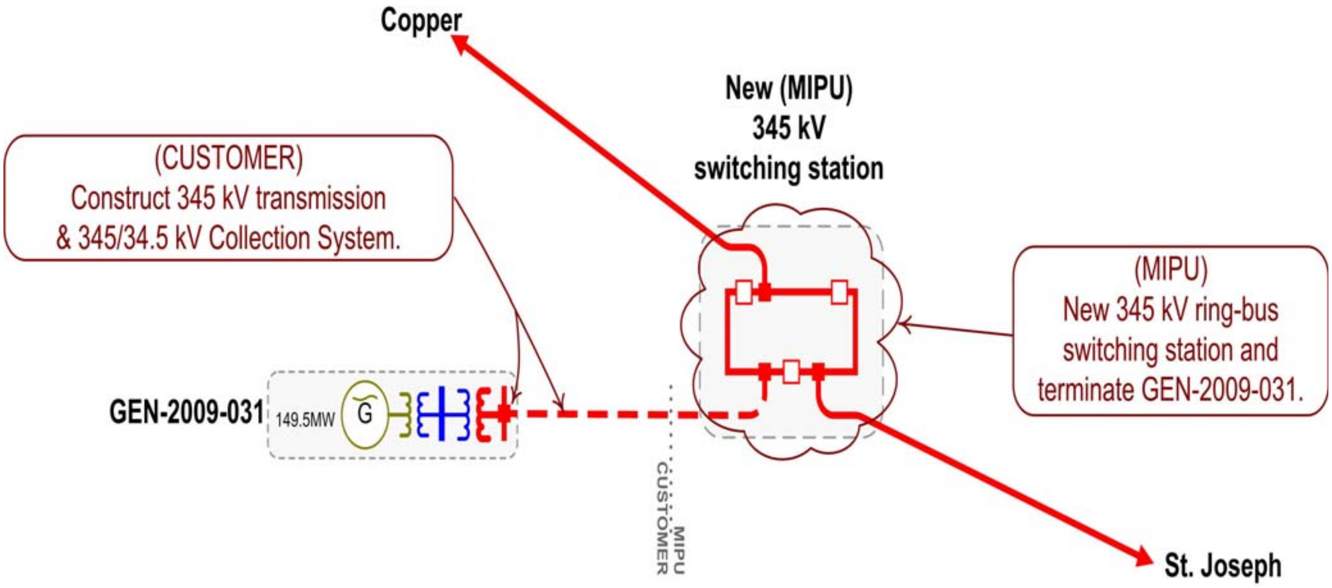
GEN-2009-022



GEN-2009-030



GEN-2009-031


Copper
New (MIPU)
345 kV
switching station
(CUSTOMER)
Construct 345 kV transmission
& 345/34.5 kV Collection System.
(MIPU)
New 345 kV ring-bus
switching station and
terminate GEN-2009-031.
GEN-2009-031
149.5MW
G
MIPU
CUSTOMER
St. Joseph

E: Cost Allocation per Interconnection Request

This section shows each Generation Interconnection Request Customer and their Direct Assigned Facilities and Network Upgrades upon which they have an impact in this study assuming all prior queued projects remain in the queue and achieve commercial operation.

The required interconnection costs listed do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT. In addition, costs associated with a short circuit analysis will be allocated should the Interconnection Request Customer choose to execute a Facility Study Agreement.

There may be additional costs allocated to each Customer. See Appendix F for more details.

Appendix E. - Cost Allocation Per Request

Interconnection Request	Allocated Costs	E + C Costs
GEN-2006-044N02		
GEN-2006-044N02 Interconnection Costs	$1,000,000.00	$1,000,000.00
Total	**$1,000,000.00**	
GEN-2007-019		
Clearwater - Gill EC 138kV CKT 1	$367,070.78	$3,200,000.00
Rebuild transmission		
GEN-2007-019 Interconnection Costs	$7,000,000.00	$7,000,000.00
Harper - Milan Tap 138kV CKT 1	$802,967.33	$7,000,000.00
Rebuild transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$499.13	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,570.00	$100,000.00
Replace terminal equipment (South of Anadarko)		
Medicine Lodge - Pratt 345kV CKT 1	$218,409.79	$20,000,000.00
New transmission		
Medicine Lodge 138/115kV Transformer CKT 2	$242,557.72	$5,000,000.00
Milan Tap - Clearwater 138kV CKT 1	$550,606.17	$4,800,000.00
Rebuild transmission		
Pratt 345/115 Transformer CKT 1	$163,807.34	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1	$14,382,255.19	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$38,335.76	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$1,085,795.60	$40,000,000.00
New transmission & transformer		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$5,305,494.79	$26,000,000.00
New transmission		
Total	**$30,160,369.60**	
GEN-2007-049		
Carter Junction - Lake Creek 69kV CKT 1	$300,000.00	$300,000.00
Replace terminal Equipment		
GEN-2007-049 Interconnection Costs	$500,000.00	$500,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,017.21	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		

Interconnection Request	Allocated Costs	E + C Costs
Washita - Anadarko 138kV CKT 2	$872,019.31	$10,000,000.00
New Transmission		
Total	**$1,674,036.52**	
GEN-2008-022		
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1	$26,604,877.72	$35,000,000.00
New transmission		
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1	$107,299,744.40	$200,000,000.00
New Transmission		
GEN-2008-022 Interconnection Costs	$7,000,000.00	$7,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$14,492,918.71	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$52,614.51	$100,000.00
Replace terminal equipment (North of GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$28,298.40	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$25,514.87	$100,000.00
Replace terminal equipment (South of Anadarko)		
Lawton Eastside - Sunnysisde 345kV CKT 1	$105,300.68	$200,000.00
Replace terminal equipment		
Potter County - Conway 345kV CKT 1	$6,852,506.26	$30,000,000.00
New transmission		
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project	$81,059,515.04	$160,000,000.00
New transmission		
Tolk Station East - Plant X Station 230kV CKT 2	$4,353,747.12	$10,000,000.00
Rebuild transmission		
Tolk Station East - TUCO Interchange 230kV CKT 1	$13,558,893.28	$48,000,000.00
Rebuild transmission		
Tolk Station West - Plant X Station 230kV CKT 1	$4,331,964.30	$10,000,000.00
Rebuild transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$11,367,884.54	$84,000,000.00
New Transmission		
Woodward - Woodring 345kV CKT 1	$18,094,415.84	$110,000,000.00
New Transmission		
Total	**$295,228,195.67**	
GEN-2008-028		
GEN-2008-028 Interconnection Costs	$1,500,000.00	$1,500,000.00

Interconnection Request	Allocated Costs	E + C Costs
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$18,652,898.39	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$3,136.51	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Potter County - Conway 345kV CKT 1	$3,834,308.00	$30,000,000.00
New transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$5,901,814.86	$104,000,000.00
New transmission		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$2,177,130.61	$26,000,000.00
New transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$14,630,869.00	$84,000,000.00
New Transmission		
Woodward - Woodring 345kV CKT 1	$12,337,188.52	$110,000,000.00
New Transmission		
Total	**$59,037,345.89**	
GEN-2008-033		
GEN-2008-033 Interconnection Costs	$3,500,000.00	$3,500,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$48.53	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$1,934.72	$100,000.00
Replace terminal equipment (South of Anadarko)		
Total	**$3,501,983.25**	
GEN-2008-034		
GEN-2008-034 Interconnection Costs	$1,000,000.00	$1,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$1,934.72	$100,000.00
Replace terminal equipment (South of Anadarko)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$48.53	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Total	**$1,001,983.25**	
GEN-2008-037		
GEN-2008-037 (Tap on Blue Canyon - Washita 138kV CKT 1) - Washita 138kV CKT 1	$300,000.00	$300,000.00
Replace terminal equipment		
GEN-2008-037 Interconnection Costs	$2,000,000.00	$2,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$767.74	$100,000.00
Replace terminal equipment (South of Anadarko)		

Interconnection Request	Allocated Costs	E + C Costs
Lawton Eastside - Cimarron 345kV CKT 1 Project	$5,203.91	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Washita - Anadarko 138kV CKT 2	$9,127,980.69	$10,000,000.00
New Transmission		
Total	**$11,433,952.34**	
GEN-2008-044		
GEN-2008-044 Interconnection Costs	$2,500,000.00	$2,500,000.00
Woodward - Woodring 345kV CKT 1	$7,157,252.31	$110,000,000.00
New Transmission		
Total	**$9,657,252.31**	
GEN-2008-045		
GEN-2008-045 Interconnection Costs	$2,500,000.00	$2,500,000.00
Woodward - Woodring 345kV CKT 1	$16,531,591.86	$110,000,000.00
New Transmission		
Total	**$19,031,591.86**	
GEN-2008-046		
GEN-2008-046 Interconnection Costs	$2,000,000.00	$2,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$7,530.36	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$25,066.01	$100,000.00
Replace terminal equipment (South of Anadarko)		
Total	**$2,032,596.37**	
GEN-2008-047		
GEN-2008-047 Interconnection Costs	$9,000,000.00	$9,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$1,057.17	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Potter County - Conway 345kV CKT 1	$1,503,206.57	$30,000,000.00
New transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$3,957,233.28	$104,000,000.00
New transmission		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$1,459,790.57	$26,000,000.00
New transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$18,112,491.76	$84,000,000.00
New Transmission		

Interconnection Request	Allocated Costs	E + C Costs
Woodward - Woodring 345kV CKT 1 New Transmission	$13,029,416.99	$110,000,000.00
Total	**$47,063,196.34**	

GEN-2008-050		
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	$6,218,116.77	$35,000,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	$25,078,196.08	$200,000,000.00
GEN-2008-050 Interconnection Costs	$2,000,000.00	$2,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$3,387,298.44	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$6,613.93	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$5,963.36	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	$12,297.11	$100,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	$24,610.97	$200,000.00
Potter County - Conway 345kV CKT 1 New transmission	$1,601,574.14	$30,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	$18,945,305.26	$160,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	$1,017,561.83	$10,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	$3,168,997.15	$48,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	$1,012,470.72	$10,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$2,656,912.55	$84,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	$4,229,043.70	$110,000,000.00
Total	**$69,364,962.01**	

GEN-2008-058		
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	$21,503,031.79	$200,000,000.00

Interconnection Request	Allocated Costs	E + C Costs
GEN-2008-058 Interconnection Costs	$1,000,000.00	$1,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$3,966,644.68	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$6,158.21	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$4,594.68	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	$11,439.31	$100,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	$22,824.97	$200,000.00
Potter County - Conway 345kV CKT 1 New transmission	$2,323,737.74	$30,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	$22,518,712.96	$160,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	$8,558,808.69	$20,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	$1,933,414.85	$10,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	$12,415,043.27	$48,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	$1,924,655.20	$10,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$3,111,337.31	$84,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	$4,578,604.32	$110,000,000.00
Total	**$83,879,007.98**	

Interconnection Request	Allocated Costs	E + C Costs
GEN-2008-059		
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	$739,557.04	$3,200,000.00
GEN-2008-059 Interconnection Costs	$2,500,000.00	$2,500,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	$1,617,781.03	$7,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$1,042.54	$100,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	$4,040,552.22	$20,000,000.00

Interconnection Request	Allocated Costs	E + C Costs
Medicine Lodge 138/115kV Transformer CKT 2	$2,667,464.75	$5,000,000.00
Medicine Lodge 345/138/13.8kV Transformer CKT 1	$10,252,881.10	$15,000,000.00
Milan Tap - Clearwater 138kV CKT 1	$1,109,335.56	$4,800,000.00
Rebuild transmission		
Pratt 345/115 Transformer CKT 1	$3,030,414.16	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1	$445,944.45	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$1,571.42	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$49,590.28	$40,000,000.00
New transmission & transformer		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$164,505.21	$26,000,000.00
New transmission		
St. John - Ninnescah - Pratt 115kV CKT 1	$2,247,289.20	$9,000,000.00
Rebuild transmission		
Total	**$28,867,928.96**	
GEN-2008-060		
Clearwater - Gill EC 138kV CKT 1	$274,043.19	$3,200,000.00
Rebuild transmission		
GEN-2008-060 Interconnection Costs	$6,000,000.00	$6,000,000.00
Harper - Milan Tap 138kV CKT 1	$599,469.48	$7,000,000.00
Rebuild transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,687.43	$100,000.00
Replace terminal equipment (South of Anadarko)		
Medicine Lodge - Pratt 345kV CKT 1	$219,738.86	$20,000,000.00
New transmission		
Medicine Lodge 138/115kV Transformer CKT 2	$188,034.42	$5,000,000.00
Milan Tap - Clearwater 138kV CKT 1	$411,064.79	$4,800,000.00
Rebuild transmission		
Pratt 345/115 Transformer CKT 1	$164,804.14	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1	$25,457,173.96	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$22,386.91	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$469,669.72	$40,000,000.00
New transmission & transformer		

Interconnection Request	Allocated Costs	E + C Costs
Total	**$33,809,072.90**	
GEN-2008-061		
GEN-2008-061 Interconnection Costs	$6,000,000.00	$6,000,000.00
Smoky Hills - Summit 230kV CKT 1	$22,035.75	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$35,066,989.31	$40,000,000.00
New transmission & transformer		
Total	**$41,089,025.06**	
GEN-2008-062		
GEN-2008-062 Interconnection Costs	$1,000,000.00	$1,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$4,286,925.41	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$1,417.31	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Ochiltree - Tri County REC-Cole 115kV CKT 1	$7,945,077.81	$8,000,000.00
Rebuild transmission		
Potter County - Conway 345kV CKT 1	$1,093,509.62	$30,000,000.00
New transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$1,463,294.76	$104,000,000.00
New transmission		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$539,797.31	$26,000,000.00
New transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$3,362,557.54	$84,000,000.00
New Transmission		
Woodward - Woodring 345kV CKT 1	$3,152,637.40	$110,000,000.00
New Transmission		
Total	**$22,845,217.16**	
GEN-2008-064		
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1	$21,410,950.29	$200,000,000.00
New Transmission		
GEN-2008-064 Interconnection Costs	$1,000,000.00	$1,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$3,979,327.39	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$4,557.83	$100,000.00
Replace terminal equipment (South of Anadarko)		

Interconnection Request	Allocated Costs	E + C Costs
Lawton Eastside - Cimarron 345kV CKT 1 Project	$6,147.47	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$11,419.83	$100,000.00
Replace terminal equipment (North of GEN-2007-043 Tap)		
Lawton Eastside - Sunnysisde 345kV CKT 1	$22,780.23	$200,000.00
Replace terminal equipment		
Potter County - Conway 345kV CKT 1	$2,382,149.52	$30,000,000.00
New transmission		
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project	$23,687,568.20	$160,000,000.00
New transmission		
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project	$9,740,922.18	$20,000,000.00
Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.		
Tolk Station East - Plant X Station 230kV CKT 2	$1,755,582.38	$10,000,000.00
Rebuild transmission		
Tolk Station East - TUCO Interchange 230kV CKT 1	$11,463,205.77	$48,000,000.00
Rebuild transmission		
Tolk Station West - Plant X Station 230kV CKT 1	$1,748,103.37	$10,000,000.00
Rebuild transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$3,121,285.31	$84,000,000.00
New Transmission		
Woodward - Woodring 345kV CKT 1	$4,587,328.80	$110,000,000.00
New Transmission		
Total	**$84,921,328.57**	

GEN-2008-066

Clearwater - Gill EC 138kV CKT 1	$135,332.66	$3,200,000.00
Rebuild transmission		
GEN-2008-066 Interconnection Costs	$1,000,000.00	$1,000,000.00
Harper - Milan Tap 138kV CKT 1	$296,040.20	$7,000,000.00
Rebuild transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$45.31	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Milan Tap - Clearwater 138kV CKT 1	$202,998.99	$4,800,000.00
Rebuild transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$4,629,369.39	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$13,736.49	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$398,630.07	$40,000,000.00
New transmission & transformer		

Interconnection Request	Allocated Costs	E + C Costs
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	$1,707,736.02	$26,000,000.00
Total	**$8,383,889.13**	
GEN-2008-071		
GEN-2008-071 Interconnection Costs	$1,000,000.00	$1,000,000.00
Total	**$1,000,000.00**	
GEN-2008-083		
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	$1,078,059.65	$35,000,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	$13,475,578.63	$200,000,000.00
GEN-2008-083 Interconnection Costs	$700,000.00	$700,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$1,564,675.52	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$3,432.23	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$3,335.76	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	$6,383.97	$100,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	$12,802.72	$200,000.00
Lubbock South - South Plains REC-Woodrow 115kV CKT 1 Rebuild transmission	$5,000,000.00	$5,000,000.00
Lynn County - Grassland 115kV CKT 1 Rebuild transmission	$2,780,000.00	$2,780,000.00
Potter County - Conway 345kV CKT 1 New transmission	$500,188.99	$30,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	$5,628,960.64	$160,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	$514,805.72	$20,000,000.00
South Plains REC-Woodrow - Lynn County 115kV CKT 1 Rebuild transmission	$7,220,000.00	$7,220,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$1,227,292.51	$84,000,000.00

Interconnection Request	Allocated Costs	E + C Costs
Woodward - Woodring 345kV CKT 1 New Transmission	$2,039,408.90	$110,000,000.00
Total	**$41,754,925.24**	

GEN-2008-085

Interconnection Request	Allocated Costs	E + C Costs
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	$1,098,945.86	$35,000,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	$11,232,498.81	$200,000,000.00
GEN-2008-085 Interconnection Costs	$4,000,000.00	$4,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$1,928,695.82	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	$5,845.27	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$3,146.04	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$2,476.54	$100,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	$11,680.43	$200,000.00
Potter County - Conway 345kV CKT 1 New transmission	$978,339.20	$30,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	$8,159,937.91	$160,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	$1,185,463.41	$20,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	$939,693.82	$10,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	$7,393,860.54	$48,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	$982,806.41	$10,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$1,512,820.97	$84,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	$2,259,482.69	$110,000,000.00
Total	**$41,695,693.72**	

GEN-2008-087

Interconnection Request	Allocated Costs	E + C Costs
Clearwater - Gill EC 138kV CKT 1	$350,778.92	$3,200,000.00
Rebuild transmission		
GEN-2008-087 Interconnection Costs	$3,000,000.00	$3,000,000.00
Harper - Milan Tap 138kV CKT 1	$767,328.88	$7,000,000.00
Rebuild transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,637.91	$100,000.00
Replace terminal equipment (South of Anadarko)		
Medicine Lodge - Pratt 345kV CKT 1	$194,986.34	$20,000,000.00
New transmission		
Medicine Lodge 138/115kV Transformer CKT 2	$227,685.30	$5,000,000.00
Milan Tap - Clearwater 138kV CKT 1	$526,168.38	$4,800,000.00
Rebuild transmission		
Pratt 345/115 Transformer CKT 1	$146,239.75	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1	$17,211,660.70	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$33,876.76	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$914,397.01	$40,000,000.00
New transmission & transformer		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$6,349,239.05	$26,000,000.00
New transmission		
Total	**$29,724,999.00**	

GEN-2008-088

Interconnection Request	Allocated Costs	E + C Costs
GEN-2008-088 Interconnection Costs	$600,000.00	$600,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$1,518,200.01	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$1,609.06	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Potter County - Conway 345kV CKT 1	$588,968.58	$30,000,000.00
New transmission		
Vega - Wildorado - Switch 2749 69kV CKT 1 Project	$1,680,000.00	$1,680,000.00
Rebuild transmission		
Vega - Wildorado - Switch 2749 69kV CKT 1 Project	$6,320,000.00	$6,320,000.00
Rebuild transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$1,190,838.28	$84,000,000.00
New Transmission		
Total	**$11,899,615.93**	

Interconnection Request	Allocated Costs	E + C Costs
GEN-2008-098		
GEN-2008-098 Interconnection Costs	$11,000,000.00	$11,000,000.00
Total	**$11,000,000.00**	
GEN-2008-108		
GEN-2008-108 Interconnection Costs	$4,000,000.00	$4,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$6,068,802.13	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$4,108.63	$100,000.00
Ochiltree - Tri County REC-Cole 115kV CKT 1 Rebuild transmission	$54,922.19	$8,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	$2,857,685.28	$30,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	$2,394,580.69	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	$883,340.98	$26,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$4,760,217.27	$84,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	$5,422,404.26	$110,000,000.00
Total	**$26,446,061.43**	
GEN-2008-110		
GEN-2008-110 Interconnection Costs	$1,500,000.00	$1,500,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	$15,544,081.99	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	$2,613.76	$100,000.00
Potter County - Conway 345kV CKT 1 New transmission	$3,195,256.67	$30,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	$4,918,179.05	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	$1,814,275.51	$26,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	$12,192,390.84	$84,000,000.00

Interconnection Request	Allocated Costs	E + C Costs
Woodward - Woodring 345kV CKT 1 New Transmission	$10,280,990.43	$110,000,000.00
Total	**$49,447,788.25**	
GEN-2008-121N01		
GEN-2008-121N Interconnection Costs	$8,000,000.00	$8,000,000.00
Total	**$8,000,000.00**	
GEN-2008-122		
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	$86,780.34	$3,200,000.00
GEN-2008-122 Interconnection Costs	$2,000,000.00	$2,000,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	$189,832.00	$7,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	$851.02	$100,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	$69,583.97	$20,000,000.00
Medicine Lodge 138/115kV Transformer CKT 2	$59,544.23	$5,000,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	$130,170.52	$4,800,000.00
Pratt 345/115 Transformer CKT 1	$52,187.98	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	$8,061,438.42	$104,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	$7,089.19	$200,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	$148,728.75	$40,000,000.00
Total	**$10,806,206.42**	
GEN-2008-123N		
GEN-2008-123N Interconnection Costs	$3,000,000.00	$3,000,000.00
Total	**$3,000,000.00**	
GEN-2009-003		
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	$922,194.39	$3,200,000.00
GEN-2009-003 Interconnection Costs	$1,000,000.00	$1,000,000.00

Interconnection Request	Allocated Costs	E + C Costs
Harper - Milan Tap 138kV CKT 1	$2,017,300.23	$7,000,000.00
Rebuild transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,057.83	$100,000.00
Replace terminal equipment (South of Anadarko)		
Medicine Lodge - Pratt 345kV CKT 1	$15,256,728.82	$20,000,000.00
New transmission		
Medicine Lodge 138/115kV Transformer CKT 2	$1,614,713.58	$5,000,000.00
Medicine Lodge 345/138/13.8kV Transformer CKT 1	$4,747,118.90	$15,000,000.00
Milan Tap - Clearwater 138kV CKT 1	$1,383,291.58	$4,800,000.00
Rebuild transmission		
Pratt 345/115 Transformer CKT 1	$11,442,546.62	$15,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1	$564,496.16	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$3,492.16	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$140,844.80	$40,000,000.00
New transmission & transformer		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$208,237.96	$26,000,000.00
New transmission		
St. John - Ninnescah - Pratt 115kV CKT 1	$6,752,710.80	$9,000,000.00
Rebuild transmission		
Total	**$46,055,733.83**	
GEN-2009-005		
GEN-2009-005 Interconnection Costs	$11,000,000.00	$11,000,000.00
Total	**$11,000,000.00**	
GEN-2009-018		
GEN-2009-018 Interconnection Costs	$4,000,000.00	$4,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$8,609,531.51	$84,000,000.00
New transmission		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$2,776.88	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Potter County - Conway 345kV CKT 1	$2,288,569.41	$30,000,000.00
New transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$2,928,209.88	$104,000,000.00
New transmission		

Interconnection Request	Allocated Costs	E + C Costs
Spearville - GEN-2008-060 Tap 345kV CKT 1	$1,080,192.36	$26,000,000.00
New transmission		
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	$6,753,102.12	$84,000,000.00
New Transmission		
Woodward - Woodring 345kV CKT 1	$6,300,233.99	$110,000,000.00
New Transmission		
Total	**$31,962,616.15**	
GEN-2009-022		
Clearwater - Gill EC 138kV CKT 1	$324,242.68	$3,200,000.00
Rebuild transmission		
GEN-2009-022 Interconnection Costs	$8,000,000.00	$8,000,000.00
Harper - Milan Tap 138kV CKT 1	$709,280.85	$7,000,000.00
Rebuild transmission		
Milan Tap - Clearwater 138kV CKT 1	$486,364.01	$4,800,000.00
Rebuild transmission		
Reno County - GEN-2008-060 Tap 345kV CKT 1	$11,684,349.23	$104,000,000.00
New transmission		
Smoky Hills - Summit 230kV CKT 1	$57,475.55	$200,000.00
Replace terminal equipment		
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	$1,725,354.46	$40,000,000.00
New transmission & transformer		
Spearville - GEN-2008-060 Tap 345kV CKT 1	$4,310,259.63	$26,000,000.00
New transmission		
Total	**$27,297,326.41**	
GEN-2009-030		
GEN-2009-030 Interconnection Costs	$10,000,000.00	$10,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	$14,091.39	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)		
Lawton Eastside - Cimarron 345kV CKT 1 Project	$12,007.05	$100,000.00
Replace terminal equipment (South of Anadarko)		
Total	**$10,026,098.44**	
GEN-2009-031		
GEN-2009-031 Interconnection Costs	$9,000,000.00	$9,000,000.00
Total	**$9,000,000.00**	

Appendix F. - Cost Allocation Per Request

(Including Previously Allocated Network Upgrades*)

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2006-044N02			
GEN-2006-044N02 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$1,000,000.00**	
GEN-2007-019			
GEN-2007-019 Interconnection Costs	PISIS Allocation	$7,000,000.00	$7,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$14,382,255.19	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$5,305,494.79	$26,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$38,335.76	$200,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$2,570.00	$100,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$367,070.78	$3,200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$550,606.17	$4,800,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$802,967.33	$7,000,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$1,085,795.60	$40,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$499.13	$100,000.00
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$242,557.72	$5,000,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	PISIS Allocation	$218,409.79	$20,000,000.00
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$163,807.34	$15,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
	Current Study Total	**$30,160,369.60**	
GEN-2007-049			
GEN-2007-049 Interconnection Costs	PISIS Allocation	$500,000.00	$500,000.00
Carter Junction - Lake Creek 69kV CKT 1 Replace terminal Equipment	PISIS Allocation	$300,000.00	$300,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$2,017.21	$100,000.00
Washita - Anadarko 138kV CKT 2 New Transmission	PISIS Allocation	$872,019.31	$10,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
	Current Study Total	**$1,674,036.52**	
GEN-2008-022			
GEN-2008-022 Interconnection Costs	PISIS Allocation	$7,000,000.00	$7,000,000.00
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	PISIS Allocation	$26,604,877.72	$35,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	PISIS Allocation	$81,059,515.04	$160,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$28,298.40	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	PISIS Allocation	$52,614.51	$100,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	PISIS Allocation	$105,300.68	$200,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	PISIS Allocation	$107,299,744.40	$200,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$25,514.87	$100,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$6,852,506.26	$30,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$18,094,415.84	$110,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	PISIS Allocation	$4,331,964.30	$10,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$11,367,884.54	$84,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$14,492,918.71	$84,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	PISIS Allocation	$4,353,747.12	$10,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	PISIS Allocation	$13,558,893.28	$48,000,000.00
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
	Current Study Total	**$295,228,195.67**	

GEN-2008-028

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2008-028 Interconnection Costs	PISIS Allocation	$1,500,000.00	$1,500,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$14,630,869.00	$84,000,000.00
New Transmission			
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$18,652,898.39	$84,000,000.00
New transmission			
Woodward - Woodring 345kV CKT 1	PISIS Allocation	$12,337,188.52	$110,000,000.00
New Transmission			
Potter County - Conway 345kV CKT 1	PISIS Allocation	$3,834,308.00	$30,000,000.00
New transmission			
Spearville - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$2,177,130.61	$26,000,000.00
New transmission			
Reno County - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$5,901,814.86	$104,000,000.00
New transmission			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$3,136.51	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Finney Switching Station - Holcomb 345KV CKT 2	Previously Allocated		$6,299,839.00
Per GEN-2006-044 Facility Study			
Conway - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$40,000,000.00
Per Cluster I Impact Restudy			
Anadarko - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$130,000,000.00
Per Cluster I Impact Restudy			
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			
	Current Study Total	**$59,037,345.89**	
GEN-2008-033			
GEN-2008-033 Interconnection Costs	PISIS Allocation	$3,500,000.00	$3,500,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$1,934.72	$100,000.00
Replace terminal equipment (South of Anadarko)			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$48.53	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
	Current Study Total	**$3,501,983.25**	

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2008-034			
GEN-2008-034 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$1,934.72	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$48.53	$100,000.00
	Current Study Total	**$1,001,983.25**	
GEN-2008-037			
GEN-2008-037 Interconnection Costs	PISIS Allocation	$2,000,000.00	$2,000,000.00
GEN-2008-037 (Tap on Blue Canyon - Washita 138kV CKT 1) - Washita 138kV CKT 1 Replace terminal equipment	PISIS Allocation	$300,000.00	$300,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$5,203.91	$100,000.00
Washita - Anadarko 138kV CKT 2 New Transmission	PISIS Allocation	$9,127,980.69	$10,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$767.74	$100,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
	Current Study Total	**$11,433,952.34**	
GEN-2008-044			
GEN-2008-044 Interconnection Costs	PISIS Allocation	$2,500,000.00	$2,500,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$7,157,252.31	$110,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
	Current Study Total	**$9,657,252.31**	
GEN-2008-045			
GEN-2008-045 Interconnection Costs	PISIS Allocation	$2,500,000.00	$2,500,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$16,531,591.86	$110,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Midpoint(Wheeler) - Woodward 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Knoll - Spearville 345KV CKT 1	Previously Allocated		$236,000,000.00
Total E & C Cost for Spearville-Knoll-Axtell Project			
	Current Study Total	**$19,031,591.86**	
GEN-2008-046			
GEN-2008-046 Interconnection Costs	PISIS Allocation	$2,000,000.00	$2,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$25,066.01	$100,000.00
Replace terminal equipment (South of Anadarko)			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$7,530.36	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
	Current Study Total	**$2,032,596.37**	
GEN-2008-047			
GEN-2008-047 Interconnection Costs	PISIS Allocation	$9,000,000.00	$9,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$18,112,491.76	$84,000,000.00
New Transmission			
Woodward - Woodring 345kV CKT 1	PISIS Allocation	$13,029,416.99	$110,000,000.00
New Transmission			
Reno County - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$3,957,233.28	$104,000,000.00
New transmission			
Spearville - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$1,459,790.57	$26,000,000.00
New transmission			
Potter County - Conway 345kV CKT 1	PISIS Allocation	$1,503,206.57	$30,000,000.00
New transmission			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$1,057.17	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
	Current Study Total	**$47,063,196.34**	
GEN-2008-050			
GEN-2008-050 Interconnection Costs	PISIS Allocation	$2,000,000.00	$2,000,000.00
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	PISIS Allocation	$6,218,116.77	$35,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	PISIS Allocation	$18,945,305.26	$160,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$6,613.93	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	PISIS Allocation	$12,297.11	$100,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	PISIS Allocation	$24,610.97	$200,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	PISIS Allocation	$25,078,196.08	$200,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$5,963.36	$100,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$1,601,574.14	$30,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$4,229,043.70	$110,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	PISIS Allocation	$1,012,470.72	$10,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$2,656,912.55	$84,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$3,387,298.44	$84,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	PISIS Allocation	$1,017,561.83	$10,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	PISIS Allocation	$3,168,997.15	$48,000,000.00
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
	Current Study Total	**$69,364,962.01**	

GEN-2008-058

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2008-058 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	PISIS Allocation	$8,558,808.69	$20,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	PISIS Allocation	$22,518,712.96	$160,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$6,158.21	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	PISIS Allocation	$11,439.31	$100,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	PISIS Allocation	$12,415,043.27	$48,000,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	PISIS Allocation	$1,924,655.20	$10,000,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	PISIS Allocation	$1,933,414.85	$10,000,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	PISIS Allocation	$22,824.97	$200,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$2,323,737.74	$30,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1	PISIS Allocation	$21,503,031.79	$200,000,000.00
New Transmission			
Woodward - Woodring 345kV CKT 1	PISIS Allocation	$4,578,604.32	$110,000,000.00
New Transmission			
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$3,966,644.68	$84,000,000.00
New transmission			
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$3,111,337.31	$84,000,000.00
New Transmission			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$4,594.68	$100,000.00
Replace terminal equipment (South of Anadarko)			
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Anadarko - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$130,000,000.00
Per Cluster I Impact Restudy			
Midpoint(Wheeler) - Woodward 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Conway - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$40,000,000.00
Per Cluster I Impact Restudy			
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			
Finney Switching Station - Holcomb 345KV CKT 2	Previously Allocated		$6,299,839.00
Per GEN-2006-044 Facility Study			
	Current Study Total	**$83,879,007.98**	
GEN-2008-059			
GEN-2008-059 Interconnection Costs	PISIS Allocation	$2,500,000.00	$2,500,000.00
Medicine Lodge 345/138/13.8kV Transformer CKT 1	PISIS Allocation	$10,252,881.10	$15,000,000.00
Medicine Lodge - Pratt 345kV CKT 1	PISIS Allocation	$4,040,552.22	$20,000,000.00
New transmission			
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$3,030,414.16	$15,000,000.00
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$2,667,464.75	$5,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
St. John - Ninnescah - Pratt 115kV CKT 1 Rebuild transmission	PISIS Allocation	$2,247,289.20	$9,000,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$1,617,781.03	$7,000,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$739,557.04	$3,200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$1,109,335.56	$4,800,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$1,042.54	$100,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$445,944.45	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$164,505.21	$26,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$1,571.42	$200,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$49,590.28	$40,000,000.00
Sawyer - Medicine Lodge 115KV CKT 1 (South of GEN-2008-059 Tap)	Previously Assigned		$2,443,750.00
Sawyer - Medicine Lodge 115KV CKT 1 (North of GEN-2008-059 Tap)	Previously Assigned		$2,443,750.00
Pratt - Sawyer 115KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$1,612,500.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Medicine Lodge 138/115/xxKV Autotransformer CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$5,625,000.00
Medicine Lodge - Flat Ridge Wind Farm Tap 138KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$2,012,500.00
Flat Ridge Wind Farm Tap - Harper 138KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$6,037,500.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$28,867,928.96**	

GEN-2008-060

GEN-2008-060 Interconnection Costs	PISIS Allocation	$6,000,000.00	$6,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$25,457,173.96	$104,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$2,687.43	$100,000.00
Replace terminal equipment (South of Anadarko)			
Smoky Hills - Summit 230kV CKT 1	PISIS Allocation	$22,386.91	$200,000.00
Replace terminal equipment			
Harper - Milan Tap 138kV CKT 1	PISIS Allocation	$599,469.48	$7,000,000.00
Rebuild transmission			
Milan Tap - Clearwater 138kV CKT 1	PISIS Allocation	$411,064.79	$4,800,000.00
Rebuild transmission			
Clearwater - Gill EC 138kV CKT 1	PISIS Allocation	$274,043.19	$3,200,000.00
Rebuild transmission			
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$164,804.14	$15,000,000.00
Medicine Lodge - Pratt 345kV CKT 1	PISIS Allocation	$219,738.86	$20,000,000.00
New transmission			
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$188,034.42	$5,000,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	PISIS Allocation	$469,669.72	$40,000,000.00
New transmission & transformer			
Spearville - Comanche 345KV CKT 1	Previously Allocated		$50,000,000.00
Per Cluster I Impact Restudy			
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Knoll - Spearville 345KV CKT 1	Previously Allocated		$236,000,000.00
Total E & C Cost for Spearville-Knoll-Axtell Project			
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Midpoint(Wheeler) - Woodward 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			
	Current Study Total	**$33,809,072.90**	
GEN-2008-061			
GEN-2008-061 Interconnection Costs	PISIS Allocation	$6,000,000.00	$6,000,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project	PISIS Allocation	$35,066,989.31	$40,000,000.00
New transmission & transformer			
Smoky Hills - Summit 230kV CKT 1	PISIS Allocation	$22,035.75	$200,000.00
Replace terminal equipment			
	Current Study Total	**$41,089,025.06**	
GEN-2008-062			
GEN-2008-062 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Ochiltree - Tri County REC-Cole 115kV CKT 1	PISIS Allocation	$7,945,077.81	$8,000,000.00
Rebuild transmission			
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$3,362,557.54	$84,000,000.00
New Transmission			
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$4,286,925.41	$84,000,000.00
New transmission			
Woodward - Woodring 345kV CKT 1	PISIS Allocation	$3,152,637.40	$110,000,000.00
New Transmission			
Potter County - Conway 345kV CKT 1	PISIS Allocation	$1,093,509.62	$30,000,000.00
New transmission			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$1,417.31	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
Spearville - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$539,797.31	$26,000,000.00
New transmission			
Reno County - GEN-2008-060 Tap 345kV CKT 1	PISIS Allocation	$1,463,294.76	$104,000,000.00
New transmission			
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$40,000,000.00
Per Cluster I Impact Restudy			
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Anadarko - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$130,000,000.00
Per Cluster I Impact Restudy			
Finney Switching Station - Holcomb 345KV CKT 2	Previously Allocated		$6,299,839.00
Per GEN-2006-044 Facility Study			
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			
	Current Study Total	**$22,845,217.16**	
GEN-2008-064			
GEN-2008-064 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project	PISIS Allocation	$9,740,922.18	$20,000,000.00
Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.			
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project	PISIS Allocation	$23,687,568.20	$160,000,000.00
New transmission			

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$6,147.47	$100,000.00
Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$11,419.83	$100,000.00
Replace terminal equipment (North of GEN-2007-043 Tap)			
Tolk Station East - TUCO Interchange 230kV CKT 1	PISIS Allocation	$11,463,205.77	$48,000,000.00
Rebuild transmission			
Potter County - Conway 345kV CKT 1	PISIS Allocation	$2,382,149.52	$30,000,000.00
New transmission			
Lawton Eastside - Sunnysisde 345kV CKT 1	PISIS Allocation	$22,780.23	$200,000.00
Replace terminal equipment			
Tolk Station West - Plant X Station 230kV CKT 1	PISIS Allocation	$1,748,103.37	$10,000,000.00
Rebuild transmission			
Tolk Station East - Plant X Station 230kV CKT 2	PISIS Allocation	$1,755,582.38	$10,000,000.00
Rebuild transmission			
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1	PISIS Allocation	$21,410,950.29	$200,000,000.00
New Transmission			
Woodward - Woodring 345kV CKT 1	PISIS Allocation	$4,587,328.80	$110,000,000.00
New Transmission			
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$3,121,285.31	$84,000,000.00
New Transmission			
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2	PISIS Allocation	$3,979,327.39	$84,000,000.00
New transmission			
Lawton Eastside - Cimarron 345kV CKT 1 Project	PISIS Allocation	$4,557.83	$100,000.00
Replace terminal equipment (South of Anadarko)			
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Anadarko - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$130,000,000.00
Per Cluster I Impact Restudy			
Midpoint(Wheeler) - Woodward 345KV CKT 1	Previously Allocated		$229,000,000.00
Total E & C Cost for TUCO - Woodward Project			
Conway - Midpoint(Wheeler) 345KV CKT 1	Previously Allocated		$40,000,000.00
Per Cluster I Impact Restudy			
Comanche - Woodward 345KV CKT 1	Previously Allocated		$80,000,000.00
Per Cluster I Impact Restudy			
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Medicine Lodge - Wichita 345KV CKT 1	Previously Allocated		$90,000,000.00
Per Cluster I Impact Restudy			
Comanche - Medicine Lodge 345KV CKT 1	DISIS Allocated		$60,000,000.00
Per Cluster I Impact Restudy			

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
	Current Study Total	**$84,921,328.57**	
GEN-2008-066			
GEN-2008-066 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$1,707,736.02	$26,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$4,629,369.39	$104,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$13,736.49	$200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$202,998.99	$4,800,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$296,040.20	$7,000,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$135,332.66	$3,200,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$398,630.07	$40,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$45.31	$100,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
	Current Study Total	**$8,383,889.13**	
GEN-2008-071			
GEN-2008-071 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	DISIS Allocation		$32,000,000.00
	Current Study Total	**$1,000,000.00**	
GEN-2008-083			

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2008-083 Interconnection Costs	PISIS Allocation	$700,000.00	$700,000.00
Lynn County - Grassland 115kV CKT 1 Rebuild transmission	PISIS Allocation	$2,780,000.00	$2,780,000.00
Lubbock South - South Plains REC-Woodrow 115kV CKT 1 Rebuild transmission	PISIS Allocation	$5,000,000.00	$5,000,000.00
South Plains REC-Woodrow - Lynn County 115kV CKT 1 Rebuild transmission	PISIS Allocation	$7,220,000.00	$7,220,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$3,432.23	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	PISIS Allocation	$6,383.97	$100,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	PISIS Allocation	$13,475,578.63	$200,000,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	PISIS Allocation	$12,802.72	$200,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	PISIS Allocation	$5,628,960.64	$160,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$3,335.76	$100,000.00
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	PISIS Allocation	$1,078,059.65	$35,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$2,039,408.90	$110,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$1,227,292.51	$84,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$1,564,675.52	$84,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$500,188.99	$30,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	PISIS Allocation	$514,805.72	$20,000,000.00
Grassland Interchange 230/115KV Transformer CKT 2 Per Cluster I Impact Restudy	DISIS Allocated		$3,000,000.00
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
	Current Study Total	**$41,754,925.24**	
GEN-2008-085			
GEN-2008-085 Interconnection Costs	PISIS Allocation	$4,000,000.00	$4,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project New transmission	PISIS Allocation	$8,159,937.91	$160,000,000.00
Tolk Station East - TUCO Interchange 230kV CKT 1 Rebuild transmission	PISIS Allocation	$7,393,860.54	$48,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$3,146.04	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (North of GEN-2007-043 Tap)	PISIS Allocation	$5,845.27	$100,000.00
Tolk Station West - Plant X Station 230kV CKT 1 Rebuild transmission	PISIS Allocation	$982,806.41	$10,000,000.00
Lawton Eastside - Sunnysisde 345kV CKT 1 Replace terminal equipment	PISIS Allocation	$11,680.43	$200,000.00
Tolk Station East - Plant X Station 230kV CKT 2 Rebuild transmission	PISIS Allocation	$939,693.82	$10,000,000.00
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1 New Transmission	PISIS Allocation	$11,232,498.81	$200,000,000.00
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project Frio Draw Interchange, 345/230/xxkV Transformer, & Other related project equipment.	PISIS Allocation	$1,185,463.41	$20,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$978,339.20	$30,000,000.00
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1 New transmission	PISIS Allocation	$1,098,945.86	$35,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$2,259,482.69	$110,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$1,928,695.82	$84,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$1,512,820.97	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$2,476.54	$100,000.00
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
	Current Study Total	**$41,695,693.72**	
GEN-2008-087			
GEN-2008-087 Interconnection Costs	PISIS Allocation	$3,000,000.00	$3,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$17,211,660.70	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$6,349,239.05	$26,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$2,637.91	$100,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$33,876.76	$200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$526,168.38	$4,800,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$350,778.92	$3,200,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$767,328.88	$7,000,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$914,397.01	$40,000,000.00
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$227,685.30	$5,000,000.00
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$146,239.75	$15,000,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	PISIS Allocation	$194,986.34	$20,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$29,724,999.00**	

GEN-2008-088			
GEN-2008-088 Interconnection Costs	PISIS Allocation	$600,000.00	$600,000.00
Vega - Wildorado - Switch 2749 69kV CKT 1 Project Rebuild transmission	PISIS Allocation	$1,680,000.00	$1,680,000.00
Vega - Wildorado - Switch 2749 69kV CKT 1 Project Rebuild transmission	PISIS Allocation	$6,320,000.00	$6,320,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$1,609.06	$100,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$1,190,838.28	$84,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$1,518,200.01	$84,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$588,968.58	$30,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
	Current Study Total	**$11,899,615.93**	
GEN-2008-098			
GEN-2008-098 Interconnection Costs	PISIS Allocation	$11,000,000.00	$11,000,000.00
	Current Study Total	**$11,000,000.00**	
GEN-2008-108			
GEN-2008-108 Interconnection Costs	PISIS Allocation	$4,000,000.00	$4,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$2,857,685.28	$30,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$6,068,802.13	$84,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$4,760,217.27	$84,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$4,108.63	$100,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$5,422,404.26	$110,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$883,340.98	$26,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$2,394,580.69	$104,000,000.00
Ochiltree - Tri County REC-Cole 115kV CKT 1 Rebuild transmission	PISIS Allocation	$54,922.19	$8,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
	Current Study Total	**$26,446,061.43**	

GEN-2008-110

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2008-110 Interconnection Costs	PISIS Allocation	$1,500,000.00	$1,500,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$12,192,390.84	$84,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$15,544,081.99	$84,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$10,280,990.43	$110,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$3,195,256.67	$30,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$1,814,275.51	$26,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$4,918,179.05	$104,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$2,613.76	$100,000.00
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
	Current Study Total	**$49,447,788.25**	
GEN-2008-121N01			
GEN-2008-121N Interconnection Costs	PISIS Allocation	$8,000,000.00	$8,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$8,000,000.00**	
GEN-2008-122			
GEN-2008-122 Interconnection Costs	PISIS Allocation	$2,000,000.00	$2,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$8,061,438.42	$104,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$851.02	$100,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$7,089.19	$200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$130,170.52	$4,800,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$86,780.34	$3,200,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$189,832.00	$7,000,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	PISIS Allocation	$69,583.97	$20,000,000.00
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$52,187.98	$15,000,000.00
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$59,544.23	$5,000,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$148,728.75	$40,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
	Current Study Total	**$10,806,206.42**	
GEN-2008-123N			
GEN-2008-123N Interconnection Costs	PISIS Allocation	$3,000,000.00	$3,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$3,000,000.00**	
GEN-2009-003			
GEN-2009-003 Interconnection Costs	PISIS Allocation	$1,000,000.00	$1,000,000.00
Pratt 345/115 Transformer CKT 1	PISIS Allocation	$11,442,546.62	$15,000,000.00
Medicine Lodge - Pratt 345kV CKT 1 New transmission	PISIS Allocation	$15,256,728.82	$20,000,000.00
St. John - Ninnescah - Pratt 115kV CKT 1 Rebuild transmission	PISIS Allocation	$6,752,710.80	$9,000,000.00
Medicine Lodge 345/138/13.8kV Transformer CKT 1	PISIS Allocation	$4,747,118.90	$15,000,000.00
Medicine Lodge 138/115kV Transformer CKT 2	PISIS Allocation	$1,614,713.58	$5,000,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$922,194.39	$3,200,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$1,383,291.58	$4,800,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$2,017,300.23	$7,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$2,057.83	$100,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$208,237.96	$26,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$564,496.16	$104,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$3,492.16	$200,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$140,844.80	$40,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Sawyer - Medicine Lodge 115KV CKT 1 (South of GEN-2008-059 Tap)	Previously Assigned		$2,443,750.00
Pratt - Sawyer 115KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$1,612,500.00
Sawyer - Medicine Lodge 115KV CKT 1 (North of GEN-2008-059 Tap)	Previously Assigned		$2,443,750.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Medicine Lodge 138/115/xxKV Autotransformer CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$5,625,000.00
Medicine Lodge - Flat Ridge Wind Farm Tap 138KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$2,012,500.00
Flat Ridge Wind Farm Tap - Harper 138KV CKT 1 Per 2007-AG3-AFS9	Previously Allocated		$6,037,500.00
	Current Study Total	**$46,055,733.83**	
GEN-2009-005			
GEN-2009-005 Interconnection Costs	PISIS Allocation	$11,000,000.00	$11,000,000.00
	Current Study Total	**$11,000,000.00**	
GEN-2009-018			
GEN-2009-018 Interconnection Costs	PISIS Allocation	$4,000,000.00	$4,000,000.00
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New transmission	PISIS Allocation	$8,609,531.51	$84,000,000.00
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2 New Transmission	PISIS Allocation	$6,753,102.12	$84,000,000.00
Potter County - Conway 345kV CKT 1 New transmission	PISIS Allocation	$2,288,569.41	$30,000,000.00
Woodward - Woodring 345kV CKT 1 New Transmission	PISIS Allocation	$6,300,233.99	$110,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$2,776.88	$100,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$1,080,192.36	$26,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$2,928,209.88	$104,000,000.00
Hitchland - Woodward 345kV CKT 1 (Woodward - GEN-2008-047 Tap)	Previously Assigned		$84,000,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Hitchland - Woodward 345kV CKT 1 (Hitchland - GEN-2008-047 Tap)	Previously Allocated		$84,000,000.00
Conway - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$40,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	DISIS Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
	Current Study Total	**$31,962,616.15**	
GEN-2009-022			
GEN-2009-022 Interconnection Costs	PISIS Allocation	$8,000,000.00	$8,000,000.00
Reno County - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$11,684,349.23	$104,000,000.00
Spearville - GEN-2008-060 Tap 345kV CKT 1 New transmission	PISIS Allocation	$4,310,259.63	$26,000,000.00
Smoky Hills - Summit 230kV CKT 1 Replace terminal equipment	PISIS Allocation	$57,475.55	$200,000.00
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project New transmission & transformer	PISIS Allocation	$1,725,354.46	$40,000,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild transmission	PISIS Allocation	$709,280.85	$7,000,000.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild transmission	PISIS Allocation	$486,364.01	$4,800,000.00
Clearwater - Gill EC 138kV CKT 1 Rebuild transmission	PISIS Allocation	$324,242.68	$3,200,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$27,297,326.41**	
GEN-2009-030			
GEN-2009-030 Interconnection Costs	PISIS Allocation	$10,000,000.00	$10,000,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (Between Anadarko and GEN-2007-043 Tap)	PISIS Allocation	$14,091.39	$100,000.00
Lawton Eastside - Cimarron 345kV CKT 1 Project Replace terminal equipment (South of Anadarko)	PISIS Allocation	$12,007.05	$100,000.00

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
Anadarko - Midpoint(Wheeler) 345KV CKT 1 (East of GEN-2009-0303 Tap)	Previously Allocated		$65,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
	Current Study Total	**$10,026,098.44**	
GEN-2009-031			
GEN-2009-031 Interconnection Costs	PISIS Allocation	$9,000,000.00	$9,000,000.00
	Current Study Total	**$9,000,000.00**	

* Current Study Requests' Costs of Previously Allocated Network Upgrades will be determined by a restudy, if neccesary.

F: Cost Allocation per Interconnection Request (Including Prior Queued Upgrades)

This section shows each Generation Interconnection Request Customer, their current study impacted Network Upgrades, and the previously allocated upgrades upon which they may rely upon to accommodate their interconnection to the transmission system.

The costs associated with the current study Network Upgrades and Interconnection Facilities are allocated to the Customers as shown in this report.

If a higher queued interconnection request (listed in Appendix B.) withdraws or terminates their LGIA the Network Upgrades assigned to the higher queued requests may be reallocated to the remaining requests that have an impact on the Network Upgrade under a restudy. The actual costs allocated to each Generation Interconnection Request Customer will be determined at the time of a restudy.

Additionally, Expansion Plan (STEP), Aggregate Study, and Balanced Portfolio assigned projects are also included in this table so that the Customer will know that interconnection service may be delayed until the completion of these projects.

The required interconnection costs listed do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT. In addition, costs associated with a short circuit analysis will be allocated should the Interconnection Request Customer choose to execute a Facility Study Agreement.

G: Cost Allocation per Proposed Study Network Upgrade

This section shows each Direct Assigned Facility and Network Upgrade and the Generation Interconnection Request Customer(s) which have an impact in this study assuming all higher queued projects remain in the queue and achieve commercial operation.

The required interconnection costs listed do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT. In addition, costs associated with a short circuit analysis will be allocated should the Interconnection Request Customer choose to execute a Facility Study Agreement.

There may be additional costs allocated to each Customer. See Appendix F for more details.

Appendix G. - Cost Allocation Per Upgrade Facility

Upgrade Facility	Allocated Costs	E + C Costs
Carter Junction - Lake Creek 69kV CKT 1		**$300,000.00**
Replace terminal Equipment		
GEN-2007-049	$300,000.00	
Total	**$300,000.00**	
Clearwater - Gill EC 138kV CKT 1		**$3,200,000.00**
Rebuild transmission		
GEN-2007-019	$367,070.78	
GEN-2008-059	$739,557.04	
GEN-2008-060	$274,043.19	
GEN-2008-066	$135,332.66	
GEN-2008-087	$350,778.92	
GEN-2008-122	$86,780.34	
GEN-2009-003	$922,194.39	
GEN-2009-022	$324,242.68	
Total	**$3,200,000.00**	
Frio Draw Interchange - GEN-2007-034 (Tap on Eddy County - Tolk 345kV CKT 1) 345kV CKT 1		**$35,000,000.00**
New transmission		
GEN-2008-022	$26,604,877.72	
GEN-2008-050	$6,218,116.77	
GEN-2008-083	$1,078,059.65	
GEN-2008-085	$1,098,945.86	
Total	**$35,000,000.00**	
GEN-2005-015 (Tap on TUCO - Oklaunion 345kV CKT 1) - Lawton Eastside 345kV CKT 1		**$200,000,000.00**
New Transmission		
GEN-2008-022	$107,299,744.40	
GEN-2008-050	$25,078,196.08	
GEN-2008-058	$21,503,031.79	
GEN-2008-064	$21,410,950.29	
GEN-2008-083	$13,475,578.63	
GEN-2008-085	$11,232,498.81	
Total	**$200,000,000.00**	
GEN-2006-044N02 Interconnection Costs		**$1,000,000.00**
GEN-2006-044N02	$1,000,000.00	
Total	**$1,000,000.00**	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2007-019 Interconnection Costs			**$7,000,000.00**
GEN-2007-019		$7,000,000.00	
	Total	**$7,000,000.00**	
GEN-2007-049 Interconnection Costs			**$500,000.00**
GEN-2007-049		$500,000.00	
	Total	**$500,000.00**	
GEN-2008-022 Interconnection Costs			**$7,000,000.00**
GEN-2008-022		$7,000,000.00	
	Total	**$7,000,000.00**	
GEN-2008-028 Interconnection Costs			**$1,500,000.00**
GEN-2008-028		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2008-033 Interconnection Costs			**$3,500,000.00**
GEN-2008-033		$3,500,000.00	
	Total	**$3,500,000.00**	
GEN-2008-034 Interconnection Costs			**$1,000,000.00**
GEN-2008-034		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-037 (Tap on Blue Canyon - Washita 138kV CKT 1) - Washita 138kV CKT 1			**$300,000.00**
Replace terminal equipment			
GEN-2008-037		$300,000.00	
	Total	**$300,000.00**	
GEN-2008-037 Interconnection Costs			**$2,000,000.00**
GEN-2008-037		$2,000,000.00	
	Total	**$2,000,000.00**	
GEN-2008-044 Interconnection Costs			**$2,500,000.00**
GEN-2008-044		$2,500,000.00	
	Total	**$2,500,000.00**	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2008-045 Interconnection Costs			**$2,500,000.00**
GEN-2008-045		$2,500,000.00	
	Total	**$2,500,000.00**	
GEN-2008-046 Interconnection Costs			**$2,000,000.00**
GEN-2008-046		$2,000,000.00	
	Total	**$2,000,000.00**	
GEN-2008-047 Interconnection Costs			**$9,000,000.00**
GEN-2008-047		$9,000,000.00	
	Total	**$9,000,000.00**	
GEN-2008-050 Interconnection Costs			**$2,000,000.00**
GEN-2008-050		$2,000,000.00	
	Total	**$2,000,000.00**	
GEN-2008-058 Interconnection Costs			**$1,000,000.00**
GEN-2008-058		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-059 Interconnection Costs			**$2,500,000.00**
GEN-2008-059		$2,500,000.00	
	Total	**$2,500,000.00**	
GEN-2008-060 Interconnection Costs			**$6,000,000.00**
GEN-2008-060		$6,000,000.00	
	Total	**$6,000,000.00**	
GEN-2008-061 Interconnection Costs			**$6,000,000.00**
GEN-2008-061		$6,000,000.00	
	Total	**$6,000,000.00**	
GEN-2008-062 Interconnection Costs			**$1,000,000.00**
GEN-2008-062		$1,000,000.00	
	Total	**$1,000,000.00**	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2008-064 Interconnection Costs			**$1,000,000.00**
GEN-2008-064		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-066 Interconnection Costs			**$1,000,000.00**
GEN-2008-066		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-071 Interconnection Costs			**$1,000,000.00**
GEN-2008-071		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-083 Interconnection Costs			**$700,000.00**
GEN-2008-083		$700,000.00	
	Total	**$700,000.00**	
GEN-2008-085 Interconnection Costs			**$4,000,000.00**
GEN-2008-085		$4,000,000.00	
	Total	**$4,000,000.00**	
GEN-2008-087 Interconnection Costs			**$3,000,000.00**
GEN-2008-087		$3,000,000.00	
	Total	**$3,000,000.00**	
GEN-2008-088 Interconnection Costs			**$600,000.00**
GEN-2008-088		$600,000.00	
	Total	**$600,000.00**	
GEN-2008-098 Interconnection Costs			**$11,000,000.00**
GEN-2008-098		$11,000,000.00	
	Total	**$11,000,000.00**	
GEN-2008-108 Interconnection Costs			**$4,000,000.00**
GEN-2008-108		$4,000,000.00	
	Total	**$4,000,000.00**	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2008-110 Interconnection Costs			**$1,500,000.00**
GEN-2008-110		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2008-121N Interconnection Costs			**$8,000,000.00**
GEN-2008-121N01		$8,000,000.00	
	Total	**$8,000,000.00**	
GEN-2008-122 Interconnection Costs			**$2,000,000.00**
GEN-2008-122		$2,000,000.00	
	Total	**$2,000,000.00**	
GEN-2008-123N Interconnection Costs			**$3,000,000.00**
GEN-2008-123N		$3,000,000.00	
	Total	**$3,000,000.00**	
GEN-2009-003 Interconnection Costs			**$1,000,000.00**
GEN-2009-003		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2009-005 Interconnection Costs			**$11,000,000.00**
GEN-2009-005		$11,000,000.00	
	Total	**$11,000,000.00**	
GEN-2009-018 Interconnection Costs			**$4,000,000.00**
GEN-2009-018		$4,000,000.00	
	Total	**$4,000,000.00**	
GEN-2009-022 Interconnection Costs			**$8,000,000.00**
GEN-2009-022		$8,000,000.00	
	Total	**$8,000,000.00**	
GEN-2009-030 Interconnection Costs			**$10,000,000.00**
GEN-2009-030		$10,000,000.00	
	Total	**$10,000,000.00**	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2009-031 Interconnection Costs		**$9,000,000.00**
GEN-2009-031	$9,000,000.00	
Total	**$9,000,000.00**	
Harper - Milan Tap 138kV CKT 1		**$7,000,000.00**
Rebuild transmission		
GEN-2007-019	$802,967.33	
GEN-2008-059	$1,617,781.03	
GEN-2008-060	$599,469.48	
GEN-2008-066	$296,040.20	
GEN-2008-087	$767,328.88	
GEN-2008-122	$189,832.00	
GEN-2009-003	$2,017,300.23	
GEN-2009-022	$709,280.85	
Total	**$7,000,000.00**	
Hitchland - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2		**$84,000,000.00**
New transmission		
GEN-2008-022	$14,492,918.71	
GEN-2008-028	$18,652,898.39	
GEN-2008-050	$3,387,298.44	
GEN-2008-058	$3,966,644.68	
GEN-2008-062	$4,286,925.41	
GEN-2008-064	$3,979,327.39	
GEN-2008-083	$1,564,675.52	
GEN-2008-085	$1,928,695.82	
GEN-2008-088	$1,518,200.01	
GEN-2008-108	$6,068,802.13	
GEN-2008-110	$15,544,081.99	
GEN-2009-018	$8,609,531.51	
Total	**$84,000,000.00**	
Lawton Eastside - Cimarron 345kV CKT 1 Project		**$100,000.01**
Replace terminal equipment (South of Anadarko)		
GEN-2007-019	$2,570.00	
GEN-2007-019	$499.13	
GEN-2007-049	$2,017.21	
GEN-2008-022	$25,514.87	
GEN-2008-022	$28,298.40	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2008-022	$52,614.51	
GEN-2008-028	$3,136.51	
GEN-2008-033	$48.53	
GEN-2008-033	$1,934.72	
GEN-2008-034	$48.53	
GEN-2008-034	$1,934.72	
GEN-2008-037	$5,203.91	
GEN-2008-037	$767.74	
GEN-2008-046	$25,066.01	
GEN-2008-046	$7,530.36	
GEN-2008-047	$1,057.17	
GEN-2008-050	$12,297.11	
GEN-2008-050	$5,963.36	
GEN-2008-050	$6,613.93	
GEN-2008-058	$4,594.68	
GEN-2008-058	$11,439.31	
GEN-2008-058	$6,158.21	
GEN-2008-059	$1,042.54	
GEN-2008-060	$2,687.43	
GEN-2008-062	$1,417.31	
GEN-2008-064	$6,147.47	
GEN-2008-064	$11,419.83	
GEN-2008-064	$4,557.83	
GEN-2008-066	$45.31	
GEN-2008-083	$3,335.76	
GEN-2008-083	$6,383.97	
GEN-2008-083	$3,432.23	
GEN-2008-085	$5,845.27	
GEN-2008-085	$2,476.54	
GEN-2008-085	$3,146.04	
GEN-2008-087	$2,637.91	
GEN-2008-088	$1,609.06	
GEN-2008-108	$4,108.63	
GEN-2008-110	$2,613.76	
GEN-2008-122	$851.02	
GEN-2009-003	$2,057.83	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2009-018		$2,776.88	
GEN-2009-030		$12,007.05	
GEN-2009-030		$14,091.39	
	Total	**$299,999.98**	
Lawton Eastside - Sunnysisde 345kV CKT 1			**$200,000.00**
Replace terminal equipment			
GEN-2008-022		$105,300.68	
GEN-2008-050		$24,610.97	
GEN-2008-058		$22,824.97	
GEN-2008-064		$22,780.23	
GEN-2008-083		$12,802.72	
GEN-2008-085		$11,680.43	
	Total	**$200,000.00**	
Lubbock South - South Plains REC-Woodrow 115kV CKT 1			**$5,000,000.00**
Rebuild transmission			
GEN-2008-083		$5,000,000.00	
	Total	**$5,000,000.00**	
Lynn County - Grassland 115kV CKT 1			**$2,780,000.00**
Rebuild transmission			
GEN-2008-083		$2,780,000.00	
	Total	**$2,780,000.00**	
Medicine Lodge - Pratt 345kV CKT 1			**$20,000,000.00**
New transmission			
GEN-2007-019		$218,409.79	
GEN-2008-059		$4,040,552.22	
GEN-2008-060		$219,738.86	
GEN-2008-087		$194,986.34	
GEN-2008-122		$69,583.97	
GEN-2009-003		$15,256,728.82	
	Total	**$20,000,000.00**	
Medicine Lodge 138/115kV Transformer CKT 2			**$5,000,000.00**
GEN-2007-019		$242,557.72	
GEN-2008-059		$2,667,464.75	
GEN-2008-060		$188,034.42	
GEN-2008-087		$227,685.30	
GEN-2008-122		$59,544.23	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2009-003	$1,614,713.58	
Total	**$5,000,000.00**	
Medicine Lodge 345/138/13.8kV Transformer CKT 1		**$15,000,000.00**
GEN-2008-059	$10,252,881.10	
GEN-2009-003	$4,747,118.90	
Total	**$15,000,000.00**	
Milan Tap - Clearwater 138kV CKT 1		**$4,800,000.00**
Rebuild transmission		
GEN-2007-019	$550,606.17	
GEN-2008-059	$1,109,335.56	
GEN-2008-060	$411,064.79	
GEN-2008-066	$202,998.99	
GEN-2008-087	$526,168.38	
GEN-2008-122	$130,170.52	
GEN-2009-003	$1,383,291.58	
GEN-2009-022	$486,364.01	
Total	**$4,800,000.00**	
Ochiltree - Tri County REC-Cole 115kV CKT 1		**$8,000,000.00**
Rebuild transmission		
GEN-2008-062	$7,945,077.81	
GEN-2008-108	$54,922.19	
Total	**$8,000,000.00**	
Potter County - Conway 345kV CKT 1		**$29,999,999.98**
New transmission		
GEN-2008-022	$6,852,506.26	
GEN-2008-028	$3,834,308.00	
GEN-2008-047	$1,503,206.57	
GEN-2008-050	$1,601,574.14	
GEN-2008-058	$2,323,737.74	
GEN-2008-062	$1,093,509.62	
GEN-2008-064	$2,382,149.52	
GEN-2008-083	$500,188.99	
GEN-2008-085	$978,339.20	
GEN-2008-088	$588,968.58	
GEN-2008-108	$2,857,685.28	
GEN-2008-110	$3,195,256.67	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2009-018	$2,288,569.41	
Total	**$29,999,999.98**	
Potter County - Frio Draw Interchange 345kV CKT 1 and Interchange Project		**$160,000,000.01**
New transmission		
GEN-2008-022	$81,059,515.04	
GEN-2008-050	$18,945,305.26	
GEN-2008-058	$22,518,712.96	
GEN-2008-058	$8,558,808.69	
GEN-2008-064	$23,687,568.20	
GEN-2008-064	$9,740,922.18	
GEN-2008-083	$514,805.72	
GEN-2008-083	$5,628,960.64	
GEN-2008-085	$8,159,937.91	
GEN-2008-085	$1,185,463.41	
Total	**$180,000,000.01**	
Pratt 345/115 Transformer CKT 1		**$14,999,999.99**
GEN-2007-019	$163,807.34	
GEN-2008-059	$3,030,414.16	
GEN-2008-060	$164,804.14	
GEN-2008-087	$146,239.75	
GEN-2008-122	$52,187.98	
GEN-2009-003	$11,442,546.62	
Total	**$14,999,999.99**	
Reno County - GEN-2008-060 Tap 345kV CKT 1		**$104,000,000.02**
New transmission		
GEN-2007-019	$14,382,255.19	
GEN-2008-028	$5,901,814.86	
GEN-2008-047	$3,957,233.28	
GEN-2008-059	$445,944.45	
GEN-2008-060	$25,457,173.96	
GEN-2008-062	$1,463,294.76	
GEN-2008-066	$4,629,369.39	
GEN-2008-087	$17,211,660.70	
GEN-2008-108	$2,394,580.69	
GEN-2008-110	$4,918,179.05	
GEN-2008-122	$8,061,438.42	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2009-003	$564,496.16	
GEN-2009-018	$2,928,209.88	
GEN-2009-022	$11,684,349.23	
Total	**$104,000,000.02**	
Smoky Hills - Summit 230kV CKT 1		**$199,999.99**
Replace terminal equipment		
GEN-2007-019	$38,335.76	
GEN-2008-059	$1,571.42	
GEN-2008-060	$22,386.91	
GEN-2008-061	$22,035.75	
GEN-2008-066	$13,736.49	
GEN-2008-087	$33,876.76	
GEN-2008-122	$7,089.19	
GEN-2009-003	$3,492.16	
GEN-2009-022	$57,475.55	
Total	**$199,999.99**	
Smoky Hills - Summit 345kV CKT 1 and Smoky Hills 345/230kV Transformer Project		**$40,000,000.00**
New transmission & transformer		
GEN-2007-019	$1,085,795.60	
GEN-2008-059	$49,590.28	
GEN-2008-060	$469,669.72	
GEN-2008-061	$35,066,989.31	
GEN-2008-066	$398,630.07	
GEN-2008-087	$914,397.01	
GEN-2008-122	$148,728.75	
GEN-2009-003	$140,844.80	
GEN-2009-022	$1,725,354.46	
Total	**$40,000,000.00**	
South Plains REC-Woodrow - Lynn County 115kV CKT 1		**$7,220,000.00**
Rebuild transmission		
GEN-2008-083	$7,220,000.00	
Total	**$7,220,000.00**	
Spearville - GEN-2008-060 Tap 345kV CKT 1		**$26,000,000.00**
New transmission		
GEN-2007-019	$5,305,494.79	
GEN-2008-028	$2,177,130.61	
GEN-2008-047	$1,459,790.57	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2008-059	$164,505.21	
GEN-2008-062	$539,797.31	
GEN-2008-066	$1,707,736.02	
GEN-2008-087	$6,349,239.05	
GEN-2008-108	$883,340.98	
GEN-2008-110	$1,814,275.51	
GEN-2009-003	$208,237.96	
GEN-2009-018	$1,080,192.36	
GEN-2009-022	$4,310,259.63	
Total	**$26,000,000.00**	
St. John - Ninnescah - Pratt 115kV CKT 1		**$9,000,000.00**
Rebuild transmission		
GEN-2008-059	$2,247,289.20	
GEN-2009-003	$6,752,710.80	
Total	**$9,000,000.00**	
Tolk Station East - Plant X Station 230kV CKT 2		**$10,000,000.00**
Rebuild transmission		
GEN-2008-022	$4,353,747.12	
GEN-2008-050	$1,017,561.83	
GEN-2008-058	$1,933,414.85	
GEN-2008-064	$1,755,582.38	
GEN-2008-085	$939,693.82	
Total	**$10,000,000.00**	
Tolk Station East - TUCO Interchange 230kV CKT 1		**$48,000,000.01**
Rebuild transmission		
GEN-2008-022	$13,558,893.28	
GEN-2008-050	$3,168,997.15	
GEN-2008-058	$12,415,043.27	
GEN-2008-064	$11,463,205.77	
GEN-2008-085	$7,393,860.54	
Total	**$48,000,000.01**	
Tolk Station West - Plant X Station 230kV CKT 1		**$10,000,000.00**
Rebuild transmission		
GEN-2008-022	$4,331,964.30	
GEN-2008-050	$1,012,470.72	
GEN-2008-058	$1,924,655.20	
GEN-2008-064	$1,748,103.37	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2008-085	$982,806.41	
Total	**$10,000,000.00**	
Vega - Wildorado - Switch 2749 69kV CKT 1 Project		**$6,320,000.00**
Rebuild transmission		
GEN-2008-088	$6,320,000.00	
GEN-2008-088	$1,680,000.00	
Total	**$8,000,000.00**	
Washita - Anadarko 138kV CKT 2		**$10,000,000.00**
New Transmission		
GEN-2007-049	$872,019.31	
GEN-2008-037	$9,127,980.69	
Total	**$10,000,000.00**	
Woodward - GEN-2008-047 (Tap on Hitchland - Woodward 345kV CKT 2) 345kV CKT 2		**$84,000,000.00**
New Transmission		
GEN-2008-022	$11,367,884.54	
GEN-2008-028	$14,630,869.00	
GEN-2008-047	$18,112,491.76	
GEN-2008-050	$2,656,912.55	
GEN-2008-058	$3,111,337.31	
GEN-2008-062	$3,362,557.54	
GEN-2008-064	$3,121,285.31	
GEN-2008-083	$1,227,292.51	
GEN-2008-085	$1,512,820.97	
GEN-2008-088	$1,190,838.28	
GEN-2008-108	$4,760,217.27	
GEN-2008-110	$12,192,390.84	
GEN-2009-018	$6,753,102.12	
Total	**$84,000,000.00**	
Woodward - Woodring 345kV CKT 1		**$110,000,000.01**
New Transmission		
GEN-2008-022	$18,094,415.84	
GEN-2008-028	$12,337,188.52	
GEN-2008-044	$7,157,252.31	
GEN-2008-045	$16,531,591.86	
GEN-2008-047	$13,029,416.99	
GEN-2008-050	$4,229,043.70	
GEN-2008-058	$4,578,604.32	

Upgrade Facility	Allocated Costs	E + C Costs
GEN-2008-062	$3,152,637.40	
GEN-2008-064	$4,587,328.80	
GEN-2008-083	$2,039,408.90	
GEN-2008-085	$2,259,482.69	
GEN-2008-108	$5,422,404.26	
GEN-2008-110	$10,280,990.43	
GEN-2009-018	$6,300,233.99	
Total	**$110,000,000.01**	

Current Study Upgrades Total **$1,224,099,999.99**

H: ACCC Analysis (No Upgrades)

See Attachment

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
2	0	G08_062	--NONCONVERGED--	1052	'TO->FROM'	0.2447	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_108	--NONCONVERGED--	1052	'TO->FROM'	0.20319	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_028	--NONCONVERGED--	1052	'TO->FROM'	0.28141	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G09_018	--NONCONVERGED--	1052	'TO->FROM'	0.24709	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_110	--NONCONVERGED--	1052	'TO->FROM'	0.28141	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_062	--NONCONVERGED--	1052		0.2447	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_108	--NONCONVERGED--	1052		0.20319	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_028	--NONCONVERGED--	1052		0.28141	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G09_018	--NONCONVERGED--	1052		0.24709	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_110	--NONCONVERGED--	1052		0.28141	102.9532	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	6	G08_062	--NONCONVERGED--	1052		0.20657	87.58253	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	6	G08_028	--NONCONVERGED--	1052		0.23464	87.58253	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	6	G09_018	--NONCONVERGED--	1052		0.2083	87.58253	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	6	G08_110	--NONCONVERGED--	1052		0.23464	87.58253	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_062	--NONCONVERGED--	1792		0.26067	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_108	--NONCONVERGED--	1792		0.20006	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_047	--NONCONVERGED--	1792		0.57845	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_028	--NONCONVERGED--	1792		0.31445	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G09_018	--NONCONVERGED--	1792		0.2642	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_110	--NONCONVERGED--	1792		0.31445	64.63872	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_062	--NONCONVERGED--	1052		0.26138	52.6829	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_108	--NONCONVERGED--	1052		0.21988	52.6829	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_028	--NONCONVERGED--	1052		0.29809	52.6829	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
2	0	G09_018	--NONCONVERGED--	1052		0.26377	52.6829	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
2	0	G08_110	--NONCONVERGED--	1052		0.29809	52.6829	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	--NONCONVERGED--	79.7	'FROM->TO'	0.43081	253.7201	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'
3	0	G09_003	--NONCONVERGED--	79.7	'FROM->TO'	0.55738	253.7201	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'
3	0	G08_059	--NONCONVERGED--	79.7		0.43081	253.7201	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'
3	0	G09_003	--NONCONVERGED--	79.7		0.55738	253.7201	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'
3	0	G08_059	--NONCONVERGED--	95.6	'FROM->TO'	0.3258	235.3225	'HARPER - MILAN TAP 138KV CKT 1'
3	0	G09_003	--NONCONVERGED--	95.6	'FROM->TO'	0.25332	235.3225	'HARPER - MILAN TAP 138KV CKT 1'
3	0	G08_059	--NONCONVERGED--	110	'TO->FROM'	0.3258	192.7797	'CLEARWATER - MILAN TAP 138KV CKT 1'
3	0	G09_003	--NONCONVERGED--	110	'TO->FROM'	0.25332	192.7797	'CLEARWATER - MILAN TAP 138KV CKT 1'
3	0	G09_003	--NONCONVERGED--	88	'FROM->TO'	0.21794	181.2665	'ST JOHN - ST_JOHN 115KV CKT 1'
3	0	G08_059	--NONCONVERGED--	110	'FROM->TO'	0.3258	180.9733	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	--NONCONVERGED--	110	'FROM->TO'	0.25332	180.9733	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	--NONCONVERGED--	88	'TO->FROM'	0.21794	157.8087	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_060	--NONCONVERGED--	355.3	'FROM->TO'	0.42028	133.7119	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_122	--NONCONVERGED--	355.3	'FROM->TO'	0.42028	133.7119	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	--NONCONVERGED--	92	'FROM->TO'	0.21794	133.6606	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	--NONCONVERGED--	170	'FROM->TO'	0.32863	107.8005	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	--NONCONVERGED--	170	'FROM->TO'	0.25616	107.8005	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	--NONCONVERGED--	79.7	'TO->FROM'	0.43501	104.3609	'NINNESC3 115.00 - PRATT 115KV CKT 1'
3	0	G09_003	--NONCONVERGED--	79.7	'TO->FROM'	0.56157	104.3609	'NINNESC3 115.00 - PRATT 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	--NONCONVERGED--	79.7		0.43501	104.3609	'NINNESC3 115.00 - PRATT 115KV CKT 1'
3	0	G09_003	--NONCONVERGED--	79.7		0.56157	104.3609	'NINNESC3 115.00 - PRATT 115KV CKT 1'
4	0	G08_066	--NONCONVERGED--	98	'FROM->TO'	0.43677	125.2635	'SYRACUSE - WILLIAMSON 115KV CKT 1'
4	0	G08_066	--NONCONVERGED--	98	'TO->FROM'	0.43677	123.3995	'FLETCHER - WILLIAMSON 115KV CKT 1'
5	0	G08_108	--NONCONVERGED--	0		0.24428	9999	'SPP-SWPS-03B'
5	0	G08_088	--NONCONVERGED--	0		0.26381	9999	'SPP-SWPS-03B'
5	6	G08_108	--NONCONVERGED--	0		0.19263	9999	'SPP-SWPS-03B'
5	6	G08_088	--NONCONVERGED--	0		0.23045	9999	'SPP-SWPS-03B'
5	0	G08_088	--NONCONVERGED--	35	'TO->FROM'	1	155.5784	'SWITCH 2749 - WILDORADO 69KV CKT 1'
5	0	G08_088	--NONCONVERGED--	54	'FROM->TO'	1	104.3872	'VEGA SUB - WILDORADO 69KV CKT 1'
6	2	G08_083	--NONCONVERGED--	54	'TO->FROM'	1	145.4028	'LYNTEGAR REC-HACKBERRY - SOUTHLAND SUB 69KV CKT 1'
6	2	G08_083	--NONCONVERGED--	54	'TO->FROM'	1	142.3767	'DIEKEMPER SUB - LYNTEGAR REC-HACKBERRY 69KV CKT 1'
6	2	G08_083	--NONCONVERGED--	54	'FROM->TO'	1	138.7606	'DIEKEMPER SUB - GRAHAM INTERCHANGE 69KV CKT 1'
6	2	G08_064	--NONCONVERGED--	1195		0.19662	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_022	--NONCONVERGED--	1195		0.2217	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_083	--NONCONVERGED--	1195		0.22176	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_085	--NONCONVERGED--	1195		0.19682	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_058	--NONCONVERGED--	1195		0.19615	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_050	--NONCONVERGED--	1195		0.2217	81.58194	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_064	--NONCONVERGED--	956		0.19236	78.33823	'SPS-TAP 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_022	--NONCONVERGED--	956		0.50875	78.33823	'SPS-TAP 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_050	--NONCONVERGED--	956		0.50875	78.33823	'SPS-TAP 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_064	--NONCONVERGED--	1083		0.19662	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_022	--NONCONVERGED--	1083		0.2217	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_083	--NONCONVERGED--	1083		0.22176	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_085	--NONCONVERGED--	1083		0.19682	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_058	--NONCONVERGED--	1083		0.19616	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_050	--NONCONVERGED--	1083		0.2217	73.00063	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
6	2	G08_064	--NONCONVERGED--	1195		0.24099	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_022	--NONCONVERGED--	1195		0.28995	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_083	--NONCONVERGED--	1195		0.28988	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_085	--NONCONVERGED--	1195		0.2414	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_058	--NONCONVERGED--	1195		0.2401	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_050	--NONCONVERGED--	1195		0.28995	66.54008	'MIDPT_BUS 7 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_062	--NONCONVERGED--	1792		0.27173	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
6	2	G08_108	--NONCONVERGED--	1792		0.21034	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
6	2	G08_047	--NONCONVERGED--	1792		0.59066	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
6	2	G08_028	--NONCONVERGED--	1792		0.32591	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
6	2	G09_018	--NONCONVERGED--	1792		0.27523	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
6	2	G08_110	--NONCONVERGED--	1792		0.32591	32.13486	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
7	0	G07_049	--NONCONVERGED--	36	'FROM->TO'	0.33548	114.8262	'CARTER JCT - LAKE CREEK 69KV CKT 1'
7	0	G08_037	--NONCONVERGED--	324	'FROM->TO'	0.99369	107.2118	'GEN08-037 138.00 - WASHITA 138KV CKT 1'
7	0	G09_030	--NONCONVERGED--	260	'TO->FROM'	0.27434	105.715	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'
7	0	G08_037	--NONCONVERGED--	260	'TO->FROM'	0.58542	105.715	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
7	0	G09_030	--NONCONVERGED--	143	'TO->FROM'	0.54645	101.1093	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
11	0	G08_061	--NONCONVERGED--	319	'FROM->TO'	0.60968	107.1864	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
1	0	G08_044	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.48766	114.471	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
1	0	G08_047	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.24307	114.471	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
1	0	G08_045	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.33369	114.471	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
1	0	G08_044	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.43889	109.8071	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
1	0	G08_047	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.21442	109.8071	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
1	0	G08_045	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.27239	109.8071	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
1	0	G08_044	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.43889	109.7019	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
1	0	G08_047	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.21442	109.7019	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
1	0	G08_045	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.27239	109.7019	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
1	0	G08_044	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.41518	103.3847	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
1	0	G08_047	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.19628	103.3847	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
1	0	G08_045	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'	1195	'TO->FROM'	0.24497	103.3847	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.37271	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.30144	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.43583	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.37683	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_088	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.24982	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.43583	141.8202	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_108	'HARRINGTON STATION - NICHOLS STATION 230KV CKT 1'	617	'FROM->TO'	0.23464	119.3486	'Harrington Station Mid Bus - NICHOLS STATION 230KV CKT 2'
2	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43795	119.1874	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43795	119.1874	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G08_108	'Harrington Station Mid Bus - NICHOLS STATION 230KV CKT 2'	617	'FROM->TO'	0.23405	119.0652	'HARRINGTON STATION - NICHOLS STATION 230KV CKT 1'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22688	114.226	'CIRCLE - MULLERGREN 230KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25452	113.7833	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.2164	113.7833	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28869	113.7833	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25683	113.7833	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28869	113.7833	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
2	0	G08_108	'HARRINGTON STATION - POTTER COUNTY INTERCHANGE 230KV CKT 2'	351	'TO->FROM'	0.25894	110.2058	'Harrington Station East Bus - Harrington Station Mid Bus 230KV CKT 1'
2	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39034	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.40438	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.48961	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39663	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39057	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.40438	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39034	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.40438	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.48961	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39663	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39057	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.40438	110.136	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39034	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
2	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.40438	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.48961	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39663	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39057	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.40438	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
2	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39034	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.40438	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.48961	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39663	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39057	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.40438	110.1342	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24936	108.8065	'SPP-MKEC-05'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28093	108.8065	'SPP-MKEC-05'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24936	108.7861	'SPP-WERE-34'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28093	108.7861	'SPP-WERE-34'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24936	108.7861	'SPP-WERE-34A'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28093	108.7861	'SPP-WERE-34A'
2	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32812	108.4138	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
2	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25568	108.4138	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
2	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32812	108.3292	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
2	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25568	108.3292	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
2	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43308	107.718	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
2	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43308	107.718	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24936	107.6553	'SPP-MKEC-08'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28093	107.6553	'SPP-MKEC-08'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24952	107.5616	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28109	107.5616	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
2	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43308	107.5282	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
2	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43308	107.5282	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.24163	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.20017	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.2783	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.24401	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.2783	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G07_019	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'	1052	'FROM->TO'	0.66488	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.24163	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G08_108	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.20017	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G08_028	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.2783	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G09_018	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.24401	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G08_110	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.2783	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G07_019	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 1'	1052	'FROM->TO'	0.66488	106.5102	'FINNEY SWITCHING STATION - HOLCOMB 345KV CKT 2'
2	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.33483	105.3054	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.26241	105.3054	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.57706	105.1585	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
2	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.57706	105.1585	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'
2	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.47722	104.9821	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.47722	104.9821	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
2	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24936	104.0753	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.28093	104.0753	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
2	0	G08_064	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'	497	'FROM->TO'	0.24946	104.0043	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_022	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'	497	'FROM->TO'	0.23202	104.0043	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_085	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'	497	'FROM->TO'	0.24835	104.0043	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_058	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'	497	'FROM->TO'	0.25397	104.0043	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_050	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'	497	'FROM->TO'	0.23202	104.0043	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.27573	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.23669	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_047	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.21401	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.31016	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.27795	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_088	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.20854	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.31016	104.0008	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21901	103.9014	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
2	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21901	103.7637	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25452	103.5238	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.2164	103.5238	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28869	103.5238	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25683	103.5238	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28869	103.5238	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
2	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.62381	102.3853	'SPP-WERE-34'
2	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70848	102.3853	'SPP-WERE-34'
2	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.62381	102.3853	'SPP-WERE-34A'
2	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70848	102.3853	'SPP-WERE-34A'
2	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.62381	102.3826	'SPP-MKEC-05'
2	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70848	102.3826	'SPP-MKEC-05'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.2548	102.1208	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.21669	102.1208	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28898	102.1208	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25711	102.1208	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28898	102.1208	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25943	101.9069	'SPP-SWPS-03B'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.22276	101.9069	'SPP-SWPS-03B'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29178	101.9069	'SPP-SWPS-03B'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.26152	101.9069	'SPP-SWPS-03B'
2	0	G08_088	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.19426	101.9069	'SPP-SWPS-03B'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29178	101.9069	'SPP-SWPS-03B'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25597	101.7079	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.21649	101.7079	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29075	101.7079	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.2582	101.7079	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29075	101.7079	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.2447	101.7057	'GEN531447 1-HOLCOMB GENERATOR'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.20319	101.7057	'GEN531447 1-HOLCOMB GENERATOR'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28141	101.7057	'GEN531447 1-HOLCOMB GENERATOR'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.24709	101.7057	'GEN531447 1-HOLCOMB GENERATOR'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.28141	101.7057	'GEN531447 1-HOLCOMB GENERATOR'
2	6	G08_108	'HARRINGTON STATION - NICHOLS STATION 230KV CKT 1'	617	'FROM->TO'	0.2165	100.9355	'Harrington Station Mid Bus - NICHOLS STATION 230KV CKT 2'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25767	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.22065	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29071	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25989	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	0	G08_088	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.19165	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29071	100.8508	'GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1'
2	6	G08_108	'Harrington Station Mid Bus - NICHOLS STATION 230KV CKT 2'	617	'FROM->TO'	0.21593	100.6757	'HARRINGTON STATION - NICHOLS STATION 230KV CKT 1'
2	0	G08_062	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25721	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G08_108	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.21955	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G08_028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29003	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G09_018	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.25924	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G08_088	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.19117	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G08_110	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'	1052	'TO->FROM'	0.29003	100.6132	'GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1'
2	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32865	100.4814	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
2	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25617	100.4814	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.61917	415.0438	'SPP-WERE-34'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70383	415.0438	'SPP-WERE-34'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.61917	415.0438	'SPP-WERE-34A'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70383	415.0438	'SPP-WERE-34A'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.61917	415.0347	'SPP-MKEC-05'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70383	415.0347	'SPP-MKEC-05'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.9958	404.5654	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.9958	404.5654	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.61917	402.2562	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70383	402.2562	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.62081	366.9511	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70547	366.9511	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.61917	366.8221	'SPP-MKEC-08'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.70383	366.8221	'SPP-MKEC-08'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.9958	305.2093	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.9958	305.2083	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.33138	296.6682	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25896	296.6682	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.42664	287.6639	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55123	287.6639	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43061	272.9775	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55718	272.9775	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.431	269.5806	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55723	269.5806	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.35888	262.9528	'SPP-WERE-78'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.29599	262.9528	'SPP-WERE-78'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.35888	262.9335	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.29599	262.9335	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.42664	262.5881	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55123	262.5881	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.62337	262.3463	'SPP-MKEC-05'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70803	262.3463	'SPP-MKEC-05'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.62337	262.3433	'SPP-WERE-34'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70803	262.3433	'SPP-WERE-34'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.62337	262.3433	'SPP-WERE-34A'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70803	262.3433	'SPP-WERE-34A'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.35888	262.167	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.29599	262.167	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.4288	260.2068	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55473	260.2068	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32529	259.1704	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25284	259.1704	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	259.1038	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	259.1038	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32529	259.0437	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25284	259.0437	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.40155	259.0158	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.51914	259.0158	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	258.6719	'GEN571160 1-GEN2008-060 34.500'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	258.6719	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43516	257.8163	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.56064	257.8163	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43516	257.8163	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 2'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.56064	257.8163	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 2'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43093	257.7008	'MINGO - SETAB 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55747	257.7008	'MINGO - SETAB 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	257.5846	'HARPER 138KV SWITCHED SHUNT'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	257.5846	'HARPER 138KV SWITCHED SHUNT'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43083	257.5677	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55739	257.5677	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	1	254.4014	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	1	254.4014	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.62337	251.2553	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70803	251.2553	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32772	250.4478	'CIRCLE - MULLERGREN 230KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25564	250.4478	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.427	249.7731	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55264	249.7731	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.4277	249.5118	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55307	249.5118	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	249.4975	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	249.4975	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.42926	249.1586	'SPP-MKEC-02'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55544	249.1586	'SPP-MKEC-02'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3278	247.8932	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25535	247.8932	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	247.4951	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	247.4951	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	247.2251	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	247.2251	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.38661	246.7977	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.33215	246.7977	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.38661	246.791	'SPP-MKEC-06'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.33215	246.791	'SPP-MKEC-06'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.38325	246.3965	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.49573	246.3965	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.38325	246.3672	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.49573	246.3672	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.33138	245.8663	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25896	245.8663	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32624	245.4891	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25377	245.4891	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.4295	244.3677	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55579	244.3677	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32632	244.0934	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25383	244.0934	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32731	244.0897	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25493	244.0897	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32789	244.0581	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25544	244.0581	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3263	243.3809	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25383	243.3809	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32615	242.9297	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25371	242.9297	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32632	241.9802	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25383	241.9802	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32587	241.9118	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25327	241.9118	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24722	241.8881	'SPP-MKEC-05'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27879	241.8881	'SPP-MKEC-05'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24722	241.8703	'SPP-WERE-34'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27879	241.8703	'SPP-WERE-34'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24722	241.8703	'SPP-WERE-34A'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27879	241.8703	'SPP-WERE-34A'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	241.246	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	241.246	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32618	241.1987	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25375	241.1987	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32746	241.1582	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25499	241.1582	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32567	241.0117	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.2532	241.0117	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	240.4084	'GEN336153 1-WATERFORD UNIT#3'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	240.4084	'GEN336153 1-WATERFORD UNIT#3'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	240.2585	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	240.2585	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32567	240.0933	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.2532	240.0933	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24722	237.4079	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27879	237.4079	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	236.2186	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	236.2186	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22191	235.5346	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.38761	234.2674	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.38761	234.2674	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.33138	233.0377	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25896	233.0377	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.31943	232.0852	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.413	232.0852	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.31943	232.0838	'SPP-MKEC-06'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.413	232.0838	'SPP-MKEC-06'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	230.9257	'GEN560276 1-G06-06 0.6900'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	230.9257	'GEN560276 1-G06-06 0.6900'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	230.8323	'GEN560273 1-G05-12 0.6900'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	230.8323	'GEN560273 1-G05-12 0.6900'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32049	230.8082	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.24906	230.8082	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	230.4189	'GEN560232 1-G08-79 0.5750'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	230.4189	'GEN560232 1-G08-79 0.5750'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.32651	230.2001	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25437	230.2001	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	230.0955	'GEN572035 1-GEN2007-019 0.5750'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	230.0955	'GEN572035 1-GEN2007-019 0.5750'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3268	230.0124	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.2543	230.0124	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	229.9537	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	229.9537	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	229.9176	'GEN572062 1-GEN08-087 0.7000'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	229.9176	'GEN572062 1-GEN08-087 0.7000'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3252	229.8857	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25279	229.8857	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3252	229.7599	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25279	229.7599	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	229.5525	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	229.5525	'GEN560279 1-G08-18 0.6900'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	228.0424	'GEN571160 1-GEN2008-060 34.500'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	228.0424	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	227.3412	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	227.3412	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	227.078	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	227.078	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22523	226.9192	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	226.2971	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	226.2971	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24722	224.2749	'SPP-MKEC-08'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27879	224.2749	'SPP-MKEC-08'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24791	224.1985	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.27947	224.1985	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.54884	223.2718	'SPP-MKEC-09B'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.64805	223.2718	'SPP-MKEC-09B'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	219.4182	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	219.4182	'GEN539787 1-G01-39A 0.6000'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.625	217.0218	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70967	217.0218	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.62337	216.8886	'SPP-MKEC-08'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.70803	216.8886	'SPP-MKEC-08'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.35888	216.5519	'SPP-WERE-78'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.29599	216.5519	'SPP-WERE-78'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.35888	216.5354	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.29599	216.5354	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.35888	215.9126	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.29599	215.9126	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32529	213.3168	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25284	213.3168	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32529	213.2065	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25284	213.2065	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.44119	210.297	'SPP-MKEC-09B'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.34198	210.297	'SPP-MKEC-09B'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.31943	210.0953	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.413	210.0953	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.31943	210.0924	'SPP-MKEC-06'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.413	210.0924	'SPP-MKEC-06'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.377	209.5137	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.48797	209.5137	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.5749	209.2073	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.5749	209.1667	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	209.0363	'GEN571101 1-GEN2008-059 0.6900'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	209.0363	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.377	208.2733	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.48797	208.2733	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.377	208.2512	'SPP-WERE-78'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.48797	208.2512	'SPP-WERE-78'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	206.3303	'GEN571101 1-GEN2008-059 0.6900'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	206.3303	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32772	205.818	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25564	205.818	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21758	204.6412	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21758	204.3372	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.35888	204.2708	'SPP-WERE-78'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.29599	204.2708	'SPP-WERE-78'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.35888	204.2546	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.29599	204.2546	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.35888	203.6422	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.29599	203.6422	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3278	203.6131	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25535	203.6131	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	203.3392	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	203.3392	'GEN539648 1-NINNESC3 115.00'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	203.0357	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	203.0357	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.38661	202.7162	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.33215	202.7162	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.38661	202.7144	'SPP-MKEC-06'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.33215	202.7144	'SPP-MKEC-06'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32624	201.5846	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25377	201.5846	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32529	201.0514	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25284	201.0514	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32529	200.9487	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25284	200.9487	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24722	200.4627	'SPP-MKEC-05'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27879	200.4627	'SPP-MKEC-05'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24722	200.4467	'SPP-WERE-34'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27879	200.4467	'SPP-WERE-34'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24722	200.4467	'SPP-WERE-34A'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27879	200.4467	'SPP-WERE-34A'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32632	200.3686	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25383	200.3686	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32731	200.3678	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25493	200.3678	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32789	200.3394	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25544	200.3394	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3263	199.7567	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25383	199.7567	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32615	199.3572	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25371	199.3572	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.38761	198.976	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.38761	198.9733	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32632	198.5429	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25383	198.5429	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32587	198.472	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25327	198.472	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	197.9018	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	197.9018	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32618	197.8615	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25375	197.8615	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21875	197.8567	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32746	197.8281	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25499	197.8281	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32567	197.7009	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.2532	197.7009	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	197.1761	'GEN336153 1-WATERFORD UNIT#3'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	197.1761	'GEN336153 1-WATERFORD UNIT#3'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	197.0476	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	197.0476	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32567	196.9082	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.2532	196.9082	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32596	196.8584	'MINGO - SETAB 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25345	196.8584	'MINGO - SETAB 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32597	196.7867	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.2535	196.7867	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24722	196.4606	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27879	196.4606	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21812	194.8357	'CIRCLE (CIRCLE1X) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.22191	193.8954	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32772	193.718	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25564	193.718	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.38761	193.659	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.38761	193.659	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21883	192.7491	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21936	191.8333	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3278	191.5467	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25535	191.5467	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32029	191.4065	'59TH ST - EL PASO 138KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.24888	191.4065	'59TH ST - EL PASO 138KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	191.3295	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	191.3295	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.23348	191.1317	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.30156	191.1317	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.23348	191.0568	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.30156	191.0568	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32029	191.0446	'59TH ST - GILL ENERGY CENTER SOUTH 138KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.24888	191.0446	'59TH ST - GILL ENERGY CENTER SOUTH 138KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	190.9939	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	190.9939	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21931	190.8885	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.38661	190.7027	'SPP-MKEC-06'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.33215	190.7027	'SPP-MKEC-06'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.38661	190.7017	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.33215	190.7017	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.3258	190.5353	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'HARPER - MILAN TAP 138KV CKT 1'	95.6	'FROM->TO'	0.25332	190.5353	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21841	190.3162	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	190.2421	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.47292	189.7866	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.47292	189.7866	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21822	189.7626	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32624	189.5728	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25377	189.5728	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.9686	'GEN560276 1-G06-06 0.6900'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.9686	'GEN560276 1-G06-06 0.6900'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.8893	'GEN560273 1-G05-12 0.6900'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.8893	'GEN560273 1-G05-12 0.6900'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32049	188.8575	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.24906	188.8575	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.5324	'GEN560232 1-G08-79 0.5750'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.5324	'GEN560232 1-G08-79 0.5750'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32731	188.3873	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25493	188.3873	'AXTELL - KNOLL345 345.00 345KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32632	188.3798	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25383	188.3798	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32789	188.3551	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25544	188.3551	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.32651	188.3315	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25437	188.3315	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21942	188.244	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.2436	'GEN572035 1-GEN2007-019 0.5750'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.2436	'GEN572035 1-GEN2007-019 0.5750'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.22523	188.2036	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24722	188.1944	'SPP-MKEC-05'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27879	188.1944	'SPP-MKEC-05'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3268	188.1795	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.2543	188.1795	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24722	188.1741	'SPP-WERE-34'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27879	188.1741	'SPP-WERE-34'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24722	188.1741	'SPP-WERE-34A'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27879	188.1741	'SPP-WERE-34A'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.1309	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.1309	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	188.097	'GEN572062 1-GEN08-087 0.7000'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	188.097	'GEN572062 1-GEN08-087 0.7000'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3252	188.0695	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25279	188.0695	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3252	187.9628	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25279	187.9628	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3263	187.7843	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25383	187.7843	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	187.7805	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	187.7805	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21841	187.6746	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	187.421	'CLEARWATER 138KV SWITCHED SHUNT'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	187.421	'CLEARWATER 138KV SWITCHED SHUNT'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32615	187.3919	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25371	187.3919	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21826	186.8964	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.2205	186.7197	'SPP-MKEC-02'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32632	186.6008	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25383	186.6008	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32587	186.5	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25327	186.5	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	186.498	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	186.4972	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	186.4718	'GEN571160 1-GEN2008-060 34.500'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	186.4718	'GEN571160 1-GEN2008-060 34.500'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	186.1691	'GEN532651 1-JEFFREY ENERGY CENTER UNIT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	185.9863	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	185.9863	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32618	185.9336	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25375	185.9336	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21785	185.9009	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32746	185.899	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25499	185.899	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	185.8627	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	185.8627	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32567	185.7757	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.2532	185.7757	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	185.6456	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	185.6456	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	185.6234	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	185.2667	'GEN336153 1-WATERFORD UNIT#3'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	185.2667	'GEN336153 1-WATERFORD UNIT#3'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	185.1424	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	185.1424	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32567	185.0028	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.2532	185.0028	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32596	184.9454	'MINGO - SETAB 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25345	184.9454	'MINGO - SETAB 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32597	184.8863	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.2535	184.8863	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	184.7069	'GEN335831 1-RIVERBEND UNIT#1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	184.7069	'GEN335831 1-RIVERBEND UNIT#1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3257	184.6543	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25322	184.6543	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	184.5664	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25333	184.5664	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24722	184.5177	'SPP-MKEC-08'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27879	184.5177	'SPP-MKEC-08'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24791	184.4555	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.27947	184.4555	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	184.4548	'GEN337910 1-ARKANSAS NUCLEAR ONE UNIT #1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	184.4548	'GEN337910 1-ARKANSAS NUCLEAR ONE UNIT #1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	184.3927	'GEN542955 1-LACYGNE UNIT #1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	184.3927	'GEN542955 1-LACYGNE UNIT #1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24722	184.3616	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27879	184.3616	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32856	184.2135	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25715	184.2135	'RENO COUNTY - WICHITA 345KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.22191	181.783	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.38761	181.7278	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.38761	181.7278	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32029	179.7221	'59TH ST - EL PASO 138KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.24888	179.7221	'59TH ST - EL PASO 138KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32029	179.3595	'59TH ST - GILL ENERGY CENTER SOUTH 138KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.24888	179.3595	'59TH ST - GILL ENERGY CENTER SOUTH 138KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	179.0428	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	179.0428	'GEN539787 1-G01-39A 0.6000'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	177.224	'GEN560276 1-G06-06 0.6900'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	177.224	'GEN560276 1-G06-06 0.6900'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32049	177.2116	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.24906	177.2116	'GILL ENERGY CENTER SOUTH - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	177.1472	'GEN560273 1-G05-12 0.6900'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	177.1472	'GEN560273 1-G05-12 0.6900'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	176.8022	'GEN560232 1-G08-79 0.5750'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	176.8022	'GEN560232 1-G08-79 0.5750'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22119	176.5894	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.32651	176.5629	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25437	176.5629	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	176.5398	'GEN560279 1-G08-18 0.6900'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	176.5066	'GEN572035 1-GEN2007-019 0.5750'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	176.5066	'GEN572035 1-GEN2007-019 0.5750'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.22523	176.477	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3268	176.449	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.2543	176.449	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	176.4129	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	176.4129	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	176.3685	'GEN572062 1-GEN08-087 0.7000'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	176.3685	'GEN572062 1-GEN08-087 0.7000'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3252	176.3522	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25279	176.3522	'GEN08-098 345.00 - WOLF CREEK 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3252	176.2348	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25279	176.2348	'GEN08-098 345.00 - LACYGNE 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21757	176.0732	'HOYT - JEFFERY ENERGY CENTER 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	176.0576	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	176.0576	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21754	175.8397	'WRTOD400'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	175.2799	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.20877	175.2413	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.26996	175.2413	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21197	175.2268	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	174.7686	'GEN571160 1-GEN2008-060 34.500'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	174.7686	'GEN571160 1-GEN2008-060 34.500'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	174.7224	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	174.168	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	174.168	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	174.1626	'GEN539787 1-G01-39A 0.6000'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	173.9629	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	173.9629	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	173.6218	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43526	173.6158	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43526	173.6158	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24722	172.958	'SPP-MKEC-08'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27879	172.958	'SPP-MKEC-08'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24791	172.8971	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.27947	172.8971	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	171.7113	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21013	171.2117	'SPP-MKEC-09B'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.24957	171.2117	'SPP-MKEC-09B'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.44119	171.1706	'SPP-MKEC-09B'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.34198	171.1706	'SPP-MKEC-09B'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.31943	171.1372	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.413	171.1372	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.31943	171.1291	'SPP-MKEC-06'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.413	171.1291	'SPP-MKEC-06'
3	0	G08_060	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.21049	170.6649	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_122	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.21049	170.6649	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.5749	170.1562	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.5749	170.1224	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	167.6685	'GEN571101 1-GEN2008-059 0.6900'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	167.6685	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	167.4709	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	167.4709	'GEN539787 1-G01-39A 0.6000'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.377	166.4605	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.48797	166.4605	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.377	166.4386	'SPP-WERE-78'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.48797	166.4386	'SPP-WERE-78'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21758	166.1969	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21758	165.8577	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	165.4904	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	165.1736	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	165.1736	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22119	164.7952	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43501	164.12	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56157	164.12	'GEN539648 1-NINNESC3 115.00'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	164.0846	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	164.0846	'GEN539648 1-NINNESC3 115.00'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.377	163.4471	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.48797	163.4471	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.38761	160.213	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.38761	160.2105	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.31943	160.1233	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.413	160.1233	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.31943	160.116	'SPP-MKEC-06'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.413	160.116	'SPP-MKEC-06'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21875	159.7325	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.44119	159.7184	'SPP-MKEC-09B'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.34198	159.7184	'SPP-MKEC-09B'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.5749	158.5835	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.5749	158.556	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21812	156.9165	'CIRCLE (CIRCLE1X) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	156.2109	'GEN571101 1-GEN2008-059 0.6900'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	156.2109	'GEN571101 1-GEN2008-059 0.6900'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21758	155.4253	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21758	155.0965	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	1	154.8085	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	1	154.7811	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	154.6208	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	154.6208	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21883	154.4945	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.37194	154.1181	'SPP-WERE-34'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.42504	154.1181	'SPP-WERE-34'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.37194	154.1181	'SPP-WERE-34A'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.42504	154.1181	'SPP-WERE-34A'
3	0	G08_059	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.3258	154.097	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'CLEARWATER - MILAN TAP 138KV CKT 1'	110	'TO->FROM'	0.25332	154.097	'GEN573551 1-GEN09-003 0.5750'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.37194	154.0908	'SPP-MKEC-05'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.42504	154.0908	'SPP-MKEC-05'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	153.8016	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	153.8016	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21936	153.4915	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21931	152.9837	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.23348	152.6604	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.30156	152.6604	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.23348	152.5991	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.30156	152.5991	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	152.3353	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21841	152.0367	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21822	151.8512	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.6082	150.9243	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.6082	150.9243	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43129	150.5865	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43129	150.5865	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43129	150.2351	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43129	150.2351	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21942	149.9571	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	149.688	'GEN539648 1-NINNESC3 115.00'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.38761	149.6815	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.38761	149.6791	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21841	149.3929	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21875	149.2402	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.2205	148.6709	'SPP-MKEC-02'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21826	148.6654	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	148.3583	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	148.3566	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	148.0261	'GEN532651 1-JEFFREY ENERGY CENTER UNIT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	147.8421	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21812	146.5527	'CIRCLE (CIRCLE1X) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.37194	145.7269	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.42504	145.7269	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21883	144.204	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21936	143.2408	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.43081	143.1121	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'NINNESC3 115.00 - ST JOHN 115KV CKT 1'	79.7	'FROM->TO'	0.55738	143.1121	'GEN573551 1-GEN09-003 0.5750'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	142.9684	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	142.9684	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.3258	142.865	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'	110	'FROM->TO'	0.25332	142.865	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21931	142.7853	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.23348	142.4891	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.30156	142.4891	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.23348	142.4305	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.30156	142.4305	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.21794	142.2082	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	142.1639	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21841	141.8611	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21822	141.7028	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.39591	141.2442	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.39591	141.2442	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21942	139.8675	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43084	139.4159	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.55543	139.4159	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21841	139.3165	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.22119	139.0823	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	139.0597	'GEN560279 1-G08-18 0.6900'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.2205	138.6371	'SPP-MKEC-02'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21826	138.6186	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21757	138.4072	'HOYT - JEFFERY ENERGY CENTER 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	138.3315	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	138.3299	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21754	138.1754	'WRTOD400'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	137.8932	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.20877	137.7123	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.26996	137.7123	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21197	137.5763	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	137.4946	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	137.3607	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	136.7173	'GEN539787 1-G01-39A 0.6000'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	136.243	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4238	135.6817	'MINGO - SETAB 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4238	135.6817	'MINGO - SETAB 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42345	135.1094	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42345	135.1094	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42362	134.4956	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42362	134.4956	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	134.3508	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21013	133.8651	'SPP-MKEC-09B'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.24957	133.8651	'SPP-MKEC-09B'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42711	133.8561	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42711	133.8561	'Hitchland Interchange - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.62338	133.1435	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42263	132.5565	'HOLCOMB - SETAB 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42263	132.5565	'HOLCOMB - SETAB 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42368	131.9183	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42368	131.9183	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	131.8227	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	131.8227	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42362	131.6949	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42362	131.6949	'GEN09-022 345.00 - MINGO 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43123	130.9853	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43123	130.9853	'COMANCH5 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42733	130.6028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42733	130.6028	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.9764	'GEN532651 1-JEFFREY ENERGY CENTER UNIT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.9764	'GEN532651 1-JEFFREY ENERGY CENTER UNIT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.8992	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.8992	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.8982	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.8982	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.6145	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	129.6145	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43959	128.8714	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43959	128.8714	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43959	128.8714	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.43959	128.8714	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21757	128.8231	'HOYT - JEFFERY ENERGY CENTER 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21754	128.5994	'WRTOD400'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	128.4016	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.243	'GEN336153 1-WATERFORD UNIT#3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.243	'GEN336153 1-WATERFORD UNIT#3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.2007	'GEN542955 1-LACYGNE UNIT #1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.2007	'GEN542955 1-LACYGNE UNIT #1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42072	128.168	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42072	128.168	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.20877	128.1594	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.26996	128.1594	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42017	128.1571	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42017	128.1571	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.1314	'GEN542957 1-IATAN UNIT #1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	128.1314	'GEN542957 1-IATAN UNIT #1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	128.0757	'MANNING TAP - SCOTT CITY 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	128.0757	'MANNING TAP - SCOTT CITY 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	128.0695	'NESS CITY - NESS CITY 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	128.0695	'NESS CITY - NESS CITY 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21197	128.0282	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	127.9681	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.9123	'GEN542956 2-LACYGNE UNIT #2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.9123	'GEN542956 2-LACYGNE UNIT #2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42029	127.8905	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42029	127.8905	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.8738	'GEN573551 1-GEN09-003 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.8738	'GEN573551 1-GEN09-003 0.5750'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	127.8393	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	127.8029	'DIGHTON TAP - MANNING TAP 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	127.8029	'DIGHTON TAP - MANNING TAP 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.7549	'GEN335831 1-RIVERBEND UNIT#1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.7549	'GEN335831 1-RIVERBEND UNIT#1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.22119	127.6349	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.6304	'GEN640009 1-COOPER NUCLEAR STATION'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.6304	'GEN640009 1-COOPER NUCLEAR STATION'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.6268	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.6268	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	127.5546	'ALEXANDER - NESS CITY 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	127.5546	'ALEXANDER - NESS CITY 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.4107	'GEN542951 5-HAWTHORN UNIT #5'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.4107	'GEN542951 5-HAWTHORN UNIT #5'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	127.3877	'ALEXANDER - NEKOMA 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41159	127.3877	'ALEXANDER - NEKOMA 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.2723	'GEN338146 1-INDEPENDENCE UNIT #2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.2723	'GEN338146 1-INDEPENDENCE UNIT #2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.2597	'GEN539648 1-NINNESC3 115.00'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.2597	'GEN539648 1-NINNESC3 115.00'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42029	127.2473	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42029	127.2473	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	127.2463	'BEELER - DIGHTON TAP 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	127.2463	'BEELER - DIGHTON TAP 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	127.2141	'GEN539787 1-G01-39A 0.6000'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40839	127.198	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40839	127.198	'SEWARD - ST JOHN 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.1649	'GEN645012 2-NEBRASKA CITY 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.1649	'GEN645012 2-NEBRASKA CITY 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40835	127.1627	'SPP-MKEC-06'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40835	127.1627	'SPP-MKEC-06'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.0788	'GEN337910 1-ARKANSAS NUCLEAR ONE UNIT #1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.0788	'GEN337910 1-ARKANSAS NUCLEAR ONE UNIT #1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.019	'GEN337653 1-WHITE BLUFF UNIT #2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.019	'GEN337653 1-WHITE BLUFF UNIT #2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.0124	'GEN645011 1-NEBRASKA CITY 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	127.0124	'GEN645011 1-NEBRASKA CITY 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	126.9918	'BEELER - NESS CITY 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41571	126.9918	'BEELER - NESS CITY 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.9802	'GEN337652 1-WHITE BLUFF UNIT #1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.9802	'GEN337652 1-WHITE BLUFF UNIT #1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.8413	'GEN532663 1-LAWRENCE ENERGY CENTER UNIT 5'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.8413	'GEN532663 1-LAWRENCE ENERGY CENTER UNIT 5'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4217	126.8097	'GERALD GENTLEMAN STATION - RED WILLOW 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4217	126.8097	'GERALD GENTLEMAN STATION - RED WILLOW 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.7902	'GEN337041 1-GERALD ANDRUS'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.7902	'GEN337041 1-GERALD ANDRUS'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	126.7703	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42017	126.4208	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42017	126.4208	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42071	126.3607	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42071	126.3607	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2965	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2965	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2822	'GEN300007 1-NEW MADRID UNIT 2'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2822	'GEN300007 1-NEW MADRID UNIT 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2758	'GEN300006 1-NEW MADRID UNIT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2758	'GEN300006 1-NEW MADRID UNIT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2569	'GEN645001 1-FORT CALHOUN 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2569	'GEN645001 1-FORT CALHOUN 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2063	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.2063	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.1148	'GEN541151 3-SIBLEY GENERATING UNIT #3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.1148	'GEN541151 3-SIBLEY GENERATING UNIT #3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.0908	'GEN501813 1-RODEMACHER UNIT 3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	126.0908	'GEN501813 1-RODEMACHER UNIT 3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42033	126.0133	'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42033	126.0133	'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.988	'GEN335206 1-NELSON UNIT 6'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.988	'GEN335206 1-NELSON UNIT 6'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.9445	'GEN336801 1-BAXTER WILSON UNIT #1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.9445	'GEN336801 1-BAXTER WILSON UNIT #1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42021	125.94	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42021	125.94	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8985	'GEN530689 1-G06-32 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8985	'GEN530689 1-G06-32 0.5750'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8787	'GEN501812 1-RODEMACHER UNIT 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8787	'GEN501812 1-RODEMACHER UNIT 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8708	'GEN501801 1-DOLET HILLS UNIT1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.8708	'GEN501801 1-DOLET HILLS UNIT1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42056	125.8631	'LYDIA - VALLIANT 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42056	125.8631	'LYDIA - VALLIANT 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42056	125.8438	'SPP-AEPW-01'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42056	125.8438	'SPP-AEPW-01'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4196	125.83	'COLBY - MINGO 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4196	125.83	'COLBY - MINGO 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41859	125.7443	'MINGO (MINGO) 345/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41859	125.7443	'MINGO (MINGO) 345/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42368	125.7386	'SPP-MKEC-09B'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42368	125.7386	'SPP-MKEC-09B'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4201	125.7092	'CIMARRON - G07-43T 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4201	125.7092	'CIMARRON - G07-43T 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42047	125.7063	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42047	125.7063	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.6558	'GEN300003 1-THOMAS HILL UNIT 3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.6558	'GEN300003 1-THOMAS HILL UNIT 3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41952	125.6463	'COLBY - HOXIE 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41952	125.6463	'COLBY - HOXIE 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.6	'GEN335546 1-DOW COGEN'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.6	'GEN335546 1-DOW COGEN'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5981	'STEGALL TY 345/230KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5981	'STEGALL TY 345/230KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5979	'STEGALL - STEGALL TRANSFORMER 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5979	'STEGALL - STEGALL TRANSFORMER 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5966	'NEB01WAPAB3'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42036	125.5966	'NEB01WAPAB3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.5601	'GEN509394 1-FLINT CREEK'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.5601	'GEN509394 1-FLINT CREEK'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42032	125.5437	'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42032	125.5437	'GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.5161	'GEN512688 2-GRDA1 GSU2 22'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.5161	'GEN512688 2-GRDA1 GSU2 22'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4839	'SPP-WERE-34'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4839	'SPP-WERE-34'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4839	'SPP-WERE-34A'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4839	'SPP-WERE-34A'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41979	125.4769	'EAST MANHATTAN - JEFFREY ENERGY CENTER 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41979	125.4769	'EAST MANHATTAN - JEFFREY ENERGY CENTER 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42119	125.4719	'CUDAHY - G08-79T 115.00 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42119	125.4719	'CUDAHY - G08-79T 115.00 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4688	'SPP-MKEC-05'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.4688	'SPP-MKEC-05'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42012	125.467	'ANADARK7 345.00 - G07-43T 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42012	125.467	'ANADARK7 345.00 - G07-43T 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42064	125.4589	'FPL SWITCH - MOORELAND 138KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42064	125.4589	'FPL SWITCH - MOORELAND 138KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4536	'GEN546702 1-NM GEN N1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4536	'GEN546702 1-NM GEN N1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41601	125.4351	'LACROSSE TAP - NEKOMA 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41601	125.4351	'LACROSSE TAP - NEKOMA 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4289	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4289	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4288	'GEN509403 1-PIRKEY GENERATION'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.4288	'GEN509403 1-PIRKEY GENERATION'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41952	125.4186	'BEACH STATION - HOXIE 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41952	125.4186	'BEACH STATION - HOXIE 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.3788	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41925	125.3788	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42065	125.3603	'FPL SWITCH - WOODWARD 138KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42065	125.3603	'FPL SWITCH - WOODWARD 138KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.3512	'GEN560235 1-G08-92 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.3512	'GEN560235 1-G08-92 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.344	'GEN511840 1-NORTHEASTERN STATION #3'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.344	'GEN511840 1-NORTHEASTERN STATION #3'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.3316	'GEN511841 1-NORTHEASTERN STATION #4'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.3316	'GEN511841 1-NORTHEASTERN STATION #4'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.2921	'GEN335137 2-PPG'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	125.2921	'GEN335137 2-PPG'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41601	125.2509	'HEIZER - LACROSSE TAP 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41601	125.2509	'HEIZER - LACROSSE TAP 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4144	125.2264	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4144	125.2264	'GREAT BEND TAP - SEWARD 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4144	125.2248	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4144	125.2248	'GREAT BEND TAP - MULLERGREN 115KV CKT 1'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	124.9502	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_059	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21013	124.4839	'SPP-MKEC-09B'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.24957	124.4839	'SPP-MKEC-09B'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.3729	123.9465	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.426	123.9465	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.37194	123.7969	'SPP-MKEC-08'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.42504	123.7969	'SPP-MKEC-08'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41829	123.4405	'CIRCLE - RENO COUNTY 115KV CKT 2'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41829	123.4405	'CIRCLE - RENO COUNTY 115KV CKT 2'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41869	123.3918	'MORRIS COUNTY - SUMMIT 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41869	123.3918	'MORRIS COUNTY - SUMMIT 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4081	123.3889	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4081	123.3889	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.3268	'GEN527882 1-CUNNINGHAM GEN #2 20 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.3268	'GEN527882 1-CUNNINGHAM GEN #2 20 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.2587	'GEN527903 1-HOBBS PLANT #3 (ST)'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.2587	'GEN527903 1-HOBBS PLANT #3 (ST)'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41964	123.2441	'SPP-MKEC-03'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41964	123.2441	'SPP-MKEC-03'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.2037	'GEN573711 1-GEN08-022 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.2037	'GEN573711 1-GEN08-022 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41908	123.1867	'MOUNDRIDGE - RENO COUNTY 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41908	123.1867	'MOUNDRIDGE - RENO COUNTY 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1613	'GEN539653 1-CIMARRON RIVER PLANT GENERATOR'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1613	'GEN539653 1-CIMARRON RIVER PLANT GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1179	'GEN526331 1-JONES GEN #1 22 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1179	'GEN526331 1-JONES GEN #1 22 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1175	'GEN526332 1-JONES GEN #2 21 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	123.1175	'GEN526332 1-JONES GEN #2 21 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41884	123.1099	'G07-25T 345.00 - G08-13T 345.00 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41884	123.1099	'G07-25T 345.00 - G08-13T 345.00 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41995	123.0722	'AMRN_OUTS6'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41995	123.0722	'AMRN_OUTS6'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41995	123.0685	'LACYGNE - NEOSHO 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41995	123.0685	'LACYGNE - NEOSHO 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41951	123.011	'SWISSVALE - WEST GARDNER 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41951	123.011	'SWISSVALE - WEST GARDNER 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.9065	'GEN539787 1-G01-39A 0.6000'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.9065	'GEN539787 1-G01-39A 0.6000'
3	0	G08_060	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.7712	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.7712	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.7712	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.7712	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	122.7473	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	122.7473	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.23236	122.7473	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.21688	122.7473	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	122.7473	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	122.7473	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.23236	122.7473	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.21688	122.7473	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41888	122.6478	'G08-13T 345.00 - WOODRING 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41888	122.6478	'G08-13T 345.00 - WOODRING 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41797	122.4977	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41797	122.4977	'KNOLL 230 - SMOKYHLLS6 230.00 230KV CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.284	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.284	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.2839	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.46033	122.2839	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.4352	122.2047	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56143	122.2047	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	122.1336	'COVERT 3 115.00 - SMITH CENTER 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	122.1336	'COVERT 3 115.00 - SMITH CENTER 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	122.1325	'COVERT 3 115.00 - WALDO 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	122.1325	'COVERT 3 115.00 - WALDO 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.116	'GEN523971 1-HARRINGTON GEN #1 24 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.116	'GEN523971 1-HARRINGTON GEN #1 24 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.1096	'GEN523972 1-HARRINGTON GEN #2 24 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	122.1096	'GEN523972 1-HARRINGTON GEN #2 24 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41803	121.997	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41803	121.997	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	121.99	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	121.99	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.23236	121.99	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.21688	121.99	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	121.99	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.50331	121.99	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.23236	121.99	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1'	336	'FROM->TO'	0.21688	121.99	'SPEARVILLE (SPEARVL2) 345/230/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	121.9457	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	121.9457	'GEN2008-059 115.00 - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	121.9423	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	121.9423	'PRATT - SAWYER 3 115.00 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43481	121.7787	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56137	121.7787	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	121.7456	'RUSSELL - WALDO 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	121.7456	'RUSSELL - WALDO 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.708	'GEN560232 1-G08-79 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.708	'GEN560232 1-G08-79 0.5750'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.5709	'GEN525562 1-TOLK GEN #2 24 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.5709	'GEN525562 1-TOLK GEN #2 24 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.4567	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	121.4567	'GEN539767 1-GRAY COUNTY WIND FARM'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.3536	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.3536	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.2988	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.2988	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.2541	'SPP-WERE-78'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41759	121.2541	'SPP-WERE-78'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41076	121.0962	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41076	121.0962	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41939	121.0774	'HOYT - STRANGER CREEK 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41939	121.0774	'HOYT - STRANGER CREEK 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.9859	'GEN543115 1-GREAT PLAINS ENERGY WIND GENERATION AT SPEARVILLE'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.9859	'GEN543115 1-GREAT PLAINS ENERGY WIND GENERATION AT SPEARVILLE'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41527	120.8166	'CIRCLE - EAST MCPHERSON 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41527	120.8166	'CIRCLE - EAST MCPHERSON 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.6932	'GEN525561 1-TOLK GEN #1 24 KV'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.6932	'GEN525561 1-TOLK GEN #1 24 KV'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.4308	'GEN560096 1-G07-40 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.4308	'GEN560096 1-G07-40 0.5750'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.2277	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	120.2277	'GEN539670 4-JUDSON LARGE GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41938	119.9454	'HOYT - JEFFERY ENERGY CENTER 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41938	119.9454	'HOYT - JEFFERY ENERGY CENTER 345KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	119.8184	'SPP-MKEC-02'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41542	119.8184	'SPP-MKEC-02'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.38654	119.7232	'KNOLL 230 - S HAYS6 230.00 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.38654	119.7232	'KNOLL 230 - S HAYS6 230.00 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41931	119.7104	'WRTOD400'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.41931	119.7104	'WRTOD400'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.4433	'GEN560432 1-G08-124 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.4433	'GEN560432 1-G08-124 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.4335	'GEN531106 1-G07-38 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.4335	'GEN531106 1-G07-38 0.6900'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	119.263	'GEN571101 1-GEN2008-059 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.1785	'GEN560270 1-G04-14 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.1785	'GEN560270 1-G04-14 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.1275	'GEN572035 1-GEN2007-019 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	119.1275	'GEN572035 1-GEN2007-019 0.5750'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	118.9958	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.4163	118.9958	'GEN2008-059 115.00 - MEDICINE LODGE 115KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	118.604	'GEN560279 1-G08-18 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	118.604	'GEN560279 1-G08-18 0.6900'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.22119	118.5468	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40935	118.3272	'CIRCLE (CIRCLE1X) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.40935	118.3272	'CIRCLE (CIRCLE1X) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	118.2313	'GEN560273 1-G05-12 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	118.2313	'GEN560273 1-G05-12 0.6900'
3	0	G08_060	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.21964	118.1839	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G08_122	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.21964	118.1839	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	117.5343	'GEN560276 1-G06-06 0.6900'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	117.5343	'GEN560276 1-G06-06 0.6900'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	117.4858	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	117.4858	'GEN531447 1-HOLCOMB GENERATOR'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	116.998	'GEN572062 1-GEN08-087 0.7000'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	116.998	'GEN572062 1-GEN08-087 0.7000'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.44214	115.949	'GRAY CO 345.00 - HOLCOMB 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.44214	115.949	'GRAY CO 345.00 - HOLCOMB 345KV CKT 1'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.32863	115.4462	'GEN539630 1-FLATRDG1 34.500'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.25616	115.4462	'GEN539630 1-FLATRDG1 34.500'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.349	114.6648	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.349	114.6648	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	114.0797	'GEN572012 1-GEN08-122 0.5750'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.42028	114.0797	'GEN572012 1-GEN08-122 0.5750'
3	0	G08_060	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.19189	113.8033	'KNOLL 230 - S HAYS6 230.00 230KV CKT 1'
3	0	G08_122	'CIRCLE - MULLERGREN 230KV CKT 1'	319	'TO->FROM'	0.19189	113.8033	'KNOLL 230 - S HAYS6 230.00 230KV CKT 1'
3	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60965	113.3619	'CIRCLE - MULLERGREN 230KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	113.1841	'GEN539648 1-NINNESC3 115.00'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43084	113.129	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.55543	113.129	'GEN2008-060 230.00 - SPEARVILLE 230KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43502	112.0097	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56159	112.0097	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43502	111.8743	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56159	111.8743	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.33422	111.8276	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.2618	111.8276	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43299	111.0712	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.55893	111.0712	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
3	0	G08_060	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.44289	109.9412	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_122	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'	355.3	'FROM->TO'	0.44289	109.9412	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43501	109.9237	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56157	109.9237	'GEN539677 3-A. M. MULLERGREN GENERATOR'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43501	109.4752	'HARPER 138KV SWITCHED SHUNT'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56157	109.4752	'HARPER 138KV SWITCHED SHUNT'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43513	109.3712	'MINGO - SETAB 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56167	109.3712	'MINGO - SETAB 345KV CKT 1'
3	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.62966	109.0461	'AXTELL - KNOLL345 345.00 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.40575	108.9576	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.52334	108.9576	'MULLERGREN (MULGREN6) 230/115/13.8KV TRANSFORMER CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43935	108.9534	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56484	108.9534	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43935	108.9534	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 2'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56484	108.9534	'NORTH JUDSON LARGE SUB - SPEARVILLE 115KV CKT 2'
3	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60891	108.855	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60891	108.6812	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43659	108.5482	'CUDAHY - G08-79T 115.00 115KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56285	108.5482	'CUDAHY - G08-79T 115.00 115KV CKT 1'
3	0	G08_123N	'HASTINGS - HASTINGS CITY 115KV CKT 1'	137	'FROM->TO'	0.34757	108.5167	'GEN08-121N 345.00 - MOORE 345KV CKT 1'
3	0	G08_121N1	'HASTINGS - HASTINGS CITY 115KV CKT 1'	137	'FROM->TO'	0.22979	108.5167	'GEN08-121N 345.00 - MOORE 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43501	108.4456	'GEN571160 1-GEN2008-060 34.500'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56157	108.4456	'GEN571160 1-GEN2008-060 34.500'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43504	108.3569	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.56161	108.3569	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
3	0	G08_059	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.25548	106.5926	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G09_003	'SEWARD - ST JOHN 115KV CKT 1'	79.7	'TO->FROM'	0.33004	106.5926	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
3	0	G08_059	'FLATRDG3 138.00 - HARPER 138KV CKT 1'	286	'FROM->TO'	0.33138	106.3828	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'FLATRDG3 138.00 - HARPER 138KV CKT 1'	286	'FROM->TO'	0.25896	106.3828	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
3	0	G09_003	'HUNTSVILLE - ST_JOHN 115KV CKT 1'	88	'TO->FROM'	0.21794	105.9799	'GEN573551 1-GEN09-003 0.5750'
3	0	G08_059	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.27815	105.0863	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.35998	105.0863	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.27815	105.0699	'SPP-WERE-78'
3	0	G09_003	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.35998	105.0699	'SPP-WERE-78'
3	0	G09_003	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'	92	'FROM->TO'	0.21794	104.7071	'GEN539648 1-NINNESC3 115.00'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.36171	104.2628	'SPP-WERE-78'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.29883	104.2628	'SPP-WERE-78'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.36171	104.2563	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.29883	104.2563	'HUNTSVILLE - ST_JOHN 115KV CKT 1'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.36171	103.9487	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.29883	103.9487	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.27815	103.1512	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G09_003	'GREAT BEND TAP - SEWARD 115KV CKT 1'	89.6	'TO->FROM'	0.35998	103.1512	'HUNTSVILLE - HUTCHINSON ENERGY CENTER 115KV CKT 1'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.32813	102.3237	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.25568	102.3237	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
3	0	G08_059	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.32813	102.2495	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G09_003	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'	170	'FROM->TO'	0.25568	102.2495	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43476	100.5223	'WRTOD400'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.5613	100.5223	'WRTOD400'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.4319	100.2611	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.55727	100.2611	'RENO COUNTY - WICHITA 345KV CKT 1'
3	0	G08_059	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.43346	100.1511	'SPP-MKEC-02'
3	0	G09_003	'NINNESC3 115.00 - PRATT 115KV CKT 1'	79.7	'TO->FROM'	0.55964	100.1511	'SPP-MKEC-02'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.57683	155.8029	'BEARCRK2 - SYRACUSE 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.57683	154.2231	'BEARCRK2 - SYRACUSE 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.57683	153.2563	'BEARCRK2 - JOHNCR 3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.57683	151.6765	'BEARCRK2 - JOHNCR 3 115.00 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.57683	150.7182	'BIG BOW 3 115.00 - JOHNCR 3 115.00 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.57683	150.629	'BIG BOW 3 115.00 - ULYSPLT3 115.00 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.57683	150.5299	'PIONEER - ULYSPLT3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.57683	149.1381	'BIG BOW 3 115.00 - JOHNCR 3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.57683	149.0493	'BIG BOW 3 115.00 - ULYSPLT3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.57683	148.9505	'PIONEER - ULYSPLT3 115.00 115KV CKT 1'
4	0	G08_066	'BEARCRK2 - SYRACUSE 115KV CKT 1'	92	'TO->FROM'	0.42263	133.7628	'SYRACUSE - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'BEARCRK2 - SYRACUSE 115KV CKT 1'	92	'TO->FROM'	0.42263	132.9732	'FLETCHER - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44324	130.4102	'HOLCOMB - SETAB 345KV CKT 1'
4	0	G08_066	'BEARCRK2 - JOHNCR 3 115.00 115KV CKT 1'	92	'FROM->TO'	0.42263	129.5827	'SYRACUSE - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44324	128.8286	'HOLCOMB - SETAB 345KV CKT 1'
4	0	G08_066	'BEARCRK2 - JOHNCR 3 115.00 115KV CKT 1'	92	'FROM->TO'	0.42263	128.7971	'FLETCHER - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.67538	118.2057	'SPP-SUNC-13'
4	0	G08_066	'CITIES SERVICE TAP - CNTRLPL3 115.00 115KV CKT 1'	143	'TO->FROM'	0.22815	118.1298	'CNTRLPL3 115.00 - SETAB 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.54064	118.0406	'SPP-SUNC-11'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.43677	117.8694	'GEN531447 1-HOLCOMB GENERATOR'
4	0	G08_066	'CNTRLPL3 115.00 - SETAB 115KV CKT 1'	143	'FROM->TO'	0.22815	117.7541	'SPP-SUNC-12'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.67538	116.6332	'SPP-SUNC-13'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.54064	116.4635	'SPP-SUNC-11'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.43677	116.2892	'GEN531447 1-HOLCOMB GENERATOR'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46145	115.9726	'G06-34T 115.00 - KANARADO 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46145	115.6749	'KANARADO - NATIONAL SUNFLOWER INDUSTRY TAP 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46145	115.333	'NATIONAL SUNFLOWER INDUSTRY TAP - RULETON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46113	115.2127	'SETAB (SETAB) 345/115/13.8KV TRANSFORMER CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46145	114.3919	'G06-34T 115.00 - KANARADO 115KV CKT 1'
4	0	G08_066	'CITIES SERVICE TAP - SETAB 115KV CKT 1'	143	'FROM->TO'	0.22815	114.3444	'CNTRLPL3 115.00 - SETAB 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46145	114.0944	'KANARADO - NATIONAL SUNFLOWER INDUSTRY TAP 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46145	113.7528	'NATIONAL SUNFLOWER INDUSTRY TAP - RULETON 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46113	113.6347	'SETAB (SETAB) 345/115/13.8KV TRANSFORMER CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44381	113.4632	'GOODLAND TAP - RULETON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.43772	112.9565	'SCOTT CITY - SETAB 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44381	112.442	'GOODLAND - GOODLAND TAP 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.43967	112.3491	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44381	112.305	'BREWSTER - GOODLAND 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44381	112.1651	'BREWSTER - MINGO 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44381	111.8813	'GOODLAND TAP - RULETON 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.43772	111.3801	'SCOTT CITY - SETAB 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	111.2434	'LAWN RIDGE - RULETON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	111.1137	'LAWN RIDGE - ST.FRANCIS TAP 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44285	111.0363	'SPP-SUNC-12'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	110.885	'ST.FRANCIS - ST.FRANCIS TAP 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44381	110.8608	'GOODLAND - GOODLAND TAP 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.43967	110.7681	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	110.7531	'BIRD CITY - ST.FRANCIS 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44381	110.7238	'BREWSTER - GOODLAND 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	110.6685	'BIRD CITY - MCDONLD3 115.00 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44285	110.6683	'CNTRLPL3 115.00 - SETAB 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.44037	110.6678	'ATWOOD - MCDONLD3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44381	110.5838	'BREWSTER - MINGO 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.6636	'LAWN RIDGE - RULETON 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.534	'LAWN RIDGE - ST.FRANCIS TAP 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44285	109.4561	'SPP-SUNC-12'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.3053	'ST.FRANCIS - ST.FRANCIS TAP 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.1734	'BIRD CITY - ST.FRANCIS 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.0888	'BIRD CITY - MCDONLD3 115.00 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44285	109.0885	'CNTRLPL3 115.00 - SETAB 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.44037	109.0881	'ATWOOD - MCDONLD3 115.00 115KV CKT 1'
4	0	G08_066	'LEOTI - SELKIRK 115KV CKT 1'	143	'TO->FROM'	0.41093	103.7713	'SYRACUSE - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'LEOTI - SELKIRK 115KV CKT 1'	143	'TO->FROM'	0.41093	103.3531	'FLETCHER - WILLIAMSON 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.43677	102.9199	'GEN573602 1-GEN09-022 0.6900'
4	0	G08_066	'CIMARRON RIVER PLANT - CIMARRON RIVER TAP 115KV CKT 1'	89.6	'FROM->TO'	0.19114	102.8853	'HOLCOMB (HOLCOMB) 345/115/13.8KV TRANSFORMER CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46201	102.0626	'PALMER3 - TRIBUNE SWITCH 115KV CKT 1'
4	0	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22709	101.7742	'CIRCLE - MULLERGREN 230KV CKT 1'
4	6	G09_003	'ST JOHN - ST_JOHN 115KV CKT 1'	88	'FROM->TO'	0.22708	101.6583	'CIRCLE - MULLERGREN 230KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46201	101.589	'PALMER3 - SHARON SPRINGS 115KV CKT 1'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.43677	101.4818	'GEN531486 1-CNTRLPL2 34.500'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.4435	101.4409	'SPP-SUNC-14'
4	0	G08_066	'BEARCRK2 - SYRACUSE 115KV CKT 1'	92	'TO->FROM'	0.20649	101.2861	'SPP-SUNC-05'
4	0	G08_066	'SYRACUSE - WILLIAMSON 115KV CKT 1'	98	'FROM->TO'	0.46201	100.4995	'G06-34T 115.00 - SHARON SPRINGS 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46201	100.492	'PALMER3 - TRIBUNE SWITCH 115KV CKT 1'
4	0	G08_066	'FLETCHER - WILLIAMSON 115KV CKT 1'	98	'TO->FROM'	0.46201	100	'PALMER3 - SHARON SPRINGS 115KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
5	6	G08_064	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24166	118.757	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_022	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.21093	118.757	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_085	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.23822	118.757	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_058	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24259	118.757	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_050	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.21093	118.757	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25336	113.1818	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_022	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22098	113.1818	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24983	113.1818	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25436	113.1818	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	6	G08_050	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22098	113.1818	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_064	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.2355	113.1465	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_022	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22409	113.1465	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_085	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.23049	113.1465	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_058	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.23578	113.1465	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_050	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22409	113.1465	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.38522	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39925	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.48448	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.3915	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.38544	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39925	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.38522	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39925	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.48448	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.3915	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.38544	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39925	112.293	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.38522	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39925	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.48448	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.3915	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.38544	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'	560	'FROM->TO'	0.39925	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'
5	0	G08_064	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.38522	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_022	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39925	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_083	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.48448	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_085	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.3915	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_058	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.38544	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_050	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.39925	112.2903	'TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 2'
5	0	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24689	108.2519	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_022	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.23494	108.2519	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24167	108.2519	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.24721	108.2519	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
5	0	G08_050	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.23494	108.2519	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
5	6	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.29194	106.8556	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	6	G08_022	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25428	106.8556	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	6	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.28802	106.8556	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	6	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.29316	106.8556	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	6	G08_050	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25428	106.8556	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	6	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.20472	103.2428	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.2024	103.2428	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.20545	103.2428	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.28583	103.2118	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	0	G08_022	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.272	103.2118	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	0	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.27987	103.2118	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	0	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.28626	103.2118	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	0	G08_050	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.272	103.2118	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
5	0	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.19916	102.0353	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_022	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.19108	102.0353	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.19567	102.0353	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.19942	102.0353	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_050	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.19108	102.0353	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	0	G08_062	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.54667	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_064	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.21412	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_108	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.37303	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_022	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.20842	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G09_018	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.55284	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_085	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.21158	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_088	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.29112	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_058	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.21404	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	0	G08_050	'Hitchland Interchange ((HITCHLND)) 345/230/13.2KV TRANSFORMER CKT 1'	560	'FROM->TO'	0.20842	101.3281	'G05-17T 345.00 - Hitchland Interchange 345KV CKT 1'
5	6	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33588	100.9374	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
5	6	G08_064	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.22991	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_108	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.19133	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_022	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.23334	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_083	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.24106	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_085	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.23042	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_088	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.207	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_058	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.22987	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
5	6	G08_050	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'	1052	'TO->FROM'	0.23334	100.1136	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.32138	174.734	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'
6	2	G08_022	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20358	174.734	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.29971	174.734	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.33762	174.734	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'
6	2	G08_050	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20358	174.734	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.31988	173.9787	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'
6	2	G08_022	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.20261	173.9787	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'
6	2	G08_085	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.29944	173.9787	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
6	2	G08_058	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.33604	173.9787	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'
6	2	G08_050	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.20261	173.9787	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'
6	2	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25191	166.4472	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25163	166.4472	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.25383	166.4472	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_064	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'TO->FROM'	0.24238	163.2998	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_085	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'TO->FROM'	0.24214	163.2998	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_058	'BUSHLAND INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'TO->FROM'	0.24425	163.2998	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_085	'DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1'	351	'TO->FROM'	0.2146	139.7963	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'
6	2	G08_058	'DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1'	351	'TO->FROM'	0.1926	139.7963	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'
6	2	G08_064	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22101	139.4278	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_085	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22065	139.4278	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_058	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.22262	139.4278	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_064	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.21126	137.6239	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_085	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.21085	137.6239	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_058	'BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1'	351	'FROM->TO'	0.21276	137.6239	'G06-39T 230.00 - POTTER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_064	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.26096	126.7354	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'
6	2	G08_085	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.25581	126.7354	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'
6	2	G08_058	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.262	126.7354	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.22525	120.0663	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.21306	120.0663	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.23625	120.0663	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_083	'GRASSLAND INTERCHANGE - LYNN COUNTY INTERCHANGE 115KV CKT 1'	160	'FROM->TO'	0.75236	119.0436	'GRASSLAND INTERCHANGE - Jones Station Bus#2 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.21854	116.8989	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.21234	116.8989	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.22918	116.8989	'TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.1961	116.4666	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20515	116.4666	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.19148	113.394	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.20029	113.394	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_064	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'	351	'TO->FROM'	0.19888	110.0558	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_085	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'	351	'TO->FROM'	0.20573	110.0558	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_058	'G06-39T 230.00 - PLANT X STATION 230KV CKT 1'	351	'TO->FROM'	0.20169	110.0558	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'
6	2	G08_083	'LYNN COUNTY INTERCHANGE - SOUTH PLAINS REC-WOODROW INTERCHANGE 115KV CKT 1'	154	'FROM->TO'	0.75236	110.0186	'GRASSLAND INTERCHANGE - Jones Station Bus#2 230KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.22923	106.9176	'LAMB COUNTY INTERCHANGE 230/115KV TRANSFORMER CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.1989	106.9176	'LAMB COUNTY INTERCHANGE 230/115KV TRANSFORMER CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.22923	106.8944	'GEN08-085 230.00 - LAMB COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.1989	106.8944	'GEN08-085 230.00 - LAMB COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_037	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'	717	'FROM->TO'	0.1997	106.878	'CIMARRON - G07-43T 345.00 345KV CKT 1'
6	2	G08_064	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.21769	106.6805	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_085	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.20477	106.6805	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	2	G08_058	'DEAF SMITH COUNTY INTERCHANGE - G06-39T 230.00 230KV CKT 1'	351	'FROM->TO'	0.21668	106.6805	'G05-15T 345.00 - TUCO INTERCHANGE 345KV CKT 1'
6	6	G08_083	'LUBBOCK SOUTH INTERCHANGE - SOUTH PLAINS REC-WOODROW INTERCHANGE 115KV CKT 1'	154	'TO->FROM'	0.75792	105.9362	'GRASSLAND INTERCHANGE - Jones Station Bus#2 230KV CKT 1'
6	2	G08_037	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'	717	'FROM->TO'	0.20032	105.7409	'ANADARK7 345.00 - G07-43T 345.00 345KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
6	2	G08_085	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.2309	104.0973	'LAMB COUNTY INTERCHANGE 230/115KV TRANSFORMER CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.1945	104.0973	'LAMB COUNTY INTERCHANGE 230/115KV TRANSFORMER CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.2309	104.0747	'GEN08-085 230.00 - LAMB COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.1945	104.0747	'GEN08-085 230.00 - LAMB COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_022	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.22954	103.6503	'TOLK STATION EAST - TOLK STATION TAP 230KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.43399	103.6503	'TOLK STATION EAST - TOLK STATION TAP 230KV CKT 1'
6	2	G08_050	'PLANT X STATION - TOLK STATION WEST 230KV CKT 1'	497	'TO->FROM'	0.22954	103.6503	'TOLK STATION EAST - TOLK STATION TAP 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.19447	103.4748	'AMARILLO SOUTH INTERCHANGE - G07-48T 230.00 230KV CKT 1'
6	6	G08_064	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.23603	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G09_030	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.20412	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_022	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.25095	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_083	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.25791	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_085	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.2397	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_088	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.20568	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G07_049	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.21572	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_058	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.23638	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_050	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.25095	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	6	G08_037	'CIMARRON - G07-43T 345.00 345KV CKT 1'	1011	'TO->FROM'	0.30909	103.3916	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_064	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.23057	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G09_030	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.2134	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_022	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.24591	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_083	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.24613	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_085	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.23069	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G07_049	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.22377	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_058	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.23028	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_050	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.24591	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_037	'CIMARRON - G07-43T 345.00 345KV CKT 1'	956	'TO->FROM'	0.32133	102.9167	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20993	102.5889	'CURRY COUNTY INTERCHANGE - DEAF SMITH REC-#20 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.21606	102.5889	'CURRY COUNTY INTERCHANGE - DEAF SMITH REC-#20 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.19132	102.5502	'AMOCO SWITCHING STATION - YOAKUM COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_083	'LUBBOCK SOUTH INTERCHANGE - SOUTH PLAINS REC-WOODROW INTERCHANGE 115KV CKT 1'	154	'TO->FROM'	0.75236	102.0693	'GRASSLAND INTERCHANGE - Jones Station Bus#2 230KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.19385	101.8181	'SWISHER COUNTY INTERCHANGE - TUCO INTERCHANGE 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20993	101.7546	'DEAF SMITH REC-#20 - PARMER COUNTY SUB 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.21606	101.7546	'DEAF SMITH REC-#20 - PARMER COUNTY SUB 115KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20993	101.4528	'CARGILL SUB - PARMER COUNTY SUB 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.21606	101.4528	'CARGILL SUB - PARMER COUNTY SUB 115KV CKT 1'
6	2	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33643	101.3496	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.19477	100.868	'G07-48T 230.00 - SWISHER COUNTY INTERCHANGE 230KV CKT 1'
6	2	G08_064	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20993	100.6733	'CARGILL SUB - FRIONA SUB 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.21606	100.6733	'CARGILL SUB - FRIONA SUB 115KV CKT 1'
6	2	G08_085	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.20308	100.1201	'LAMB COUNTY INTERCHANGE - PLANT X STATION 115KV CKT 1'
6	2	G08_058	'PLANT X STATION - TOLK STATION EAST 230KV CKT 2'	497	'TO->FROM'	0.19367	100.1201	'LAMB COUNTY INTERCHANGE - PLANT X STATION 115KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.99579	191.8125	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.99579	189.9502	'HYDRO - SICKLES 138KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.99579	185.8336	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.99579	184.2182	'BINGER NIJECT - ONEY 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.99579	183.2234	'ONEY - WASHITA 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.35761	181.1263	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.99579	155.832	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.34232	147.5689	'MIDPT_BUS 7 345.00 (WHEEL-MIDPT) 345/230/13.2KV TRANSFORMER CKT 1'
7	0	G09_030	'ANADARKO - WASHITA 138KV CKT 1'	228	'TO->FROM'	0.36256	135.6808	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'
7	0	G08_037	'ANADARKO - WASHITA 138KV CKT 1'	228	'TO->FROM'	0.74811	135.6808	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	1	133.4107	'CARTER JCT - DILL JCT 69KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33845	132.5894	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33619	132.1827	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33845	131.2768	'HINTON - WEATHERFORD JCT. 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33845	131.1469	'CAN_GAS4 138.00 - HINTON 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.34494	130.9901	'CLINTON AIR FORCE BASE TAP - ELK CITY 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33845	130.761	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33811	130.5588	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33811	130.2528	'HYDRO - SICKLES 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.34494	130.1794	'CLINTON AIR FORCE BASE TAP - HOBART JUNCTION 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33811	129.565	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33811	129.2924	'BINGER NIJECT - ONEY 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33811	129.1244	'ONEY - WASHITA 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.3296	128.9069	'G03-05T 138.00 - PARADISE 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33601	128.7232	'HOBART JUNCTION - TAMARAC TAP 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33601	128.6858	'OMPA-ALTUS TAMARACK - TAMARAC TAP 138KV CKT 1'
7	0	G09_030	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'	260	'TO->FROM'	0.40245	127.1875	'ANADARKO - WASHITA 138KV CKT 1'
7	0	G08_037	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'	260	'TO->FROM'	0.83659	127.1875	'ANADARKO - WASHITA 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33716	127.1084	'WEATHERFORD TAP - WEATHERFORD WIND FARM 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33531	126.8407	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33601	126.6722	'OMPA-ALTUS TAMARACK - OMPVET-4 138.00 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33716	126.3366	'WEATHERFORD SOUTHEAST - WEATHERFORD TAP 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.3296	125.3654	'SNYDER (SNYDER) 138/69/13.8KV TRANSFORMER CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.3296	125.3326	'PARADISE - SNYDER 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33601	124.8296	'OMPA-ALTUS PARK - OMPVET-4 138.00 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.34194	124.4367	'MOORELAND - MOREWOOD SW 138KV CKT 1'
7	0	G09_030	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'	260	'TO->FROM'	0.62717	119.0252	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G08_037	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'	260	'TO->FROM'	0.62717	119.0252	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.57514	117.0102	'SOUTHWESTERN STATION - WASHITA 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	115.3403	'GEN511952 1-WEATHERFORD WIND FARM TURBINES'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.55084	115.165	'CIMARRON - G07-43T 345.00 345KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.22602	113.0214	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.22602	112.0552	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.55107	109.8891	'ANADARK7 345.00 - G07-43T 345.00 345KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.35354	108.7314	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.21441	108.6965	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	108.5906	'GEN560193 1-G09-16 0.6900'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.35354	108.2559	'HYDRO - SICKLES 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.51565	108.1583	'BECKHAM CO 230.00 - ELK CITY 230KV 230KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.51565	108.1558	'ELK CITY 230KV (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.35354	108.0505	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.51933	107.8188	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'
7	0	G09_030	'CLINTON - G07-32T 138.00 138KV CKT 1'	143	'FROM->TO'	1	107.6525	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.35354	107.6105	'HYDRO - SICKLES 138KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.35354	107.1876	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.35354	106.7683	'BINGER NIJECT - ONEY 138KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.35354	106.6265	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.35354	106.5134	'ONEY - WASHITA 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.55423	106.4001	'ANADARKO - WASHITA 138KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.35354	106.2405	'BINGER NIJECT - ONEY 138KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.35354	106.0058	'ONEY - WASHITA 138KV CKT 1'
7	0	G09_030	'CLINTON - G07-32T 138.00 138KV CKT 1'	143	'FROM->TO'	1	105.8096	'HYDRO - SICKLES 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54771	105.6017	'LAWTON EASTSIDE - SUNNYSIDE 345KV CKT 1'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.19548	105.5184	'CIMARRON - G07-43T 345.00 345KV CKT 1'
7	0	G09_030	'HINTON - WEATHERFORD JCT. 138KV CKT 1'	210	'TO->FROM'	0.22602	105.2407	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.51933	105.125	'HINTON - WEATHERFORD JCT. 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.55832	105.0996	'ANADARK7 345.00 (ANDRK345) 345/138/13.8KV TRANSFORMER CKT 2'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.51933	104.8361	'CAN_GAS4 138.00 - HINTON 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	104.7648	'GEN560020 1-G06-35 0.5750'
7	0	G09_030	'HYDRO - SICKLES 138KV CKT 1'	264	'FROM->TO'	0.99579	104.6019	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54765	104.3756	'ANADARKO - POCASSETT 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54765	104.252	'POCASSETT - TUTTLE 138KV CKT 1'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.51933	104.0503	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54765	103.9489	'SUNSHINE CANYON - TUTTLE 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54956	103.6407	'ANADARKO - SOUTHWESTERN STATION 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	103.6146	'GEN525561 1-TOLK GEN #1 24 KV'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54805	103.5698	'CORNVILLE - TUTTLE 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	103.5202	'GEN560042 1-G06-02 0.6900'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54805	103.3468	'TUTTLE - TUTTLE CONOCO TAP 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54752	103.2827	'NORGE ROAD - SOUTHWESTERN STATION 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54805	103.2573	'CIMARRON - TUTTLE CONOCO TAP 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	103.2289	'GEN525562 1-TOLK GEN #2 24 KV'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	103.174	'GEN572501 1-2007-049 0.6900'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.32478	103.0705	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'	143	'TO->FROM'	0.54645	103.0584	'GEN560290 1-G08-23 0.5750'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.32478	102.6439	'HYDRO - SICKLES 138KV CKT 1'
7	0	G09_030	'BINGER NIJECT - SICKLES 138KV CKT 1'	264	'TO->FROM'	0.99579	102.1498	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G09_030	'CLINTON - G07-32T 138.00 138KV CKT 1'	143	'FROM->TO'	1	101.7392	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.32478	101.6857	'BINGER NIJECT - SICKLES 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.35865	101.5979	'BECKHAM CO 230.00 - ELK CITY 230KV 230KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.35865	101.5974	'ELK CITY 230KV (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1'
7	0	G09_030	'HINTON - WEATHERFORD JCT. 138KV CKT 1'	210	'TO->FROM'	0.35354	101.3406	'HYDRO - WEATHERFORD 138KV CKT 1'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.32478	101.3103	'BINGER NIJECT - ONEY 138KV CKT 1'
7	0	G09_030	'BINGER NIJECT - ONEY 138KV CKT 1'	264	'FROM->TO'	0.99579	101.1924	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G09_030	'CAN_GAS4 138.00 - JENSEN ROAD 138KV CKT 1'	191	'FROM->TO'	0.20202	101.1585	'CIMARRON - G07-43T 345.00 345KV CKT 1'
7	0	G09_030	'WEATHERFORD JCT. - WEATHERFORD SOUTHEAST 138KV CKT 1'	210	'TO->FROM'	0.20202	101.1426	'CIMARRON - G07-43T 345.00 345KV CKT 1'
7	0	G09_030	'JENSEN ROAD - JENSEN TAP 138KV CKT 1'	191	'FROM->TO'	0.32478	101.0819	'ONEY - WASHITA 138KV CKT 1'
7	0	G09_030	'HINTON - WEATHERFORD JCT. 138KV CKT 1'	210	'TO->FROM'	0.35354	100.9078	'HYDRO - SICKLES 138KV CKT 1'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.33548	100.8378	'GEN560193 1-G09-16 0.6900'
7	0	G07_049	'CARTER JCT - LAKE CREEK 69KV CKT 1'	36	'FROM->TO'	0.32991	100.5859	'ANADARKO - G03-05T 138.00 138KV CKT 1'
7	0	G09_030	'ONEY - WASHITA 138KV CKT 1'	264	'FROM->TO'	0.99579	100.5292	'CLINTON JUNCTION - G07-32T 138.00 138KV CKT 1'
7	0	G09_030	'HYDRO - WEATHERFORD 138KV CKT 1'	179	'TO->FROM'	0.47802	100.3359	'BECKHAM CO 230.00 - STATELINE INTERCHANGE 230KV CKT 1'
7	0	G09_030	'CLINTON - G07-32T 138.00 138KV CKT 1'	143	'FROM->TO'	1	100.1447	'BINGER NIJECT - ONEY 138KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.62292	122.6601	'COMANCH5 345.00 - SPEARVILLE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60818	119.6565	'CIRCLE - MULLERGREN 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.62809	118.3217	'AXTELL - KNOLL345 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60744	118.2944	'COMANCH5 345.00 - MED-LDG5 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60744	118.1889	'MED-LDG5 345.00 - WICHITA 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.69042	116.9405	'KNOLL345 345.00 345/230KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	116.3184	'GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	115.6418	'GEN532653 1-JEFFREY ENERGY CENTER UNIT 3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	115.6407	'GEN532652 1-JEFFREY ENERGY CENTER UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	115.307	'GEN532651 1-JEFFREY ENERGY CENTER UNIT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.63127	115.1666	'MULLERGREN - S HAYS6 230.00 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61066	112.3243	'NORTHWEST - TATONGA EHV 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	112.2257	'GEN542955 1-LACYGNE UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	111.8533	'GEN542956 2-LACYGNE UNIT #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	111.8144	'GEN336821 1-GRAND GULF UNIT'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61068	111.731	'GRAND ISLAND - SWEETWATER 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61143	111.4187	'GEN08-121N 345.00 - MOORE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61191	111.418	'AXTELL - PAULINE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	111.3608	'GEN336153 1-WATERFORD UNIT#3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	111.3377	'GEN542957 1-IATAN UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	111.09	'GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60985	110.9133	'EAST MANHATTAN - ELMCREK6 230.00 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.834	'GEN335831 1-RIVERBEND UNIT#1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.6675	'GEN542951 5-HAWTHORN UNIT #5'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.59861	110.5653	'JEFFERY ENERGY CENTER - SUMMIT 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.5541	'GEN532663 1-LAWRENCE ENERGY CENTER UNIT 5'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61082	110.4588	'TATONGA EHV 345.00 - WWRDEHV7 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.4562	'GEN337910 1-ARKANSAS NUCLEAR ONE UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.2383	'GEN338146 1-INDEPENDENCE UNIT #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61143	110.1718	'GEN08-121N 345.00 - PAULINE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.1343	'GEN337653 1-WHITE BLUFF UNIT #2'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	110.115	'GEN337652 1-WHITE BLUFF UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60932	109.8194	'GEN08-047 345.00 - WWRDEHV7 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.8139	'GEN532722 1-EVANS ENERGY CENTER UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.7305	'GEN337041 1-GERALD ANDRUS'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60939	109.621	'LAWTON EASTSIDE - OKLAUNION 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.3591	'GEN501801 1-DOLET HILLS UNIT1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60932	109.3304	'GEN08-047 345.00 - Hitchland Interchange 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60964	109.3106	'ANADARK7 345.00 - MIDPT_BUS 7 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.2993	'GEN514806 1-SOONER UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.2618	'GEN514805 1-SOONER UNIT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60909	109.2571	'EAST MANHATTAN (EMANHT3X) 230/115/18.0KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.2404	'GEN541151 3-SIBLEY GENERATING UNIT #3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.2276	'GEN501813 1-RODEMACHER UNIT 3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60977	109.1787	'STEGALL - STEGALL TRANSFORMER 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60977	109.1781	'STEGALL TY 345/230KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60977	109.1774	'NEB01WAPAB3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.1542	'GEN512688 2-GRDA1 GSU2 22'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.1534	'GEN509394 1-FLINT CREEK'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.0642	'GEN335206 1-NELSON UNIT 6'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.0542	'GEN300007 1-NEW MADRID UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	109.0468	'GEN300006 1-NEW MADRID UNIT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60171	109.0241	'CIRCLE - EAST MCPHERSON 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.9864	'GEN509403 1-PIRKEY GENERATION'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.9715	'GEN501812 1-RODEMACHER UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.9555	'GEN511840 1-NORTHEASTERN STATION #3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.9366	'GEN511841 1-NORTHEASTERN STATION #4'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60943	108.8954	'COOPER - GEN09-031 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.8951	'GEN515225 1-MUSKOGEE 5G'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.8884	'GEN515226 1-MUSKOGEE 6G'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60943	108.8836	'GEN09-031 345.00 - ST JOE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.875	'GEN515223 1-MUSKOGEE 4G'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61009	108.8733	'GRAND ISLAND - MCCOOL 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.8717	'GEN336801 1-BAXTER WILSON UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.8475	'GEN511839 1-NORTHEASTERN STATION #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.7918	'GEN512689 1-GRDA1 GSU1 22'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.6949	'GEN511843 1-RIVERSIDE STATION #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.668	'GEN511842 1-RIVERSIDE STATION #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.6166	'GEN532694 1-HUTCHINSON ENERGY CENTER UNIT 4'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.576	'GEN509404 1-WELSH #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.576	'GEN509405 1-WELSH #2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.576	'GEN509406 1-WELSH #3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61133	108.5633	'G09-11T 115.00 - PHILLIPSBURG 115KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.5562	'GEN546702 1-NM GEN N1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.5537	'GEN335546 1-DOW COGEN'

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61032	108.5113	'MEDICINE LODGE 138/115KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.5042	'GEN520947 1-HUGO1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60961	108.4805	'AECI-1_FS1T 345.00 - FAIRPORT 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61027	108.4632	'SPP-MKEC-08'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60977	108.4473	'NUNDRWD - WAYSIDE 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.447	'GEN532672 1-TECUMSEH ENERGY CENTER UNIT 8'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60939	108.4107	'G05-15T 345.00 - OKLAUNION 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61027	108.4091	'SPP-WERE-34'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61027	108.4091	'SPP-WERE-34A'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61067	108.3918	'SPP-MKEC-06'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.3916	'GEN300003 1-THOMAS HILL UNIT 3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61027	108.3913	'SPP-MKEC-05'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61067	108.3727	'SEWARD - ST JOHN 115KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60992	108.2672	'GEN09-022 345.00 - RED WILLOW 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61027	108.2463	'CLEARWATER - GILL ENERGY CENTER WEST 138KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61183	108.2398	'KNOLL 230 230/115KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61145	108.2354	'PHILLIPSBURG - SMITH CENTER 115KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.6101	108.233	'MCCOOL - MOORE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.2106	'GEN542954 3-MONTROSE UNIT #3'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.2071	'GEN336170 1-GULF OXY U4'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	108.1943	'GEN542952 1-MONTROSE UNIT #1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60973	108.1909	'STEGALL - WAYSIDE 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.56165	106.4791	'SUMMIT (SUMMIT1X) 345/230/14.4KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.6095	106.2267	'AUBURN ROAD - JEFFREY ENERGY CENTER 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61077	106.1856	'COLBY - MINGO 115KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	106.1547	'GEN572062 1-GEN08-087 0.7000'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61143	106.1216	'GEN2008-060 230.00 - MULLERGREN 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	106.1207	'GEN560279 1-G08-18 0.6900'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	106.1126	'GEN525562 1-TOLK GEN #2 24 KV'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	106.1109	'GEN523971 1-HARRINGTON GEN #1 24 KV'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	106.1077	'GEN523972 1-HARRINGTON GEN #2 24 KV'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60571	106.0285	'WR-DOUBLE17'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.9943	'GEN573602 1-GEN09-022 0.6900'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.9836	'GEN571160 1-GEN2008-060 34.500'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60913	105.9313	'AMRN_OUTS6'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60913	105.9267	'LACYGNE - NEOSHO 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.9168	'GEN525561 1-TOLK GEN #1 24 KV'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60766	105.8662	'G08-13T 345.00 - WOODRING 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60955	105.8458	'SPP-WERE-70B'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.8172	'GEN560170 1-G09-11 0.6900'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.7602	'GEN539677 3-A. M. MULLERGREN GENERATOR'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61489	105.6262	'FINNEY SWITCHING STATION - STEVENS CO 345.00 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61118	105.505	'AXTELL - SWEETWATER 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.59547	105.3599	'MORRIS COUNTY - SUMMIT 230KV CKT 1'

Appendix H: ACCC Results - PISIS-2009-001

GROUP	SCENARIO	SOURCE	ELEMENT	RATE	DIRECTION	TDF	LOADING	CONTINGENCY
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.59996	105.315	'EAST MCPHERSON - SUMMIT 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	105.2271	'GEN539670 4-JUDSON LARGE GENERATOR'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.6105	105.2108	'CONCORDIA - ELMCREK6 230.00 230KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.6105	105.2106	'CONCORDIA (CONCORD6) 230/115/13.8KV TRANSFORMER CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60786	105.1298	'EMPORIA ENERGY CENTER - MORRIS COUNTY 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60698	104.944	'SWISSVALE - WEST GARDNER 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61221	104.4542	'GRAY CO 345.00 - HOLCOMB 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.61226	104.0299	'GRAY CO 345.00 - SPEARVILLE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.59005	103.8999	'RENO COUNTY - WICHITA 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	103.2931	'GEN531447 1-HOLCOMB GENERATOR'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	103.0886	'GEN640010 1-GERALD GENTLEMAN STATION UNIT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60968	102.7714	'GEN640011 2-GERALD GENTLEMAN STATION UNIT 2'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.59445	102.7181	'RENO COUNTY - SUMMIT 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.63248	101.3423	'KNOLL345 345.00 - SPEARVILLE 345KV CKT 1'
11	0	G08_061	'SMOKYHLLS6 230.00 - SUMMIT 230KV CKT 1'	319	'FROM->TO'	0.60602	100.8164	'HOYT - STRANGER CREEK 345KV CKT 1'
15	0	G08_123N	'HASTINGS - HASTINGS CITY 115KV CKT 1'	137	'FROM->TO'	0.34884	120.3266	'GEN08-121N 345.00 - MOORE 345KV CKT 1'
15	0	G08_121N1	'HASTINGS - HASTINGS CITY 115KV CKT 1'	137	'FROM->TO'	0.23106	120.3266	'GEN08-121N 345.00 - MOORE 345KV CKT 1'

I: Stability Study for Group 1

Final Report

For

Southwest Power Pool

From

S&C Electric Company

PRELIMINARY IMPACT STUDY
PISIS-2009-001 (Group 1)

S&C Project No. 4379

March 5, 2010

S&C Electric Company

S&C Electric Company, Chicago, IL 60626-3997, Phone: (773) 338-1000
Power Systems Services Division Fax: (773) 338-4254

TABLE OF CONTENTS

Report Revision History:

Date of Report	Issue	Comments
February 26, 2010	Rev. 0	Final report
March 5, 2010	Rev. 1	Final report issued with stability plots

Report prepared by:

George Tsai
Senior Engineer

Report approved by:

Vincent Stewart
Manager – Consulting and Analytical Services

EXECUTIVE SUMMARY

S&C Electric Company has performed an interconnection impact study for the Preliminary Impact Study PISIS-2009-001 (Group 1) in response to a request through the Southwest Power Pool (SPP) Tariff studies. Group 1 consists of GEN-2008-044 (199.8 MW) and GEN-2008-045 (300.6 MW), which will interconnect into Oklahoma Gas and Electric (OKGE) at the Tatonga and Woodward 345 kV substations respectively. Studies were performed for summer 2010 and winter 2009 peak loading with Group 1 wind farms and prior queued projects operating at rated output power (100% output power) and remaining wind farms at 20% output power. Group 1 wind farms consist of Vestas V90 1.8 MW VCUS wind turbine generators.

Group 1 can successfully interconnect into the transmission system at the desired locations provided that the wind farms can supply the reactive power needed to meet a voltage schedule equal to the base case voltage or nominal voltage, whichever is higher at the Point of Interconnection (POI) for transmission facility outage contingencies specified by SPP. Power factor requirements for the worst single transmission facility outage contingencies, which were specified by SPP, consist of the following:

1. 99.92% lagging power factor (capacitive) from GEN-2008-044 into Tatonga 345 kV to meet a voltage schedule at Tatonga 345 kV of 1.01 pu for summer and winter peak.
2. 97.81% leading power factor (inductive) from GEN-2008-045 into Woodward 345 kV to meet a voltage schedule at Woodward 345 kV of 1.01 pu for summer peak and 1.03 pu for winter peak.

To satisfy the above requirements,

1. Two (2) 25.2 MVAR capacitor banks are required at GEN-2008-044, one at each 34.5 kV collector bus.
2. GEN-2007-021 and GEN-2007-044, which consist of GE 1.5 MW wind turbine generators, should have the GE WindCONTROL™ configured to meet a voltage schedule of 1.01 pu at Tatonga 345 kV.
3. GEN-2008-019 34.5/138 kV transformer no load tap changer, which is currently at 105 %, should be changed to 102.5 %.

4. GEN-2007-062, which consists of GE 1.5 MW wind turbine generators, is required to have the GE WindCONTROL™ meet a voltage schedule of 1.01 pu and 1.03 pu for summer and winter peak respectively at Woodward 345 kV.

Transient stability analysis show that nearby areas remain stable and Preliminary Impact Study PISIS-2009-001 (Group 1) and prior queued project survive the 3-phase and single-line-to-ground fault contingencies specified by SPP.

1. INTRODUCTION

S&C Electric Company has performed an interconnection impact study for the Preliminary Impact Study PISIS-2009-001 (Group 1) in response to a request through the Southwest Power Pool (SPP). Studies were performed for summer 2010 and winter 2009 peak loading with Group 1 wind farms and prior queued projects operating at rated output power (100% output power).

Preliminary Impact Study PISIS-2009-001 (Group 1) consists of the following wind generation projects:

- **GEN-2008-044** – Vestas V90 1.8 MW – 199.8 MW – Interconnection at the 345 kV Tatonga Substation.
- **GEN-2008-045** – Vestas V90 1.8 MW – 300.6 MW – Interconnection at the 345/745 kV Woodward District Station.

Single line diagrams of Group 1 projects are included in Appendix A

2. TRANSMISSION SYSTEM AND STUDY AREA

The study area involves transmission facilities at 345 kV. The wind generation projects in Group 1 will interconnect into Oklahoma Gas and Electric (OKGE). In addition to OKGE, the following areas were monitored for steady-state (power flow) and dynamic stability analysis:

Midwest Energy, Inc. (MIDW)
Sunflower Electric Power Company (SUNC)
Westar Energy, Inc (WERE)
Western Farmers Electric Cooperative (WFEC)
AEP West (AEPW)
Southwestern Public Service (SPS)

3. POWER FLOW BASE CASES

The following power flow base cases were received from SPP on December 14, 2009:

PISIS_10SP-G1.sav – Summer peak 2010, which includes aggregate representation of wind turbine generators for Preliminary Impact Study PISIS-2009-001 (Group 1) wind farms and prior queued projects at 100% output power. Other cluster projects were also included with wind farms at 20% output power.

PISIS_09WP-G1.sav – Winter peak 2009, which includes aggregate representation of wind turbine generators for Preliminary Impact Study PISIS-2009-001 (Group 1) wind farms and prior queued projects at 20% output power. The original base case was later corrected with Group 1 projects dispatched at 100% after discussions with SPP.

4 WIND FARM MODELS

Preliminary Impact Study PISIS-2009-001 (Group 1) wind farms and prior queued projects were modeled as aggregates of wind turbine generators. The aggregate models were part of the base case supplied by SPP.

4.1 Vestas V90 1.8 MW Vestas Converter Unity System (VCUS) Wind Turbine Generator

The Vestas V90 1.8 MW VCUS wind turbine generator is a variable-speed induction (asynchronous) generator with electrical pitch and yaw control. The turbine would normally be configured to satisfy a power factor of unity at the generator bus. For power flow analysis and transient stability analysis, a conventional generator with zero (0) reactive power output was used to represent each of the equivalent turbines operating at unity power factor.

5. POWER FLOW ANALYSIS

Transmission voltages should not exceed 105% of nominal system voltage during normal and emergency operating conditions. The above is true in general; however, voltage deviations of up to 110% may be allowed depending on equipment ratings and specific location requirements. Operating voltage should be at or above 95% of nominal although depending on equipment ratings, it is possible to operate below this limit, but above 90% voltage.

5.1 Facility Outage Contingencies

Single transmission facility outage contingencies specified by SPP are listed in Table 5.1.

Table 5.1: List of Power Flow Contingencies

Cont. No.	N-1 Outage Contingency
1	Woodward to Tatonga 345kV lines
2	Woodward to GEN08-047 345kV lines
3	Woodward to Comanche 345kV line
4	Woodward 345kV to 138kV transformer
5	GEN-2008-013 to GEN-2007-025 345kV line
6	Comanche to Medicine Lodge 345kV lines
7	Comanche to Spearville 345kV line
8	Woodring to Cimarron 345kV line
9	Cimarron to Draper 345kV line
10	Northwest to Tatonga 345kV line
11	Northwest to Spring Creek 345kV line
12	Northwest to Cimarron 345kV line
13	Northwest 345kV to 138kV transformer T2
14	Hitchland to GEN-2003-013 345kV line
15	Hitchland to GEN-2005-017 345kV line
16	Woodward EHV to Iodine 138kV line
17	Woodward to GEN-2001-037 138kV line
18	GEN-2001-037 to Mooreland 138kV line
19	Mooreland to Glass Mountain 138kV line
20	Mooreland to Morewood 138kV line
21	Taloga to Dewey 138kV line
22	Dewey to Southard 138kV line
23	Woodward to Midpoint/Wheeler 345kV line
24	Midpoint/Wheeler to WASHITA CO 345kV lines
25	Midpoint/Wheeler to Tuco 345kV lines
26	El Reno – Roman Nose 138kV lines
27	Woodward – Woodring 345kV lines

Voltage levels within the study area were monitored for each contingency in Table 5.1. Result summarized in Table 5.2 and 5.3 indicate that there are locations where the voltages are outside of the 90% to 110% wide voltage range.

Table 5.2: Voltage excursions for Summer 2010

Cont. No.	> 110%	< 90%						
	514897 SMITH 1S	514777 CLEO COR	514791 CLEO	520855 CLEO JT	514778 CLEO COR	515716 CLEO COR	521040 RNGWOOD	514793 ALINE
FLAT, 1 thru 9, 11 thru 26	✓							
10	✓	✓	✓	✓	✓	✓	✓	✓
27	✓	✓	✓	✓	✓	✓	✓	

Table 5.3: Voltage excursions for Winter 2009

Cont. No.	> 110%			< 90%
	515405 G07-62_3G2	515547 G07-62_4G2	51540 G07-62_4G1	
10	✓	✓	✓	

5.2 Power Factor Requirements at the Point of Interconnection (POI)

SPP has specific voltage requirements for interconnecting wind farm projects. Wind generation projects are required to meet a voltage schedule at the POI consistent with the voltage in the SPP base case or nominal voltage, whichever is higher, for single transmission facility outage contingencies specified by SPP.

Voltage schedules at the point of interconnect locations from the original Preliminary Impact Study PISIS-2009-001 (Group 1) base cases are listed in Table 5.4.

Table 5.4: Base Case Voltage Schedule at POI Locations

Point of Interconnection	Summer Peak 2010 (pu)	Winter Peak 2009 (pu)
Tatonga 345kV (#515378)	1.00	1.00
Woodward 345kV (#515375)	1.01	1.03

Transient stability analysis results, which are covered in Section 6, indicate that a voltage schedule at Tatonga 345 kV of 1.01 pu for summer and winter peak is required for wind turbine generators from GEN-2007-021 and GEN-2007-044 to settle to flat steady-state response post fault. Table 5.5 lists the voltage schedule required at each POI location.

Table 5.5: Required Voltage Schedule at POI Locations

Point of Interconnection	Summer Peak 2010 (pu)	Winter Peak 2009 (pu)
Tatonga 345kV (#515378)	1.01	1.01
Woodward 345kV (#515375)	1.01	1.03

Power factor requirements for GEN2008-044 and GEN2008-045 to maintain the voltage schedules in Table 5.5 are summarized in Table 5.6.

Table 5.6: Power factor Requirements at POI

Point of Interconnection	Interconnection Request	Leading Power Factor Requirements		Lagging Power Factor Requirements	
		Contingency (table 5.1)	Power Factor	Contingency (table 5.1)	Power Factor
Tatonga 345kV (#515378)	GEN2008-044			All with exception of winter and summer contingencies No. 3 and 27	99.92%
Woodward 345kV (#515375)	GEN2008-045	No. 10 summer	-97.81%		

Two (2) 25.2 MVAR capacitor banks were added to GEN-2008-044, one at each 34.5 kV collector bus to meet the power factor requirement at Tatonga 345 kV as indicated in Table 5.6. Table 5.7 summarizes the control scheme for each interconnection request project, capacitor bank requirements, and transformer no-load tap settings. The following changes were made to prior queued projects:

1. GEN-2007-021 and GEN-2007-044, which consist of GE 1.5 MW wind turbine generators and regulate the voltage at Tatonga 345 kV to 1.00 pu, were changed to regulate the voltage at Tatonga 345 kV to 1.01 pu.

2. GEN-2008-019 34.5/138 kV transformer no load tap setting of 105 % was changed to 102.5 % to prevent the Mitsubishi 2.3 MW MWT-92 wind turbine generators from "getting stuck" at 0.90 pu voltage for a number of dynamic fault contingencies.

GEN-2007-062, which also consists of GE 1.5 MW wind turbine generators, presently regulate the voltage at Woodward to 1.01 pu and 1.03 pu for summer and winter peak respectively and should be left as such.

Figures 5.1 to 5.2 are power flow diagrams of Group 1 interconnection request projects.

Table 5.7: Summary of wind farm control, capacitor bank sizes and transformer tap settngs assumptions for transient stability analysis

Interconnection Request	Wind Turbine Generators		Voltage Schedule at POI		Cap Banks	XFMR No-Load Tap Setting (% of High Side Winding)	
	Make	Control Scheme	Summer (pu)	Winter (pu)		230/34.5 kV (%)	WTG GSU (%)
GEN-2008-045	Vestas V90 1.8 MW	Meet unity power factor at generator bus	1.01	1.03	none	105	100
GEN-2008-044	Vestas V90 1.8 MW	Meet unity power factor at generator bus	1.01	1.01	Two (2) 25.2 MVAR, one at each 34.5 kV collector bus	105	100

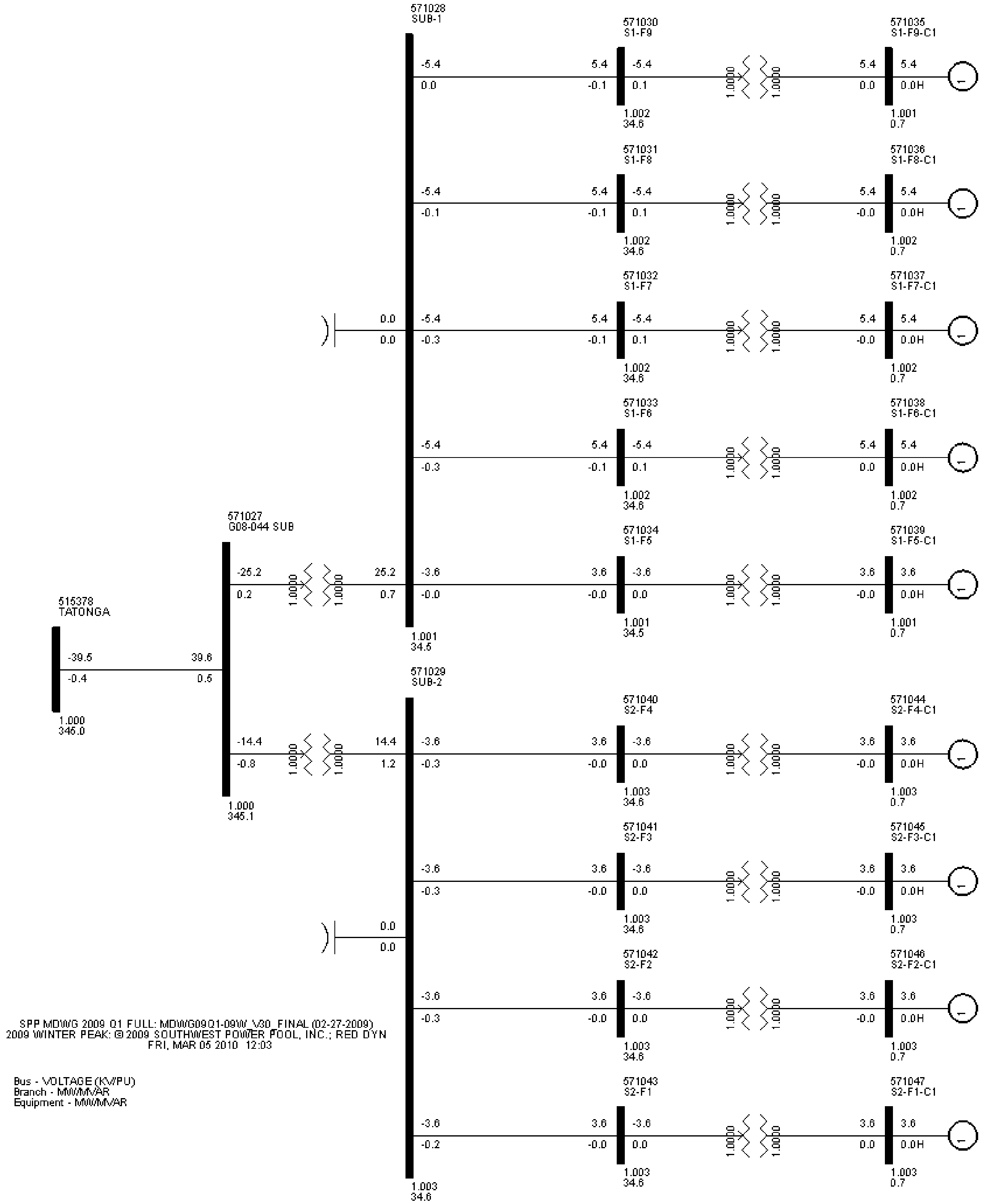


Figure 5.1: Power flow diagram of GEN-2008-045 for Fault No. 10 Winter Peak

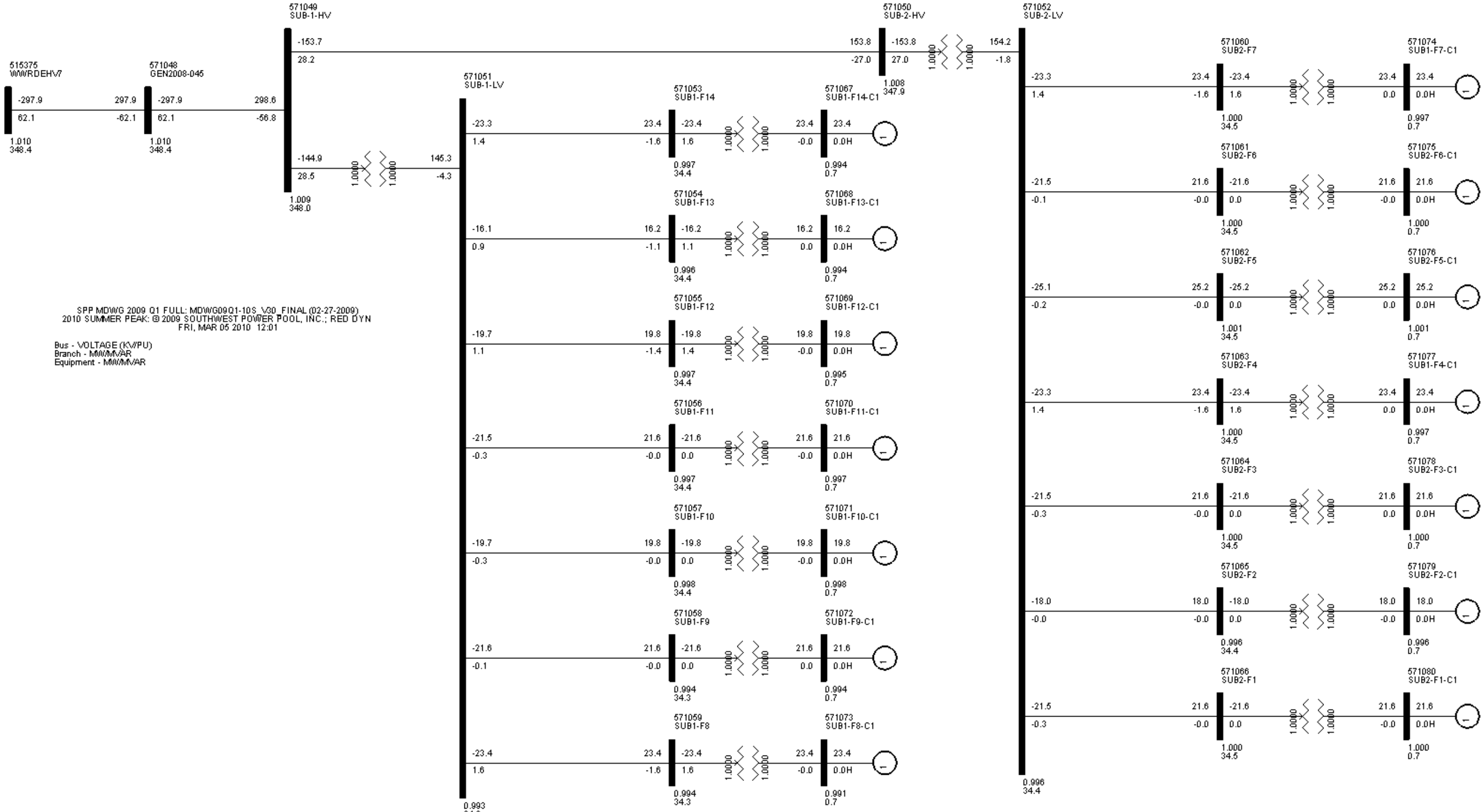


Figure 5.2: Power flow diagram of GEN-2008-044 for Fault No. 10 Summer Peak

6. TRANSIENT STABILITY ANALYSIS AND RESULTS

Transient stability analysis was performed for fault contingencies in Table 6.1.

Table 6.1: SPP fault contingencies

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on one of the Woodward (515375) to Tatonga (515378) 345kV lines, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on one of the Woodward (515375) to GEN08-047 (573500) 345kV lines, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on the Woodward (515375) to Comanche (765341) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Woodward 345kV (515375) to 138kV (515376) transformer, near the 345 kV bus. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on one of the Tatonga (515378) to Woodward (515375) 345kV lines, near Tatonga. a. Apply fault at the Tatonga 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT115-3PH	3 phase fault on the GEN-2008-013 (210130) to GEN-2007-025 (532781) 345kV line, near GEN-2008-013. a. Apply fault at the GEN-2008-013 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault.

Cont. No.	Cont. Name	Description
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on one of the Comanche (765341) to Medicine Lodge (765342) 345kV lines, near Comanche. a. Apply fault at the Comanche 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	*Single phase fault and sequence like previous*
15	FLT15-3PH	3 phase fault on the Comanche (765341) to Spearville (531469) 345kV line, near Comanche. a. Apply fault at the Comanche 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*
17	FLT17-3PH	3 phase fault on the Woodring (514715) to Cimarron (514901) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Cimarron (514901) to Draper (514934) 345kV line, near Cimarron. a. Apply fault at the Cimarron 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the Northwest (514880) to Tatonga (515378) 345kV line, near Tatonga. a. Apply fault at the Tatonga 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	*Single phase fault and sequence like previous*
23	FLT23-3PH	3 phase fault on the Northwest (514880) to Spring Creek (514881) 345kV line, near Northwest. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
25	FLT25-3PH	3 phase fault on the Northwest (514880) to Cimarron (514901) 345kV line, near Northwest. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-1PH	*Single phase fault and sequence like previous*
27	FLT27-3PH	3 phase fault on Northwest 345kV (514880) to 138kV (514879) transformer T2, near the 345 kV bus. a. Apply fault at the Northwest 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
28	FLT28-1PH	*Single phase fault and sequence like previous*
29	FLT29-3PH	3 phase fault on the Hitchland (523097) to GEN-2003-013 (560029) 345kV line, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-1PH	*Single phase fault and sequence like previous*
31	FLT31-3PH	3 phase fault on the Hitchland (523097) to GEN-2005-017 (51700) 345kV line, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	*Single phase fault and sequence like previous*
33	FLT33-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-1PH	*Single phase fault and sequence like previous*
35	FLT35-3PH	3 phase fault on the Woodward (514785) to GEN-2001-037 (515785) 138kV line, near Woodward. a. Apply fault at the Woodward 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	*Single phase fault and sequence like previous*
37	FLT37-3PH	3 phase fault on the GEN-2001-037 (515785) to Woodward (514785) 138kV line, near GEN-2001-037. a. Apply fault at the GEN-2001-037 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault.

Cont. No.	Cont. Name	Description
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	*Single phase fault and sequence like previous*
39	FLT39-3PH	3 phase fault on the GEN-2001-037 (515785) to Mooreland (520999) 138kV line, near GEN-2001-037. a. Apply fault at the GEN-2001-037 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT40-1PH	*Single phase fault and sequence like previous*
41	FLT41-3PH	3 phase fault on the Mooreland (520999) to GEN-2001-037 (515785) 138kV line, near Mooreland. a. Apply fault at the Mooreland 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-1PH	*Single phase fault and sequence like previous*
43	FLT43-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-1PH	*Single phase fault and sequence like previous*
45	FLT45-3PH	3 phase fault on the Mooreland (520999) to Glass Mountain (514788) 138kV line, near Mooreland. a. Apply fault at the Mooreland 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
46	FLT46-1PH	*Single phase fault and sequence like previous*
47	FLT47-3PH	3 phase fault on the Mooreland (520999) to Morewood (521001) 138kV line, near Mooreland. a. Apply fault at the Mooreland 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT48-1PH	*Single phase fault and sequence like previous*
49	FLT49-3PH	3 phase fault on the Taloga (521065) to Dewey (514787) 138kV line, near Taloga. a. Apply fault at the Taloga 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT50-1PH	*Single phase fault and sequence like previous*
51	FLT51-3PH	3 phase fault on the Dewey (514787) to Southard (514822) 138kV line, near Dewey.

Cont. No.	Cont. Name	Description
		a. Apply fault at the Dewey 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-1PH	*Single phase fault and sequence like previous*
53	FLT53-3PH	3 phase fault on the Woodward (515375) to Midpoint/Wheeler (525835) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT54-1PH	*Single phase fault and sequence like previous*
55	FLT55-3PH	3 phase fault on one of the Midpoint/Wheeler (525835) to WASHITA CO (560079) 345kV lines, near Midpoint/Wheeler. a. Apply fault at the Midpoint/Wheeler 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-1PH	*Single phase fault and sequence like previous*
57	FLT57-3PH	3 phase fault on one of the Midpoint/Wheeler (525835) to Tuco (525832) 345kV lines, near Midpoint/Wheeler. a. Apply fault at the Midpoint/Wheeler 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-1PH	*Single phase fault and sequence like previous*
59	FLT59-3PH	3 phase fault on one of the El Reno (514819) – Roman Nose (514823) 138kV lines, near Roman Nose. a. Apply fault at the Roman Nose 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT60-1PH	*Single phase fault and sequence like previous*
61	FLT61-3PH	3 phase fault on one of the Woodward (515375) – Woodring (514715) 345kV lines, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
62	FLT62-1PH	*Single phase fault and sequence like previous*

The prior queued projects monitored are listed in Table 6.2.

Table 6.2: Prior queued wind farm projects monitored

Request	Size	Wind Turbine Model	Point of Interconnection
GEN-2001-014	94	Suzlon 2.1MW	Fort Supply 138kV (520920)
GEN-2001-037	102	GE 1.5MW	Woodward-Mooreland 138kV (515785)
GEN-2002-005	120	Acciona 1.5MW	Moorewood – Elk City 138kV (521116)
GEN-2005-008	120	GE 1.5MW	Woodward 138kV (514785)
GEN-2006-024S	18.9	Suzlon 2.1MW	Buffalo Bear 69kV (521120)
GEN-2006-046	130	Mitsubishi 2.3MW	Dewey 138kV (514787)
GEN-2007-006	160	Suzlon 2.1MW	Roman Nose 138kV (514823)
GEN-2007-021	201	GE 1.5MW	Tatonga 345kV (515378)
GEN-2007-044	300	GE 1.5MW	Tatonga 345kV (515378)
GEN-2007-050	171	Siemens 2.3MW	Woodward 138kV (515376)
GEN-2007-051	200	GE 1.5MW	Mooreland 138kV (520999)
GEN-2007-062	765	GE 1.5MW	Woodward 345kV (515375)
GEN-2008-003	101	Siemens 2.3MW	Woodward 138kV (515376)
GEN-2008-019	300	Mitsubishi 2.3MW	Tatonga 345kV (515378)
GEN-2008-029	250	GE 1.5MW	Woodward 138kV (515376)

6.1 Stability Criteria

Disturbances including three-phase and single-phase to ground faults should not cause synchronous and asynchronous plants to become unstable or disconnect from the transmission grid.

The criterion for synchronous generator stability as defined by NERC is:

"Power system stability is defined as that condition in which the difference of the angular positions of synchronous machine rotor becomes constant following an aperiodic system disturbance."

Voltage magnitudes and frequencies at terminals of asynchronous generators should not exceed magnitudes and durations that will cause protection elements to operate. Furthermore, the response after the disturbance needs to be studied at the terminals of the machine to insure that there are no sustained oscillations in power output, speed, frequency, etc.

Voltage magnitudes and angles after the disturbance should settle to a constant and reasonable operating level. Frequencies should settle to the nominal 60 Hz power frequency.

6.2 Modeling of Wind Turbine Generators

Version 6.02 of the Vestas V90 model for PSS®E with the Advanced Grid Option 2 (AGO2) enabled by SPP was used for the studies.

6.3 Transient Stability Results: Summer Peak 2010

An undisturbed run of 20 seconds was performed on the Summer Peak 2010 power flow case to verify proper initialization of dynamic models. Bus #667041 is absent in the power flow case and results in MHDC3 and CMHDC3 failing to initialize properly and becoming unavailable during dynamic runs. SPP indicated that the absence of the models during the dynamic runs would not affect the transient study results.

Group 1 and prior queued projects will survive each fault contingency in Table 6.1. However, with Tatonga 345 kV voltage scheduled to 1.00 pu, wind turbine generators from GEN-2007-021 and GEN-2007-044 wind turbine generators cannot reach flat steady response post fault for contingencies No. 5, 6, 21, 22, 61, and 62. Transient stability plots are included in Appendix B.

Tatonga 345 kV should be scheduled to 1.01 pu. Transient stability results after this change are included in Appendix C. Transient stability results are summarized in Table 6.3.

6.4 Transient Stability Results: Winter Peak 2009

An undisturbed run of 20 seconds was performed on the Summer Peak 2010 power flow case to verify proper initialization of dynamic models. Bus #667041 is absent in the power flow case and results in MHDC3 and CMHDC3 failing to initialize properly and becoming unavailable during dynamic runs. SPP indicated that the absence of the models during the dynamic runs would not affect the transient study results.

Group 1 and prior queued projects will survive each fault contingency in Table 6.1. However, with Tatonga 345 kV voltage scheduled to 1.00 pu, wind turbine generators from GEN-2007-021 and GEN-2007-044 wind turbine generators cannot reach flat steady response post fault for contingencies No. 1, 2, 5, 6, 9, 10, 21, 22, 61, and 62. Transient stability plots are included in Appendix B.

Tatonga 345 kV should be scheduled to 1.01 pu. Transient stability results after this change are included in Appendix C. Transient stability results are summarized in Table 6.3.

Table 6.3: Transient Stability Results Summary (with upgrades)

Contingency Name	Summer Peak 2010	Winter Peak 2009
UNFAULTED	STABLE	STABLE
FLT01-3PH	STABLE	STABLE
FLT02-1PH	STABLE	STABLE
FLT03-3PH	STABLE	STABLE
FLT04-1PH	STABLE	STABLE
FLT05-3PH	STABLE	STABLE
FLT06-1PH	STABLE	STABLE
FLT07-3PH	STABLE	STABLE
FLT08-1PH	STABLE	STABLE
FLT09-3PH	STABLE	STABLE
FLT10-1PH	STABLE	STABLE
FLT11-3PH	STABLE	STABLE
FLT12-1PH	STABLE	STABLE
FLT13-3PH	STABLE	STABLE
FLT14-1PH	STABLE	STABLE
FLT15-3PH	STABLE	STABLE
FLT16-1PH	STABLE	STABLE
FLT17-3PH	STABLE	STABLE
FLT18-1PH	STABLE	STABLE
FLT19-3PH	STABLE	STABLE
FLT20-1PH	STABLE	STABLE
FLT21-3PH	STABLE	STABLE
FLT22-1PH	STABLE	STABLE
FLT23-3PH	STABLE	STABLE
FLT24-1PH	STABLE	STABLE
FLT25-3PH	STABLE	STABLE
FLT26-1PH	STABLE	STABLE
FLT27-3PH	STABLE	STABLE
FLT28-1PH	STABLE	STABLE
FLT29-3PH	STABLE	STABLE
FLT30-1PH	STABLE	STABLE
FLT31-3PH	STABLE	STABLE
FLT32-1PH	STABLE	STABLE
FLT33-3PH	STABLE	STABLE
FLT34-1PH	STABLE	STABLE

Contingency Name	Summer Peak 2010	Winter Peak 2009
FLT35-3PH	STABLE	STABLE
FLT36-1PH	STABLE	STABLE
FLT37-3PH	STABLE	STABLE
FLT38-1PH	STABLE	STABLE
FLT39-3PH	STABLE	STABLE
FLT40-1PH	STABLE	STABLE
FLT41-3PH	STABLE	STABLE
FLT42-1PH	STABLE	STABLE
FLT43-3PH	STABLE	STABLE
FLT44-1PH	STABLE	STABLE
FLT45-3PH	STABLE	STABLE
FLT46-1PH	STABLE	STABLE
FLT47-3PH	STABLE	STABLE
FLT48-1PH	STABLE	STABLE
FLT49-3PH	STABLE	STABLE
FLT50-1PH	STABLE	STABLE
FLT51-3PH	STABLE	STABLE
FLT52-1PH	STABLE	STABLE
FLT53-3PH	STABLE	STABLE
FLT54-1PH	STABLE	STABLE
FLT55-3PH	STABLE	STABLE
FLT56-1PH	STABLE	STABLE
FLT57-3PH	STABLE	STABLE
FLT58-1PH	STABLE	STABLE
FLT59-3PH	STABLE	STABLE
FLT60-1PH	STABLE	STABLE
FLT61-3PH	STABLE	STABLE
FLT62-1PH	STABLE	STABLE

J: Stability Study for Group 2

Report R22-10

Generator Interconnection Impact Study: PISIS -2009-001- Group 2

Prepared for

Southwest Power Pool, Inc

Submitted by:
Vikas Singhvi, Consultant
Bernardo Fernandes, Staff Consultant

March 03, 2010

Siemens PTI Project Number: P/23-115073-B-1

Siemens Energy, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of Southwest Power Pool, Inc. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor Southwest Power Pool, Inc, nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and Southwest Power Pool, Inc from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Section

1

Introduction

1.1 Background

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Siemens PTI performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customers and SPP. The requests for interconnection were placed in accordance to SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

The purpose of this report is to present the results of the steady state, stability and power factor analysis performed to evaluate the impact of the proposed cluster of interconnections of the PISIS-2009-001 with regard to Group 2 wind projects on the Southwest Power Pool system. Eventual indicative solutions to the identified issues are proposed based on the impact of each generation interconnection on the Southwest Power Pool system.

In the new scenario, Group 2 of PISIS-2009-001 comprises six different projects interconnected in the 345, 230 and 115 kV system, described in detail in Section 2.

Transient stability analysis was performed using the package provide by SPP. It contains the latest stability database in PSS™E version 30.3.2. The stability package also includes the dynamic data for the previously queued projects.

1.2 Purpose

The steady state and stability restudy was carried out to:

1. Determine the ability of the proposed generation facilities to remain in synchronism and within applicable planning standards following two types of system faults tested a) unsuccessful reclosing b) normally cleared faults.
2. Determine the amount of transient support required from the costumer to meet the power factor requirement at the POI.
3. Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

This page intentionally left blank.

Section

2

Model Development

The study has considered the 2010 Summer Peak and 2009 Winter Peak load flow models with the required interconnection generation modeled. The base cases also contain all the significant previous queued generation interconnection projects in the interconnection queue.

2.1 Power Flow Data

The Group 2 of PISIS-2009-001 contains six generation interconnection requests. Table 2-1 presents the size of the wind generation projects, the Wind Turbine Generator (WTG) manufacturers, as well as the reactive capability of each generation project point of interconnection.

Table 2-1 – Details of the Interconnection Requests

Request	Size	Wind Turbine Model	Reactive Capability of Wind Farm		Point of Interconnection
			Max (Mvar)	Min (Mvar)	
GEN-2008-028	360	GE 1.5MW	118.324	-118.324	Hitchland 345kV (#523097)
GEN-2008-047	300	GE 1.5MW	98.6	-98.6	Hitchland – Woodward 345kV (523097-515375)
GEN-2008-062	100.8	Vestas V90 1.8MW	0	0	Cole 115kV (523120)
GEN-2008-108	198	Vestas V90 1.8MW	0	0	Potter – Moore County 230kV (523959 – 523309)
GEN-2008-110	300	GE 1.5MW	98.6	-98.6	Hitchland 345kV (#523097)
GEN-2009-018	200.1	Siemens SMK203 2.3MW	96.912	-96.912	Hitchland – Moore County 230kV (523095 - 523309)

Note - The Vestas Model has unity power factor for voltage control within 0.95 p.u. - 1.05 p.u

The analysis was carried out using the database package provided by SPP which also includes the modeling data for the previously queued projects, as listed in the Table 2-2 below.

Table 2-2 – Details of the Prior Queue Interconnection Requests

Request	Size	Wind Turbine Model	Point of Interconnection	Bus No.
GEN-2002-006	150	GE 1.5MW	Texas Co. 115kV	523090
GEN-2002-008	240	GE 1.5MW	Hitchland 345kV	523097
GEN-2002-009	80	Suzlon 2.1MW	Hansford 115kV	523195
GEN-2003-013	196	GE 1.5 MW	Hitchland – Finney 345kV	560029
GEN-2003-020	160	GE 1.5 MW	Carson Co. 115kV	523924
GEN-2005-017	340	GE 1.5 MW	Hitchland – Potter 345kV	51700
GEN-2006-020	19.5	GE 1.5 MW	Hitchland – Sherman Tap 115kV	560200
GEN-2006-044	370	GE 1.5 MW	Hitchland 345kV	523097
GEN-2006-049	400	GE 1.5 MW	Hitchland – Finney 345kV	560029
GEN-2007-005	200	Furhlander 2.5MW	Pringle 115kV	523666
GEN-2007-046	199.5	GE 1.5MW	Hitchland 115kV	523093
GEN-2007-057	34.5	GE 1.5MW	Moore Co. East 115kV	523308

Figures 2-1 and 2-2 present the surrounding area of the Group 2 points of interconnection. The single line diagrams show the line flows and voltage profile for the base cases considered in the study: summer and winter peak scenarios, respectively.

Figure 2-1 - Group 2 Points of Interconnection Surrounding Area SummerPeak

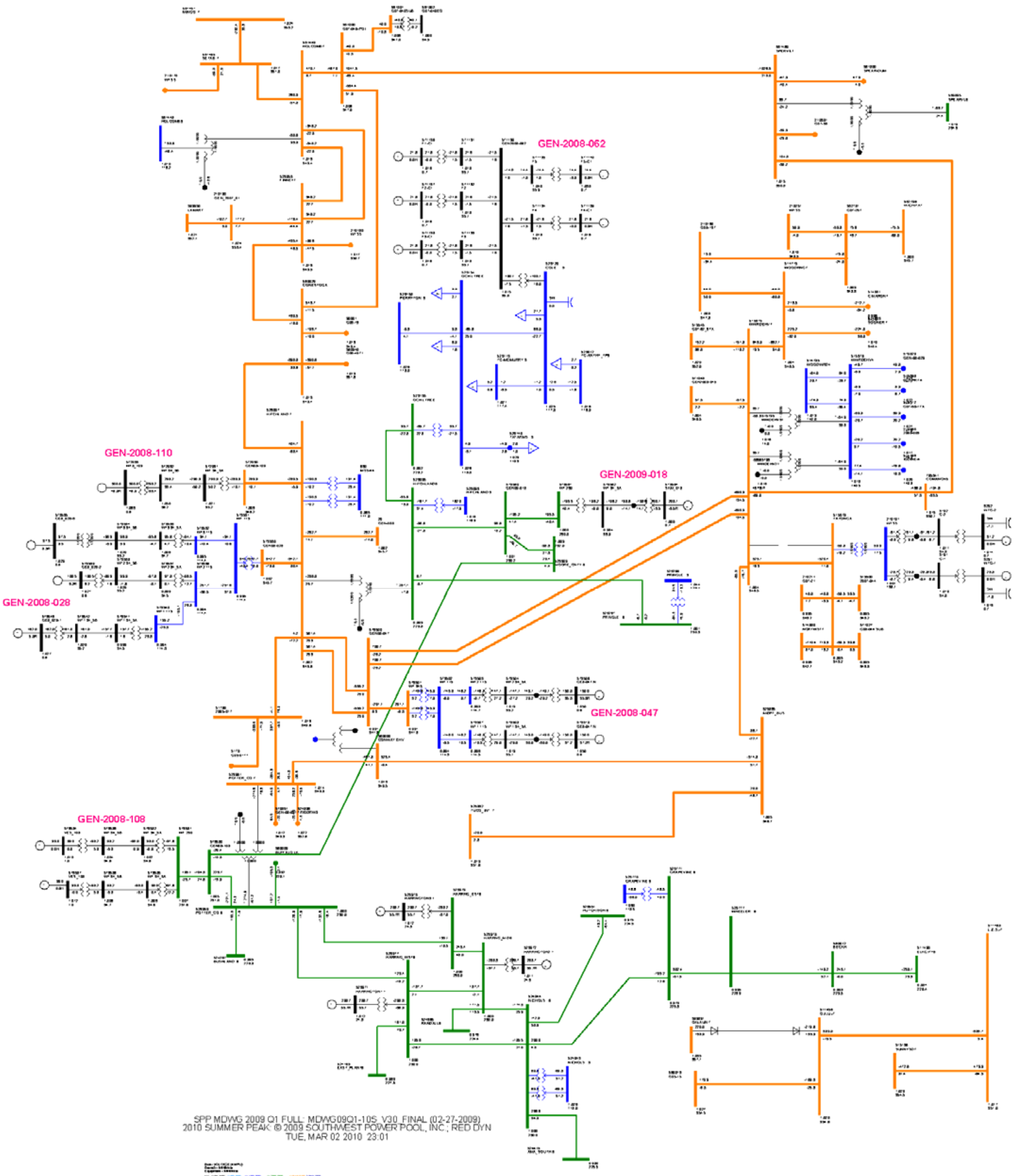
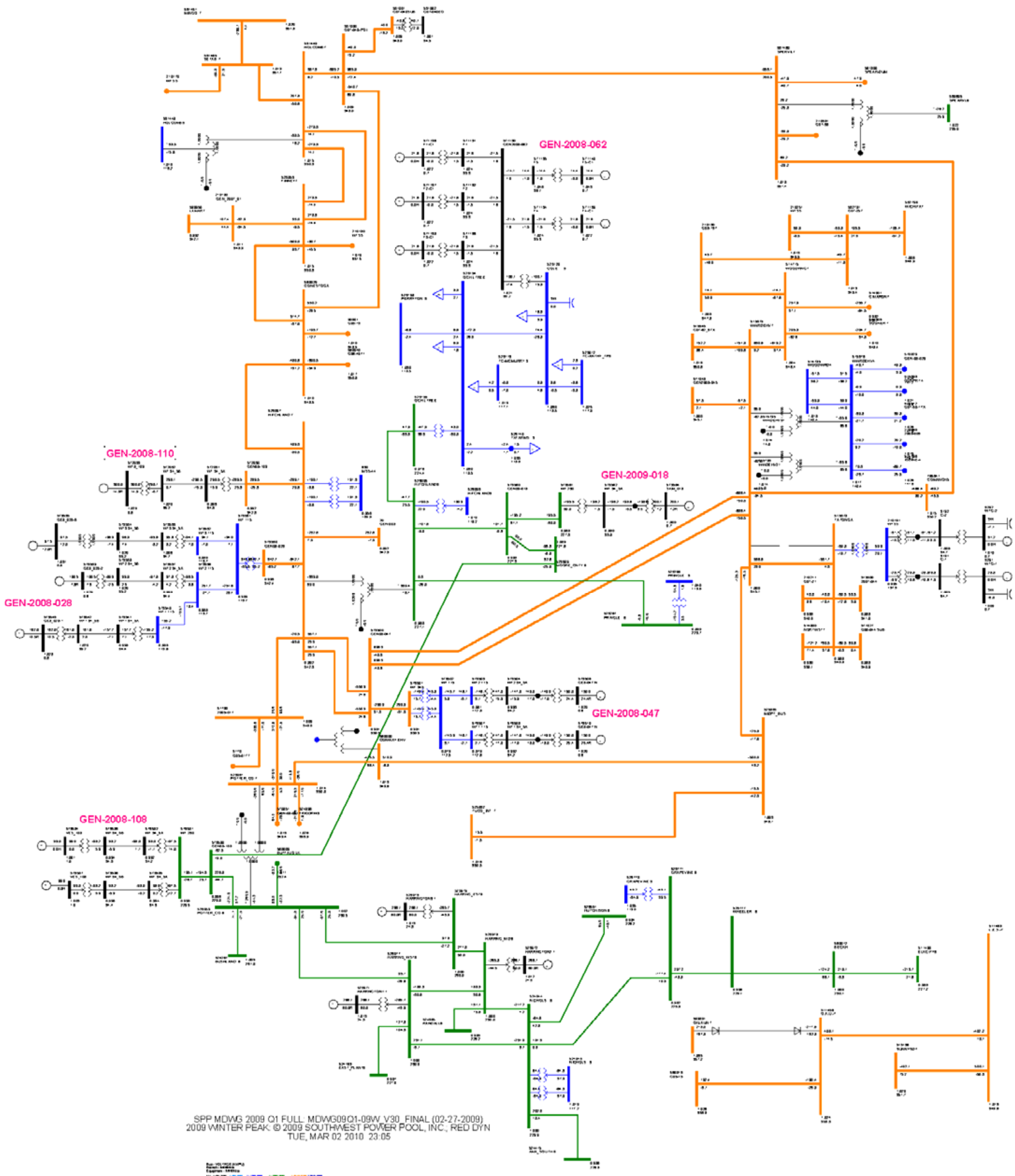


Figure 2-2 - Group 2 Points of Interconnection Surrounding Area –Winter Peak



Figures A-1 trough A-6 in Appendix A present single line diagrams, showing for each of the Group 2 projects, the modeling details and impedance data of the transformers and collector systems.

2.2 Stability Database

The transient stability analysis was performed using the data provided by SPP. Stability models for the Group 2 interconnection requests were added to the dynamic database, based on the technical documentation given. All turbine parameters used in the simulation models are the default parameters in the wind turbine package. It is assumed that each wind turbine generators (WTG's) controls the voltage of its own bus. The default voltage protection model set points recommended by the manufacturer were used, that is, the wind units were modeled with their built-in voltage ride through capability.

In the analysis, the wind generation projects are modeled using equivalents representing groups of turbines and the respective collector systems.

Also, the default frequency protection model set points recommended by the manufacturer were used.

The PSS®E dynamic models output list is shown in Appendix B, documenting the model parameters of each one of the Group 2 wind turbines modeled in the stability analysis.

Section

3

Methodology and Assumptions

The study considered 2009 and 2010 power flow cases with the required interconnection generation requests modeled as described in Section 2. The base case also contains all the significant previous queued projects in the interconnection queue.

The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
520	AEPW
524	OKGE
525	WFEC
526	SPS
531	MIDW
534	SUNC
536	WERE

3.1 Methodology

3.1.1 Stability Simulations

The stability simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single line to ground faults in the neighborhood of PISIS-2009-001 – Group 2 Points of Interconnection were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The group 2 projects were also evaluated on the matter of ability to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

3.1.2 Steady State Simulations

3.1.2.1 N-1 Contingency Analysis

An N-1 contingency analysis was performed to evaluate voltage violations, if any, caused by disturbances (tripping of the faulted line). The voltages at each POI were monitored for deviations from the base case voltage and the percentage deviations were documented.

The summer peak and winter peak load flow cases were adjusted to ensure there are no relevant pre contingency voltage criteria violations. During contingency analysis it was reported voltages of any monitored bus found to be outside the range of the post-contingency criteria and / or having more than 1% of project impact.

3.1.2.2 Power Factor Analysis

The analysis determines what power factor is necessary at the POI for each contingency.

If the required power factor at the POI is beyond the capability of the studied wind turbines to meet the requirement at the POI, capacitor banks will be considered.

A QV analysis was performed to determine the reactive support requirement at each project's POI. Mvar injections, tabulated for base case and contingency conditions, are used to determine the reactive power support required at each POI, in order to maintain the bus scheduled pre contingency voltages.

These tables are obtained through a series of AC load flow calculations. Starting with no reactive support at a bus, the voltage is computed for a series of power flows as the reactive support is changed in steps, until the power flow experiences convergence difficulties as the system approaches the voltage collapse point.

3.2 Disturbances for Stability Analysis

The stability simulations considered three-phase (3PH) faults and single line-to-ground (SLG) faults. For transmission line outages the complete fault clearing process includes the following sequence of events:

1) Line fault, cleared after 5 cycles by tripping the both line terminals.

2) After 20 cycles the line is reclosed under fault conditions (unsuccessful reclosing)

3) The fault is cleared by tripping both ends of the faulted line. Once again, 5 cycles later.

Some line outages were simulated for normal clearing (i.e. cleared in 5 cycles) and few with unsuccessful reclosing.

Furthermore, the clearing process for transformer faults is:

1) Transformer fault, cleared after 5 cycles by tripping the equipment

The disturbances evaluated are listed in the following Table 3-2:

Table 3-2: Disturbances for Stability Analysis

Cont. #	Fault Location	Fault Type	Fault Clearing
1	At Hitchland end of 345 kV line to Conestoga	3PH	trip Hitchland – Conestoga 345 kV
2	At Hitchland end of 345 kV line to Conestoga	SLG	trip Hitchland – Conestoga 345 kV
3	At Hitchland end of 345 kV line to GEN-2005-017	3PH	trip Hitchland – GEN-2005-017 345 kV
4	At Hitchland end of 345 kV line to GEN-2005-017	SLG	trip Hitchland – GEN-2005-017 345 kV
5	At Hitchland end of 345 kV line to Gen-2008-047	3PH	trip Hitchland – Gen-2008-047 345 kV
6	At Hitchland end of 345 kV line to Gen-2008-047	SLG	trip Hitchland – Gen-2008-047 345 kV
7	At Hitchland 345 kV end of 345/230 kV transformer	3PH	trip Hitchland 345/230 kV transformer
8	At Hitchland 230 kV end of 345/230 kV transformer	3PH	trip Hitchland 345/230 kV transformer
9	At Hitchland end of 230 kV line to Pringle	3PH	trip Hitchland – Pringle 230 kV
10	At Gen-2009-018 end of 230 kV line to Hitchland	3PH	trip Gen-2009-018 – Hitchland 230 kV
11	At Gen-2009-018 end of 230 kV line to Hitchland	SLG	trip Gen-2009-018 – Hitchland 230 kV
12	At Gen-2009-018 end of 230 kV line to Moore Co	3PH	trip Gen-2009-018 – Moore Co. 230 kV
13	At Gen-2009-018 end of 230 kV line to Moore Co	SLG	trip Gen-2009-018 – Moore Co. 230 kV
14	At GEN-2005-017 end of 345 kV line to Potter Co	3PH	trip GEN-2005-017 – Potter Co 345 kV
15	At GEN-2005-017 end of 345 kV line to Potter Co	SLG	trip GEN-2005-017 – Potter Co 345 kV
16	At Gen-2008-108 end of 230 kV line to Moore Co	3PH	trip Gen-2008-108 – Moore Co. 230 kV
17	At Gen-2008-108 end of 230 kV line to Moore Co	SLG	trip Gen-2009-108 – Moore Co. 230 kV
18	At Gen-2008-108 end of 230 kV line to Potter Co	3PH	trip Gen-2008-108 – Potter Co. 230 kV
19	At Gen-2008-108 end of 230 kV line to Potter Co	SLG	trip Gen-2009-108 – Potter Co. 230 kV

Cont. #	Fault Location	Fault Type	Fault Clearing
20	At Pringle end of 230 kV line to Harrington	3PH	trip Pringle –Harrington 230 kV
21	At Pringle end of 230 kV line to Harrington	SLG	trip Pringle –Harrington 230 kV
22	At Conestoga end of 345 kV line to Finney	3PH	trip Conestoga – Finney 345 kV
23	At Conestoga end of 345 kV line to Finney	SLG	trip Conestoga – Finney 345 kV
24	At Holocomb end of 345 kV line to Setab	3PH	trip Holocomb – Setab 345 kV
25	At Holocomb end of 345 kV line to Setab	SLG	trip Holocomb – Setab 345 kV
26	At Holocomb end of 345 kV line to GEN-2007-040	3PH	trip Holocomb – GEN-2007-040 345 kV
27	At Holocomb end of 345 kV line to GEN-2007-040	SLG	trip Holocomb – GEN-2007-040 345 kV
28	At Woodward end of 345 kV line to Tatonga	3PH	trip Woodward – Tatonga 345 kV
29	At Hitchland end of 115 kV line to Texas Co	3PH	trip Hitchland – Texas Co 115 kV
30	At Hitchland end of 115 kV line to Texas Co	SLG	trip Hitchland – Texas Co 115 kV
31	At Hitchland end of 115 kV segment to Sherman	3PH	trip Hitchland - GEN-2007-046 – DWS Frisco-Sherman Tap – Moore Co East 115 kV
32	At Hitchland end of 115 kV segment to Sherman	SLG	trip Hitchland - GEN-2007-046 – DWS Frisco-Sherman Tap – Moore Co East 115 kV
33	At Hitchland end of 115 kV line to Hansford	3PH	trip Hitchland – Hansford 115 kV
34	At Hitchland end of 115 kV line to Hansford	SLG	trip Hitchland – Hansford 115 kV
35	At Hitchland 115 kV end of 230/115 kV transformer	3PH	trip Hitchland 230/115 kV transformer
36	At Pringle end of 115 kV line to Spearman	3PH	trip Pringle – Spearman 115 kV
37	At Pringle end of 115 kV line to Spearman	SLG	trip Pringle – Spearman 115 kV
38	At Moore Co. East end of 115 kV segment to Sherman	3PH	trip Hitchland - GEN-2007-046 – DWS Frisco-Sherman Tap – Moore Co East 115 kV

Cont. #	Fault Location	Fault Type	Fault Clearing
39	At Moore Co. East end of 115 kV segment to Sherman	SLG	trip Hitchland - GEN-2007-046 – DWS Frisco-Sherman Tap – Moore Co East 115 kV
40	At Moore Co East of 115 kV line to RB Hogu	3PH	trip Moore Co East – RB Hogu 115 kV
41	At Moore Co East of 115 kV line to RB Hogu	SLG	trip Moore Co East – RB Hogu 115 kV
42	At Moore Co West of 115 kV line to Dumas	3PH	trip Moore Co West – Dumas 115 kV
43	At Moore Co West of 115 kV line to Dumas	SLG	trip Moore Co West – Dumas 115 kV
44	At Moore Co West of 115 kV line to RB Sneed	3PH	trip Moore Co West – RB Sneed 115 kV
45	At Moore Co West of 115 kV line to RB Sneed	SLG	trip Moore Co West – RB Sneed 115 kV
46	At Moore Co East 115 kV end of 230/115 kV transformer	3PH	trip Moore Co East 230/115 kV transformer
47	At Moore Co East 115 kV end of 230/115 kV transformer	SLG	trip Moore Co East 230/115 kV transformer
48	At Cole end of 115 kV line to Ochiltree	3PH	trip Cole – Ochiltree 115 kV
49	At Cole end of 115 kV line to Ochiltree	SLG	trip Cole – Ochiltree 115 kV
50	At Cole end of the 115 kV line to Tri County Anthony / Beaver	3PH	trip Cole – Tri County Anthony / Beaver 115 kV
51	At Cole end of the 115 kV line to Tri County Anthony / Beaver	SLG	trip Cole – Tri County Anthony / Beaver 115 kV
52	At Spearman of 115 kV line to Spearman Sub	3PH	trip Spearman – Spearman Sub 115 kV
53	At Spearman of 115 kV line to Spearman Sub	SLG	trip Spearman – Spearman Sub 115 kV
54	At Ochiltree 115 kV end of 230/115 kV transformer	3PH	trip Ochiltree 230/115 kV transformer
55	At Texas Co of 115 kV line to TC-MMRY3	3PH	trip Texas Co – TC-MMRY3 115 kV
56	At Texas Co of 115 kV line to TC-MMRY3	SLG	trip Texas Co – TC-MMRY3 115 kV
57	At Texas Co 115 kV end of 115 kV phase shift transformer	3PH	trip Texas Co 115 kV phase shift transformer
58	At Dalhart of 115 kV line to Sherman	3PH	trip Dalhart – Sherman 115 kV
59	At Dalhart of 115 kV line to Sherman	SLG	trip Dalhart – Sherman 115 kV

Cont. #	Fault Location	Fault Type	Fault Clearing
60	At Gen – 2008-047 end of the 345 kV line to Hitchland	3PH	trip Gen-2008-047 – Hitchland 345 kV
61	At Gen – 2008-047 end of the 345 kV line to Hitchland	SLG	trip Gen-2008-047 – Hitchland 345 kV
62	At Gen – 2008-047 end of the 345 kV line to Woodward	3PH	trip Gen-2008-047 – Woodward 345 kV
63	At Gen – 2008-047 end of the 345 kV line to Woodward	SLG	trip Gen-2008-047 – Woodward 345 kV
64	At Potter end of the 345 kV line to Conway	3PH	trip Potter – Conway 345 kV
65	At Potter end of the 345 kV line to Conway	SLG	trip Potter – Conway 345 kV
66	At Potter end of the 345 kV line to Frio Draw	3PH	trip Potter – Frio Draw 345 kV
67	At Potter end of the 345 kV line to Frio Draw	SLG	trip Potter – Frio Draw 345 kV
68	At Gen-2007-040 end of the 345 kV line to Conestoga	3PH	trip Gen-2007-040 – Conestoga 345 kV
69	At Gen-2007-040 end of the 345 kV line to Conestoga	SLG	trip Gen-2007-040 – Conestoga 345 kV
70	At Conway end of the 345 kV line to Potter	3PH	trip Potter – Conway 345 kV

In order to simulate single line to ground faults, equivalent reactances were calculated. Table 3-3 presents the reactances applied to the buses in the stability simulations:

Table 3-3: Equivalent Reactances – Line to Ground Faults

Bus Number	Name	Equivalent Reactance (Mvar)
523097	Hitchland 345 kV	4200
573560	Gen-2009-018	2500
573580	Gen-2008-108	2000
523267	Pringle 230 kV	1550
560029	Conestoga	2500
531449	Holcomb 345 kV	3500
523093	Hitchland 115 kV	1300

Bus Number	Name	Equivalent Reactance (Mvar)
523266	Pringle 115 kV	1300
523308	Moore Co East 115 kV	1500
523304	Moore Co West 115 kV	1500
523120	Cole 115 kV	480
523186	Spearman 115 kV	950
523090	Texas Co 115 kV	900
523246	Dalhart 115 kV	410
573500	Gen-2008-047 345 kV	3500
523961	Potter Co. 345 kV	3700
51700	Gen 05-017 345 kV	2700
531000	Gen-2007-040 345 kV	3500

The following Figures 3-1 and 3-2 present the most of fault locations within the study area.

Figure 3-1 – Fault Locations in the Study Area – *Diagram1, 345 and 230 kV Systems*

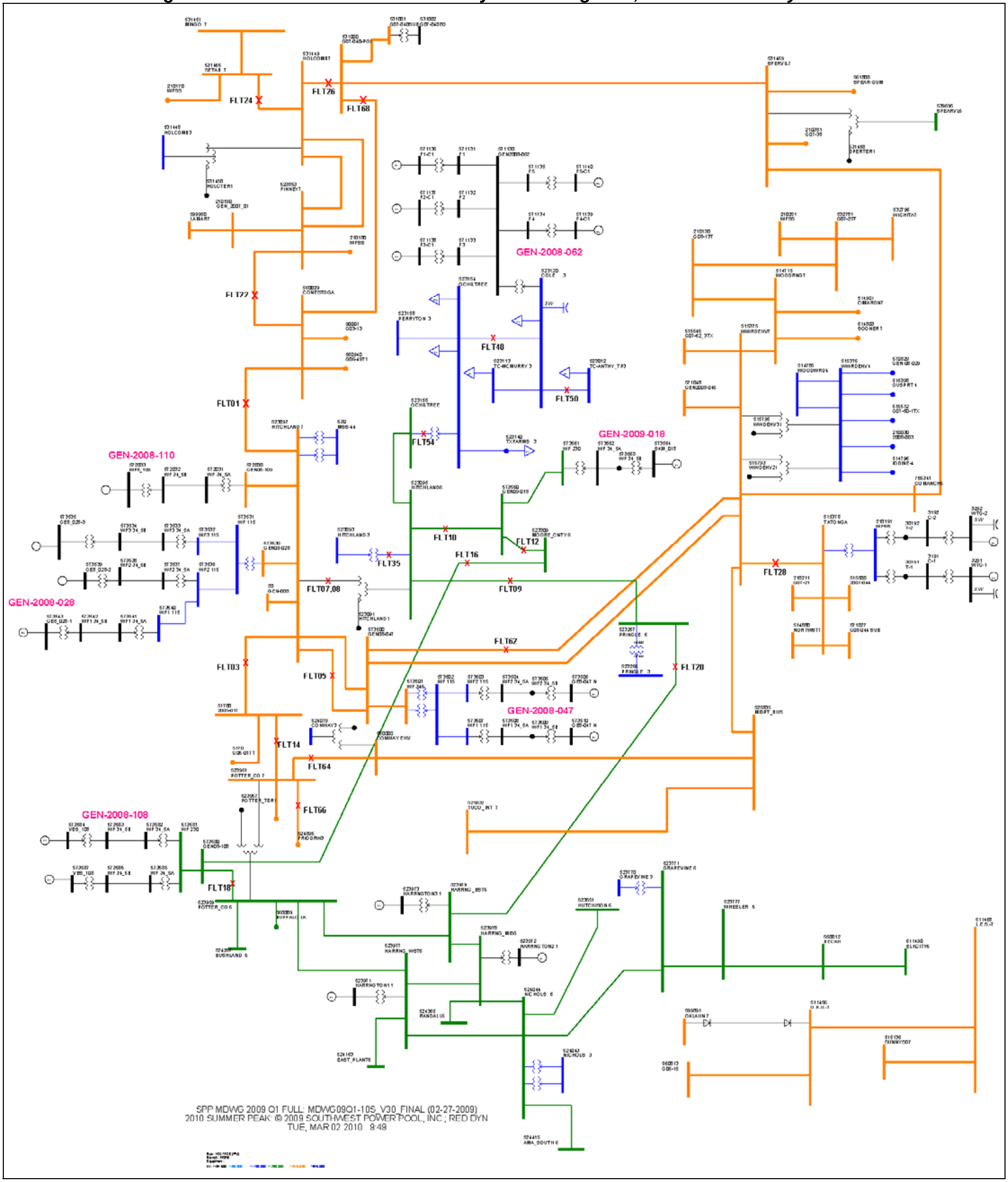
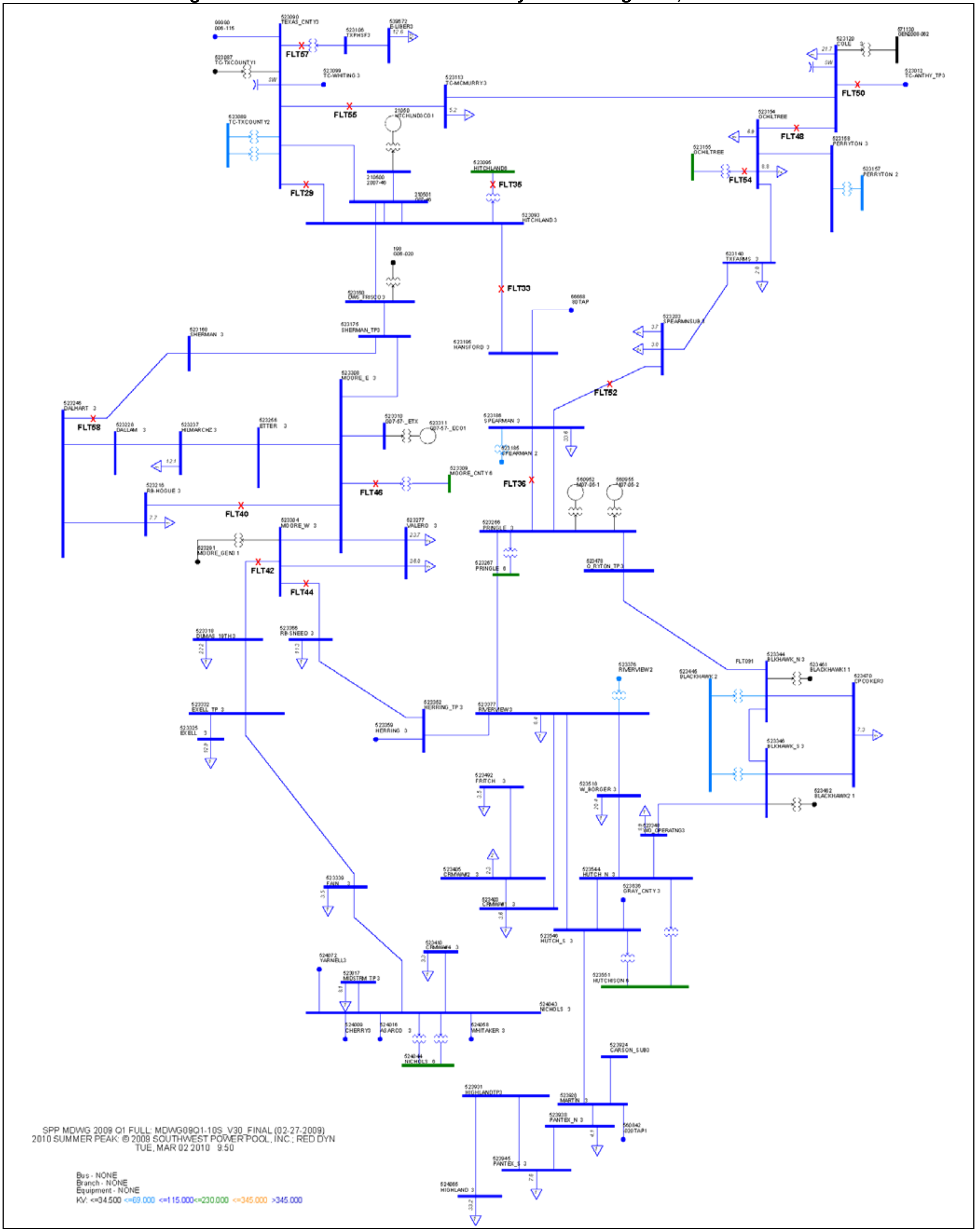


Figure 3-2 – Fault Locations in the Study Area – *Diagram2, 115 kV*



This page intentionally left blank.

Section

4

Analysis Performed

4.1 Steady State Performance

Table 4-1 and Table 4-2 summarize the results obtained from the steady state analysis for Summer Peak and Winter Peak base cases, respectively. The tables list the voltage deviations at the Points of Interconnection of the proposed study projects of Group 3, as well as the prior queued projects. Note that the tables list only the contingencies that cause violation in the voltage criteria or have an impact of at least 1% in the POI's voltages.

The complete set of results for both summer peak and winter peak scenarios are presented in Appendix C.

Table 4-1: Results Obtained – Steady State Analysis – Summer Peak Base Case

Bus #	Bus Name	KV	Contingency Voltage (p.u.)	Base Voltage (p.u.)	Contingency Description	% Deviation
51700	2005-017	345.0	**1.0136**	1.0136	Base Case	-
90001	G03-13	345.0	**1.0129**	1.0129	Base Case	-
515375	WWRDEHV7	345.0	**1.0045**	1.0045	Base Case	-
523090	TEXAS_CNTY3	115.0	**1.0223**	1.0223	Base Case	-
523095	HITCHLAND6	230.0	**1.0005**	1.0005	Base Case	-
523097	HITCHLAND 7	345.0	**1.0024**	1.0024	Base Case	-
523120	COLE 3	115.0	**1.0263**	1.0263	Base Case	-
523160	DWS_FRISCO 3	115.0	**1.0193**	1.0193	Base Case	-
523175	SHERMAN_TP3	115.0	**1.0090**	1.0090	Base Case	-
523195	HANSFORD 3	115.0	**1.0243**	1.0243	Base Case	-
523266	PRINGLE 3	115.0	**1.0450**	1.0450	Base Case	-
523308	MOORE_E 3	115.0	**1.0183**	1.0183	Base Case	-
523309	MOORE_CNTY 6	230.0	**1.0118**	1.0118	Base Case	-
523853	FINNEY7	345.0	**1.0132**	1.0132	Base Case	-
523924	CARSON_SUB3	115.0	**1.0265**	1.0265	Base Case	-
523959	POTTER_CO 6	230.0	**1.0001**	1.0001	Base Case	-
560029	CONESTOGA	345.0	**1.0129**	1.0129	Base Case	-
572030	GEN08-109	345.0	**1.0040**	1.0040	Base Case	-
573500	GEN08-047	345.0	**0.9910**	0.9910	Base Case	-

Bus #	Bus Name	KV	Contingency Voltage (p.u.)	Base Voltage (p.u.)	Contingency Description	% Deviation
573501	WF 345	345.0	**0.9910**	0.9910	Base Case	-
573560	GEN09-018	230.0	**1.0027**	1.0027	Base Case	-
573561	WF 230	230.0	**1.0017**	1.0017	Base Case	-
573580	GEN08-108	230.0	**1.0063**	1.0063	Base Case	-
573581	WF 230	230.0	**1.0087**	1.0087	Base Case	-
573500	GEN08-047	345.0	**0.9578**	0.9910	FLT01_3PH	-3.35
573501	WF 345	345.0	**0.9579**	0.9910	FLT01_3PH	-3.34
523097	HITCHLAND 7	345.0	**0.9788**	1.0024	FLT01_3PH	-2.35
572030	GEN08-109	345.0	**0.9823**	1.0040	FLT01_3PH	-2.16
515375	WWRDEHV7	345.0	**0.9830**	1.0045	FLT01_3PH	-2.14
51700	2005-017	345.0	**0.9965**	1.0136	FLT01_3PH	-1.69
523095	HITCHLAND6	230.0	**0.9890**	1.0005	FLT01_3PH	-1.15
573560	GEN09-018	230.0	**0.9921**	1.0027	FLT01_3PH	-1.06
573561	WF 230	230.0	**0.9917**	1.0017	FLT01_3PH	-1.00
523853	FINNEY7	345.0	**1.0299**	1.0132	FLT01_3PH	1.65
90001	G03-13	345.0	**1.0354**	1.0129	FLT01_3PH	2.22
560029	CONESTOGA	345.0	**1.0354**	1.0129	FLT01_3PH	2.22
573561	WF 230	230.0	**1.0127**	1.0017	FLT10_3PH	1.10
573560	GEN09-018	230.0	**1.0143**	1.0027	FLT10_3PH	1.16
573560	GEN09-018	230.0	**0.9891**	1.0027	FLT12_3PH	-1.36
573561	WF 230	230.0	**0.9888**	1.0017	FLT12_3PH	-1.29
523095	HITCHLAND6	230.0	**0.9898**	1.0005	FLT12_3PH	-1.07
573500	GEN08-047	345.0	**0.9795**	0.9910	FLT14_3PH	-1.16
573501	WF 345	345.0	**0.9796**	0.9910	FLT14_3PH	-1.15
523175	SHERMAN_TP3	115.0	**0.9709**	1.0090	FLT31_3PH	-3.78
523195	HANSFORD 3	115.0	**1.0479**	1.0243	FLT33_3PH	2.30
523175	SHERMAN_TP3	115.0	**0.9978**	1.0090	FLT35_3PH	-1.11
523175	SHERMAN_TP3	115.0	**0.9709**	1.0090	FLT38_3PH	-3.78
523120	COLE 3	115.0	**0.9956**	1.0263	FLT48_3PH	-2.99
523090	TEXAS_CNTY3	115.0	**1.0114**	1.0223	FLT48_3PH	-1.07
523120	COLE 3	115.0	**1.0124**	1.0263	FLT54_3PH	-1.35
573500	GEN08-047	345.0	**0.9756**	0.9910	FLT62_3PH	-1.55
573501	WF 345	345.0	**0.9756**	0.9910	FLT62_3PH	-1.55
523853	FINNEY7	345.0	**1.0008**	1.0132	FLT68_3PH	-1.22

Table 4-2: Results Obtained – Steady State Analysis – Winter Peak Base Case

Bus #	Bus Name	kV	Contingency Voltage (p.u.)	Base Voltage (p.u.)	Contingency Description	% Deviation
51700	2005-017	345.0	1.0086	1.0086	Base Case	-
90001	G03-13	345.0	1.0102	1.0102	Base Case	-
515375	WWRDEHV7	345.0	1.0003	1.0003	Base Case	-
523090	TEXAS_CNTY3	115.0	1.0173	1.0173	Base Case	-
523095	HITCHLAND6	230.0	0.9876	0.9876	Base Case	-
523097	HITCHLAND 7	345.0	0.9922	0.9922	Base Case	-
523120	COLE 3	115.0	1.0304	1.0304	Base Case	-
523160	DWS_FRISCO 3	115.0	1.0157	1.0157	Base Case	-
523175	SHERMAN_TP3	115.0	1.0117	1.0117	Base Case	-
523195	HANSFORD 3	115.0	1.0202	1.0202	Base Case	-
523266	PRINGLE 3	115.0	1.0404	1.0404	Base Case	-
523308	MOORE_E 3	115.0	1.0267	1.0267	Base Case	-
523309	MOORE_CNTY 6	230.0	0.9894	0.9894	Base Case	-
523853	FINNEY7	345.0	1.0155	1.0155	Base Case	-
523924	CARSON_SUB3	115.0	1.0246	1.0246	Base Case	-
523959	POTTER_CO 6	230.0	1.0020	1.0020	Base Case	-
560029	CONESTOGA	345.0	1.0102	1.0102	Base Case	-
572030	GEN08-109	345.0	0.9921	0.9921	Base Case	-
573500	GEN08-047	345.0	0.9813	0.9813	Base Case	-
573501	WF 345	345.0	0.9812	0.9812	Base Case	-
573560	GEN09-018	230.0	0.9884	0.9884	Base Case	-
573561	WF 230	230.0	0.9882	0.9882	Base Case	-
573580	GEN08-108	230.0	0.9956	0.9956	Base Case	-
573581	WF 230	230.0	0.9980	0.9980	Base Case	-
573500	GEN08-047	345.0	0.9397	0.9813	FLT01_3PH	-4.24
573501	WF 345	345.0	0.9397	0.9812	FLT01_3PH	-4.23
523097	HITCHLAND 7	345.0	0.9624	0.9922	FLT01_3PH	-3.00
515375	WWRDEHV7	345.0	0.9717	1.0003	FLT01_3PH	-2.86
572030	GEN08-109	345.0	0.9646	0.9921	FLT01_3PH	-2.77
51700	2005-017	345.0	0.9871	1.0086	FLT01_3PH	-2.13
523095	HITCHLAND6	230.0	0.9740	0.9876	FLT01_3PH	-1.38
573560	GEN09-018	230.0	0.9763	0.9884	FLT01_3PH	-1.22
573561	WF 230	230.0	0.9767	0.9882	FLT01_3PH	-1.16
523853	FINNEY7	345.0	1.0368	1.0155	FLT01_3PH	2.10
90001	G03-13	345.0	1.0408	1.0102	FLT01_3PH	3.03
560029	CONESTOGA	345.0	1.0408	1.0102	FLT01_3PH	3.03
523097	HITCHLAND 7	345.0	0.9823	0.9922	FLT03_3PH	-1.00

Bus #	Bus Name	kV	Contingency Voltage (p.u.)	Base Voltage (p.u.)	Contingency Description	% Deviation
51700	2005-017	345.0	1.0244	1.0086	FLT03_3PH	1.57
573500	GEN08-047	345.0	0.9926	0.9813	FLT07_3PH	1.15
573501	WF 345	345.0	0.9925	0.9812	FLT07_3PH	1.15
573500	GEN08-047	345.0	0.9698	0.9813	FLT14_3PH	-1.17
573501	WF 345	345.0	0.9698	0.9812	FLT14_3PH	-1.16
573581	WF 230	230.0	0.9747	0.9980	FLT18_3PH	-2.33
573580	GEN08-108	230.0	0.9725	0.9956	FLT18_3PH	-2.32
523309	MOORE_CNTY 6	230.0	0.9740	0.9894	FLT18_3PH	-1.56
573560	GEN09-018	230.0	0.9785	0.9884	FLT18_3PH	-1.00
90001	G03-13	345.0	0.9990	1.0102	FLT22_3PH	-1.11
560029	CONESTOGA	345.0	0.9990	1.0102	FLT22_3PH	-1.11
573500	GEN08-047	345.0	0.9715	0.9813	FLT22_3PH	-1.00
573501	WF 345	345.0	0.9715	0.9812	FLT22_3PH	-0.99
523175	SHERMAN_TP3	115.0	0.9925	1.0117	FLT31_3PH	-1.90
523195	HANSFORD 3	115.0	1.0549	1.0202	FLT33_3PH	3.40
523175	SHERMAN_TP3	115.0	0.9925	1.0117	FLT38_3PH	-1.90
523308	MOORE_E 3	115.0	1.0031	1.0267	FLT46_3PH	-2.30
523175	SHERMAN_TP3	115.0	0.9976	1.0117	FLT46_3PH	-1.39
523309	MOORE_CNTY 6	230.0	1.0001	0.9894	FLT46_3PH	1.08
523120	COLE 3	115.0	0.9975	1.0304	FLT48_3PH	-3.19
523090	TEXAS_CNTY3	115.0	1.0052	1.0173	FLT48_3PH	-1.19
523120	COLE 3	115.0	1.0094	1.0304	FLT54_3PH	-2.04
523120	COLE 3	115.0	1.0420	1.0304	FLT55_3PH	1.13
573500	GEN08-047	345.0	0.9637	0.9813	FLT62_3PH	-1.79
573501	WF 345	345.0	0.9637	0.9812	FLT62_3PH	-1.78
523853	FINNEY7	345.0	1.0045	1.0155	FLT68_3PH	-1.08

In general, the Group 2 interconnection requests have more than 1% impact on the voltage profile of the monitored system, under contingencies. Significant voltage criteria violations, caused by the projects, were identified through the simulations performed. The results can be summarized as follows:

- Voltage deviation of about 3.78% in FLT 31 and 38 (summer peak). This contingency is related to loss of 115 kV segment Moore Co. East – Sherman Tap – DWS Frisco – Gen-07-046 – Hitchland. This big deviation is due to loss of reactive support from the Gen-2006-020 as it is isolated form the system as a result of the contingency.

- Voltage deviation of about 4.24% in FLT 01 (winter peak). This contingency is related to outage of 345 kV circuit between Hitchland and Conestoga. The deviation is due to the loss of transmission path from Hitchland to Finney 345 kV which results in increased flow from Hitchland to Woodward 345 kV (via GEN 2008 -047 345 kV). This results in large drop in voltage at Gen-2008-047 345 kV substation.

- The outage of 115 kV line between Hitchland and Hansford (FLT 33) substations leads to a minor voltage violation of +0.5% (in winter peak) at Hansford 115 kV. The identified violation can be mitigated using the existing system resources to control the voltages.

- The outage of 345 kV line between Hitchland and Conestoga (FLT01) substations leads to voltage violation (-1% in winter peak) at Gen08-047 and WF 345 kV substations. Again, the drop in voltage is due to increased flow from Hitchland to Woodward 345 kV (via GEN 2008 -047). In order to mitigate these undervoltages is necessary to increase the set point voltage of the project (Gen-2008-047) itself.

4.2 Power Factor Analysis

A QV analysis was performed to determine the amount of reactive support required from the projects to maintain the scheduled voltages at the respective points of interconnection. The contingencies described in Table 3-2 were evaluated in steady state conditions for summer and winter peak base cases, with variable Mvar injection at the POI's.

Table 4-3 presents the Mvar requirements and the associated power factor, the projects must be able to provide under contingencies. It should be noted that the projects connecting at Hitchland 345 kV were modeled in cases, with different permutation and combinations, based on their queue positions.

The maximum amount of Mvar i.e. 122 Mvar is required at Hitchland 345 kV when all the three projects (Gen-2008-028,047 and 110) were modeled in cases simultaneously; for the contingency related to loss of 345 kV line between Hitchland and Conestoga (FLT01).

Table 4-3: Mvar Requirements and Power Factor at the POI for the Proposed Projects Interconnection

Project	POI	Voltage (p.u)	Project Injection at POI in Base Case(Mvar)	QV Injection (Mvar)	Project Requirement (Net Mvar at POI)	Contingency	Power Factor at POI (lagging)
GEN-2008-028	Hitchland 345 kV	1.01	88.0	186.7	98.7	FLT01(WP)	0.964
GEN-2008-028 and 047	Hitchland 345 kV	1.008	128.0	195.4	67.4	FLT01 (WP)	0.994
GEN-2008-028 ,047 and 110	Hitchland 345 kV	1.002	80.8	203.0	122.2	FLT01 (SP)	0.991
GEN-2008-062	Cole 115 kV	1.030	16.0	12.9	-3.11	FLT54(WP)	1.000
GEN-2008-108	Potter-Moore 230 kV	1.005	25.7	34.4	8.7	FLT18 (WP)	1.000
GEN-2009-018	Hitchland-Moore 230 kV	1.001	31.3	70.2	38.9	FLT01(WP)	0.981

Tables showing the injected Mvar for each voltage level in base case and contingencies are presented in Appendix D for both summer peak and winter peak scenarios. The values chosen are the highest between the two scenarios.

4.3 Stability Results

The stability analysis was carried out for both summer and winter peak load flow models.

In order to determine the impact of the project on the overall system dynamics as well as to determine the requirements to meet the FERC Order 661-A Guidelines, 70 contingencies listed by Table 3-2 were simulated. The results obtained are described in this sub-section.

Tables 4-4 and 4-5 summarize the results obtained from the stability simulations for both summer and winter peak base cases, respectively. The table lists the dynamic performance of the proposed study projects of Group 2, as well as the prior queued projects. Note that only the critical contingencies that lead to trips due to LVRT, frequency protection or loss of synchronism are listed.

Table 4-4: Results Obtained – Summer Peak Base Case

Name	Wind Projects Dynamic Performance
FLT022-3PH	GEN-2003-013 (90840) tripped for under-voltage at 0.6042 s
FLT031-3PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7208 s
FLT032-1PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7292 s
FLT038-3PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7292 s
FLT039-1PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7333 s

Table 4-5: Results Obtained – Winter Peak Base Case

Name	Wind Projects Dynamic Performance
FLT022-3PH	GEN-2003-013 (90840) tripped for under-voltage at 0.6042 s
FLT031-3PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7208 s
FLT032-1PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7333 s
FLT038-3PH	GEN-2006-020 (90201) tripped for overfrequency at 0.7292 s
FLT039-1PH	GEN-2006-020 (90201) tripped for overfrequency at 0.6875 s

The outage of 345 kV line between Conestoga and Finney (FLT 22) cause trips due to LVRT in GEN-2003-013. This project has LVRT I package, which trips the WTG instantaneously for voltages under 0.3 p.u. The contingency was re-run with the project's voltage and frequency protection disabled. It was found that all the synchronous generators in the monitored area were stable (and in synchronism) and none of the Group 2 projects trip due to LVRT.

The outage of Moore Co East – Sherman Tap – DWS Frisco – Gen-07-046 – Hitchland 115 kV (FLT's 31, 32, 38 and 39) isolates the wind facility Gen-2006-020, causing trips due to overfrequency protection in both summer and winter peak scenarios.

Besides the Gen-2006-020 and Gen-2003-013 trips due to overfrequency and LVRT respectively, the results obtained show:

- The new proposed projects, did not trip during any of the contingencies tested, that is, no trips occurred due to LVRT or frequency protection.
- Furthermore, trips were not identified in the prior queued wind projects.
- All synchronous generators in the monitored areas were stable and remained in synchronism during all contingencies and the system conditions considered.
- Acceptable damping and voltage recovery was observed, within applicable standards.

Stability plots of the main contingencies evaluated for both summer peak and winter peak scenarios are presented in Appendix E.

This page intentionally left blank.

Section

5

Conclusions

The six projects of PISIS-2009-001 Group 2 have been evaluated to determine the impact of the proposed cluster of interconnections on the Southwest Power Pool system.

Steady state and stability analysis were carried out to evaluate the system performance under contingencies. Also to identify the system requirements to meet the FERC Order 661-A Guidelines for Low Voltage Ride Through (LVRT) and therefore, to allow the group 2 projects to deliver their full power to the SPP transmission system.

In general, the Group 2 interconnection requests have more than 1% impact on the voltage profile of the monitored system, under contingencies. Significant voltage criteria violations, caused by the projects, were identified through the simulations performed. The main voltage deviations were:

- About 3.78% in FLT 31 and 38 (summer peak).
- About 4.24% in FLT 01 (winter peak).

The power factor analysis determined the amount of reactive support required to maintain the scheduled voltages at each one of the points of interconnection. The amount of reactive support indicated by Table 4-3 must be provided by each interconnection request using the wind turbine generator (WTG) reactive capabilities and/or adding capacitor banks to the system.

The stability results indicate that none of the Group 2 projects trip during the contingencies tested, that is, no trips occurred due to LVRT or frequency protection. Moreover, the new interconnection requests have no adverse impact on the stability of the SPP system, for system conditions tested.

This page intentionally left blank.

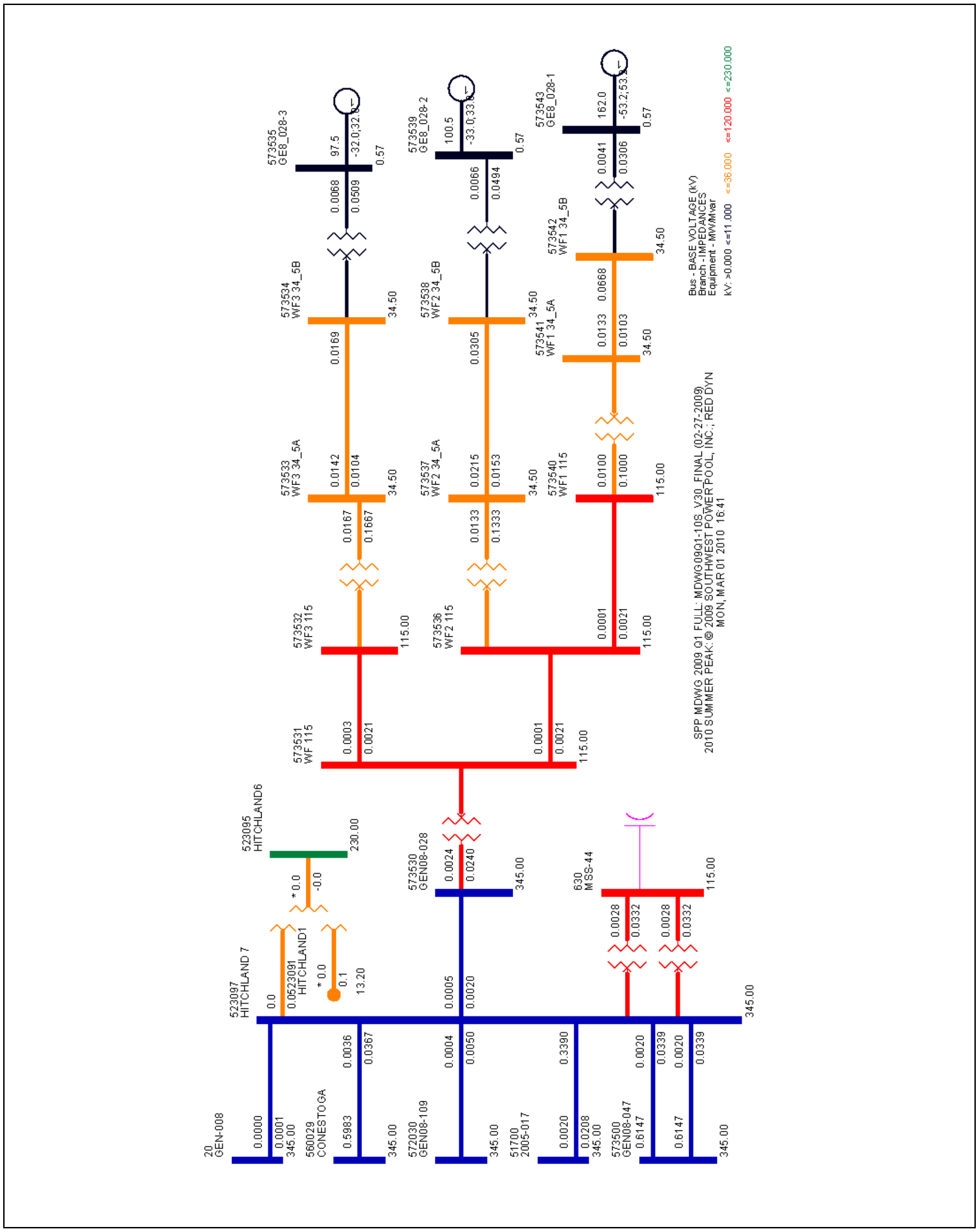
Appendix

A

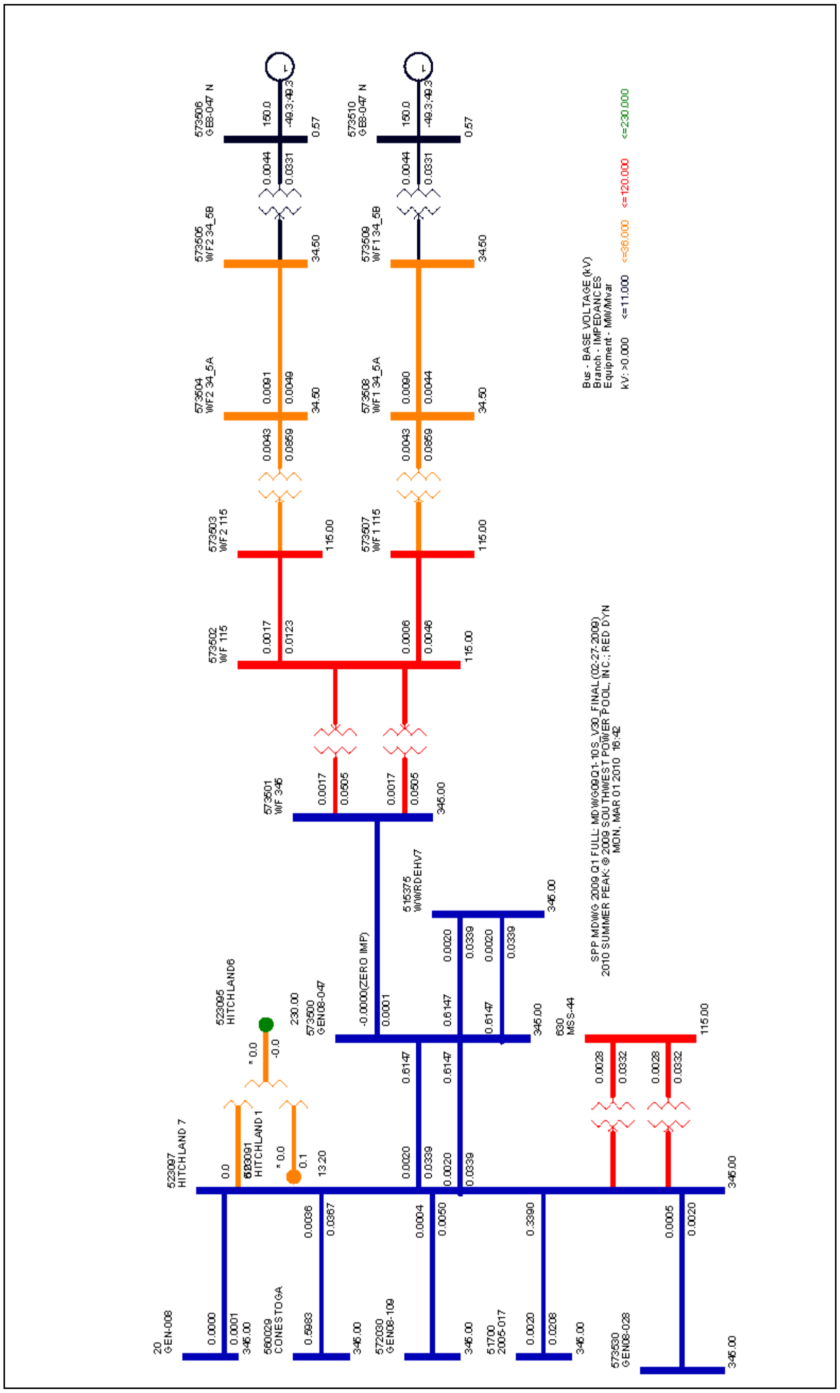
WTG Single Line Diagrams

This appendix contains single line diagrams for each of the Group 2 projects, showing the modeling details and impedance data of the transformers and collector systems.

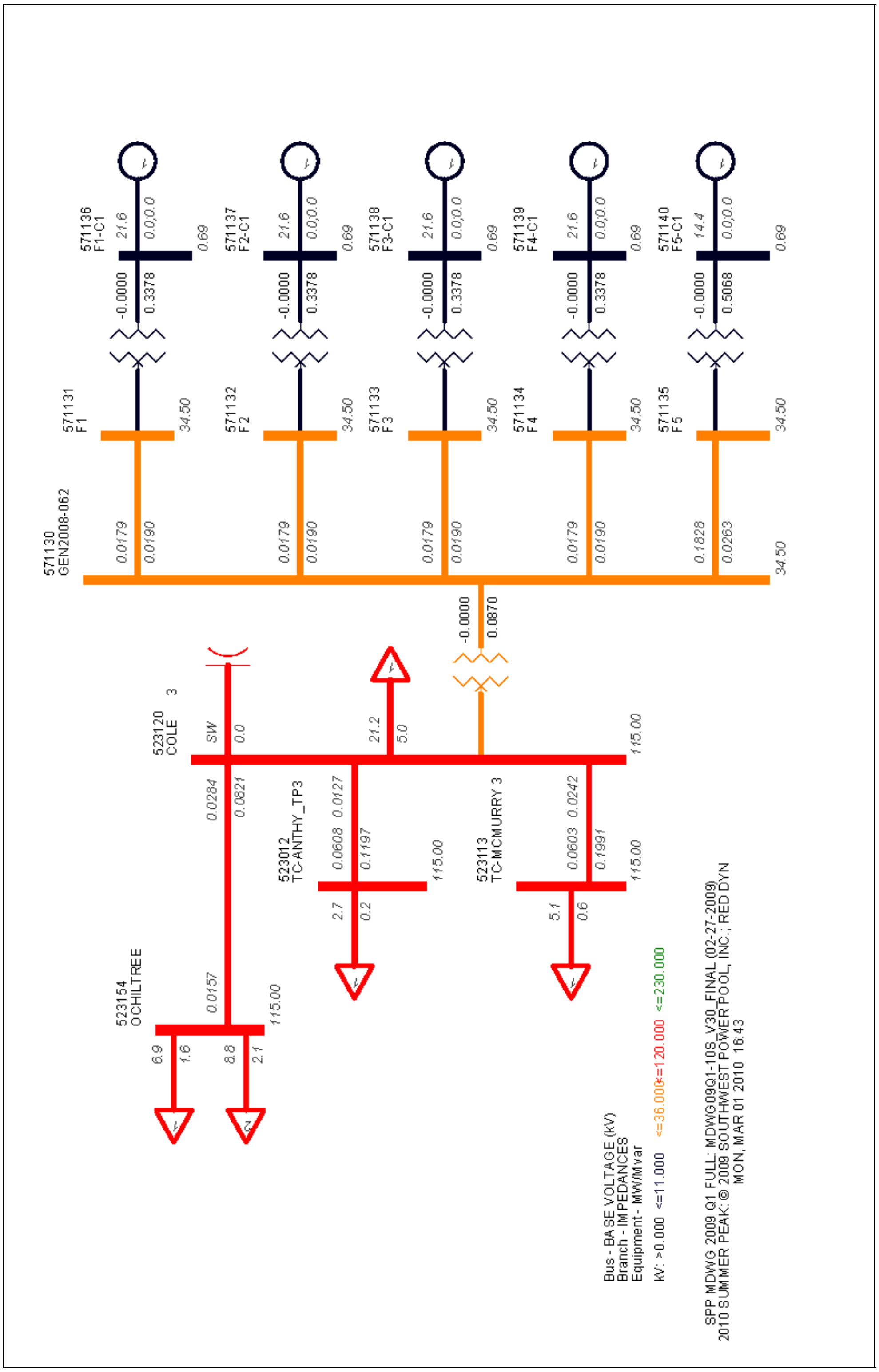
A.1 Gen -2008-028 – GE 1.5 MW



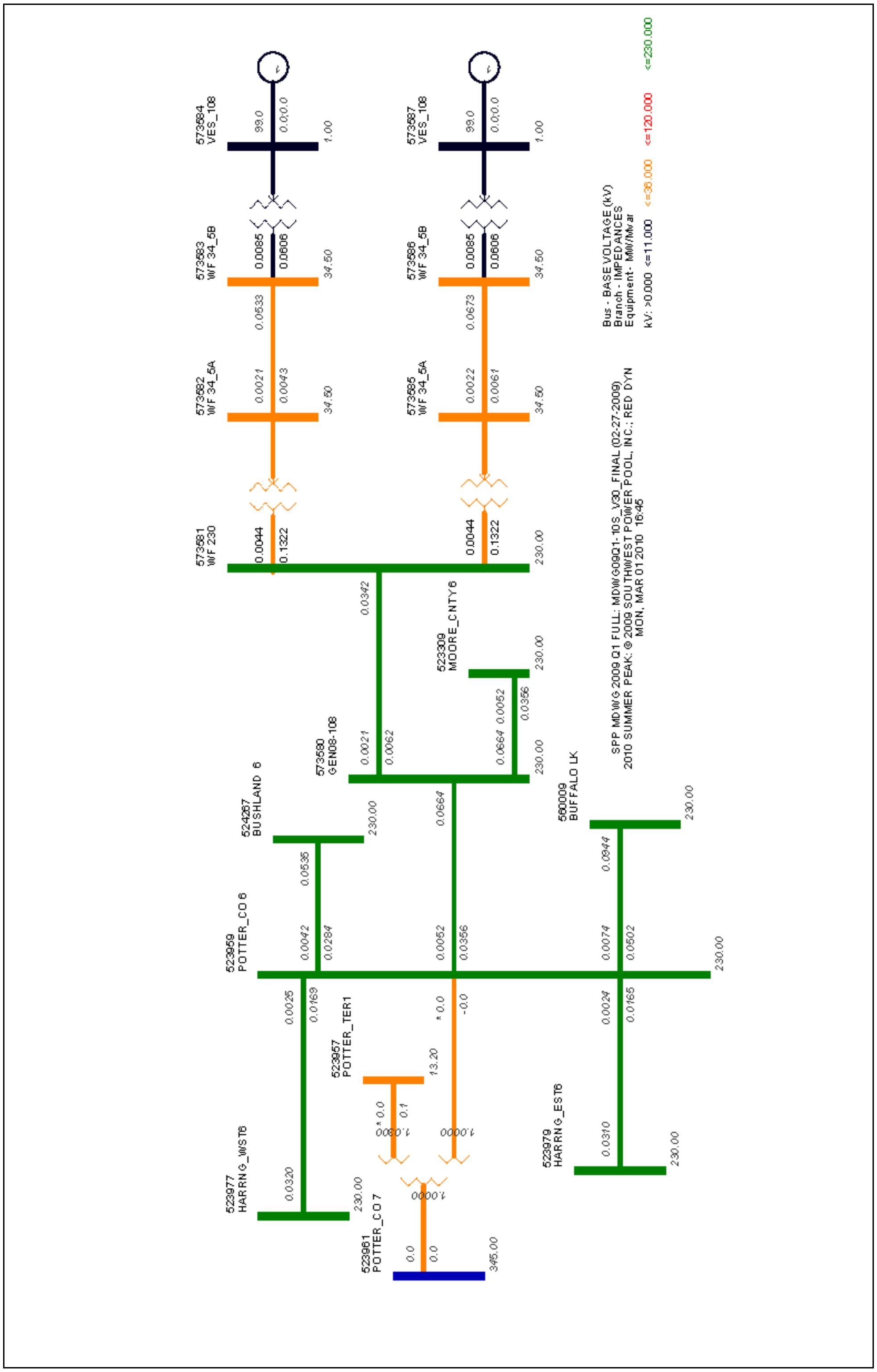
A.2 Gen -2008-047 – GE 1.5 MW



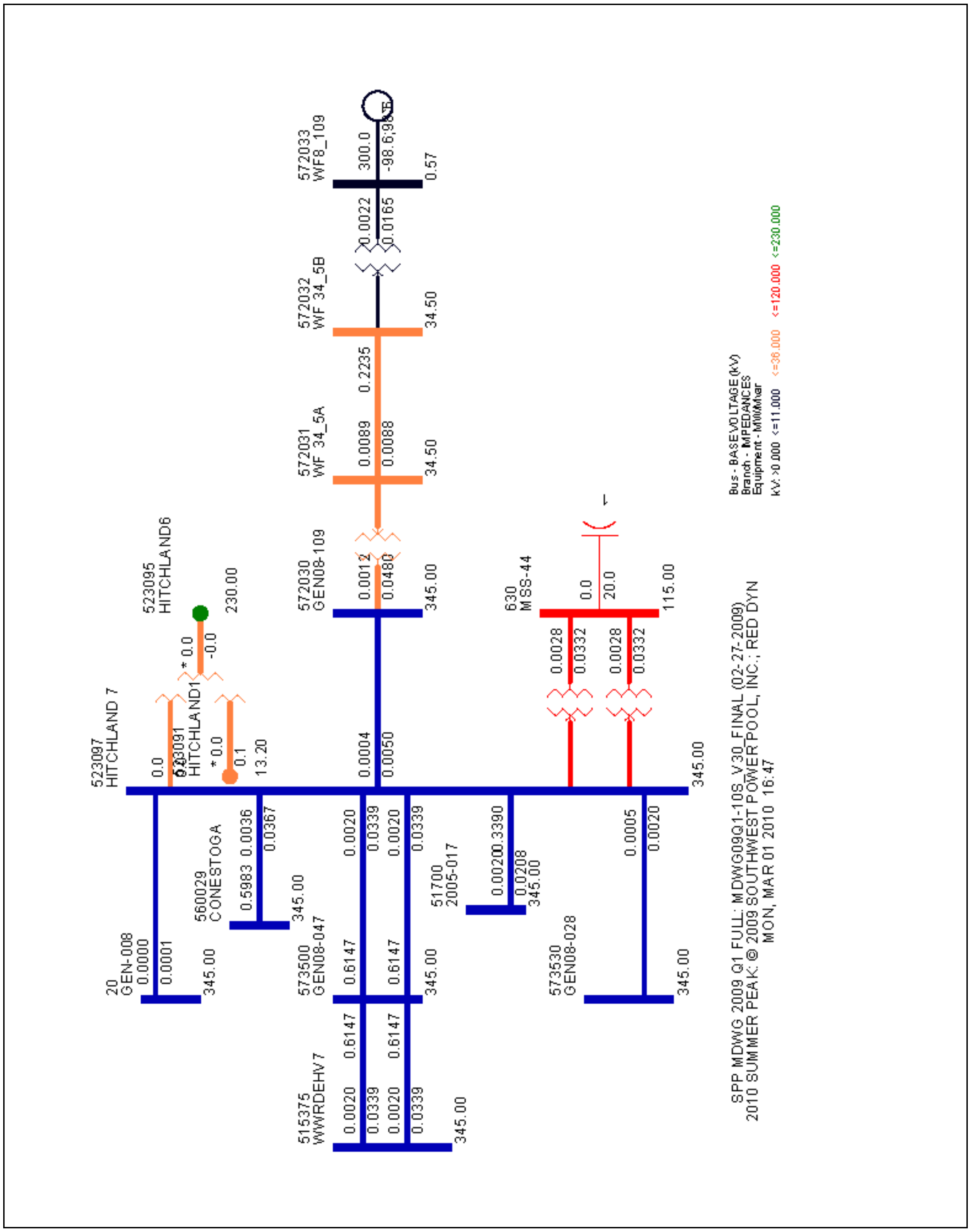
A.3 Gen -2008-062 –Vestas V90 1.8 MW



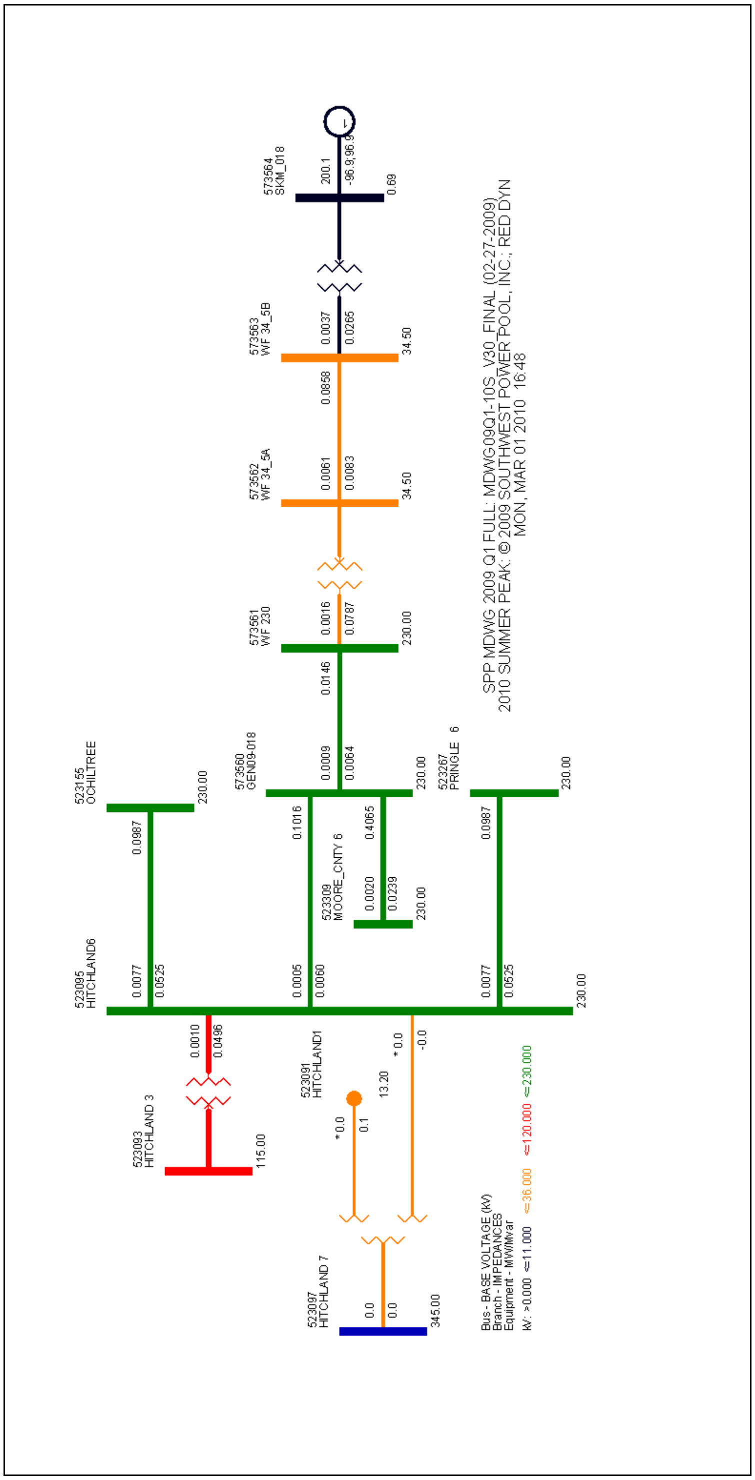
A.4 Gen -2008-108 –Vestas V90 1.8 MW



A.5 Gen -2008-110 – GE 1.5 MW



A.6 Gen -2009-018 – Siemens SMK203 2.3 MW



K: Stability Study for Group 3

R17-10

Generator Interconnection Impact Study for PISIS-2009-001 - Group 3

Prepared for

Southwest Power Pool, Inc.

Submitted by:
Ram Nath, Ph.D., Senior Staff Consultant
Bernardo Fernandes, Staff Consultant

Draft Report: March 03, 2010

Siemens PTI Project Number: P/23-115074-B-1

Siemens Energy, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of Southwest Power Pool, Inc. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor Southwest Power Pool, Inc., nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and Southwest Power Pool, Inc. from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Section

1

Introduction

1.1 Background

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Siemens PTI performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customers and SPP. The requests for interconnection were placed in accordance to SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

The purpose of this report is to present the results of the stability and power factor analysis performed to evaluate the impact of the proposed PISIS-2009-001 cluster of interconnections with regard to Group 3 projects on the Southwest Power Pool system. Eventual indicative solutions to the identified issues are proposed based on the impact of each generation interconnection on the Southwest Power Pool system.

Six projects in this cluster are connected to five different points of interconnection at different voltage levels, ranging from 115 kV to 345 kV. Section 2 describes all proposed wind farms projects in detail.

Transient stability analysis was performed using the package provide by SPP. It contains the latest stability database in PSS®E version 30.3.3. The stability package also includes the dynamic data for the previously queued projects.

1.2 Purpose

The steady state and stability study was carried out to:

(a) Determine the ability of the proposed generation facilities to remain in synchronism and within applicable planning standards following system faults with unsuccessful reclosing.

(b) Determine the amount of reactive support required from the costumer to meet the power factor requirement at the POI.

(c) Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

This page intentionally left blank.

Section

2

Model Development

The study has considered the 2009 winter peak and 2010 summer peak load flow models provided by SPP with the required interconnection generations modeled. The base cases also contain all the significant previous queued generation interconnection projects in the interconnection queue.

2.1 Power Flow Data

The Group 3 of PISIS-2009-001 contains six proposed wind generation projects. Table 2-1 presents the size of the wind generation projects, the Wind Turbine Generator (WTGs) manufacturers, the reactive capability of the wind farms, as well as the point of interconnection and the PSS®E bus numbers in the load flow models.

Table 2-1 – Details of the Interconnection Requests

Request	Size (MW)	Wind Turbine Model	Reactive Capability of Wind Farm		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
GEN-2007-019	375	GE 1.5MW	123.2	-123.2	Tap Lamar – Finney 345kV	210190
GEN-2008-059	100.8	Vestas V90 1.8MW	0 (*)	0 (*)	Tap Sawyer – Medicine Lodge 115kV	571099
GEN-2008-060	300	Vestas V90 1.8MW	0 (*)	0 (*)	Tap Spearville – Reno 345kV	571160
GEN-2008-087	299	Siemens SMK203 2.3MW	169.4	-169.4	Spearville 345kV	531469
GEN-2008-122	95	GE 1.5MW	31.1	-31.1	Tap Spearville – Reno 345kV	572010
GEN-2009-003	200	Suzlon S88	0	0	Pratt 115kV	539687

(*) – For voltage control within 0.95 p.u. – 1.050 p.u.

The analysis was carried out using the database package provided which also includes the modeling data for the previously queued projects, as shown in Table 2-2:

Table 2-2 – Details of the Prior Queued Interconnection Requests

Request	Size	Wind Turbine Model	Point of Interconnection	Bus Number
GEN-2001-039A	105	Clipper 2.5MW	Judson Large – Greensburg 115kV	103
GEN-2002-025A	150	GE 1.5 MW	Spearville 230kV	539695

Request	Size	Wind Turbine Model	Point of Interconnection	Bus Number
GEN-2004-014	154.5	GE 1.5 MW	Spearville 230kV	539695
GEN-2005-012	250	Vestas V90 3.0MW	Spearville 345kV	531469
GEN-2006-006	205	GE 1.5 MW	Spearville 230kV	539695
GEN-2006-021	100	Clipper 2.5MW	Tap Harper – Medicine Lodge 138kV	539638
GEN-2006-022	150	Clipper 2.5MW	Pratt 115kV	539687
GEN-2007-038	200	Clipper 2.5MW	Spearville 345kV	531469
GEN-2008-018	405	GE 1.5 MW	Finney 345kV	523853
GEN-2007-011	135	Acciona 1.5 MW	Syracuse 115kV	531437
GEN-2007-040	200	Siemens 2.3MW	Holcomb – Spearville 345kV	531000
GEN-2008-079	100.5	G.E. 1.5 MW	Tap Cudahy – Judson Large 115kV	573029
GEN-2008-124	200	Siemens 2.3MW	Spearville 345kV	531469

Figures 2-1 to 2-4 present the surrounding area of the Group 3 points of interconnection, showing the line flows and voltage profile in the load flow models for summer and winter peak scenarios, respectively.

Figure 2-1 - Group 3 Points of Interconnection Surrounding Area – *Diagram1* Summer Peak

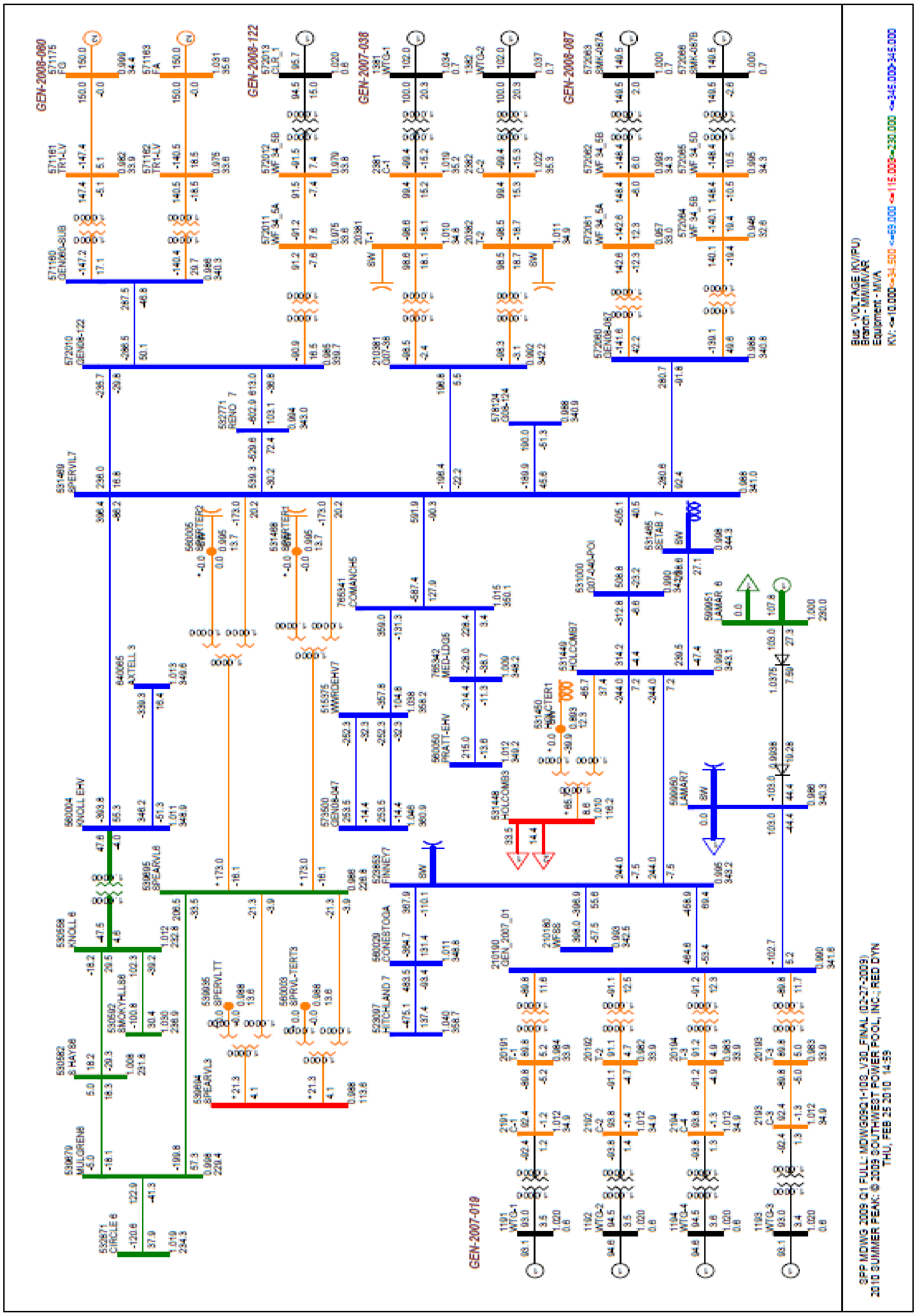


Figure 2-2 - Group 3 Points of Interconnection Surrounding Area – *Diagram2* Summer Peak

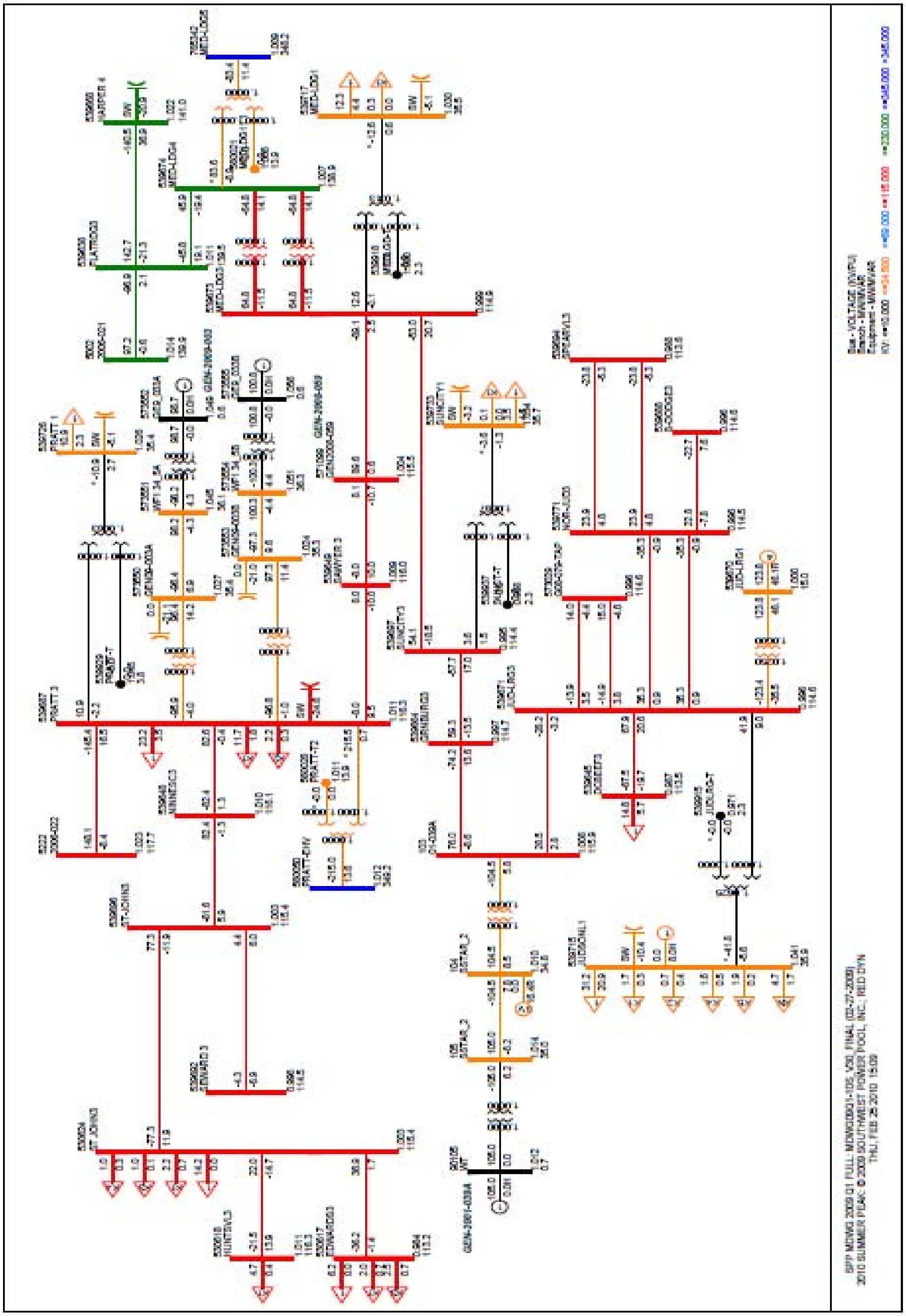


Figure 2-3 - Group 3 Points of Interconnection Surrounding Area – *Diagram1* Winter Peak

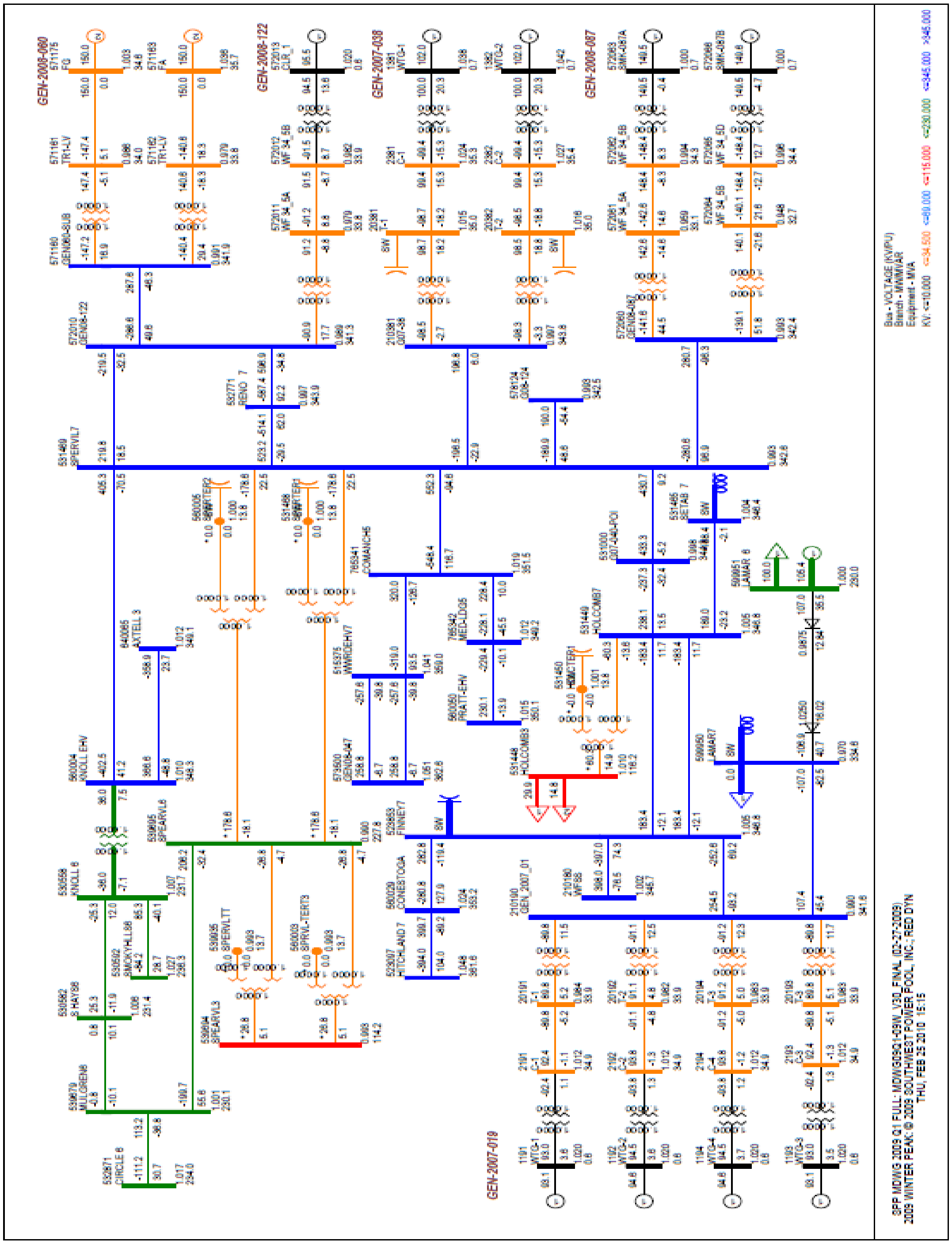
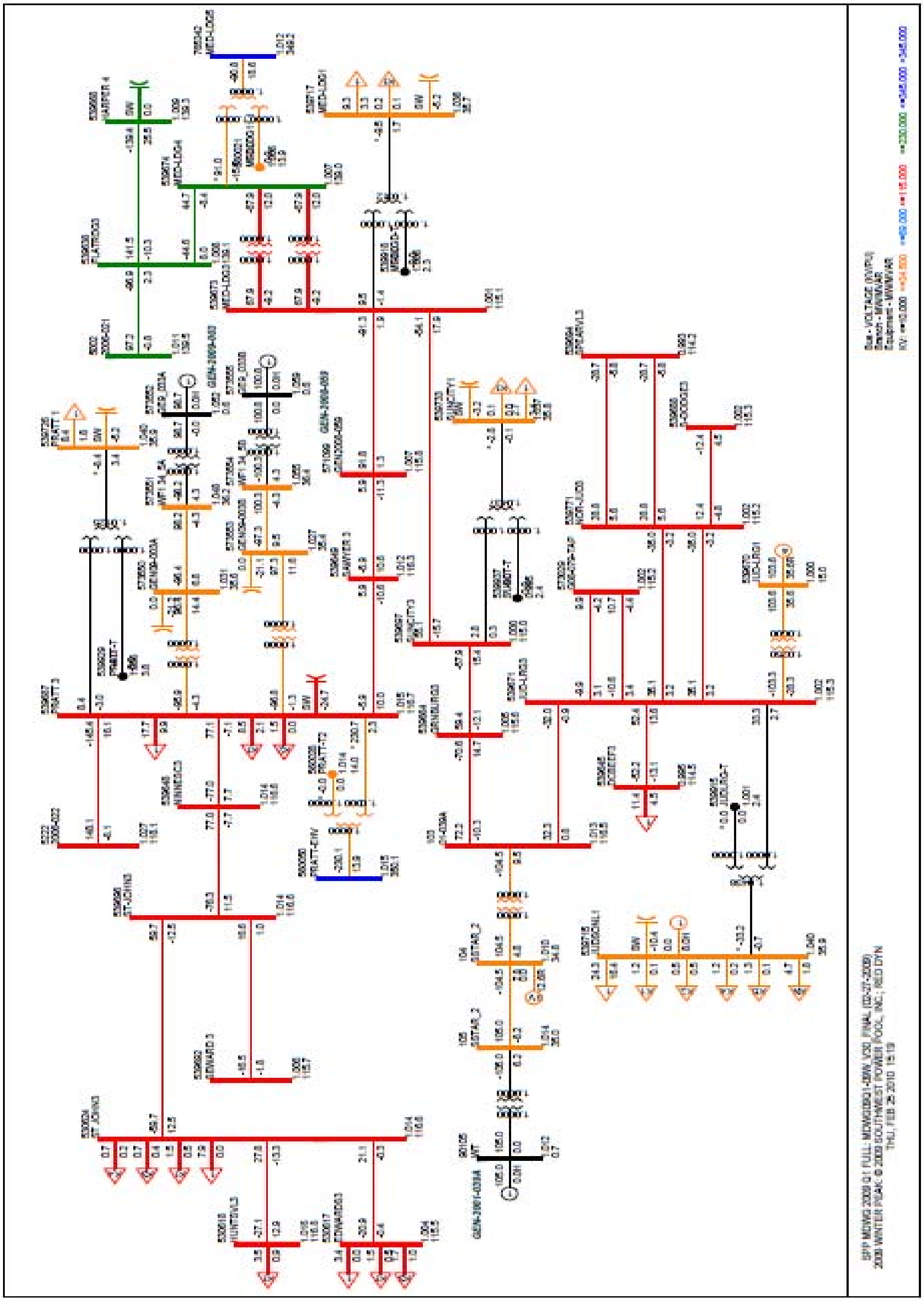


Figure 2-4 - Group 3 Points of Interconnection Surrounding Area – *Diagram2* Winter Peak



Figures A-1 to A-5 in Appendix A present the single line diagrams showing, for each of the Group 3 projects, the modeling details and impedance data of the transformers and collector systems.

2.2 Stability Database

The transient stability analysis was performed using the data provided by SPP. Stability models for the Group 3 interconnection requests were already added to the dynamic database. All turbine parameters used in the simulation models are the default parameters in the manufacturer's wind turbine packages. It is assumed that each wind turbine generator (WTG) is controlling the voltage of its own bus.

The default voltage protection model set points recommended by the manufacturer were used. The wind units were modeled with their built-in voltage ride through capability. Also, the default frequency protection model set points recommended by the manufacturer were used.

The PSS®E dynamic models output list is shown in Appendix B, documenting the model parameters of each one of the Group 3 wind turbines modeled in the stability study.

This page intentionally left blank

Section

3

Methodology and Assumptions

The study considered the 2009 winter peak and 2010 summer peak power flow cases with the required interconnection generation requests modeled as described in Section 2. The base case also contains all the significant previous queued projects in the interconnection queue.

The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
520	AEPW
524	OKGE
525	WFEC
526	SPS
531	MIDW
534	SUNC
536	WERE
640	NPPD
645	OPPD
650	LES
652	WAPA

3.1 Methodology

3.1.1 Stability Simulations

The stability simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single line to ground faults in the neighborhood of PISIS-2009-001 – Group 3 POIs were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The group 3 projects are also evaluated on the matter of ability to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

3.1.2 Steady State Simulations

3.1.2.1 N-1 Contingency Analysis

An N-1 contingency analysis was performed to evaluate voltage violations, if any, caused by disturbances (tripping of the faulted line). The voltages at each POI were monitored for deviations from the base case voltage and the percentage deviations were documented.

The summer peak and winter peak load flow cases were adjusted to ensure there are no relevant pre contingency voltage criteria violations. During contingency analysis it was reported voltages of any monitored bus found to be outside the range of the post-contingency criteria and having more than 1% of project impact.

3.1.2.2 Power Factor Analysis

The analysis will determine what power factor is necessary at the POI for each contingency.

If the required power factor at the POI is beyond the capability of the studied wind turbines to meet the requirement at the POI, capacitor banks will be considered.

A QV analysis was performed to determine the reactive support requirement at each project's POI. Mvar injections, plotted for base case and contingency conditions, are used to determine the reactive power support required at each POI, in order to maintain the bus scheduled pre contingency voltages.

These tables are obtained through a series of AC load flow calculations. Starting with no reactive support at a bus, the voltage is computed for a series of power flows as the reactive support is changed in steps, until the power flow experiences convergence difficulties as the system approaches the voltage collapse point.

3.2 Disturbances for Stability Analysis

The faults are defined as single line to ground, and three phase faults. The fault clearing includes reclosing for selected contingencies.

For faults with unsuccessful line reclosing, the complete fault clearing process includes the following sequence of events:

1) Line fault, cleared after 5 cycles by tripping the both line terminals

2) After 20 cycles the line is reclosed under fault conditions (unsuccessful reclosing)

3) The fault is cleared by tripping both ends of the faulted line, again 5 cycles later.

For faults with normal clearing, the fault is cleared by tripping the both line terminals after 5 cycles.

The disturbances evaluated are listed in the following Table 3-2:

Table 3-2: Disturbances for Stability Analysis

Fault ID	Fault Location	Fault Type	Clearing	Fault Clearing
FLT01-3PH	At Finney end of 345 kV line to GEN-2003-013	3PH	No reclosure	Trip Finney - GEN-2003-013 345 kV
FLT02-1PH	At Finney end of 345 kV line to GEN-2003-013	SLG	Unsuccessful reclosure	Trip Finney - GEN-2003-013 345 kV
FLT03-3PH	At Finney end of 345 kV line to Holcomb	3PH	No reclosure	Trip Finney - Holcomb 345 kV #1
FLT04-1PH	At Finney end of 345 kV line to Holcomb	SLG	Unsuccessful reclosure	Trip Finney - Holcomb 345 kV #1
FLT05-3PH	At Holcomb end of 345 kV line to Setab	3PH	No reclosure	Trip Holcomb - Setab 345 kV
FLT06-1PH	At Holcomb end of 345 kV line to Setab	SLG	Unsuccessful reclosure	Trip Holcomb - Setab 345 kV
FLT07-3PH	At GEN-2007-040 end of 345 kV line to Holcomb	3PH	No reclosure	Trip Holcomb - GEN-2007-040 345 kV
FLT08-1PH	At GEN-2007-040 end of 345 kV line to Holcomb	SLG	Unsuccessful reclosure	Trip Holcomb - GEN-2007-040 345 kV
FLT09-3PH	At the 345 kV end of Holcomb 345/115 kV transformer	3PH	No reclosure	Trip Holcomb 345 kV/115 kV transformer
FLT11-3PH	At GEN-2007-019 end of 345 kV line to Lamar	3PH	Unsuccessful reclosure	Trip GEN-2007-019 - Lamar 345 kV
FLT12-1PH	At GEN-2007-019 end of 345 kV line to Lamar	SLG	Unsuccessful reclosure	Trip GEN-2007-019 - Lamar 345 kV
FLT13-3PH	At GEN-2007-019 end of 345 kV line to Finney	3PH	No reclosure	Trip GEN-2007-019 - Finney 345 kV Trip GEN-2007-019
FLT14-1PH	At GEN-2007-019 end of 345 kV line to Finney	SLG	No reclosure	Trip GEN-2007-019 - Finney 345 kV
FLT15-3PH	At GEN-2007-040 end of 345 kV line to Spearville	3PH	Unsuccessful reclosure	Trip Spearville - GEN-2007-040 345 kV
FLT16-1PH	At GEN-2007-040 end of 345 kV line to Spearville	SLG	Unsuccessful reclosure	Trip Spearville - GEN-2007-040 345 kV
FLT17-3PH	At Spearville end of 345 kV line to Comanche	3PH	Unsuccessful reclosure	Trip Spearville - Comanche 345 kV
FLT18-1PH	At Spearville end of 345 kV line to Comanche	SLG	Unsuccessful reclosure	Trip Spearville - Comanche 345 kV
FLT19-3PH	At the 345 kV end of Spearville 345/230 kV transformer	3PH	No reclosure	Trip Spearville 345 kV/230 kV transformer
FLT21-3PH	At the 230 kV end of Spearville 230/345 kV transformer	3PH	No reclosure	Trip Spearville 230 kV/345 kV transformer
FLT23-3PH	At the 230 kV end of Spearville 230/115 kV transformer #2	3PH	No reclosure	Trip Spearville 230 kV/115 kV transformer #2
FLT25-3PH	At Spearville end of 230 kV line to Mullergren	3PH	Unsuccessful reclosure	Trip Spearville - Mullergren 230 kV
FLT26-1PH	At Spearville end of 230 kV line to Mullergren	SLG	Unsuccessful reclosure	Trip Spearville - Mullergren 230 kV
FLT29-3PH	At Mullergren end of 230 kV line to South Hays	3PH	Unsuccessful reclosure	Trip Mullergren - South Hays 230 kV
FLT30-1PH	At Mullergren end of 230 kV line to South Hays	SLG	Unsuccessful reclosure	Trip Mullergren - South Hays 230 kV

Fault ID	Fault Location	Fault Type	Clearing	Fault Clearing
FLT31-3PH	At Mullergren end of 230 kV line to Circle	3PH	Unsuccessful reclosure	Trip Mullergren - Circle 230 kV
FLT32-1PH	At Mullergren end of 230 kV line to Circle	SLG	Unsuccessful reclosure	Trip Mullergren - Circle 230 kV
FLT33-3PH	At Comanche end of 345 kV line to Medicine Lodge	3PH	Unsuccessful reclosure	Trip Comanche - Medicine Lodge 345 kV
FLT34-1PH	At Comanche end of 345 kV line to Medicine Lodge	SLG	Unsuccessful reclosure	Trip Comanche - Medicine Lodge 345 kV
FLT35-3PH	At Comanche end of 345 kV line to Woodward	3PH	Unsuccessful reclosure	Trip Comanche - Woodward 345 kV
FLT36-1PH	At Comanche end of 345 kV line to Woodward	SLG	Unsuccessful reclosure	Trip Comanche - Woodward 345 kV
FLT37-3PH	At GEN-2003-013 end of 345 kV line to Hitchland	3PH	No reclosure	Trip GEN-2003-013 - Hitchland 345 kV
FLT38-1PH	At GEN-2003-013 end of 345 kV line to Hitchland	SLG	Unsuccessful reclosure	Trip GEN-2003-013 - Hitchland 345 kV
FLT39-3PH	At Woodward end of 345 kV line to GEN08-047	3PH	No reclosure	Trip GEN08-047 - Woodward 345 kV
FLT40-1PH	At Woodward end of 345 kV line to GEN08-047	SLG	Unsuccessful reclosure	Trip GEN08-047 - Woodward 345 kV
FLT41-3PH	At Knoll end of 230 kV line to Smoky Hills	3PH	Unsuccessful reclosure	Trip Knoll - Smoky Hills 230 kV
FLT42-1PH	At Knoll end of 230 kV line to Smoky Hills	SLG	Unsuccessful reclosure	Trip Knoll - Smoky Hills 230 kV
FLT43-3PH	At Spearville end of 345 kV line to Knoll	3PH	Unsuccessful reclosure	Trip Spearville - Knoll 345 kV
FLT44-1PH	At Spearville end of 345 kV line to Knoll	SLG	Unsuccessful reclosure	Trip Spearville - Knoll 345 kV
FLT45-3PH	At Knoll end of 345 kV line to Axtell	3PH	Unsuccessful reclosure	Trip Knoll - Axtell 345 kV
FLT47-3PH	At the 345 kV end of Knoll 345/230 kV transformer	3PH	No reclosure	Trip Knoll 345 kV/230 kV transformer
FLT49-3PH	At GEN-2001-039A end of 115 kV line to Judson Large	3PH	Unsuccessful reclosure	Trip GEN-2001-039A - Judson Large 115 kV
FLT50-1PH	At GEN-2001-039A end of 115 kV line to Judson Large	SLG	Unsuccessful reclosure	Trip GEN-2001-039A - Judson Large 115 kV
FLT51-3PH	At Spearville end of 115 kV line to North Judson Large	3PH	Unsuccessful reclosure	Trip Spearville - North Judson Large 115 kV
FLT52-1PH	At Spearville end of 115 kV line to North Judson Large	SLG	Unsuccessful reclosure	Trip Spearville - North Judson Large 115 kV
FLT53-3PH	At Medcine Lodge end of 115 kV line to Sun City	3PH	Unsuccessful reclosure	Trip Medicine Lodge - Sun City 115 kV
FLT54-1PH	At Medcine Lodge end of 115 kV line to Sun City	SLG	Unsuccessful reclosure	Trip Medicine Lodge - Sun City 115 kV
FLT55-3PH	At GEN-2008-059 end of 115 kV line to Medicine Lodge	3PH	Unsuccessful reclosure	Trip Medicine Lodge - GEN-2008-059 115 kV
FLT56-1PH	At GEN-2008-059 end of 115 kV line to Medicine Lodge	SLG	Unsuccessful reclosure	Trip Medicine Lodge - GEN-2008-059 115 kV

Fault ID	Fault Location	Fault Type	Clearing	Fault Clearing
FLT57-3PH	At GEN-2008-059 end of 115 kV line to Sawyer	3PH	Unsuccessful reclosure	Trip Sawyer - GEN-2008-059 115 kV
FLT58-1PH	At GEN-2008-059 end of 115 kV line to Sawyer	SLG	Unsuccessful reclosure	Trip Sawyer - GEN-2008-059 115 kV
FLT59-3PH	At Pratt end of 115 kV line to Sawyer	3PH	Unsuccessful reclosure	Trip Pratt - Sawyer 115 kV
FLT60-1PH	At Pratt end of 115 kV line to Sawyer	SLG	Unsuccessful reclosure	Trip Pratt - Sawyer 115 kV
FLT61-3PH	At Pratt end of 115 kV line to Ninnescah – St John	3PH	Unsuccessful reclosure	Trip Pratt - Ninnescah – St John 115 kV
FLT62-1PH	At Pratt end of 115 kV line to Ninnescah – St John	SLG	Unsuccessful reclosure	Trip Pratt - Ninnescah – St John 115 kV
FLT63-3PH	At St John end of 115 kV line to Huntsville	3PH	Unsuccessful reclosure	Trip Huntsville - St John 115 kV
FLT64-1PH	At St John end of 115 kV line to Huntsville	SLG	Unsuccessful reclosure	Trip Huntsville - St John 115 kV
FLT65-3PH	At St John end of 115 kV line to Seward	3PH	Unsuccessful reclosure	Trip Seward - St John 115 kV
FLT66-1PH	At St John end of 115 kV line to Seward	SLG	Unsuccessful reclosure	Trip Seward - St John 115 kV
FLT67-3PH	At Flat Ridge end of 138 kV line to Harper	3PH	Unsuccessful reclosure	Trip Flat Ridge - Harper 138 kV
FLT68-1PH	At Flat Ridge end of 138 kV line to Harper	SLG	Unsuccessful reclosure	Trip Flat Ridge - Harper 138 kV
FLT69-3PH	At GEN-2008-060 end of 345 kV line to Spearville	3PH	No reclosure	Trip Spearville - GEN-2008-060 345 kV
FLT70-1PH	At GEN-2008-060 end of 345 kV line to Spearville	SLG	Unsuccessful reclosure	Trip Spearville - GEN-2008-060 345 kV
FLT71-3PH	At GEN-2008-060 end of 345 kV line to Reno	3PH	No reclosure	Trip Reno - GEN-2008-060 345 kV
FLT72-1PH	At GEN-2008-060 end of 345 kV line to Reno	SLG	Unsuccessful reclosure	Trip Reno - GEN-2008-060 345 kV
FLT73-3PH	At Pratt end of 345 kV line to Medicine Lodge	3PH	No reclosure	Trip Pratt - Medicine Lodge 345 kV
FLT74-1PH	At Pratt end of 345 kV line to Medicine Lodge	SLG	Unsuccessful reclosure	Trip Pratt - Medicine Lodge 345 kV
FLT75-3PH	At the 138 kV end of Medicine Lodge 345/138 kV transformer	3PH	No reclosure	Trip Medicine Lodge 345/138 kV transformer
FLT76-3PH	At the 115 kV end of Pratt 345/115 kV transformer	3PH	No reclosure	Trip Pratt 345/115 kV transformer
FLT77-3PH	At the 115 kV end of Medicine Lodge 115/138 kV transformer	3PH	No reclosure	Trip Medicine Lodge 115/138 kV transformer

In order to simulate single line to ground faults, equivalent reactances were determined to be applied at the buses. Table 3-3 presents the equivalent reactances obtained for the summer peak case and Table 3-4 presents the equivalent reactance for the winter peak case.

Table 3-3: Equivalent Reactances – Line to Ground Faults
Summer Peak

BUS	Equivalent Reactance (Mvar)
523853	4100
531449	4100
531000	3700
210190	1600
531469	6100
539679	2000
765341	4400
560029	3100
515375	7300
530558	2600
103	575
539694	2000
539673	1200
571099	1000
539687	1600
530624	800
539696	800
539638	1100
572010	4200
560050	2200

Table 3-4: Equivalent Reactances – Line to Ground Faults
Winter Peak

BUS	Equivalent Reactance (Mvar)
523853	4200
531449	4200
531000	3700
210190	1600
531469	5900
539679	1800
765341	4300
560029	3100
515375	6900
530558	2575

BUS	Equivalent Reactance (Mvar)
103	575
539694	2000
539673	1200
571099	1000
539687	1600
530624	800
539696	800
539638	1100
572010	4100
560050	2100

The following Figures 3-1 and 3-2 present the fault locations within the study area.

Figure 3-1 – Fault Locations in the Study Area – *Diagram1*

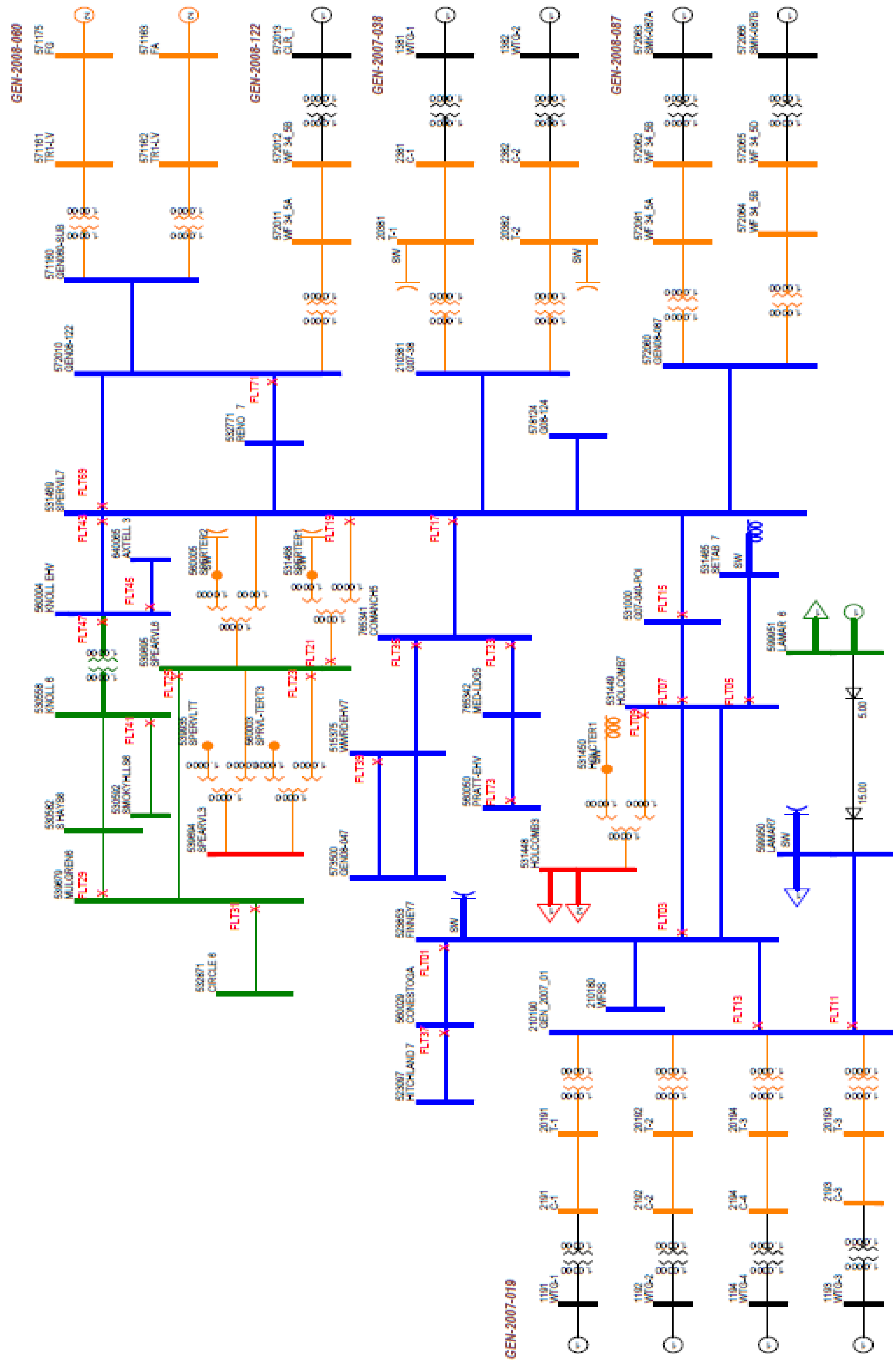
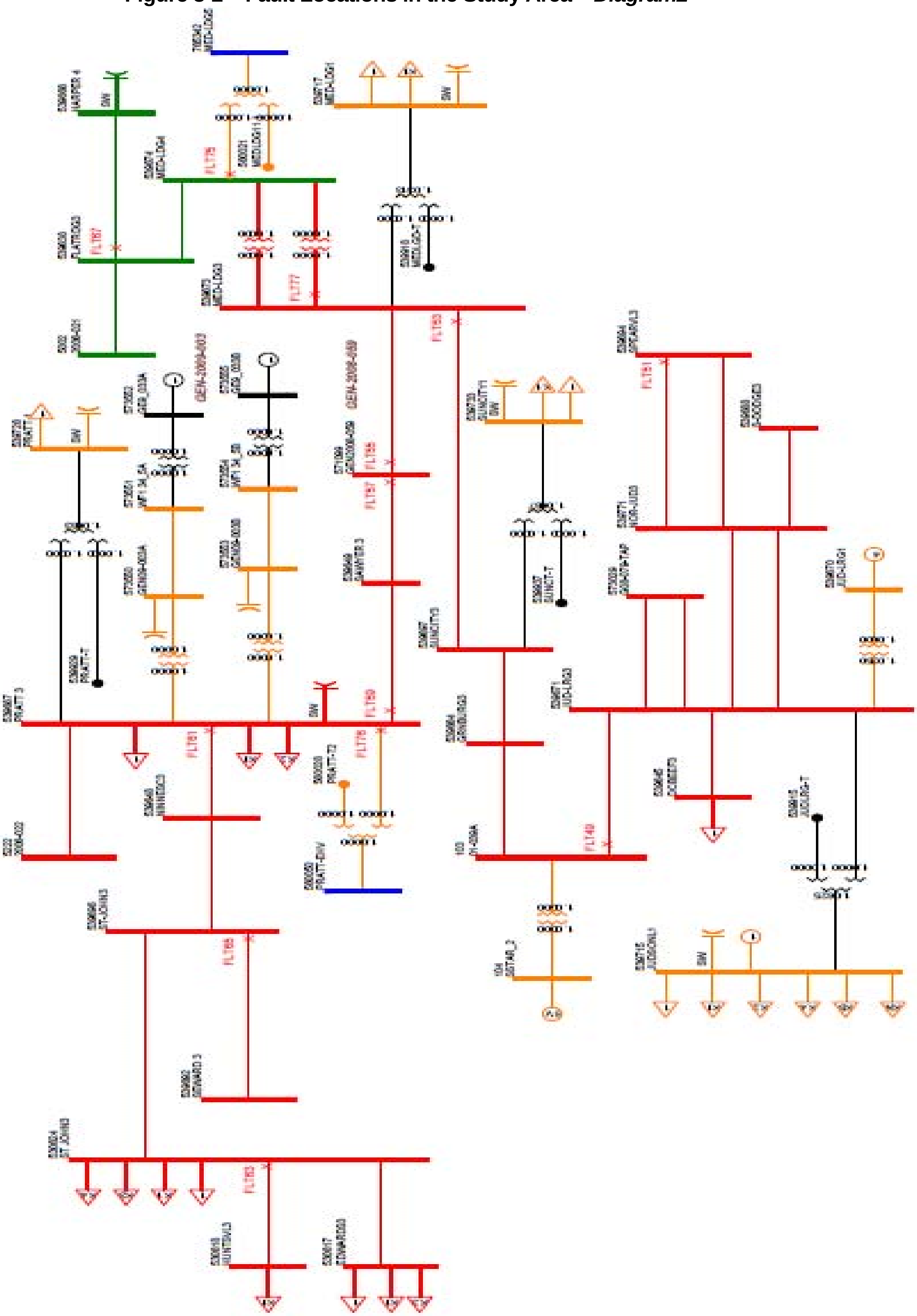


Figure 3-2 – Fault Locations in the Study Area – *Diagram2*



This page intentionally left blank.

Section

4

Analysis Performed

4.1 Steady State Performance

Table 4-1 and Table 4-2 summarize the results obtained from the steady state analysis for Summer Peak and Winter Peak base cases, respectively. The tables list the voltage deviations at the Points of Interconnection of the proposed study projects of Group 3, as well as the prior queued projects. Note the tables list only the contingencies that cause violation in the voltage criteria or have an impact of at least 1% in the POI's voltages.

The complete set of results for both summer peak and winter peak scenarios are presented in Appendix C.

Table 4-1: Results Obtained – Steady State Analysis – Summer Peak Base Case

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
103	01-039A	115.0000	-	1.0085	-
210190	GEN_2007_01	345.0000	-	0.9902	-
523853	FINNEY7	345.0000	-	0.9947	-
531000	G07-040-POI	345.0000	-	0.9900	-
531437	SYRACUS3	115.0000	-	1.0234	-
531469	SPERVIL7	345.0000	-	0.9884	-
539638	FLATRDG3	138.0000	-	1.0109	-
539687	PRATT 3	115.0000	-	1.0115	-
539695	SPEARVL6	230.0000	-	0.9860	-
571099	GEN2008-059	115.0000	-	1.0042	-
571160	GEN060-SUB	345.0000	-	0.9864	-
572010	GEN08-122	345.0000	-	0.9847	-
573029	G08-079-TAP	115.0000	-	0.9966	-
FLT 01					
210190	GEN_2007_01	345.0	0.9765	0.9902	-1.38%
523853	FINNEY7	345.0	0.9770	0.9947	-1.78%
531000	G07-040-POI	345.0	0.9711	0.9900	-1.91%
531469	SPERVIL7	345.0	0.9738	0.9884	-1.48%

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
539695	SPEARVL6	230.0	0.9740	0.9860	-1.22%
571160	GEN060-SUB	345.0	0.9716	0.9864	-1.50%
572010	GEN08-122	345.0	0.9700	0.9847	-1.49%
FLT 13					
523853	FINNEY7	345.0000	1.0071	0.9947	1.25%
531000	G07-040-POI	345.0000	1.0030	0.9900	1.31%
531469	SPERVIL7	345.0000	1.0001	0.9884	1.18%
539638	FLATRDG3	138.0000	1.0211	1.0109	1.01%
539687	PRATT 3	115.0000	1.0231	1.0115	1.15%
571099	GEN2008-059	115.0000	1.0158	1.0042	1.16%
571160	GEN060-SUB	345.0000	0.9988	0.9864	1.26%
572010	GEN08-122	345.0000	0.9970	0.9847	1.25%
FLT 15					
210190	GEN_2007_01	345.0	0.9801	0.9902	-1.02%
523853	FINNEY7	345.0	0.9816	0.9947	-1.32%
531469	SPERVIL7	345.0	1.0002	0.9884	1.19%
571160	GEN060-SUB	345.0	0.9994	0.9864	1.32%
572010	GEN08-122	345.0	0.9976	0.9847	1.31%
FLT 15					
531469	SPERVIL7	345.0000	1.0002	0.9884	1.19%
571160	GEN060-SUB	345.0000	0.9994	0.9864	1.32%
572010	GEN08-122	345.0000	0.9976	0.9847	1.31%
FLT 17					
531000	G07-040-POI	345.0	0.9797	0.9900	-1.04%
531469	SPERVIL7	345.0	0.9699	0.9884	-1.87%
539695	SPEARVL6	230.0	0.9709	0.9860	-1.53%
571160	GEN060-SUB	345.0	0.9644	0.9864	-2.23%
572010	GEN08-122	345.0	0.9628	0.9847	-2.22%
FLT 33					
539638	FLATRDG3	138.0	0.9999	1.0109	-1.09%
539687	PRATT 3	115.0	0.9961	1.0115	-1.52%
571099	GEN2008-059	115.0	0.9889	1.0042	-1.52%
FLT 35					
539638	FLATRDG3	138.0	0.9874	1.0109	-2.32%
539687	PRATT 3	115.0	0.9865	1.0115	-2.47%
571099	GEN2008-059	115.0	0.9802	1.0042	-2.39%
FLT 37					
210190	GEN_2007_01	345.0	0.9786	0.9902	-1.17%
523853	FINNEY7	345.0	0.9796	0.9947	-1.52%
531000	G07-040-POI	345.0	0.9687	0.9900	-2.15%

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
531469	SPERVIL7	345.0	0.9694	0.9884	-1.92%
539638	FLATRDG3	138.0	0.9991	1.0109	-1.17%
539687	PRATT 3	115.0	0.9967	1.0115	-1.46%
539695	SPEARVL6	230.0	0.9704	0.9860	-1.58%
571099	GEN2008-059	115.0	0.9896	1.0042	-1.45%
571160	GEN060-SUB	345.0	0.9671	0.9864	-1.96%
572010	GEN08-122	345.0	0.9654	0.9847	-1.96%
FLT 43					
531469	SPERVIL7	345.0	0.9753	0.9884	-1.33%
539695	SPEARVL6	230.0	0.9750	0.9860	-1.12%
571160	GEN060-SUB	345.0	0.9720	0.9864	-1.46%
572010	GEN08-122	345.0	0.9704	0.9847	-1.45%
FLT 53					
571099	GEN2008-059	115.0000	1.0143	1.0042	1.01%
FLT 57					
571099	GEN2008-059	115.0	0.9925	1.0042	-1.17%
FLT 59					
571099	GEN2008-059	115.0	0.9934	1.0042	-1.08%
FLT 67					
539638	FLATRDG3	138.0	0.9961	1.0109	-1.46%
FLT 71					
531469	SPERVIL7	345.0	0.9729	0.9884	-1.57%
539638	FLATRDG3	138.0	0.9972	1.0109	-1.36%
539687	PRATT 3	115.0	0.9963	1.0115	-1.50%
539695	SPEARVL6	230.0	0.9731	0.9860	-1.31%
571099	GEN2008-059	115.0	0.9888	1.0042	-1.53%
571160	GEN060-SUB	345.0	0.9713	0.9864	-1.53%
572010	GEN08-122	345.0	0.9696	0.9847	-1.53%
FLT 73					
539638	FLATRDG3	138.0	0.9880	1.0109	-2.27%
539687	PRATT 3	115.0	0.9818	1.0115	-2.94%
571099	GEN2008-059	115.0	0.9656	1.0042	-3.84%
FLT 76					
539638	FLATRDG3	138.0	0.9936	1.0109	-1.71%
539687	PRATT 3	115.0	0.9892	1.0115	-2.20%
571099	GEN2008-059	115.0	0.9724	1.0042	-3.17%

Table 4-2: Results Obtained – Steady State Analysis – Winter Peak Base Case

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
103	01-039A	115.0	-	1.0134	-
210190	GEN_2007_01	345.0	-	0.9900	-
523853	FINNEY7	345.0	-	1.0051	-
531000	G07-040-POI	345.0	-	0.9979	-
531437	SYRACUS3	115.0	-	1.0289	-
531469	SPERVIL7	345.0	-	0.9930	-
539638	FLATRDG3	138.0	-	1.0084	-
539687	PRATT 3	115.0	-	1.0147	-
539695	SPEARVL6	230.0	-	0.9903	-
571099	GEN2008-059	115.0	-	1.0067	-
571160	GEN060-SUB	345.0	-	0.9910	-
572010	GEN08-122	345.0	-	0.9893	-
573029	G08-079-TAP	115.0	-	1.0019	-
FLT 01					
210190	GEN_2007_01	345.0	0.9783	0.9900	-1.18%
523853	FINNEY7	345.0	0.9896	1.0051	-1.54%
531000	G07-040-POI	345.0	0.9831	0.9979	-1.48%
531469	SPERVIL7	345.0	0.9816	0.9930	-1.15%
571160	GEN060-SUB	345.0	0.9792	0.9910	-1.19%
572010	GEN08-122	345.0	0.9775	0.9893	-1.19%
FLT 13					
523853	FINNEY7	345.0	1.0154	1.0051	1.02%
FLT 15					
571160	GEN060-SUB	345.0	1.0009	0.9910	1.00%
572010	GEN08-122	345.0	0.9992	0.9893	1.00%
FLT 17					
531000	G07-040-POI	345.0	0.9866	0.9979	-1.13%
531469	SPERVIL7	345.0	0.9734	0.9930	-1.97%
539695	SPEARVL6	230.0	0.9742	0.9903	-1.63%
571160	GEN060-SUB	345.0	0.9680	0.9910	-2.32%
572010	GEN08-122	345.0	0.9663	0.9893	-2.32%
FLT 33					
539638	FLATRDG3	138.0	0.9933	1.0084	-1.50%
539687	PRATT 3	115.0	0.9949	1.0147	-1.95%
571099	GEN2008-059	115.0	0.9872	1.0067	-1.94%
FLT 35					
531469	SPERVIL7	345.0	0.9830	0.9930	-1.01%

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
539638	FLATRDG3	138.0	0.9787	1.0084	-2.95%
539687	PRATT 3	115.0	0.9839	1.0147	-3.04%
571099	GEN2008-059	115.0	0.9770	1.0067	-2.95%
571160	GEN060-SUB	345.0	0.9798	0.9910	-1.13%
572010	GEN08-122	345.0	0.9781	0.9893	-1.13%
FLT 37					
210190	GEN_2007_01	345.0	0.9799	0.9900	-1.02%
523853	FINNEY7	345.0	0.9918	1.0051	-1.32%
531000	G07-040-POI	345.0	0.9807	0.9979	-1.72%
531469	SPERVIL7	345.0	0.9772	0.9930	-1.59%
539638	FLATRDG3	138.0	0.9958	1.0084	-1.25%
539687	PRATT 3	115.0	0.9997	1.0147	-1.48%
539695	SPEARVL6	230.0	0.9771	0.9903	-1.33%
571099	GEN2008-059	115.0	0.9921	1.0067	-1.45%
571160	GEN060-SUB	345.0	0.9744	0.9910	-1.68%
572010	GEN08-122	345.0	0.9727	0.9893	-1.68%
FLT 43					
531469	SPERVIL7	345.0	0.9797	0.9930	-1.34%
539638	FLATRDG3	138.0	0.9965	1.0084	-1.18%
539687	PRATT 3	115.0	1.0016	1.0147	-1.29%
539695	SPEARVL6	230.0	0.9788	0.9903	-1.16%
571099	GEN2008-059	115.0	0.9940	1.0067	-1.26%
571160	GEN060-SUB	345.0	0.9759	0.9910	-1.52%
572010	GEN08-122	345.0	0.9743	0.9893	-1.52%
FLT 57					
571099	GEN2008-059	115.0	0.9944	1.0067	-1.22%
FLT 59					
571099	GEN2008-059	115.0	0.9953	1.0067	-1.13%
FLT 61					
539687	PRATT 3	115.0	1.0038	1.0147	-1.07%
FLT 71					
531469	SPERVIL7	345.0	0.9769	0.9930	-1.62%
539638	FLATRDG3	138.0	0.9917	1.0084	-1.66%
539687	PRATT 3	115.0	0.9963	1.0147	-1.81%
539695	SPEARVL6	230.0	0.9767	0.9903	-1.37%
571099	GEN2008-059	115.0	0.9884	1.0067	-1.82%
571160	GEN060-SUB	345.0	0.9753	0.9910	-1.58%
572010	GEN08-122	345.0	0.9736	0.9893	-1.59%
FLT 73					
539638	FLATRDG3	138.0	0.9777	1.0084	-3.04%
539687	PRATT 3	115.0	0.9693	1.0147	-4.47%

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
571099	GEN2008-059	115.0	0.9545	1.0067	-5.19%
FLT 75					
539638	FLATRDG3	138.0	0.9945	1.0084	-1.38%
FLT 76					
539638	FLATRDG3	138.0	0.9847	1.0084	-2.35%
539687	PRATT 3	115.0	0.9793	1.0147	-3.49%
571099	GEN2008-059	115.0	0.9635	1.0067	-4.29%

The pre contingency voltages at the POIs associated with GEN-2007-019, GEN-2008-60, GEN-2008-087 and GEN-2008-122 are all below 1.0 pu during both summer and winter peak scenarios.

The summer peak scenario is more stressed leading to a greater number of contingencies that causes significant deviations in the voltage profile, when compared to the winter peak scenario. In spite of that, in both scenarios, the voltage profile of the POI's surrounding area remains within the limits.

The contingencies involving one of the portion of the 345 kV transmission path Spearville – Commanche – Woodward – Hitchland – Conestoga – Finney – Holcomb cause large voltage deviations (about 2%) in both summer and winter scenarios.

The outage of the 345 kV between Pratt and Medicine Lodge or the outage of the Pratt 345/115 kV transformer cause overload in the 115 kV line between Gen-2008-059 and Medicine Lodge of approximately 21% (Rate B). As a consequence, there is an accentuated voltage dip (4 to 5 %) in the surrounding area, although without causing voltage violations.

The Group 3 projects have significant impact on the voltages of the buses monitored in the study system, under contingency conditions. However, no significant voltage criteria violations were identified through the simulations performed.

4.2 Power Factor Analysis

A QV analysis was performed to determine the amount of reactive support required to maintain the scheduled voltages at the points of interconnection of each one of the proposed wind facilities. The contingencies described in Table 3-2 were evaluated in steady state conditions for summer and winter peak base cases, with variable Mvar injection at the POIs.

Further, the projects GEN-2008-60, GEN-2008-087 and GEN-2008-122 are connected at the same transmission path, associated to Spearville 345 kV bus. Therefore, permutations based on the queued numbers were analyzed to determine the project requirements at each POI. Note that Gen-2008-060 and Gen-2008-122 projects shall share the POI requirement.

Table 4-3 presents for each one of the proposed wind facilities in Group 3, the Mvar requirements and the associated power factor that the projects must be able to provide under contingencies.

Table 4-3: Mvar Requirements and Power Factor at the POI for the Proposed Projects Interconnection

Project	Point of Interconnection	V Scheduled (p.u)	Project Injection at POI in Base Case (Mvar)	QV Injection (Mvar)	Project Requirement (Net Mvar at POI)	Contingency	Power Factor at POI (lagging)
GEN-2007-019	Tap Lamar – Finney 345kV	0.992	-50.5	38.0	-12.5	FLT37 (SP)	1.000
GEN-2008-059	Tap Sawyer – Medicine Lodge 115kV	1.006	-10.0	36.0	26.0	FLT73 (WP)	0.968
GEN-2008-060	Tap Spearville – Reno 345kV	1.011	-48.1	120.6	72.5	FLT37(SP)	0.972
GEN-2008-060 AND 087	Spearville 345kV	1.000	-98.5	238.0	139.5	FLT37(SP)	0.906
GEN-2008-060, 087 AND 122	Tap Spearville – Reno 345kV	0.992	-67.1	142.8	75.7	FLT37(SP)	0.982
GEN-2009-003	Pratt 115kV	1.014	5.4	44.8	50.2	FLT35(WP)	0.969

4.3 Dynamic Results

The stability analysis was carried out using both Summer Peak and Winter Peak load flow models.

In order to determine the impact of the project on the overall system dynamic performance, as well as to determine the requirements to meet the FERC Order 661-A Guidelines, 69 contingencies listed in Table 3-2 were simulated. The results obtained are described in this sub-section.

None of the contingency leads to trips due to LVRT or loss of synchronism neither in the studied projects nor in the prior queued ones. However, Gen-2009-003 is not entirely settled down, as it still presents small amplitude oscillations after 15 seconds in several contingencies (in particular FLT 33, 35, 73, 74, 75 and 76), both in summer and winter scenarios. It is important to note that Gen-2009-003 does not cause an adverse impact on the overall system stability performance, as the 30 Mvar existing SVC at bus 5220 plays a significant role in helping Gen-2009-003 to present damped oscillations under contingencies.

Additionally, contingencies FLT17, 19, 21, 23, 25 and 43 cause the GPEWind facility at bus 543116 to trip due to low voltage protection in both scenarios. This project is located in the Spearville surrounding area and has LVRT I package, which trips the WTG instantaneously for voltages under 0.3 p.u. This project is also dispatched at 15 % of its total capacity and is modeled without any reactive capability. Since it is not listed as a prior queued project to be monitored, the post -contingency system voltage recovery will not be tested disabling the undervoltage protection of this project.

The results obtained from the stability simulations for Summer Peak and Winter Peak base cases show that none of the contingency leads to trip due to LVRT issues. In general, the results obtained show for the contingencies:

- The new proposed projects, did not trip during any of the contingencies tested. That is, no trips occurred due to LVRT.
- All other generators in the monitored areas were stable and remained in synchronism during all contingencies and the system conditions considered.
- Acceptable damping and voltage recovery within applicable standards was observed.

The Plots for both the summer and winter cases are included in Appendix E1 and E2, respectively.

Section

5

Conclusions

The six projects of PISIS-2009-001 Group 3 have been evaluated to determine the impact of the proposed cluster of interconnections on the Southwest Power Pool system.

Steady state and stability analysis were carried out to evaluate the system performance under contingencies. Also to identify the system requirements to meet the FERC Order 661-A Guidelines for Low Voltage Ride Through (LVRT) and therefore, to allow the group 3 projects to deliver their full power to the SPP transmission system.

In general the Group 3 interconnection requests have significant impact on the voltage profile of the monitored system, under contingency conditions. For contingencies in the 345 kV system the worst voltage deviation is about 2%. For contingencies in the 115 kV system, the greater voltage deviation reach approximately 5%. However, no voltage criteria violations were identified through the simulations performed.

The power factor analysis determined the amount of reactive support required to maintain the scheduled voltages at each one of the points of interconnection under contingency conditions. The amount of reactive support indicated by Table 4-3 must be provided by each interconnection request using the wind turbine generator (WTG) capabilities and/or adding capacitor banks to the system.

It is important to note that the projects GEN-2008-60, GEN-2008-087 and GEN-2008-122 are connected at the same transmission path, associated to Spearville 345 kV bus. Therefore, the requirements at the respective POIs change as the projects go on line, according to their queue numbers. Also, Gen-2008-060 and Gen-2008-122 projects shall share the POI's requirement, since they are connected at the same point.

The results obtained in the stability simulations demonstrate that none the new proposed or prior queued projects trip during any of the contingencies tested. That is, no trips occurred due to LVRT. Also, all other generators in the monitored areas were stable and remained in synchronism. Therefore, the Group 3 projects does not have an adverse impact on the dynamic performance of the SPP system, for the contingencies and system conditions tested.

This page intentionally left blank.

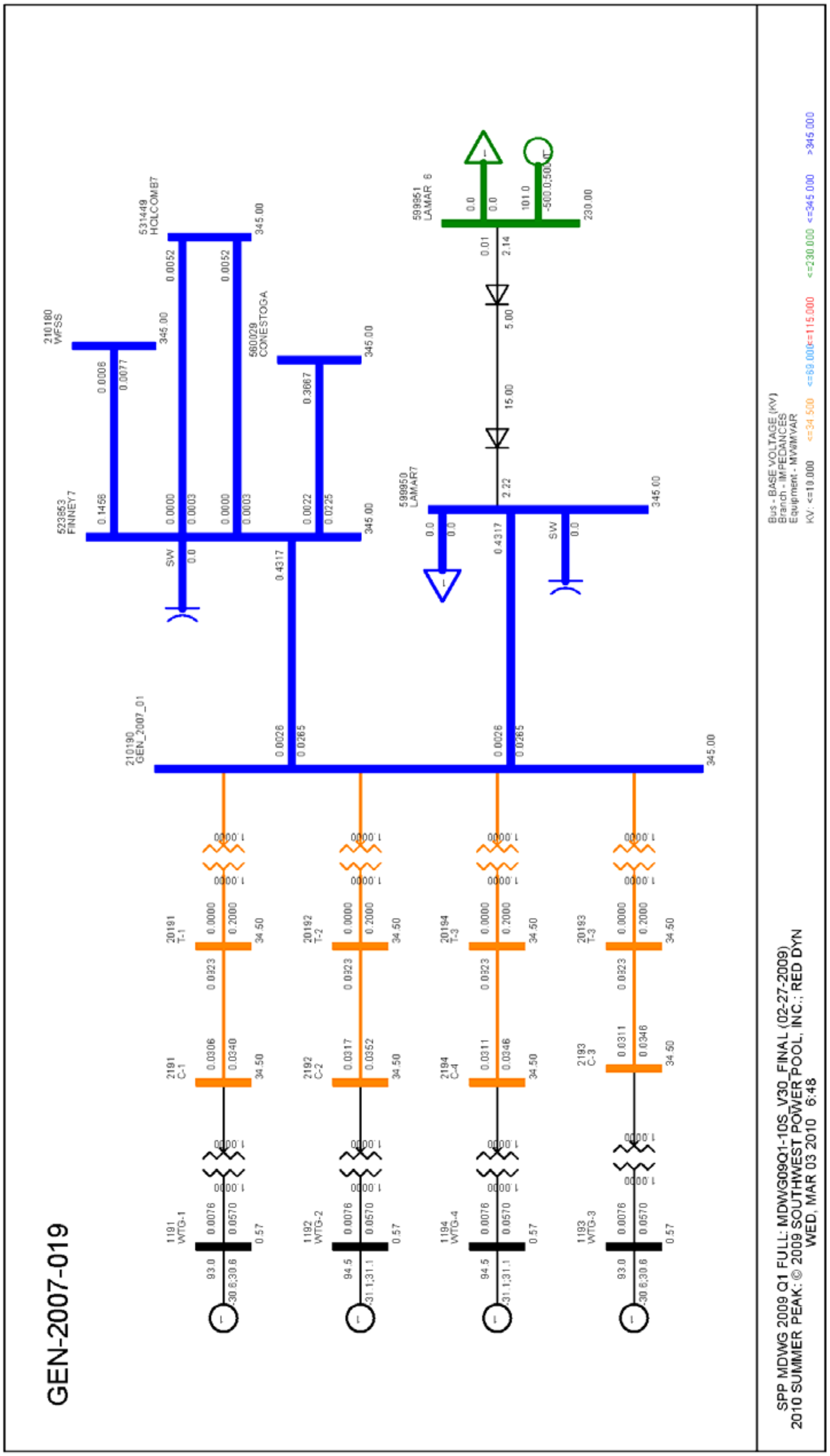
Appendix

A

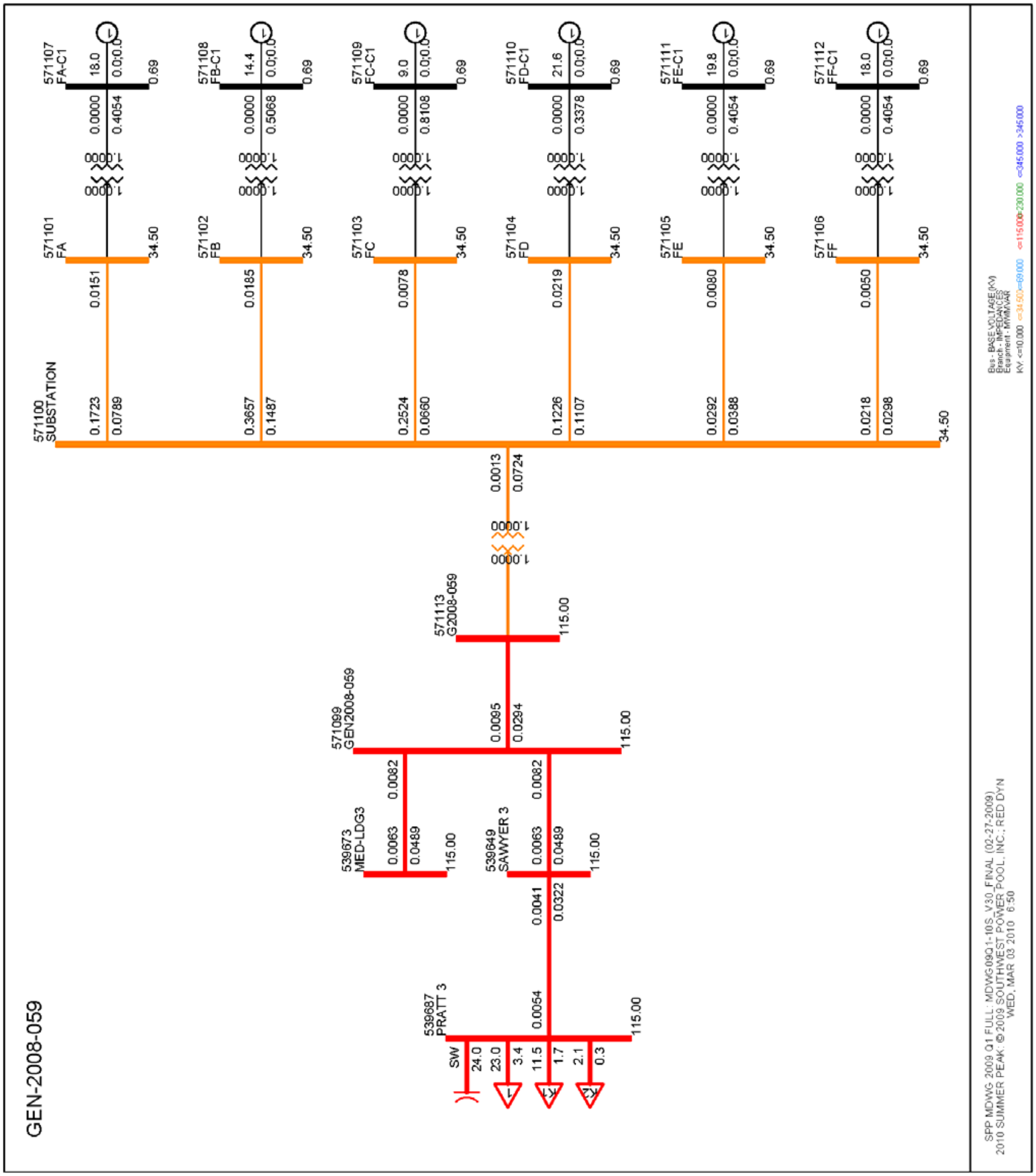
WTG Single Line Diagrams

This appendix contains single line diagrams for each of the Group 3 projects, showing the modeling details and impedance data of the transformers and collector systems.

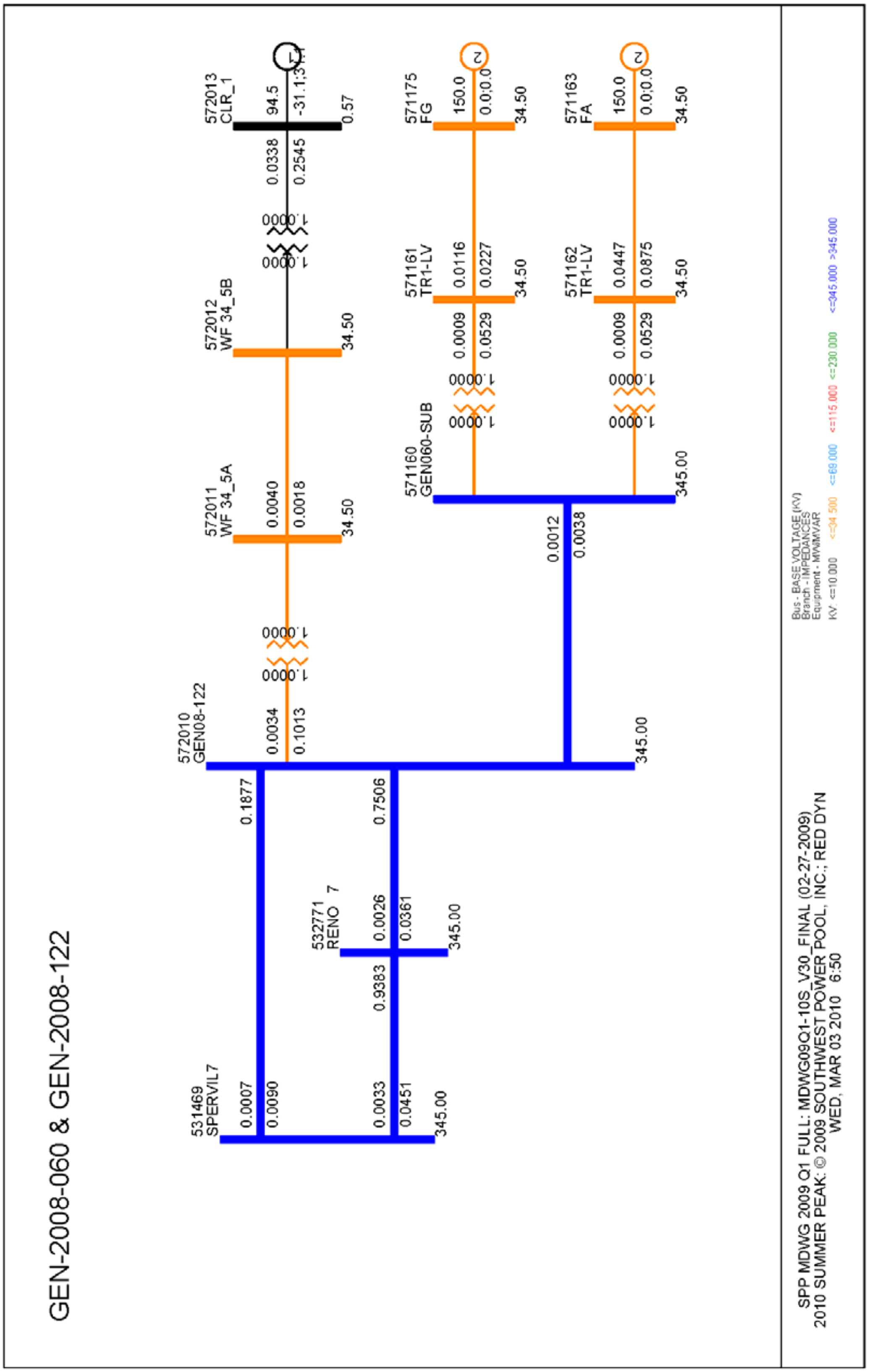
A.1 Gen-2007-019



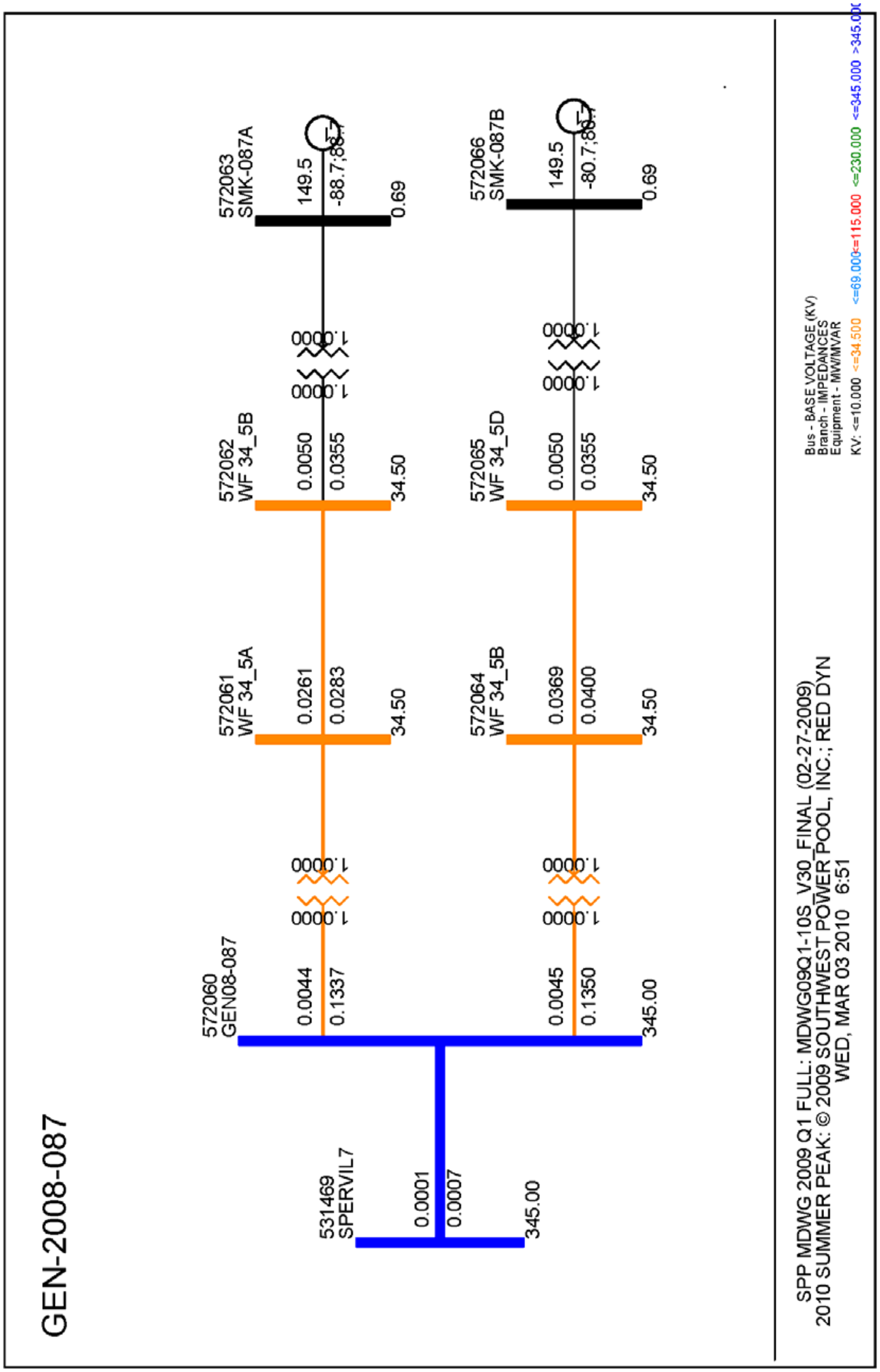
A.2 Gen-2008-059



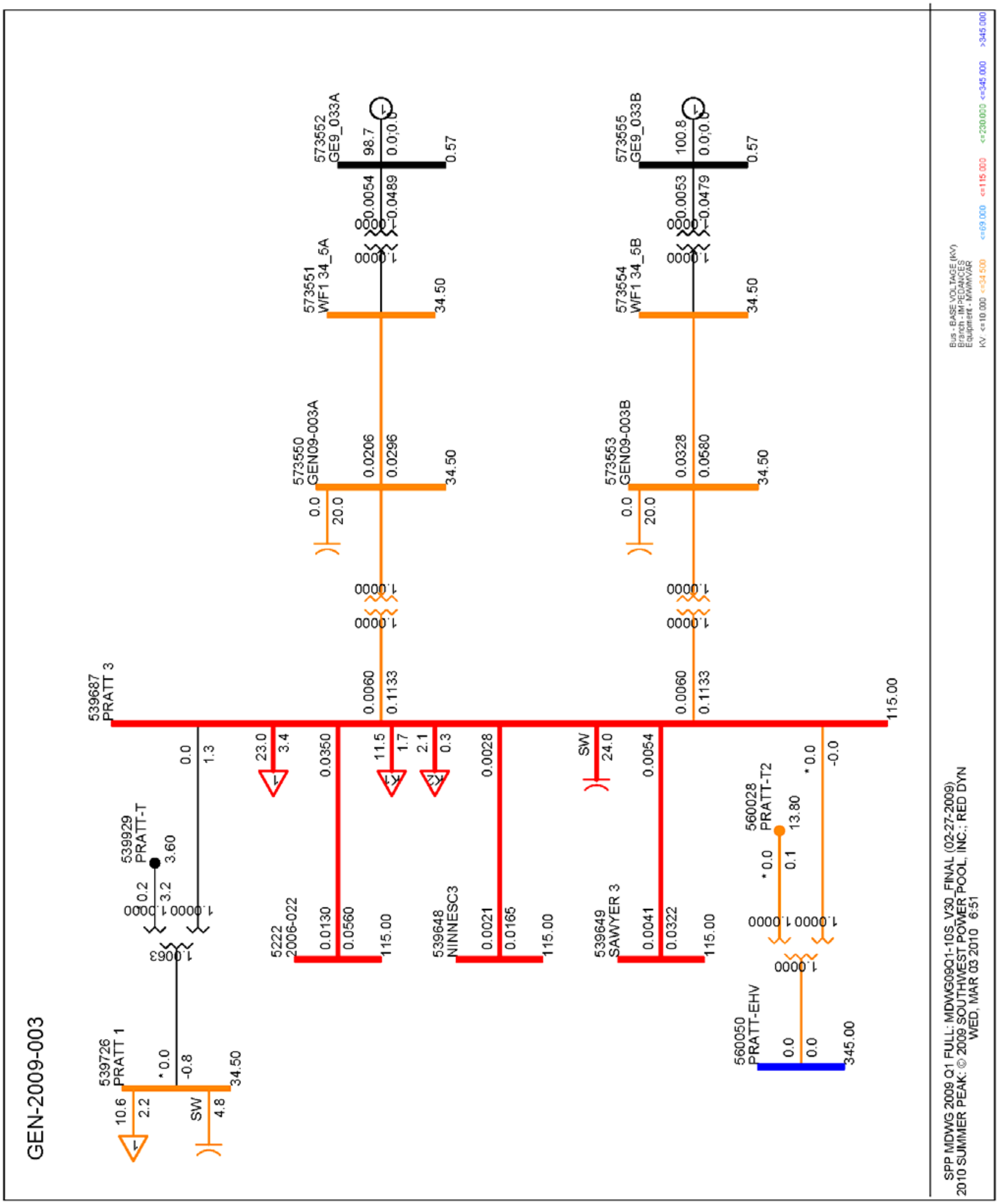
A.3 Gen-2008-060 & 2008-122



A.4 Gen-2008-087



A.5 Gen-2009-003



L: Stability Study for Group 4

Group 4
Preliminary Interconnection System Impact Study

February 24, 2010





Submitted To:
Southwest Power Pool, Inc.
415 N. McKinley - #140 Plaza West
Little Rock, AR 72205

Submitted By:
AMEC Earth & Environmental
4343 Commerce Court, Suite 407
Lisle, IL 60532

LEGAL NOTICE

This document, prepared by AMEC Earth and Environmental, is an account of work done under contract to Southwest Power Pool (SPP). Neither AMEC, nor any person or persons acting on behalf of said party (i) makes any warranty or representation, expressed or implied, with respect to the use of any information contained in this report, or that the use of any information apparatus, method, or process disclosed in this report may not infringe privately owned rights, or (ii) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method or process disclosed in this document.

EXECUTIVE SUMMARY

The Southwest Power Pool (SPP), on behalf of generation interconnection customers, desires a preliminary impact study for a generator grouping in western Kansas collectively referred to as Group 4. Group 4 consists of two (2) generators:

- GEN-2008-066. 120 MW wind farm (80 General Electric 1.5 MW turbines) connected to the Sunflower Electric Power Corporation (SUNC) Syracuse 115 kV bus.

- GEN-2009-022. 467.5 MW wind farm (187 General Electric 2.5 MW turbines) connected to the SUNC Mingo – Red Willow 345 kV line.

There are seven (7) previously queued generation interconnection requests in Group 4:

- GEN-2001-039M (99 MW of Vestas V90 3.0 MW wind turbines at the SUNC Leoti – City Services 115 kV line.)

- GEN-2006-034 (81 MW of GE 1.5 MW wind turbines at the SUNC Kanardo – Sharon Springs 115 kV line.)

- GEN-2006-040 (108 MW of Acciona 1.5 MW wind turbines at SUNC Mingo substation 115 kV bus.)

- GEN-2007-011 (135 MW of Acciona 1.5 MW wind turbines at SUNC Syracuse substation 115 kV bus.)

- GEN-2007-013 (100 MW of GE 1.5 MW wind turbines at the SUNC Selkirk substation 115 kV bus.)

- GEN-2008-017 (300 MW of GE 1.5 MW wind turbines at the SUNC Setab substation 345 kV bus.)

- GEN-2008-025 (101 MW of Siemens 2.3 MW wind turbines at the SUNC Ruleton substation 115 kV bus.)

SPP requested a stability analysis and a power factor analysis for the queued generator projects in Group 4. SPP did not request an Available Transfer Capability (ATC) study as part of this study.

Transient stability analysis shows no new problems with the dynamic response of study generation in the region of interest.

All generators in the monitored area remain stable during disturbances.

All Group 4 wind turbine generators have the capability of pre-contingency voltage recovery.

Low Voltage Ride Through (LVRT) analysis shows no Group 4 wind turbine generators and previously queued generators tripping offline.

Power factor analysis also shows no generators tripping offline due to voltage collapse.

The following is the power factor requirement as measured at each wind farm at the POIs, assuming a post-contingency voltage of 1.0 pu or the pre-contingency value, whichever is higher, for all studied contingencies:

- GEN-2008-066: 0.984 lagging-0.985 leading
- GEN-2009-022: 0.979 lagging-0.979 leading

Approximately 4 MVAR of compensation is required for GEN-2008-066 to regulate to 1.0 pu for the studied contingencies. No compensation is needed for GEN-2009-022.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

The Southwest Power Pool (hereafter referred to as SPP) commissioned AMEC Earth and Environmental (hereafter referred to as AMEC) to study the impact of a group of generators in the SPP interconnection queue referred to as Group 4. The two sites studied is in west Kansas, within approximately 240 miles of Wichita.

The sites studied were:

1. GEN-2008-066. 120 MW wind generation (80 x 1.5 MW GE wind turbines) connected to the Sunflower Electric Power Corporation (SUNC) Syracuse substation 115 kV bus.

2. GEN-2009-022. 467.5 MW wind generation (187 x 2.5 GE wind turbines) connected to the SUNC Mingo – Red Willow 345 kV line.

SPP did not request an Available Transfer Capability (ATC) study. The ATC study will be required when the generation companies request transmission service.

SPP requested a stability analysis and a power factor analysis. Given SPP's list of faults, AMEC performed a dynamics study and a power factor study to:

a. Determine the amount of reactive compensation required at the wind farm facility on the customer side following transmission line and transformer outages to meet the power factor requirement at the point of interconnection (POI).

b. Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive power support.

c. Determine the ability of the generators to remain in synchronism following three-phase and single-line-to-ground faults.

The results of the study are given in the following sections.

2. STUDY METHODOLOGY

SPP provided 2010 summer peak and 2009 winter peak load flow cases in PSS/E format. Table 1 below shows the total demand and generation in the monitored areas.

Table 1: Description of Study Areas

Area No.	Area Name	2010 Summer Peak		2009 Winter Peak	
		Load (MW)	Generation (MW)	Load (MW)	Generation (MW)
520	AEPW	10145.9	8064.4	7806.4	5644.2
524	OKGE	6263.8	7086.6	4361.2	4786.1
525	WFEC	1355.0	1289.4	1218.9	1117.1
526	SPS	5726.4	7231.0	3991.3	5552.9
531	MIDW	277.5	768.4	202.7	767.9
534	SUNC	510.4	1645.1	417.8	1585.7
536	WERE	6070.8	5721.3	4002.9	4050.1
640	NPPD	3640.3	2985.5	2779.2	2563.6
645	OPPD	2919.9	2750.7	2049.3	1892.2
650	LES	819.5	241.0	568.7	77.6

- **POWER FACTOR ANALYSIS**

A var generator with large capacity was placed at the wind farm POI. The var generator was set to hold a voltage schedule at the POI consistent with the voltage schedule in the base case or 1.0 pu, whichever is higher. A list of contingencies shown in Table 2 was simulated. If the required reactive support to maintain the pre-contingency voltage at the POI is beyond the capability of the wind farm, then additional reactive compensation at the wind farm customer side was considered.

Table 2: Steady-State Contingency Descriptions

Cont No.	Description
FLT01/02	Outage of Setab (531465) to Holcomb (531449) 345kV line
FLT03/04	Outage of the Setab (531465) to Mingo (531451) 345kV line
FLT05	Outage of Setab 345kV (531465) to 115kV (531464) to 13.8KV (531259) transformer
FLT07/08	Outage of Mingo (531451) to GEN-2009-022 (531700) 345kV line
FLT09	Outage of Mingo 345kV (531451) to 115kV (531429) to 13.8kV (531452) transformer

Cont No.	Description
FLT11/12	Outage of Gentleman (640183) to Keystone (640252) 345kV line
FLT13/14	Outage of Gentleman (640183) to Sweetwater (640374) 345kV line ckt #1
FLT15/16	Outage of Holcomb (531449) to GEN-2007-040 (531000) 345kV line
FLT17	Outage of Holcomb 345kV (531449) to 115kV (531448) to 13.8kV (531450) transformer
FLT19/20	Outage of Finney (523853) to Conestoga (560029) 345kV line
FLT21/22	Outage of Spearville (531469) to Knoll (560004) 345kV line
FLT23/24	Outage of Spearville (531469) to Comanche (765341) 345kV line
FLT25/26	Outage of Ruleton (531357) to NSI Tap (531356) 115kV line
FLT27/28	Outage of Ruleton (531357) to Lawn Ridge (531368) 115kV line
FLT29/30	Outage of Ruleton (531357) to Goodland (531443) 115kV line
FLT31/32	Outage of Tribune Switch (531438) to Selkirk (531434) 115kV line ckt #1
FLT33/34	Outage of Syracuse (531437) to Tribune (531439) 115kV line
FLT35/36	Outage of Syracuse (531437) to Williams (531440) 115kV line
FLT37/38	Outage of Atwood (530554) –Colby (530555) 115kV line
FLT39/40	Outage of Atwood Switch (531364) – Herndon (531367) 115kV line
FLT41/42	Outage of Tribune Switch (531438) – Palmer (531431) 115kV line
FLT43/44	Outage of Colby (530555) – Hoxie (530556) 115kV line
FLT45/46	Outage of Mingo (531429) – Pheasant Run (530559) 115kV line
FLT47/48	Outage of the Red Willow (640325) to GEN-2009-022 (531700) 345kV line
FLT49/50	Outage of Syracuse (531437) to Bear Creek (531473) 115kV line
FLT51/52	Outage of Knoll (560004) to Axtell (640065) 345kV line
FLT53	Outage of Knoll 345kV (560004) to 230kV (530558) transformer
FLT55/56	Outage of Knoll (530558) to Smoky Hills (530592) 230kV line
FLT57/58	Outage of Summit (532773) to Smoky Hills (560078) 345kV line
FLT59	Outage of Smoky Hills 345kV (560078) to 230kV (530592) transformer

- **DYNAMIC ANALYSIS**

The study areas are shown in Table 1. These areas are monitored in the dynamic analysis.

The transmission line and transformer faults were simulated and synchronous machine rotor angles and wind turbine generator speeds were monitored to check whether synchronism of the synchronous machines is maintained and whether the wind turbine generators trip offline during the disturbance.

All faults were simulated in three-phase (3Φ) and single-line-to-ground (1Φ) versions. Odd numbered faults are 3Φ, and even numbered faults are 1Φ.

Following is a summary of the faults simulated in this analysis.

Table 3: Fault Descriptions

Fault No.	Fault Name	Description
1	FLT01	3 phase fault on the Setab (531465) to Holcomb (531449) 345kV line, near Setab. a. Apply fault at the Setab 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
2	FLT02	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault
3	FLT03	3 phase fault on the Setab (531465) to Mingo (531451) 345kV line, near Setab. a. Apply fault at the Setab 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
4	FLT04	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
5	FLT05	3 phase fault on the Setab 345kV (531465) to 115kV (531464) to 13.8kV (531259) transformer, near the 345 kV bus. a. Apply fault at the Setab 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
6	FLT07	3 phase fault on the Mingo (531451) to GEN-2009-022 (531700) 345kV line, near GEN-2009-022. a. Apply fault at the GEN-2009-022 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
7	FLT08	*Single phase fault and sequence like previous*
8	FLT09	3 phase fault on the Mingo 345kV (531451) to 115kV (531429) to 13.8kV (531452) transformer, near the 345 kV bus. a. Apply fault at the Mingo 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
9	FLT11	3 phase fault on the Gentleman (640183) to Keystone (640252) 345kV line, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
10	FLT12	*Single phase fault and sequence like previous*
11	FLT13	3 phase fault on the Gentleman (640183) to Sweetwater (640374) 345kV line ckt #1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
12	FLT14	*Single phase fault and sequence like previous*
13	FLT15	3 phase fault on the Holcomb (531449) to GEN-2007-040 (531000) 345kV line, near Holcomb. a. Apply fault at the Holcomb 345kV bus.

Fault No.	Fault Name	Description
		b. Clear fault after 5 cycles by tripping the faulted line.
14	FLT16	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
15	FLT17	3 phase fault on the Holcomb 345kV (531449) to 115kV (531448) to 13.8kV (531450) transformer, near the 345 kV bus. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
16	FLT19	3 phase fault on the Finney (523853) to Conestoga (560029) 345kV line, near Finney. a. Apply fault at the Finney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
17	FLT20	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT21	3 phase fault on the Spearville (531469) to Knoll (560004) 345kV line, near Spearville. a. Apply fault at the Spearville 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
19	FLT22	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT23	3 phase fault on the Spearville (531469) to Comanche (765341) 345kV line, near Spearville. a. Apply fault at the Spearville 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
21	FLT24	Single phase fault on the line in previous b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT25	3 phase fault on the Ruleton (531357) to NSI Tap (531356) 115kV line, near Ruleton. a. Apply fault at the Ruleton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT26	*Single phase fault and sequence like previous*
24	FLT27	3 phase fault on the Ruleton (531357) to Lawn Ridge (531368) 115kV line, near Ruleton. a. Apply fault at the Ruleton 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
25	FLT28	*Single phase fault and sequence like previous*
26	FLT29	3 phase fault on the Ruleton (531357) to Goodland (531443) 115kV line, near Ruleton. a. Apply fault at the Ruleton 345kV bus.

Fault No.	Fault Name	Description
		b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT30	*Single phase fault and sequence like previous*
28	FLT31	3 phase fault on the Tribune Switch (531438) to Selkirk (531434) 115kV line, near Tribune Switch. a. Apply fault at the Tribune Switch 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT32	*Single phase fault and sequence like previous*
30	FLT33	3 phase fault on the Syracuse (531437) to Tribune (531439) 115kV line ckt #1, near Syracuse. a. Apply fault at the Syracuse 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT34	*Single phase fault and sequence like previous*
32	FLT35	3 phase fault on the Syracuse (531437) to Williams (531440) 115kV line, near Syracuse. a. Apply fault at the Syracuse 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
33	FLT36	*Single phase fault and sequence like previous*
34	FLT37	3 phase fault on the Atwood (530554) –Colby (530555) 115kV line, near Atwood. a. Apply fault at the Atwood 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT38	*Single phase fault and sequence like previous*
36	FLT39	3 phase fault on the Atwood Switch (531364) – Herndon (531367) 115kV line, near Atwood Switch a. Apply fault at the Atwood Switch115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT40	*Single phase fault and sequence like previous*
38	FLT41	3 phase fault on the Tribune Switch (531438) – Palmer (531431) 115kV line, near Tribune a. Apply fault at the Tribune Switch 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
39	FLT42	*Single phase fault and sequence like previous*
40	FLT43	3 phase fault on the Colby (530555) – Hoxie (530556) 115kV line, near Colby a. Apply fault at the Colby

Fault No.	Fault Name	Description
		b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
41	FLT44	*Single phase fault and sequence like previous*
42	FLT45	3 phase fault on the Mingo (531429) – Pheasant Run (530559) 115kV line, near Mingo a. Apply fault at the Mingo b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
43	FLT46	*Single phase fault and sequence like previous*
44	FLT47	3 phase fault on the Red Willow (640325) to GEN-2009-022 (531700) 345kV line, near GEN-2009-022. a. Apply fault at the GEN-2009-022 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT48	*Single phase fault and sequence like previous*
46	FLT49	3 phase fault on the Syracuse (531437) to Bear Creek (531473) 115kV line, near Syracuse. a. Apply fault at the Syracuse 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
47	FLT50	*Single phase fault and sequence like previous*
48	FLT51	3 phase fault on the Knoll (560004) to Axtell (640065) 345kV line, near Knoll. a. Apply fault at the Knoll 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
49	FLT52	*Single phase fault and sequence like previous*
50	FLT53	3 phase fault on the Knoll 345kV (560004) to 230kV (530558) transformer, near the 345 kV bus. a. Apply fault at the Knoll 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
51	FLT55	3 phase fault on the Knoll (530558) to Smoky Hills (530592) 230kV line, near Knoll. a. Apply fault at the Knoll 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT56	*Single phase fault and sequence like previous*
53	FLT57	3 phase fault on the Summit (532773) to Smoky Hills (560078) 345kV line, near Summit. a. Apply fault at the Summit 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT58	*Single phase fault and sequence like previous*

Fault No.	Fault Name	Description
55	FLT59	3 phase fault on the Smoky Hills 345kV (560078) to 230kV (530592) transformer, near the 345 kV bus. a. Apply fault at the Smoky Hills 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

In order to simulate 1Φ faults, equivalent shunt Mvar[1] were determined to be applied at the faulted buses. Table 4 presents equivalent reactors used in the transient stability study.

Table 4: Equivalent Shunt Mvar at Faulted Bus for Single-Line-to-Ground Faults

Fault Name	Faulted Bus No.	2010 Summer Peak (Mvar)	2009 Winter Peak (Mvar)
FLT02	531465	-3137.3	-3126.9
FLT04	531465	-3137.3	-3126.9
FLT08	531700	-2107.8	-2096.2
FLT12	640183	-5211.3	-5073.2
FLT14	640183	-5211.3	-5073.2
FLT16	531449	-4776.6	-4770.3
FLT20	523853	-4759.1	-4754.2
FLT22	531469	-6813.1	-6588.0
FLT24	531469	-6813.1	-6588.0
FLT26	531357	-460.6	-462.4
FLT28	531357	-460.6	-462.4
FLT30	531357	-460.6	-462.4
FLT32	531438	-571.2	-570.7
FLT34	531437	-703.6	-689.9
FLT36	531437	-703.6	-689.9
FLT38	530554	-368.3	-376.1
FLT40	531364	-193.3	-200.2
FLT42	531438	-571.2	-570.7
FLT44	530555	-978.1	-973.7
FLT46	531429	-1402.8	-1387.3
FLT48	531700	-2107.8	-2096.2
FLT50	531437	-703.6	-689.9

[1] The equivalent shunt Mvar causes the voltage at the faulted bus dropped to 0.60 pu.

Fault Name	Faulted Bus No.	2010 Summer Peak (Mvar)	2009 Winter Peak (Mvar)
FLT52	560004	-3172.3	-3104.2
FLT56	530558	-2942.4	-2813.6
FLT58	532773	-4146.7	-3973.4

Another important aspect of the dynamic analysis was to check FERC Order 661A compliance. The turbine generators were monitored to determine whether they stayed connected to the grid (Low Voltage Ride Through - LVRT) following the faults defined in Table 3. The wind farm capability of post-fault voltage recovery at the POI was also checked.

3. PROJECT DESCRIPTION

Following is a table of the proposed wind farms in Group 4.

Table 5: Points of Interconnection for Group 4

Request	Size (MW)	Turbine Model	Points Of Interconnection		
			Common Name	Bus No.	Bus Name in Model
GEN-2008-066	120	GE 1.5 MW	Syracuse 115 kV	531437	SYRACUS3
GEN-2009-022	467.5	GE 2.5 MW	Tap Mingo – Red Willow 345 kV line	531700	2009-022TAP

All of the following one-line diagrams use this color code for nominal voltages:

Red **345 kV**
Blue **161 kV**
Black **lower voltage levels**

Following is the one-line diagrams of the interconnections of GEN-2008-066 and GEN-2009-022. All voltages and line flows are from the 2010 summer peak base case.

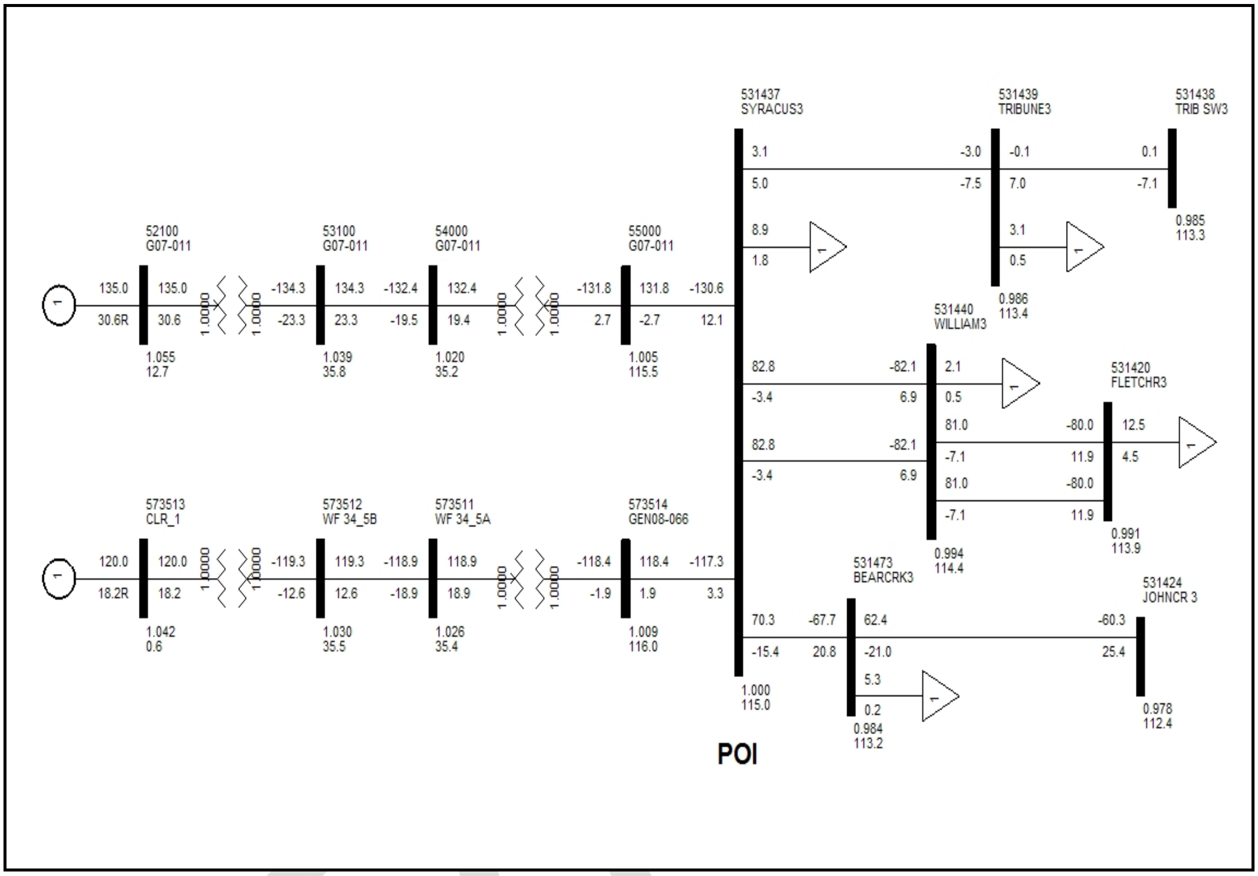


Figure 1: GEN-2008-066 Interconnection One-Line Diagram

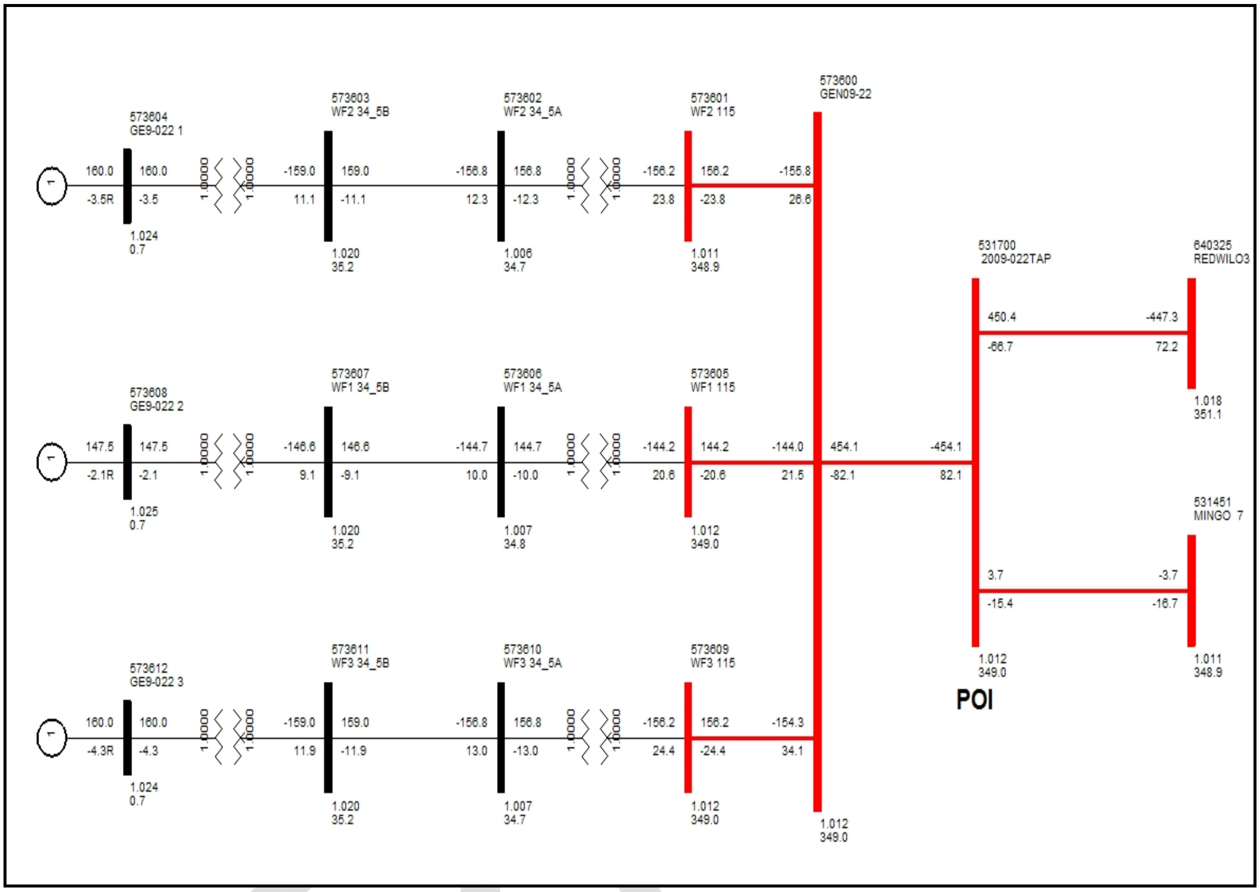


Figure 2: GEN-2009-022 Interconnection One-Line Diagram

As illustrated below, the sites in Group 4 are within approximately 240 miles to the west of Wichita, Kansas.

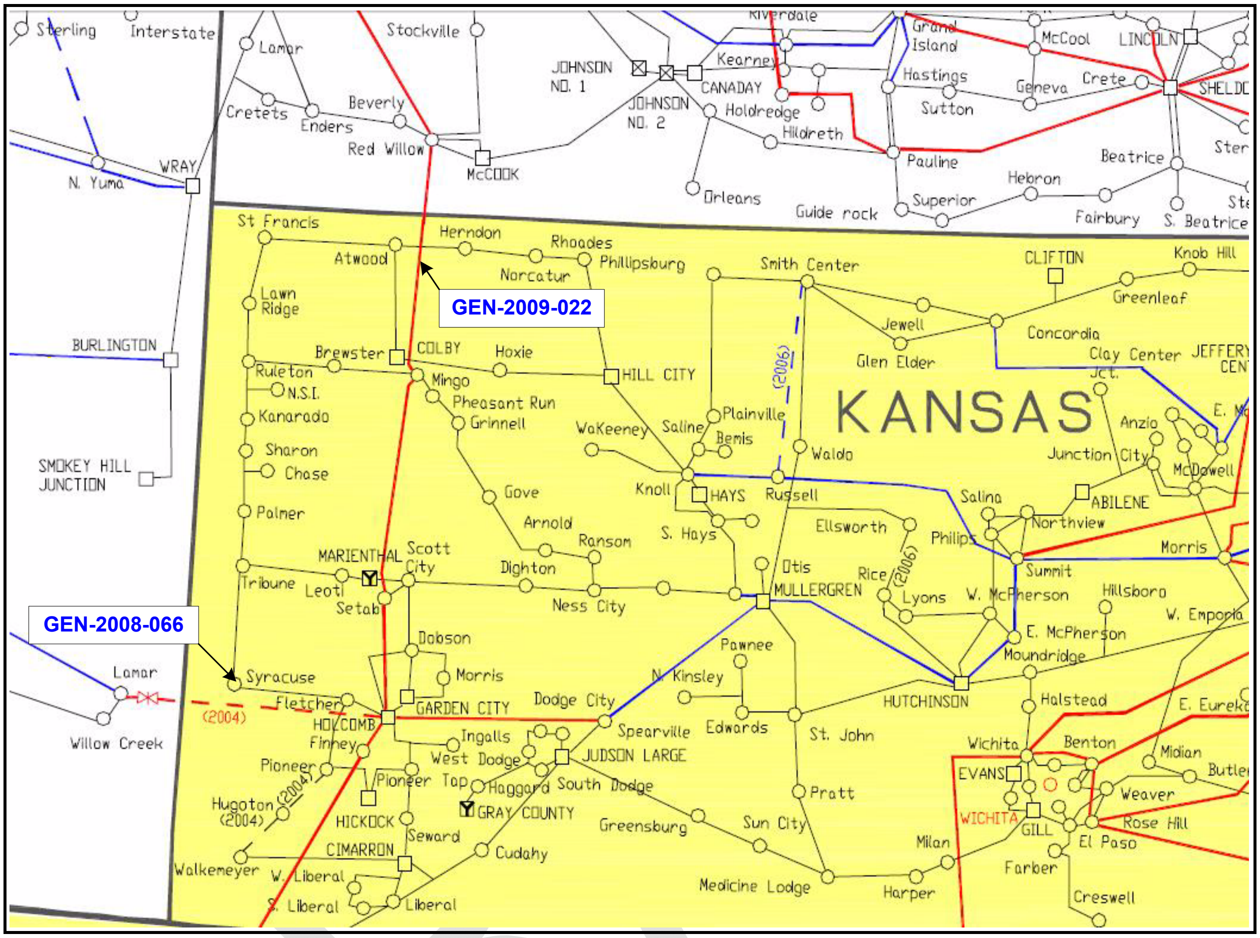


Figure 3: Geographical Location of Group 4 Requests

The following is the detailed description of the wind projects in Group 4.

GEN-2008-066

- Wind farm rating
  - Active power capability: 120 MW
  - Reactive power capability: 39.44 MVAR

- Interconnection:
  - Voltage: 115 kV
  - Location: Existing SUNC Syracuse 115 kV substation
  - Transformer: One step-up transformer connecting to the 115 kV
    - MVA: Rate A - 81, Rate B - 81, Rate C - 135
    - Voltage: 115/34.5 kV
    - X: 12.35%

- Wind turbine:
  - Number: Eighty (80)
  - Manufacturer: GE
  - Type: Doubly-fed induction generator (DFIG)

  - Machine terminal voltage: 575 V
  - Rated power: 1.5 MW
  - Frequency: 60Hz
  - Generator step-up transformer
    - MVA: 1.75
    - Voltage: 34.5/0.575kV
    - X: 4.14%

- Generator protection
  - Undervoltage
    - Relay trips when V_{bus} < 0.15 pu for t = 0.625 s
    - V_{bus} < 0.70 pu for t = 0.625 s
    - V_{bus} < 0.75 pu for t = 1.0 s
    - V_{bus} < 0.85 pu for t = 10.0 s
  - Overvoltage
    - Relay trips when V_{bus} > 1.10 pu for t = 1.0 s
    - V_{bus} > 1.15 pu for t = 0.1 s
    - V_{bus} > 1.30 pu for t = 0.02 s
  - Underfrequency
    - Relay trips when F_{bus} < 56.5 Hz for t = 0.2 s
    - F_{bus} < 57.5 Hz for t = 10.0 s
  - Overfrequency
    - Relay trips when F_{bus} > 61.5 Hz for t = 30.0 s
    - F_{bus} > 62.5 Hz for t = 0.02 s

GEN-2009-022

- Wind farm rating
  - GEN-2009-022 1:
    - Active power capability: 160.0 MW
    - Reactive power capability: 76.8 MVAR
  - GEN-2009-022 2:
    - Active power capability: 147.5 MW
    - Reactive power capability: 70.8 MVAR
  - GEN-2009-022 3:
    - Active power capability: 160.0 MW
    - Reactive power capability: 76.8 MVAR

- Interconnection:
  - Voltage: 345 kV
  - Location: Existing SUNC Mingo – Red Willow 345 kV line
  - Transformer: One step-up transformer connecting to the 345 kV
    - GEN-2009-022 1:
      - MVA: Rate A – 160.0, Rate B – 160.0, Rate C – 0.0
      - Voltage: 34.5/34.5 kV
      - X: 4.688%
    - GEN-2009-022 2:
      - MVA: Rate A – 147.5, Rate B – 147.5, Rate C – 0.0
      - Voltage: 34.5/34.5 kV
      - X: 5.085%
    - GEN-2009-022 3:
      - MVA: Rate A – 160.0, Rate B – 160.0, Rate C – 0.0
      - Voltage: 34.5/34.5 kV
      - X: 4.688%

- Wind turbine:
  - Number: One hundred eighty seven (187)
  - Manufacturer: GE
  - Type: Permanent magnet synchronous generator with rectifier and inverter
  - Machine terminal voltage: 690 V
  - Rated power: 2.5 MW
  - Frequency: 60Hz
  - Generator step-up transformer
    - MVA: 3.0
    - Voltage: 34.5/0.69kV
    - X: 6.0%

4. POWER FACTOR RESULTS

The proposed GEN-2008-066 wind farm (120 MW) will be comprised of 80 GE 1.5 MW wind turbine generators. These wind turbine generators are doubly fed induction generators (DFIG) with a reactive power capability of ± 0.95 p.f. as standard equipment and ± 0.90 p.f. optional. (GEN-2008-066 is modeled with a ± 0.95 p.f. in the power flow cases as received.) The wind turbine generators were modeled in voltage control mode. They were set to regulate the collector bus voltage.

The proposed GEN-2009-022 wind farm (467.5 MW) will be comprised of 187 GE 2.5 MW wind turbines. These wind turbine generators are permanent magnet synchronous generators interfaced to the grid via a rectifier/inverter combination. The GE 2.5 MW wind turbine is capable of ± 0.95 p.f. as standard equipment and ± 0.90 p.f. optional. (GEN-2009-022 is modeled with a ± 0.90 p.f. in the power flow cases as received.) These turbines were also set to regulate the collector bus voltage.

Table 6 lists the voltages of GEN-2008-066 POI in the base and all contingency cases without any additional shunts at the POI, and Table 7 shows the voltages at GEN-2009-022 for base case and contingency conditions without additional shunts at the POI. In both tables, no attempt was made to increase var delivery from the wind farms to the POI by tuning voltage schedules or transformer tap ratios. In all cases, yellow highlighting indicates the lowest voltage, and blue highlighting indicates the highest voltage, for the studied transmission bus.

Table 6 shows that FLT01 & FLT02 (loss of the Setab-Holcomb 345 kV line) causes the lowest post-contingency voltage at the GEN-2008-066 POI. High post-contingency voltage at the GEN-2008-066 POI was not a problem for the studied contingencies, and the highest post-contingency voltage with GEN-2008-066 online occurred for FLT41 & FLT42 (loss of the Tribune Switch-Palmer 115kV line.)

Table 6: Steady-State Results: Voltage at GEN-2008-066 POI, Existing Voltage Schedules and Transformer Tap Ratios

Cont No.	Voltage at POI (Syracuse 115 kV Bus 531437) (pu)			
	Summer Peak		Winter Peak	
	GEN-2008-066 Online	GEN-2008-066 Offline	GEN-2008-066 Online	GEN-2008-066 Offline
Base Case	0.9966	1.0019	0.9933	0.9983
FLT01 & FLT02	0.9796	0.9795	0.9735	0.9704
FLT03 & FLT04	0.9952	0.9998	0.9913	0.9953
FLT05	0.9900	0.9950	0.9870	0.9919
FLT07 & FLT08	0.9963	1.0020	0.9935	0.9990

Cont No.	Voltage at POI (Syracuse 115 kV Bus 531437) (pu)			
	Summer Peak		Winter Peak	
	GEN-2008-066 Online	GEN-2008-066 Offline	GEN-2008-066 Online	GEN-2008-066 Offline
FLT09	0.9914	0.9960	0.9870	0.9911
FLT11 & FLT12	0.9966	1.0019	0.9934	0.9984
FLT13 & FLT14	0.9955	1.0005	0.9922	0.9968
FLT15 & FLT16	0.9922	0.9964	0.9894	0.9937
FLT17	0.9956	1.0031	0.9922	0.9993
FLT19 & FLT20	0.9948	0.9998	0.9920	0.9969
FLT21 & FLT22	0.9967	1.0020	0.9934	0.9984
FLT23 & FLT24	0.9963	1.0015	0.9929	0.9978
FLT25 & FLT26	0.9889	0.9946	0.9858	0.9912
FLT27 & FLT28	0.9924	0.9967	0.9890	0.9929
FLT29 & FLT30	0.9887	0.9924	0.9852	0.9884
FLT31 & FLT32	0.9949	1.0032	0.9890	0.9964
FLT33 & FLT34	0.9966	1.0140	0.9921	1.0088
FLT35 & FLT36	0.9899	1.0089	0.9840	1.0020
FLT37 & FLT38	0.9960	1.0013	0.9927	0.9977
FLT39 & FLT40	0.9958	1.0008	0.9924	0.9971
FLT41 & FLT42	0.9987	1.0066	0.9966	1.0045
FLT43 & FLT44	0.9952	1.0001	0.9919	0.9964
FLT45 & FLT46	0.9961	1.0013	0.9929	0.9978
FLT47 & FLT48	0.9891	0.9924	0.9860	0.9891
FLT49 & FLT50	0.9821	0.9912	0.9774	0.9851
FLT51 & FLT52	0.9967	1.0021	0.9935	0.9985
FLT53	0.9966	1.0019	0.9933	0.9983
FLT55 & FLT56	0.9964	1.0017	0.9932	0.9981
FLT57 & FLT58	0.9965	1.0018	0.9933	0.9983
FLT59	0.9966	1.0019	0.9933	0.9983

Table 7, below, shows the lowest post-contingency voltage at the GEN-2009-022 POI occurs for FLT47 & FLT48 (loss of the GEN-2009-022 to Red Willow 345 kV line), which forces all the output of GEN-2009-022 to a radial 345 kV line to Red Willow 345 kV and Gentleman 345 kV. High post-contingency voltages were not a problem for the contingencies studied. The highest post-contingency voltage occurred for FLT09 (loss of the Mingo 345/115/13.8 kV transformer.)

Table 7: Steady-State Results: Voltage at GEN-2009-022 POI, Existing Voltage Schedules and Transformer Tap Ratios

Cont No.	Voltage at POI (Mingo – Red Willow 345 kV line) (pu)			
	Summer Peak		Winter Peak	
	GEN-2009-022 Online	GEN-2009-022 Offline	GEN-2009-022 Online	GEN-2009-022 Offline
Base Case	1.0110	1.0368	1.0070	1.0293
FLT01 & FLT02	0.9911	1.0088	0.9883	0.9947
FLT03 & FLT04	1.0092	1.0513	1.0011	1.0329
FLT05	1.0123	1.0404	1.0081	1.0320
FLT07 & FLT08	1.0089	1.0628	1.0025	1.0441
FLT09	1.0130	1.0417	1.0103	1.0363
FLT11 & FLT12	1.0104	1.0359	1.0072	1.0296
FLT13 & FLT14	1.0092	1.0344	1.0054	1.0276
FLT15 & FLT16	0.9969	1.0119	0.9963	1.0106
FLT17	1.0091	1.0357	1.0036	1.0242
FLT19 & FLT20	1.0064	1.0304	1.0037	1.0245
FLT21 & FLT22	1.0099	1.0343	1.0059	1.0267
FLT23 & FLT24	1.0102	1.0354	1.0061	1.0277
FLT25 & FLT26	1.0122	1.0376	1.0083	1.0304
FLT27 & FLT28	1.0097	1.0347	1.0061	1.0276
FLT29 & FLT30	1.0112	1.0368	1.0073	1.0293
FLT31 & FLT32	1.0109	1.0369	1.0070	1.0294
FLT33 & FLT34	1.0111	1.0374	1.0072	1.0299
FLT35 & FLT36	1.0088	1.0330	1.0047	1.0248
FLT37 & FLT38	1.0119	1.0369	1.0078	1.0296
FLT39 & FLT40	1.0102	1.0359	1.0062	1.0280
FLT41 & FLT42	1.0100	1.0360	1.0057	1.0275
FLT43 & FLT44	1.0089	1.0341	1.0047	1.0256
FLT45 & FLT46	1.0107	1.0367	1.0066	1.0288
FLT47 & FLT48	0.9870	1.0183	0.9879	1.0209
FLT49 & FLT50	1.0100	1.0353	1.0061	1.0277
FLT51 & FLT52	1.0095	1.0331	1.0055	1.0254
FLT53	1.0110	1.0370	1.0071	1.0294

Cont No.	Voltage at POI (Mingo – Red Willow 345 kV line) (pu)			
	Summer Peak		Winter Peak	
	GEN-2009-022 Online	GEN-2009-022 Offline	GEN-2009-022 Online	GEN-2009-022 Offline
FLT55 & FLT56	1.0108	1.0366	1.0068	1.0290
FLT57 & FLT58	1.0109	1.0368	1.0070	1.0291
FLT59	1.0109	1.0368	1.0070	1.0293

The previously queued GEN-2007-011 project was previously assigned a unity power factor as measured at the Syracuse 115 kV POI. Therefore, for the purposes of the following tables, GEN-2007-011 was modeled as a constant P injection.

GEN-2008-066 and GEN-2009-022 were also modeled as constant P injections at unity power factor, after taking losses into account. Continuous shunts were placed at the Syracuse 115 kV POI and the Mingo-Red Willow 345 kV POI, and the voltage was regulated to 1.0 pu (Syracuse 115 kV) and the pre-contingency values for Mingo-Red Willow 345 kV (1.011 pu for summer and 1.007 pu for winter.)

Table 8 shows the reactive injections needed to hold Syracuse 115 kV at 1.0 pu post-contingency, assuming GEN-2007-011 and GEN-2008-066 are both injecting at unity power factor as measured at Syracuse 115 kV (and the GEN-2009-022 POI is regulated to pre-contingency voltages.)

Table 8: Reactive requirements at GEN-2008-066 POI to regulate voltage to 1.0 pu

Cont No.	GEN-2008-066 Power Factor at POI, V=1.0 pu (Summer)					GEN-2008-066 Power Factor at POI, V=1.0 pu (Winter)				
	P	Q	MVA	PF	Lead/Lag	P	Q	MVA	PF	Lead/Lag
Base Case	117.3	-8.9	117.6	0.997	Lead	117.3	-14.1	118.1	0.993	Lead
FLT01&02	117.3	19.7	118.9	0.986	Lag	117.3	21.1	119.2	0.984	Lag
FLT03&04	117.3	-6.4	117.5	0.999	Lead	117.3	-10.7	117.8	0.996	Lead
FLT05	117.3	3.0	117.3	1.000	Lag	117.3	-2.9	117.3	1.000	Lead
FLT07&08	117.3	-8.3	117.6	0.998	Lead	117.3	-14.4	118.2	0.993	Lead
FLT09	117.3	0.7	117.3	1.000	Lag	117.3	-2.6	117.3	1.000	Lead
FLT11&12	117.3	-8.9	117.6	0.997	Lead	117.3	-14.2	118.2	0.993	Lead
FLT13&14	117.3	-7.1	117.5	0.998	Lead	117.3	-12.1	117.9	0.995	Lead
FLT15&16	117.3	-1.0	117.3	1.000	Lead	117.3	-7.6	117.5	0.998	Lead
FLT17	117.3	-7.2	117.5	0.998	Lead	117.3	-12.3	117.9	0.995	Lead
FLT19&20	117.3	-5.9	117.4	0.999	Lead	117.3	-11.9	117.9	0.995	Lead

Cont No.	GEN-2008-066 Power Factor at POI, V=1.0 pu (Summer)					GEN-2008-066 Power Factor at POI, V=1.0 pu (Winter)				
	P	Q	MVA	PF	Lead/Lag	P	Q	MVA	PF	Lead/Lag
FLT21&22	117.3	-9.1	117.7	0.997	Lead	117.3	-14.3	118.2	0.993	Lead
FLT23&24	117.3	-8.3	117.6	0.998	Lead	117.3	-13.4	118.1	0.994	Lead
FLT25&26	117.3	4.9	117.4	0.999	Lag	117.3	-0.7	117.3	1.000	Lead
FLT27&28	117.3	-1.3	117.3	1.000	Lead	117.3	-6.2	117.5	0.999	Lead
FLT29&30	117.3	5.5	117.4	0.999	Lag	117.3	0.7	117.3	1.000	Lag
FLT31&32	117.3	-6.6	117.5	0.998	Lead	117.3	-8	117.6	0.998	Lead
FLT33&34	117.3	-10.1	117.7	0.996	Lead	117.3	-14.3	118.2	0.993	Lead
FLT35&36	117.3	-1.1	117.3	1.000	Lead	117.3	-4.1	117.4	0.999	Lead
FLT37&38	117.3	-7.8	117.6	0.998	Lead	117.3	-13	118.0	0.994	Lead
FLT39&40	117.3	-7.4	117.5	0.998	Lead	117.3	-12.4	118.0	0.994	Lead
FLT41&42	117.3	-12.9	118.0	0.994	Lead	117.3	-20.2	119.0	0.985	Lead
FLT43&44	117.3	-6.4	117.5	0.999	Lead	117.3	-11.6	117.9	0.995	Lead
FLT45&46	117.3	-8.0	117.6	0.998	Lead	117.3	-13.4	118.1	0.994	Lead
FLT47&48	117.3	3.4	117.3	1.000	Lag	117.3	-1.9	117.3	1.000	Lead
FLT49&50	117.3	15.1	118.3	0.992	Lag	117.3	11.8	117.9	0.995	Lag
FLT51&52	117.3	19.7	118.9	0.986	Lag	117.3	-14.5	118.2	0.992	Lead
FLT53	117.3	19.8	119.0	0.986	Lag	117.3	-14	118.1	0.993	Lead
FLT55&56	117.3	-8.6	117.6	0.997	Lead	117.3	-13.8	118.1	0.993	Lead
FLT57&58	117.3	-8.8	117.6	0.997	Lead	117.3	-14	118.1	0.993	Lead
FLT59	117.3	-8.8	117.6	0.997	Lead	117.3	-14.1	118.1	0.993	Lead

Therefore, GEN-2008-066 has a reactive requirement of 0.985 leading-0.984 lagging at the Syracuse 115 kV POI.

For the fault that requires GEN-2008-066 to supply the most reactive power (FLT0&02-Setab-Holcomb 345 kV), and assuming unity power factor from GEN-2007-011:

With GEN-2008-066 generating at Q_{max}, after FLT01&02, GEN-2008-066 supplies 17.7 MVAR to the Syracuse POI (3.4 MVAR short of what is needed to hold the POI at unity voltage post-contingency.) Also, the post-contingency voltage of the POI is 0.9956 for this contingency, with GEN-2008-066 generating at Q_{max}. Adding a 3.2 MVAR shunt to bus 573511 (WF 34_5A 34.5 kV — the low side of the collector-to-transmission step-up transformer) brings the post-contingency voltage at the POI up to 1.0 pu, but it also drives the voltage to 1.09 pu at bus 573513 (the 0.575 kV generation bus for GEN-2008-066) and drives the 34.5 collector voltages up to 1.06 -1.07 pu.

Therefore, approximately 4 MVAR of capacitors are required at the 34.5 kV side of GEN-2008-066 to maintain 1.0 pu voltage at the POI for the worst-case contingency. Also, transformer tap adjustment is necessary to avoid overvoltage in the collector and generation system.

For the contingency that requires the Syracuse 115 kV POI to absorb the most VARs (FLT41&42 - loss of Tribune Switch-Palmer 115 kV), again assuming GEN-2007-011 is injecting at unity power factor to the POI, shunt reactors are not needed from a power factor standpoint. GEN-2008-066 generates at 2.6 MVAR lagging, the generator and collector voltages are approximately 1.0 pu, and the POI maintains a post-contingency voltage of 1.0 pu.

The same power flow cases were used to check reactive requirements at GEN-2009-022, and the results are shown below in Table 9.

Table 9: Reactive requirements at GEN-2009-022 POI to regulate voltage to pre-contingency level

Cont No.	GEN-2009-022 Power Factor at POI, V=1.011 pu (Summer)					GEN-2009-022 Power Factor at POI, V=1.007 pu (Winter)				
	P	Q	MVA	PF	Lead/Lag	P	Q	MVA	PF	Lead/Lag
Base Case	454.1	-79.5	461.0	0.985	Lead	454.2	-62.6	458.5	0.991	Lead
FLT01&02	454.1	57.9	457.8	0.992	Lag	454.2	94.5	463.9	0.979	Lag
FLT03&04	454.1	-68.6	459.3	0.989	Lead	454.2	-25.8	454.9	0.998	Lead
FLT05	454.1	-89.9	462.9	0.981	Lead	454.2	-70.4	459.6	0.988	Lead
FLT07&08	454.1	-67	459.0	0.989	Lead	454.2	-35.4	455.6	0.997	Lead
FLT09	454.1	-94.9	463.9	0.979	Lead	454.2	-87	462.5	0.982	Lead
FLT11&12	454.1	-75.5	460.3	0.986	Lead	454.2	-63.8	458.7	0.990	Lead
FLT13&14	454.1	-66.1	458.9	0.990	Lead	454.2	-50.6	457.0	0.994	Lead
FLT15&16	454.1	26.8	454.9	0.998	Lag	454.2	17.3	454.5	0.999	Lag
FLT17	454.1	-65.6	458.8	0.990	Lead	454.2	-37.2	455.7	0.997	Lead
FLT19&20	454.1	-45.4	456.4	0.995	Lead	454.2	-37.8	455.8	0.997	Lead
FLT21&22	454.1	-71.3	459.7	0.988	Lead	454.2	-53.6	457.4	0.993	Lead
FLT23&24	454.1	-73.6	460.0	0.987	Lead	454.2	-55.6	457.6	0.993	Lead
FLT25&26	454.1	-89.2	462.8	0.981	Lead	454.2	-72.5	459.9	0.987	Lead
FLT27&28	454.1	-70.5	459.5	0.988	Lead	454.2	-55.4	457.6	0.993	Lead
FLT29&30	454.1	-82.1	461.5	0.984	Lead	454.2	-65.3	458.9	0.990	Lead
FLT31&32	454.1	-78.8	460.9	0.985	Lead	454.2	-62.1	458.4	0.991	Lead
FLT33&34	454.1	-80.3	461.1	0.985	Lead	454.2	-63.2	458.6	0.990	Lead

Cont No.	GEN-2009-022 Power Factor at POI, V=1.011 pu (Summer)					GEN-2009-022 Power Factor at POI, V=1.007 pu (Winter)				
	P	Q	MVA	PF	Lead/Lag	P	Q	MVA	PF	Lead/Lag
FLT35&36	454.1	-63.8	458.6	0.990	Lead	454.2	-45.3	456.5	0.995	Lead
FLT37&38	454.1	-86.3	462.2	0.982	Lead	454.2	-68.3	459.3	0.989	Lead
FLT39&40	454.1	-74	460.1	0.987	Lead	454.2	-56	457.6	0.992	Lead
FLT41&42	454.1	-72.1	459.8	0.988	Lead	454.2	-52.1	457.2	0.993	Lead
FLT43&44	454.1	-64.3	458.6	0.990	Lead	454.2	-44.8	456.4	0.995	Lead
FLT45&46	454.1	-77.9	460.7	0.986	Lead	454.2	-59.5	458.1	0.992	Lead
FLT47&48	454.1	58.6	457.9	0.992	Lag	454.2	47.1	456.6	0.995	Lag
FLT49&50	454.1	-73.1	459.9	0.987	Lead	454.2	-56.3	457.7	0.992	Lead
FLT51&52	454.1	64.8	458.7	0.990	Lag	454.2	-50.6	457.0	0.994	Lead
FLT53	454.1	57.9	457.8	0.992	Lag	454.2	-63.2	458.6	0.990	Lead
FLT55&56	454.1	-78.3	460.8	0.985	Lead	454.2	-60.9	458.3	0.991	Lead
FLT57&58	454.1	-79.3	461.0	0.985	Lead	454.2	-62	458.4	0.991	Lead
FLT59	454.1	-79.4	461.0	0.985	Lead	454.2	-62.5	458.5	0.991	Lead

For the contingency that required the most lagging injection into GEN-2009-022 (again, FLT01&02, Winter), GEN-2009-022 was able to meet the reactive requirement, with approximately 57 MVA to spare. However, some high voltages were observed in the generator and collector system (1.09 pu at bus 573612, 690 kV generator bus #3, 1.07 pu at the other generator buses, and 1.034-1.069 pu throughout the 34.5 kV collector.)

For the contingency that required the most leading injection into GEN-2009-022 (FLT09 - loss of Mingo 345/115/13.8 kV transformer, Summer), GEN-2009-022 generates at a total of 7.5 MVAR leading, and thus was able to meet the leading power factor requirement at the POI with approximately 217 MVAR to spare. Generator and collector voltages were in the 1.00 -1.02 pu range.

Therefore, reactive compensation is not needed for GEN-2009-022. However, transformer taps may need to be adjusted to avoid overvoltage when generating in the lag.

POWER FACTOR-CONCLUSIONS

To regulate each POI to 1.0 pu or pre-contingency voltage, whichever is greater, for each studied contingency, the following power factors are required as measured at each POI:

- GEN-2008-066: 0.984 lagging-0.985 leading (requires approximately 4 MVAR compensation)

- GEN-2009-022: 0.979 lagging-0.979 leading (does not require compensation)

5. VOLTAGE RECOVERY RESULTS

Dynamic simulations were performed using each fault noted in Section 2. Voltage recovery as determined via dynamic simulation was checked against all contingencies. If the voltage recovers post-fault to a steady-state level consistent with the steady-state simulation, the generator interconnection is considered acceptable from a voltage recovery standpoint.

In these dynamic simulations, real loads are modeled as constant current and reactive loads are modeled as constant admittance; i.e. MW loads are proportional to voltage and Mvar loads are proportional to voltage squared. In contrast, loads are modeled as constant MW and constant Mvar in steady-state simulations. Therefore, due to differences in load modeling, minor differences in voltages are to be expected between dynamic and steady-state simulations.

The dynamic simulation showed all generators in Group 4 did not trip during any of the contingencies tested. That is, the wind farms GEN-2008-066 and GEN-2009-022 meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage). Tables 10 and 11 lists the post-fault voltages at the POIs[2].

Table 10: Post-Fault Voltage Recovery of GEN-2008-066 by Dynamic Simulation:

Fault No.	Voltage @ GEN-2008-066 POI (Syracuse 115 kV bus) (pu)	
	Summer Peak	Winter Peak
FLT01	0.9660	0.9666
FLT02	0.9660	0.9666
FLT03	0.9942	0.9912
FLT04	0.9941	0.9912
FLT05	0.9835	0.9852
FLT07	0.9962	0.9939
FLT08	0.9962	0.9938
FLT09	0.9899	0.9875
FLT11	0.9968	0.9937
FLT12	0.9967	0.9936
FLT13	0.9944	0.9919
FLT14	0.9944	0.9919
FLT15	0.9882	0.9889
FLT16	0.9882	0.9889

[2] The PTI utility tool PSSECHOP was used to retrieve the post-fault voltage at the PO from the dynamic simulation channel output files.

Fault No.	Voltage @ GEN-2008-066 POI (Syracuse 115 kV bus) (pu)	
	Summer Peak	Winter Peak
FLT17	0.9909	0.9903
FLT19	0.9920	0.9931
FLT20	0.9920	0.9930
FLT21	0.9968	0.9937
FLT22	0.9968	0.9937
FLT23	0.9961	0.9930
FLT24	0.9961	0.9930
FLT25	0.9830	0.9848
FLT26	0.9829	0.9847
FLT27	0.9892	0.9883
FLT28	0.9892	0.9883
FLT29	0.9830	0.9843
FLT30	0.9830	0.9842
FLT31	0.9935	0.9886
FLT32	0.9935	0.9886
FLT33	0.9970	0.9921
FLT34	0.9970	0.9920
FLT35	0.9833	0.9834
FLT36	0.9830	0.9832
FLT37	0.9953	0.9925
FLT38	0.9953	0.9925
FLT39	0.9951	0.9923
FLT40	0.9951	0.9923
FLT41	1.0007	0.9972
FLT42	1.0007	0.9972
FLT43	0.9942	0.9918
FLT44	0.9942	0.9918
FLT45	0.9958	0.9930
FLT46	0.9958	0.9930
FLT47	0.9817	0.9840
FLT48	0.9816	0.9840
FLT49	0.9706	0.9759

Fault No.	Voltage @ GEN-2008-066 POI (Syracuse 115 kV bus) (pu)	
	Summer Peak	Winter Peak
FLT50	0.9704	0.9758
FLT51	0.9969	0.9937
FLT52	0.9969	0.9937
FLT53	0.9966	0.9934
FLT55	0.9964	0.9931
FLT56	0.9963	0.9931
FLT57	0.9965	0.9932
FLT58	0.9965	0.9932
FLT59	0.9965	0.9933

Table 11: Post-Fault Voltage Recovery of GEN-2009-022 by Dynamic Simulation

Fault No.	Voltage @ GEN-2009-022 POI (Mingo – Red Willows 345 kV line) (pu)	
	Summer Peak	Winter Peak
FLT01	0.9920	0.9853
FLT02	0.9920	0.9853
FLT03	1.0096	1.0017
FLT04	1.0097	1.0017
FLT05	1.0125	1.0082
FLT07	1.0089	1.0023
FLT08	1.0088	1.0023
FLT09	1.0131	1.0104
FLT11	1.0107	1.0076
FLT12	1.0106	1.0073
FLT13	1.0093	1.0059
FLT14	1.0094	1.0058
FLT15	0.9992	0.9981
FLT16	0.9992	0.9981
FLT17	1.0091	1.0043
FLT19	1.0075	1.0069
FLT20	1.0075	1.0069
FLT21	1.0104	1.0066

Fault No.	Voltage @ GEN-2009-022 POI (Mingo – Red Willows 345 kV line) (pu)	
	Summer Peak	Winter Peak
FLT22	1.0104	1.0065
FLT23	1.0107	1.0068
FLT24	1.0107	1.0068
FLT25	1.0114	1.0075
FLT26	1.0114	1.0075
FLT27	1.0098	1.0061
FLT28	1.0098	1.0061
FLT29	1.0118	1.0078
FLT30	1.0118	1.0078
FLT31	1.0111	1.0072
FLT32	1.0111	1.0072
FLT33	1.0110	1.0072
FLT34	1.0110	1.0072
FLT35	1.0092	1.0052
FLT36	1.0092	1.0052
FLT37	1.0109	1.0072
FLT38	1.0109	1.0071
FLT39	1.0103	1.0064
FLT40	1.0103	1.0063
FLT41	1.0106	1.0064
FLT42	1.0106	1.0064
FLT43	1.0096	1.0055
FLT44	1.0096	1.0055
FLT45	1.0110	1.0069
FLT46	1.0110	1.0069
FLT47	0.9903	0.9908
FLT48	0.9902	0.9908
FLT49	1.0101	1.0063
FLT50	1.0101	1.0063
FLT51	1.0095	1.0055
FLT52	1.0095	1.0055
FLT53	1.0111	1.0072

Fault No.	Voltage @ GEN-2009-022 POI (Mingo – Red Willows 345 kV line) (pu)	
	Summer Peak	Winter Peak
FLT55	1.0109	1.0070
FLT56	1.0109	1.0069
FLT57	1.0109	1.0070
FLT58	1.0109	1.0070
FLT59	1.0110	1.0070

The two (2) plots below show the lowest post-fault voltage at the POI of GEN-2008-066 following the faults FLT01-3Φ and FLT02-1Φ in summer peak case and the lowest post-fault voltage at the POI of GEN-2009-022 following the faults in FLT01-3Φ and FLT01-1Φ in winter peak case.

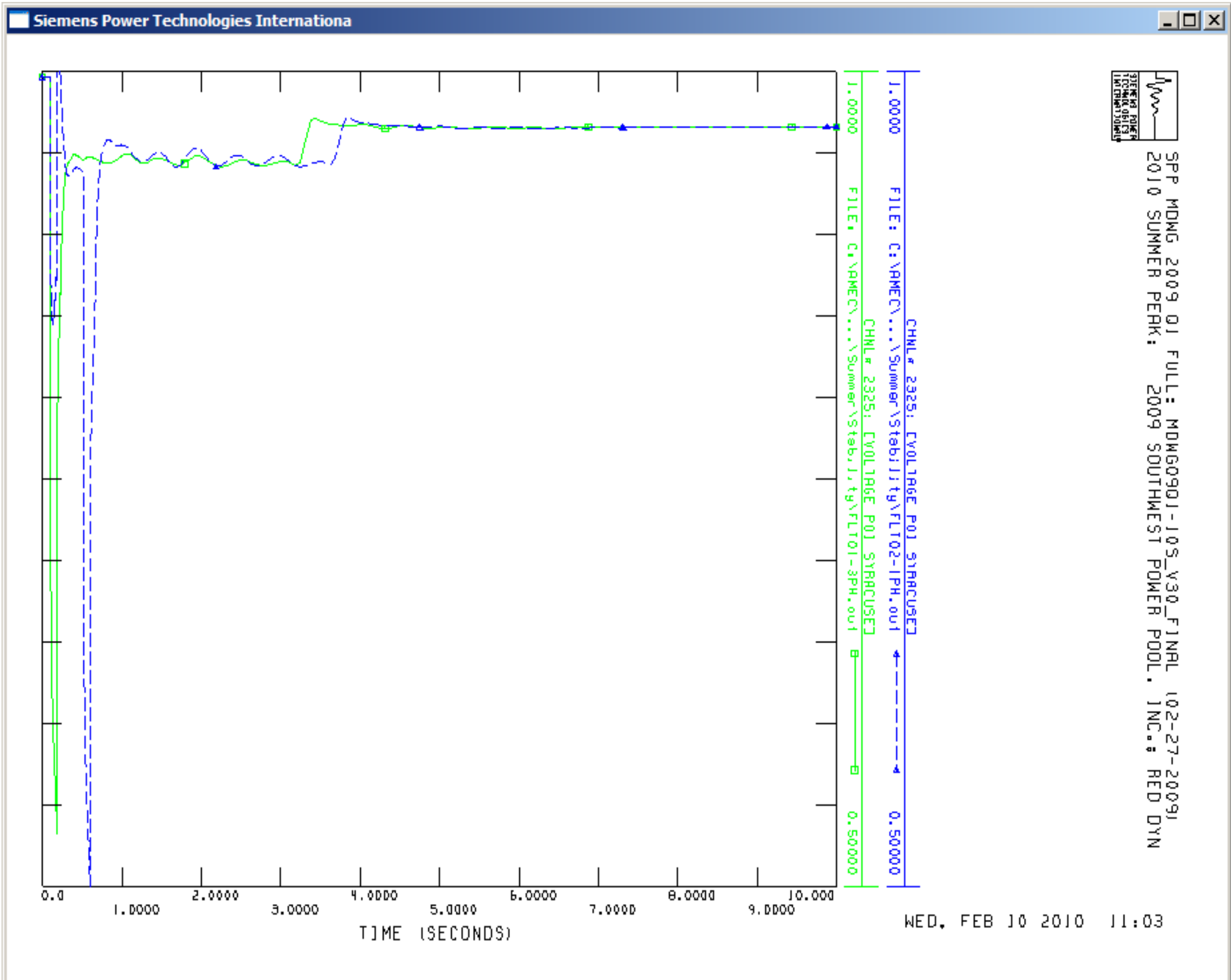


Figure 4: GEN-2008-066 POI Voltage Recovery for FLT01-3Φ & FLT02-1Φ, Summer Peak

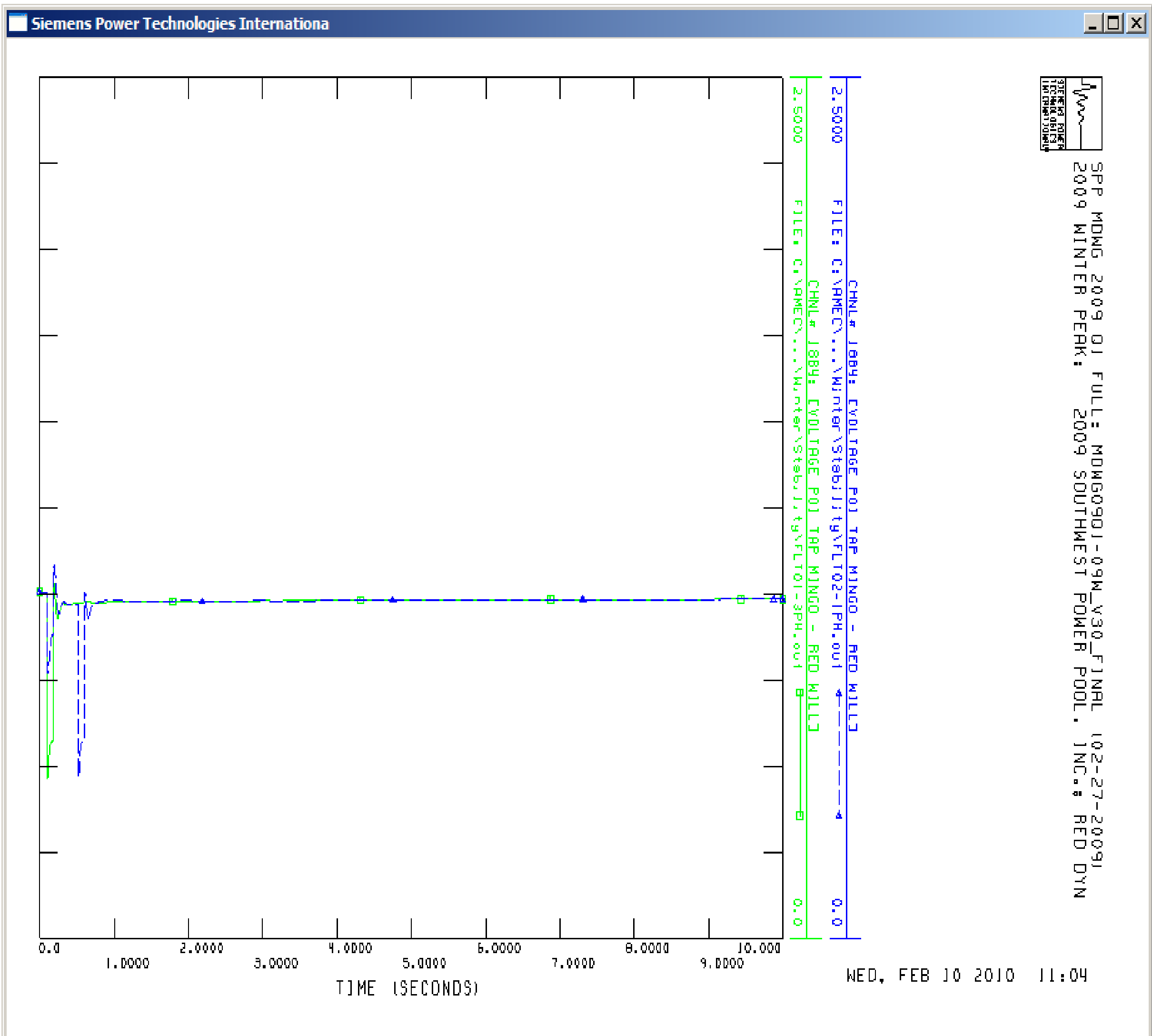


Figure 5: GEN-2009-022 POI Voltage Recovery for FLT01-3Φ & FLT02-1Φ, Winter Peak

6. TRANSIENT STABILITY RESULTS

Based on the dynamics results, GEN-2008-066 and GEN-2009-022 did not cause any new stability problems. For the faults studied, the three-phase faults are relatively severe than the corresponding single-line-to-ground faults. No synchronous generators pulled out of synchronism with the grid and no Group 4 and previously queued generators tripped.

Below are the worst-case faults[3] for the generator to be studied in Group 4, as determined by visual inspection of the rotor speed graphs from PSS/E dynamic analysis.

Table 12: Worst Faults for Dynamic Behavior within Group 4 (Summer Peak)

Generator	Worst Fault	Worst Fault Description
GEN-2008-006	FLT33-3Φ	Syracuse to Tribune 115 kV line, near Syracuse
GEN-2008-066	FLT35-3Φ	Syracuse to Williams 115 kV line, near Syracuse
GEN-2008-006	FLT49-3Φ	Syracuse to Bear Creek 115 kV line, near Syracuse
GEN-2009-022	FLT07-3Φ	Mingo to GEN-2009-022 345 kV line, near GEN-2009-022
GEN-2009-022	FLT45-3Φ	Mingo to Pheasant Run 115 kV line, near Mingo
GEN-2009-022	FLT47-3Φ	Red Willow to GEN-2009-022 345 kV line, near GEN-2009-022

In all summer peak case fault scenarios no synchronous machines were pulled out of synchronism and no wind turbine generators lost stability. No Group 4 wind turbine generators and previously queued generators tripped due to low voltage.

Following are graphs of the rotor speeds for GEN-2008-066 and GEN-2009-022 (GEN-2009-022 1, GEN-2009-022 2, and GEN-2009-022 3) after applying the respective 3Φ faults to the summer peak case.

[3] Here the severity of the faults is measured by the oscillation amplitude of the wind turbine generator speed.

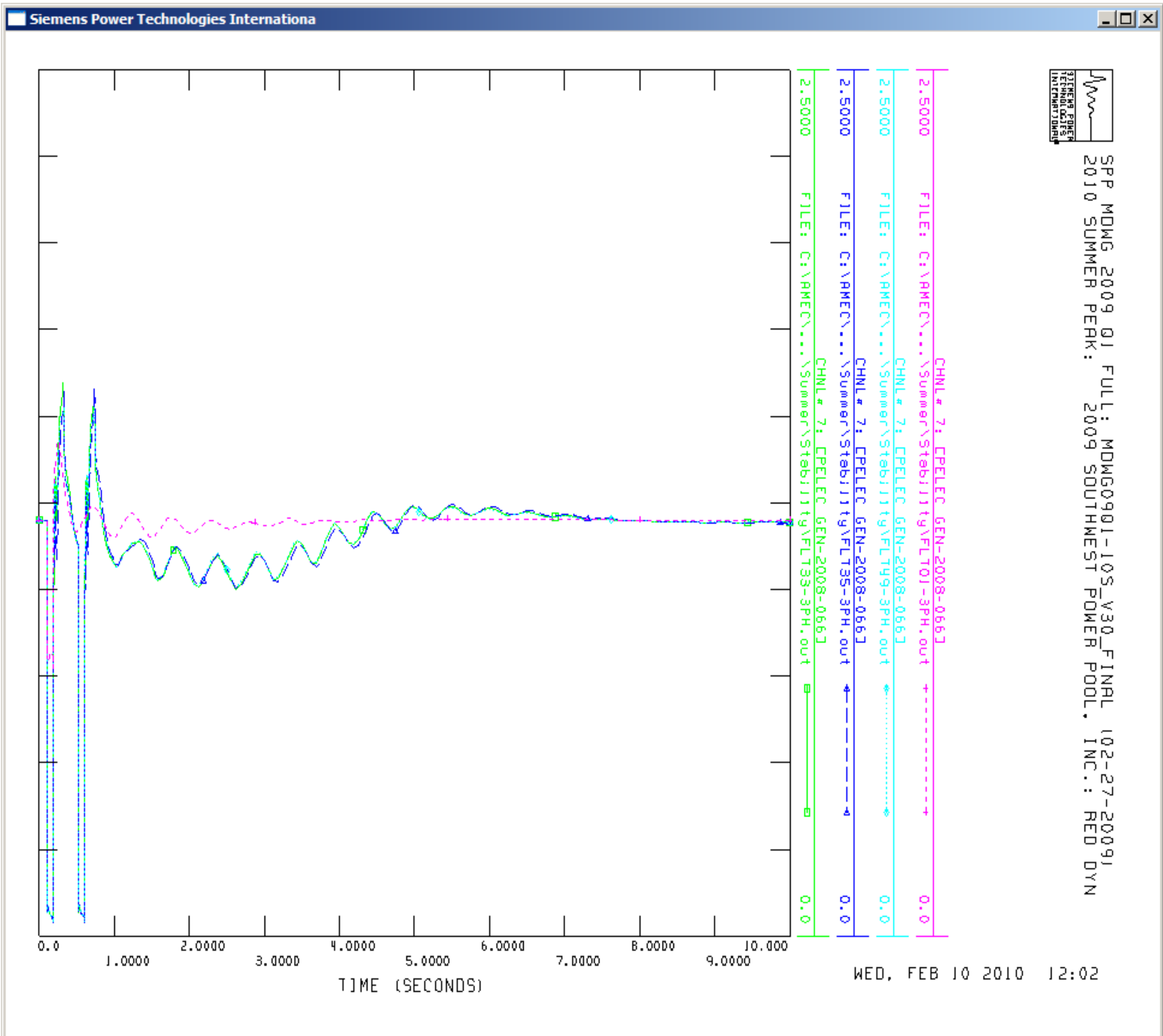


Figure 6: Response of GEN-2008-066 Wind Turbine Generator Speed to FLT01-3Φ, FLT33-3Φ, FLT35-3Φ, FLT49-3Φ in Summer Peak

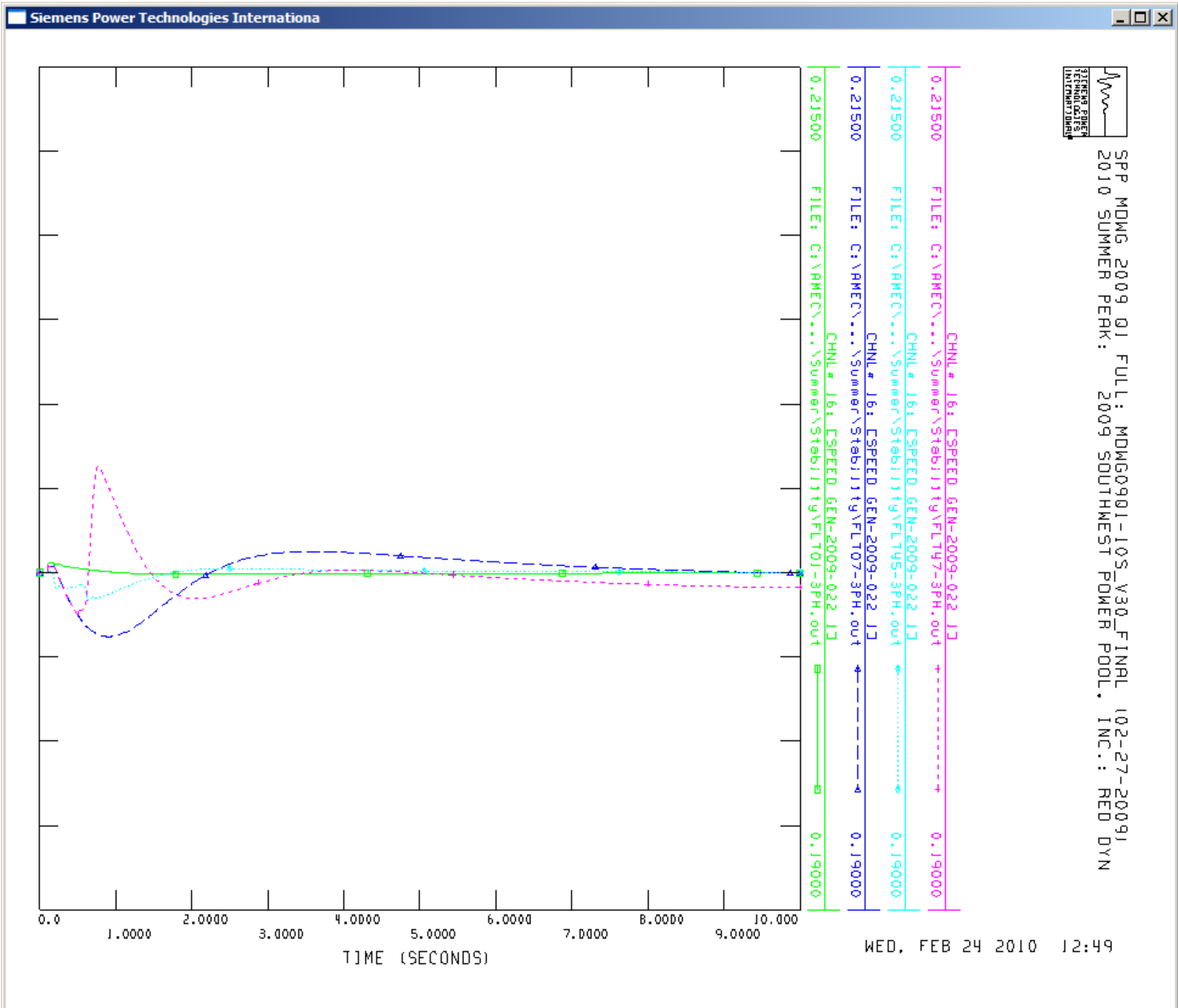


Figure 7: Response of GEN-2009-022 1 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Summer Peak

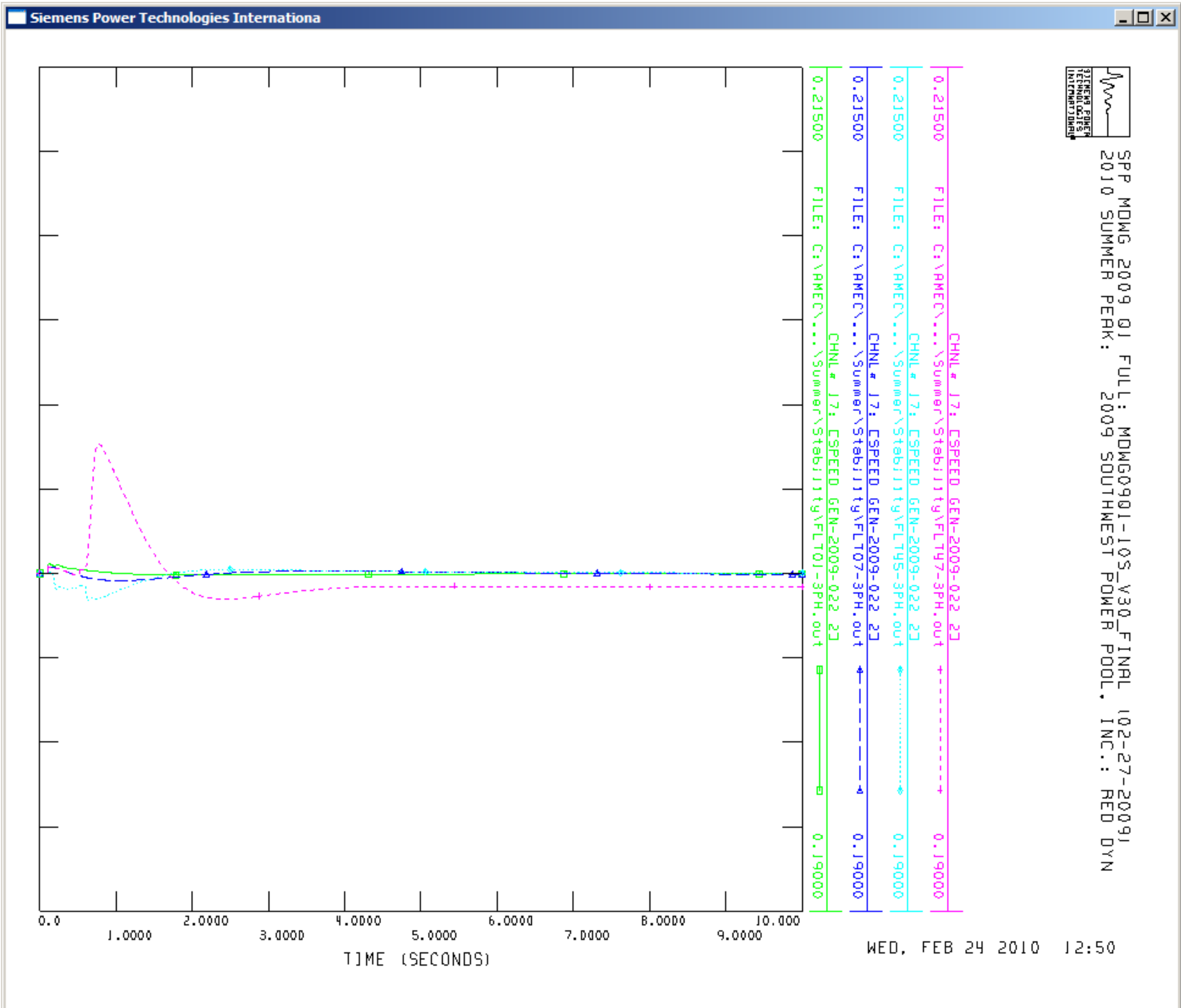


Figure 8: Response of GEN-2009-022 2 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Summer Peak

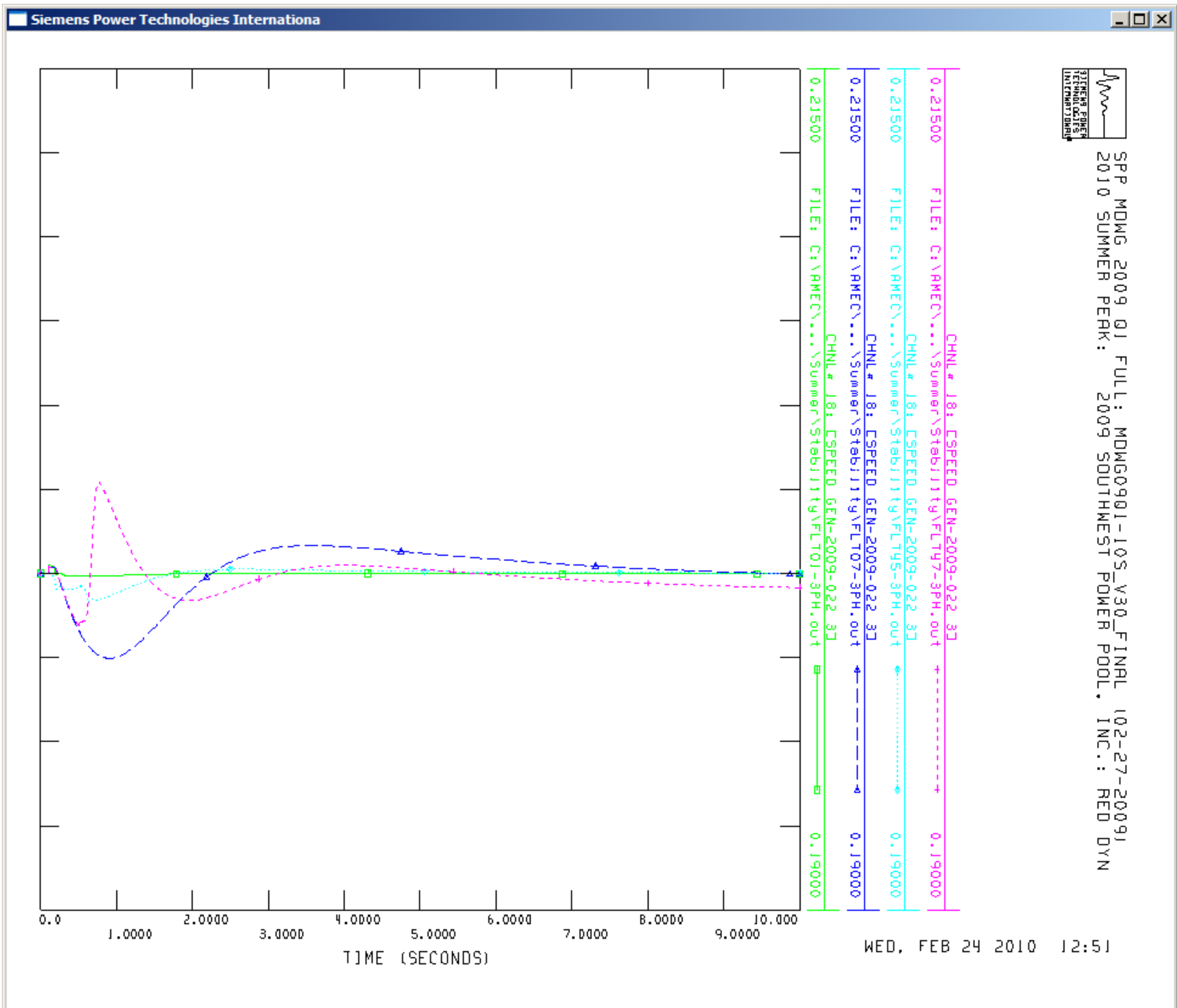


Figure 9: Response of GEN-2009-022 3 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Summer Peak

Similar results were obtained in dynamic analysis of the winter peak case. The worst-case faults for the winter peak case are shown below. The worst-case faults are the same for the winter and summer peak cases for Group 4.

Table 13: Worst Faults for Dynamic Behavior within Group 4 (Winter Peak)

Generator	Worst Fault	Worst Fault Description
GEN-2008-006	FLT33-3Φ	Syracuse to Tribune 115 kV line, near Syracuse
GEN-2008-066	FLT35-3Φ	Syracuse to Williams 115 kV line, near Syracuse

GEN-2008-006	FLT49-3Φ	Syracuse to Bear Creek 115 kV line, near Syracuse
GEN-2009-022	FLT07-3Φ	Mingo to GEN-2009-022 345 kV line, near GEN-2009-022
GEN-2009-022	FLT45-3Φ	Mingo to Pheasant Run 115 kV line, near Mingo
GEN-2009-022	FLT47-3Φ	Red Willow to GEN-2009-022 345 kV line, near GEN-2009-022

In all winter case fault scenarios no synchronous machines were pulled out of synchronism and no wind turbine generators lost stability. No Group 4 and previously queued generators tripped due to low voltage.

Following are graphs of the rotor speeds for GEN-2008-066 and GEN-2009-022 (GEN-2009-022 1, GEN-2009-022 2, and GEN-2009-022 3) after applying the respective 3Φ faults to the winter peak case.

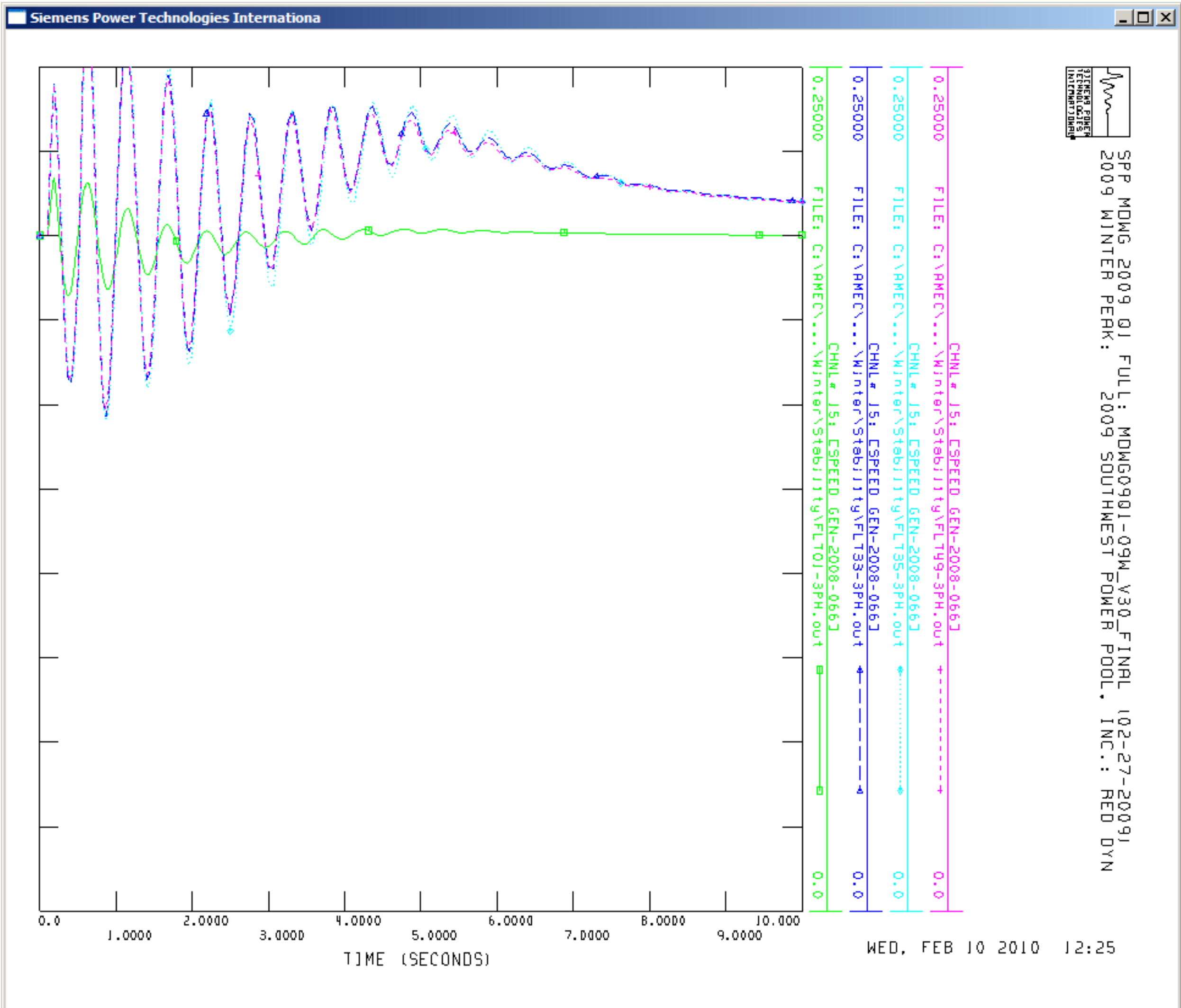


Figure 10: Response of GEN-2008-066 Wind Turbine Generator Speed to FLT01-3Φ, FLT33-3Φ, FLT35-3Φ, FLT49-3Φ in Winter Peak

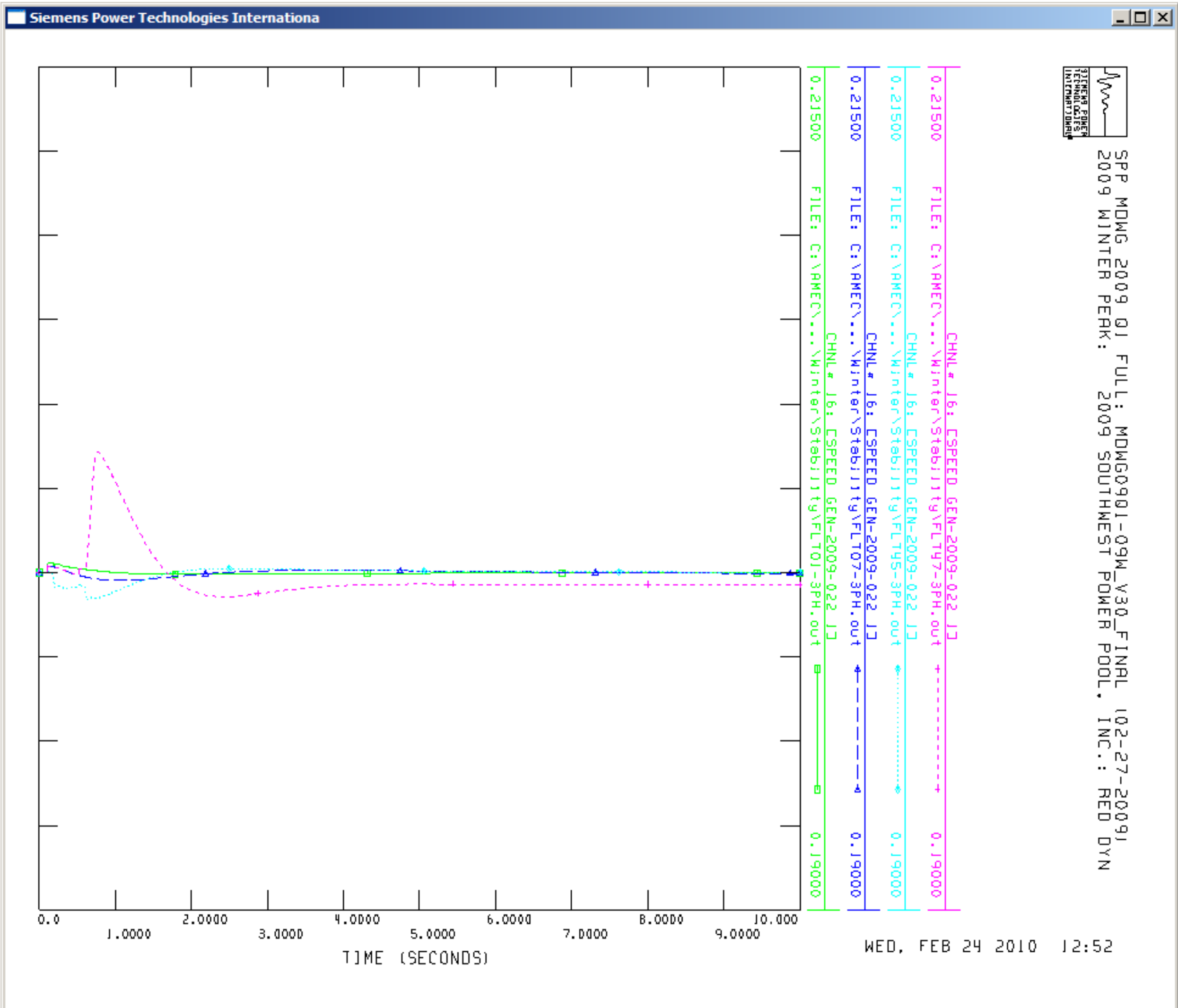


Figure 11: Response of GEN-2009-022 1 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Winter Peak

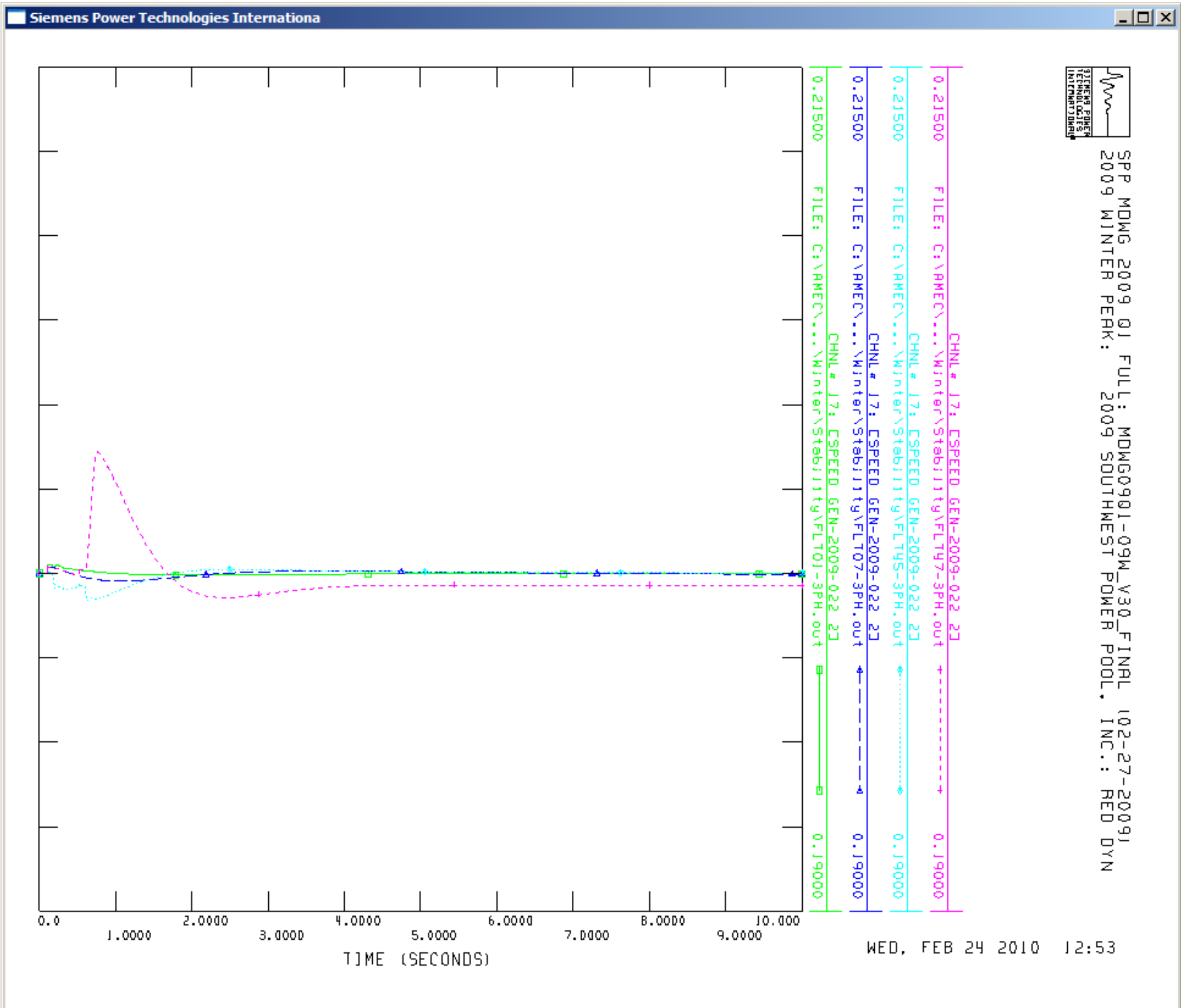


Figure 12: Response of GEN-2009-022 2 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Winter Peak

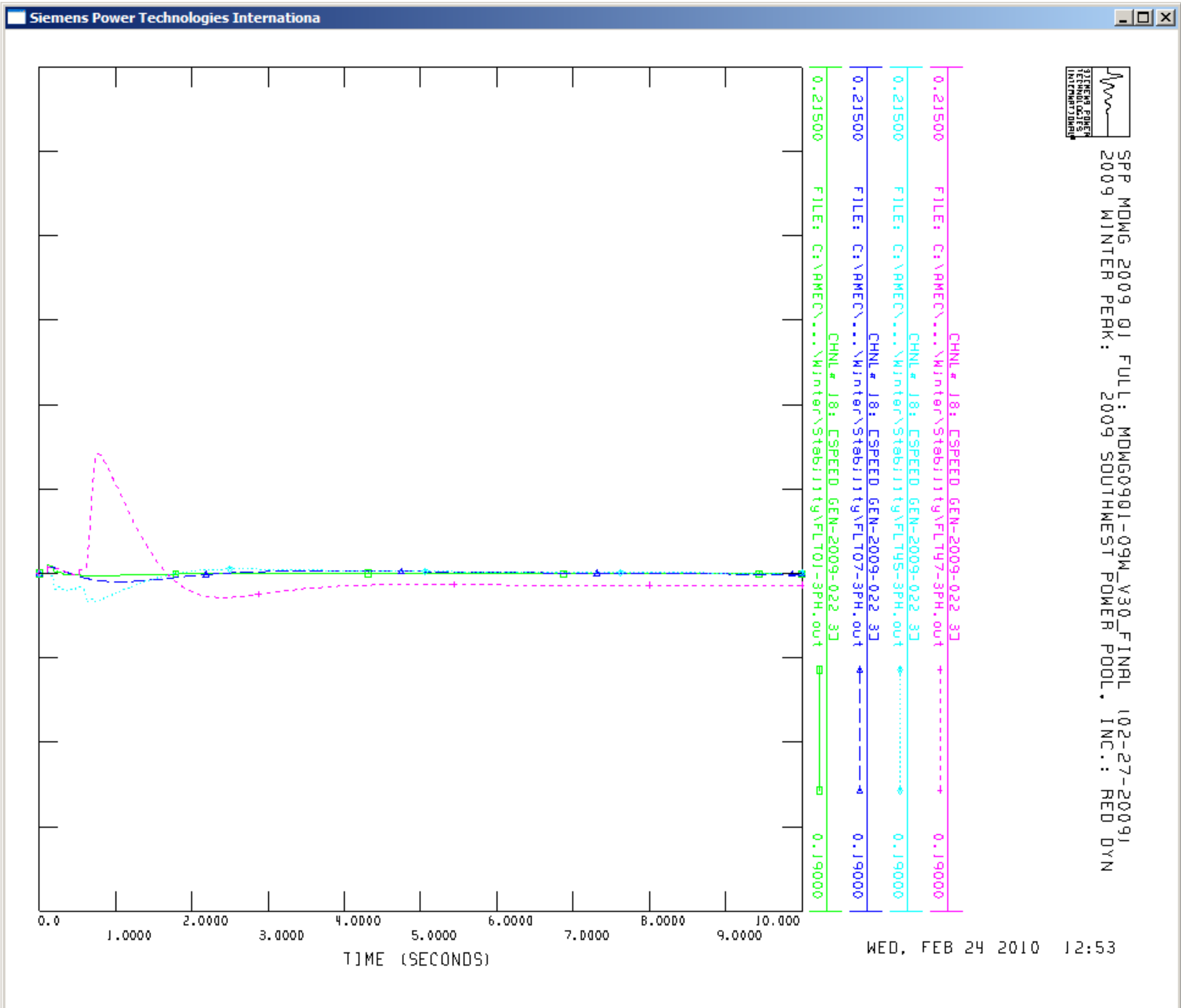


Figure 13: Response of GEN-2009-022 3 Wind Turbine Generator Speed to FLT01-3Φ, FLT07-3Φ, FLT45-3Φ, FLT47-3Φ in Winter Peak

7. CONCLUSIONS

Based on the results of Group 4 studies, the following findings had been observed:

- If minor voltage fluctuation is tolerable (down to approximately 0.98 pu for the GEN-2008-066 POI at Syracuse 115 kV, and 0.99 pu for the GEN-2009-022 POI at Mingo-Red Willow 345 kV), reactive compensation or voltage schedule tuning or transformer ratio tuning is not needed.

- To hold the GEN-2008-066 POI at 1.0 pu (greater than the pre-contingency level) for all contingencies studied requires a power factor of 0.984 lagging-0.985 leading as measured at the POI. This will require approximately 4 MVAR of capacitors at the 34.5 kV side of GEN-2008-066, assuming transformer ratios and voltage schedules allow the wind turbines to generate at Q_{max}.

- To hold the GEN-2009-022 POI at the pre-contingency level for all contingencies studied requires a power factor of 0.979 lagging-0.979 leading as measured at the POI. This is within the reactive capabilities of the turbines, but may require voltage schedule or transformer ratio adjustments.

- All generators in Group 4 appeared capable of meeting LVRT requirements. No Group 4 and previously queued generators tripped off line under the fault conditions.

- All Group 4 wind farms had the capability of recovering to the pre-contingency voltage following the fault disturbance.

- Neither the rotor angles of the synchronous machines in the studied areas suffered from instability nor the wind turbine generators in the studied lost stability under the fault disturbance.

M: Stability Study for Group 5

IMPACT STUDY FOR SPP GENERATION PISIS-2009-001 (Group 5)

SOUTHWEST POWER POOL (SPP) March 1, 2010

By

BLACK & VEATCH

Table of Contents

EXECUTIVE SUMMARY

A transient stability study has been performed for Southwest Power Pool (SPP) Preliminary Impact Study Interconnection Customers Group 5 (PISIS-2009-001 Group 5).

The Group 5 has one Interconnection Request, Gen-2008-088. The Interconnection Queue Position GEN-2008-088 is a wind farm of 62.1 MW capacity. This wind farm is proposed to be interconnected on the Vega 69 kV bus.

The 2010 summer load flow case and 2009 winter load flow case together with the SPP SDDWG 2006 stability model were used as the base case for the transient stability analysis. The study was performed using PTI's PSS/E program, which is an industry-wide accepted power system simulation program.

The power factor analysis indicated that the Gen-2008-088 wind farm will be required to maintain at least 0.976 power factor at the point of interconnection.

The study has not indicated any transient stability issues and the wind farms were found to stay connected during the contingencies that were studied.

If any previously queued projects that were included in this study drop out then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on transmission facilities.

1. Introduction

This report discusses the results of a transient stability study performed for Southwest Power Pool (SPP) Preliminary Impact Study Interconnection Customers Group 5 (PISIS-2009-001 Group 5).

The Group 5 has one Interconnection Request, Gen-2008-088. The Interconnection Queue Position GEN-2008-088 is a wind farm of 62.1 MW capacity. This wind farm is proposed to be interconnected on the Vega 69 kV bus. The system one line diagram of the area near the Queue Position GEN-2008-088 is shown in Figure 1.

The Customer has requested to study Siemens SMK203 2.3 MW wind turbine generators. Transient Stability studies were conducted with the full output of 62.1 MW (100%) for Gen-2008-088.

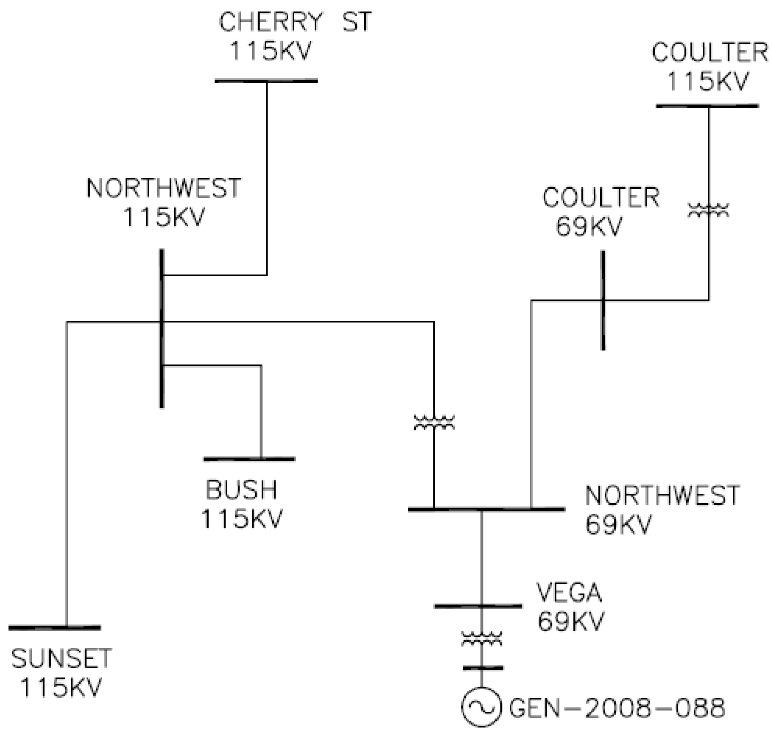


Figure 1: System One Line Diagram near GEN-2008-088

2. Stability Study Criteria

The 2010 summer load flow and 2009 winter load flow cases together with the SPP SDDWG 2006 stability model were used as the base case for the transient stability analysis. These models were provided by SPP.

Using Planning Standards approved by NERC, the following stability definition was applied in the Transient Stability Analysis:

"Power system stability is defined as that condition in which the difference of the angular positions of synchronous machine rotor becomes constant following an aperiodic system disturbance."

Disturbances such as three phase and single phase line faults were simulated for a specified duration and the synchronous machine rotor angles were monitored for their synchronism following the fault removal.

The ability of the wind generators to stay connected to the grid during the disturbances and during the fault recovery was also monitored.

3. Simulation Cases

Transient Stability studies were conducted for (i) 2010 summer and (ii) 2009 winter load flow cases.

Table 1 indicates the contingencies that were studied for each of the two cases.

Table 1: Study Cases

Cont. No.	**Cont. Name**	**Description**
1	FLT01-3PH	3 phase fault on the Potter Co. (523961) to GEN-2005-017 (51700) 345kV line, near Potter Co. a. Apply fault at the Potter Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the GEN-2003-013 (560029) to Hitchland (523097) 345kV line, near GEN-2005-017. a. Apply fault at the GEN-2003-013 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on the Potter Co. 345kV (523961) to 230kV (523959) transformer, near the 345kV kV bus. a. Apply fault at the Potter Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Cont. No.	Cont. Name	Description
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Lawton Eastside (511468) to Sunnyside (515136) 345kV line, near Lawton Eastside. a. Apply fault at the Lawton Eastside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Grapevine (523771) to Wheeler (523777) 230kV line, near Grapevine. a. Apply fault at the Grapevine 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT11-3PH	3 phase fault on the Tolk (525524) to Tuco (525830) 230kV line, near Tolk. a. Apply fault at the Tolk 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on the Tuco 230kV (525830) to 345kV (525832) transformer, near the 230kV bus. a. Apply fault at the Tuco 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
14	FLT14-1PH	*Single phase fault and sequence like previous*
15	FLT15-3PH	3 phase fault on the GEN-2005-015 (560813) to Oklaunion (511456) 345kV line, near GEN-2005-015. a. Apply fault at the GEN-2005-015 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
17	FLT17-3PH	3 phase fault on the Oklaunion (511456) to Lawton Eastside (511468) 345kV line, near Oklaunion. a. Apply fault at the Oklaunion 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Grapevine (523771) to Nichols (524044) 230kV line, near Grapevine. a. Apply fault at the Grapevine 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the Conway (524079) to Yarnell (524072) 115kV line, near Conway. a. Apply fault at the Conway 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	*Single phase fault and sequence like previous*
23	FLT23-3PH	3 phase fault on the Conway (524079) to Kirby (524088) 115kV line, near Conway. a. Apply fault at the Conway 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	*Single phase fault and sequence like previous*
25	FLT25-3PH	3 phase fault on the Wheeler 230kV (523777) to 345kV (525835) transformer, near the 230kV bus. a. Apply fault at the Wheeler 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
26	FLT26-1PH	*Single phase fault and sequence like previous*
27	FLT27-3PH	3 phase fault on the Wheeler/Midpoint (525835) to Anadarko (521210) 345kV line, near Wheeler/Midpoint. a. Apply fault at the Wheeler/Midpoint 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
28	FLT28-1PH	*Single phase fault and sequence like previous*
29	FLT29-3PH	3 phase fault on the Conway 115kV (524079) to 345kV (560000) transformer, near the 115kV bus. a. Apply fault at the Conway 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
30	FLT30-1PH	*Single phase fault and sequence like previous*
31	FLT31-3PH	3 phase fault on the Conway (560000) to Wheeler/Midpoint (525835) 345kV line, near Conway. a. Apply fault at the Conway 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	*Single phase fault and sequence like previous*
33	FLT33-3PH	3 phase fault on the Grapevine 230kV (523771) to 115kV (523770) transformer, near the 230kV bus. a. Apply fault at the Grapevine 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
34	FLT34-1PH	*Single phase fault and sequence like previous*
35	FLT35-3PH	3 phase fault on the Tuco (525832) to Wheeler/Midpoint (525835) 345kV line, near Tuco. a. Apply fault at the Tuco 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	*Single phase fault and sequence like previous*
37	FLT37-3PH	3 phase fault on the Wheeler/Midpoint (525835) to Woodward (515375) 345kV line, near Wheeler/Midpoint. a. Apply fault at the Wheeler/Midpoint 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	*Single phase fault and sequence like previous*
39	FLT39-3PH	3 phase fault on the Kirby (524088) to McClellan (523804) 115kV line, near Kirby. a. Apply fault at the Kirby 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
40	FLT40-1PH	*Single phase fault and sequence like previous*
41	FLT41-3PH	3 phase fault on the Potter (523959) to Moore County (523309) 230kV line, near Potter. a. Apply fault at the Potter 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-1PH	*Single phase fault and sequence like previous*
43	FLT43-3PH	3 phase fault on the Potter (523959) to Harrington West (523977) 230kV line, near Potter. a. Apply fault at the Potter 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-1PH	*Single phase fault and sequence like previous*
45	FLT45-3PH	3 phase fault on the Potter (523959) to Bushland (524267) 230kV line, near Potter. a. Apply fault at the Potter 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT46-1PH	*Single phase fault and sequence like previous*
47	FLT47-3PH	3 phase fault on the Potter (523959) to GEN-2006-039 (560009) 230kV line, near Potter. a. Apply fault at the Potter 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT48-1PH	*Single phase fault and sequence like previous*
49	FLT49-3PH	3 phase fault on the Kirby (524088) to McClellan (523804) 115kV line, near Kirby. a. Apply fault at the Kirby 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT50-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
51	FLT51-3PH	3 phase fault on the Northwest Tap (524096) to Northwest (524105) 69kV line, near Northwest. a. Apply fault at the Northwest 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-1PH	*Single phase fault and sequence like previous*
53	FLT53-3PH	3 phase fault on the Northwest Tap (524096) to Soncy (524200) 69kV line, near Northwest. a. Apply fault at the Northwest 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT54-1PH	*Single phase fault and sequence like previous*
55	FLT55-3PH	3 phase fault on the Northwest 115/69kV autotransformer on the 69kV bus (#524105) a. Apply fault at the Northwest 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-1PH	*Single phase fault and sequence like previous*
57	FLT57-3PH	3 phase fault on the Coulter 115/69kV autotransformer on the 69kV bus (#524305) a. Apply fault at the Northwest 69kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-1PH	*Single phase fault and sequence like previous*

4. System Modeling

The power flow and the dynamic data provided by SPP had already contained the models of Gen-2008-088 and the prior queued projects. Table 2 lists the prior queued projects that were in the study cases.

Table 2: Prior Queued Projects

Request	Size	Wind Turbine Model	Point of Interconnection
GEN-2002-022	240	Siemens 2.3MW	Bushland 230kV (524267)
GEN-2004-003	240	GE 1.5MW	Conway 115kV (524079)
GEN-2005-021	85.5	GE 1.5MW	Kirby 115kV (524088)
GEN-2006-039	400	Clipper 2.5MW	Buffalo Lk 230kV (560009)
GEN-2006-045	240	Suzlon 2.1MW	Buffalo Lk 230kV (560009)
GEN-2006-047	240	Suzlon 2.1 MW	Buffalo Lk 230kV (560009)
GEN-2007-002	160	Steam Turbine	Grapevine 115kV (523770)
GEN-2007-008	300	Suzlon 2.1 MW	Grapevine 230kV (523771)
GEN-2007-045	171	G.E. 1.5MW	Conway 115kV (524079)
GEN-2007-048	400	Furhlander	Amarillo South – Swisher 230kV line (525228)
GEN-2008-051	322	Siemens 2.3MW	Potter 345kV (523961)

5. Power Factor Analysis

A power factor analysis was performed by modeling a VAR generator at high voltage bus of Gen-2008-088. The VAR generator was set to hold a voltage schedule of 1.0 per unit at the POI, i.e., Vega 69 kV and all the contingencies listed in Table 1 were run. Table 3 shows the calculated power factors that need to be maintained at the POI. The lowest power factor that would be required is 0.974 under FLT53-3PH contingency.

Table 3: Required Power Factor

	Required power factor at POI	
Fault Case	**Summer Case**	**Winter Case**
FLT01-3PH	0.982	0.984
FLT03-3PH	0.981	0.983
FLT05-3PH	0.981	0.983
FLT07-3PH	0.981	0.983
FLT09-3PH	0.982	0.984
FLT11-3PH	0.982	0.983
FLT13-3PH	0.981	0.983
FLT15-3PH	0.981	0.983
FLT17-3PH	0.981	0.983
FLT19-3PH	0.981	0.983
FLT21-3PH	0.981	0.983
FLT23-3PH	0.981	0.983
FLT25-3PH	0.981	0.983
FLT27-3PH	0.982	0.984

	Required power factor at POI	
Fault Case	Summer Case	Winter Case
FLT29-3PH	0.982	0.986
FLT31-3PH	0.982	0.984
FLT33-3PH	0.981	0.983
FLT35-3PH	0.981	0.983
FLT37-3PH	0.981	0.983
FLT39-3PH	0.981	0.983
FLT41-3PH	0.981	0.983
FLT43-3PH	0.982	0.984
FLT45-3PH	0.981	0.984
FLT47-3PH	0.982	0.983
FLT49-3PH	0.994	0.991
FLT51-3PH	0.968	0.987
FLT53-3PH	0.974	0.989
FLT55-3PH	0.979	0.983
FLT57-3PH	0.981	0.983

6. Simulation Results

Initial simulation was carried out without any disturbance to verify the numerical stability of the model and was confirmed to be stable. Table 4 provides the summary of the study results for the contingencies that were studied.

Table 4: Stability Study Results Summary

Fault Case	Summer Case	Winter Case
FLT01-3PH	- -	- -
FLT02-1PH	- -	- -
FLT03-3PH	- -	- -
FLT04-1PH	- -	- -
FLT05-3PH	- -	- -
FLT06-1PH	- -	- -
FLT07-3PH	- -	- -
FLT08-1PH	- -	- -
FLT09-3PH	- -	- -
FLT10-1PH	- -	- -
FLT11-3PH	- -	- -
FLT12-1PH	- -	- -
FLT13-3PH	- -	- -

FLT14-1PH	- -	- -
FLT15-3PH	- -	- -
FLT16-1PH	- -	- -
FLT17-3PH	- -	- -
FLT18-1PH	- -	- -
FLT19-3PH	- -	- -
FLT20-1PH	- -	- -
FLT21-3PH	- -	- -
FLT22-1PH	- -	- -
FLT23-3PH	- -	- -
FLT24-1PH	- -	- -
FLT25-3PH	- -	- -
FLT26-1PH	- -	- -
FLT27-3PH	- -	- -
FLT28-1PH	- -	- -
FLT29-3PH	- -	- -
FLT30-1PH	- -	- -
FLT31-3PH	- -	- -
FLT32-1PH	- -	- -
FLT33-3PH	- -	- -
FLT34-1PH	- -	- -
FLT35-3PH	- -	- -
FLT36-1PH	- -	- -
FLT37-3PH	- -	- -
FLT38-1PH	- -	- -
FLT39-3PH	- -	- -
FLT40-1PH	- -	- -
FLT41-3PH	- -	- -
FLT42-1PH	- -	- -
FLT43-3PH	- -	- -
FLT44-1PH	- -	- -
FLT45-3PH	- -	- -
FLT46-1PH	- -	- -
FLT47-3PH	- -	- -
FLT48-1PH	- -	- -
FLT49-3PH	- -	- -
FLT50-1PH	- -	- -
FLT51-3PH	- -	- -
FLT52-1PH	- -	- -
FLT53-3PH	- -	- -
FLT54-1PH	- -	- -

FLT55-3PH	- -	- -
FLT56-1PH	- -	- -

T : Gen-2008-088 tripped due to angle deviation
UV : Gen-2008-088 tripped due to under voltage
PT : Post-Transient voltage issues encountered
S : Stability issues encountered

PQ : Prior queued project tripped
- - : Wind Farm did not trip

Figure 2 shows the system response for FLT01-3PH case.

7. Summary

A transient stability analysis was conducted for Southwest Power Pool (SPP) Preliminary Impact Study Interconnection Customers Group 5 (PISIS-2009-001 Group 5). The study was conducted for two different power flow scenarios, i.e., one for summer peak and one for winter peak.

The power factor analysis indicated that the Gen-2008-088 wind farm will be required to maintain at least 0.976 power factor at the point of interconnection.

The study has not indicated any stability issues and the wind farms were found to be stayed connected to the grid during the contingencies studied.

Disclaimer

If any previously queued projects that were included in this study drop out, then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on transmission facilities. Since this is also a preliminary System Impact Study, not all previously queued projects were assumed to be in service in this System Impact Study. If any of those projects are constructed, then this System Impact Study may have to be revised to determine the impacts of this Interconnection Customer's project on transmission facilities. In accordance with FERC and SPP procedures, the study cost for restudy shall be borne by the Interconnection Customer.

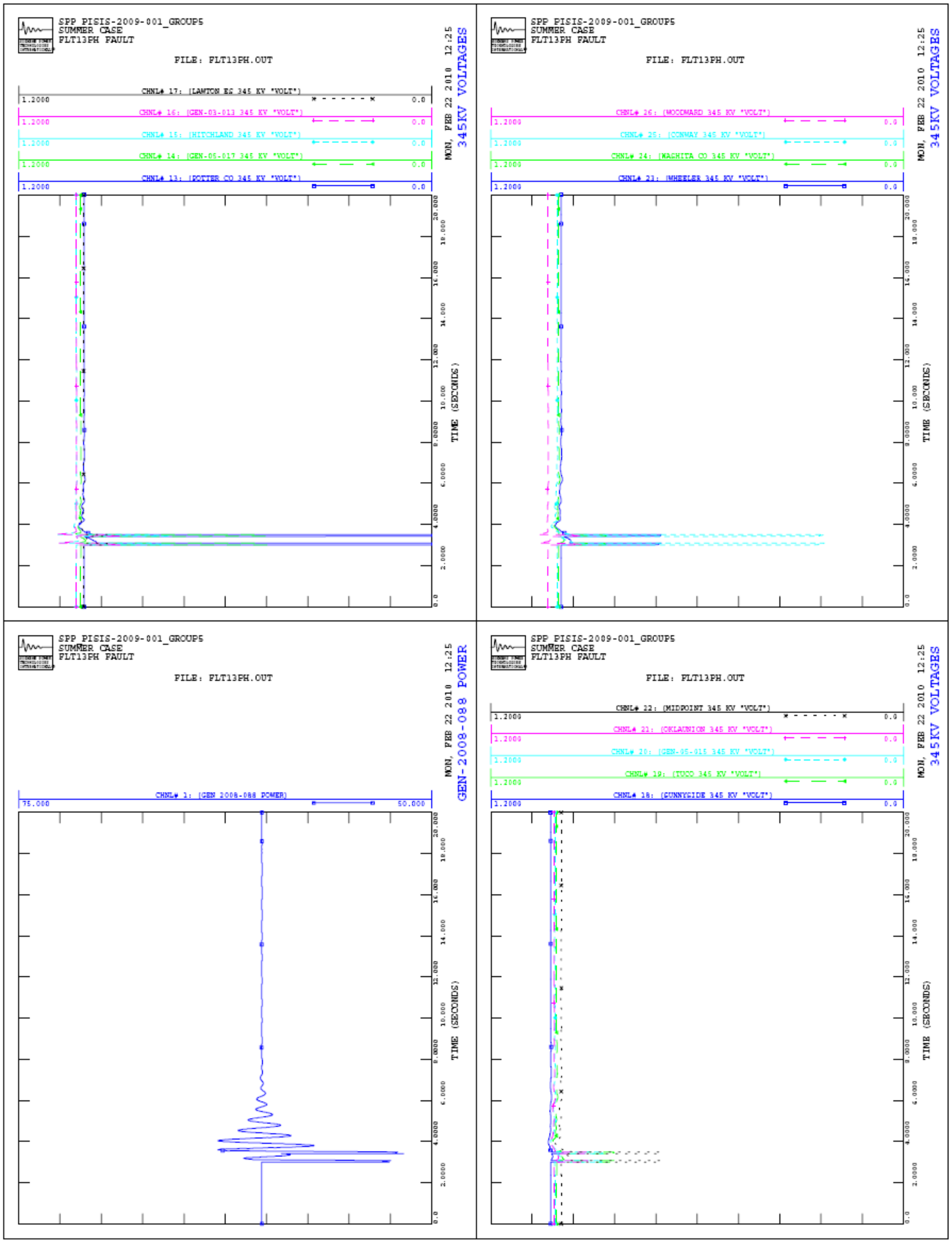


Figure 2: System Responses for FLT01-3PH

Figure 2: System Responses for FLT01-3PH (cont'd)

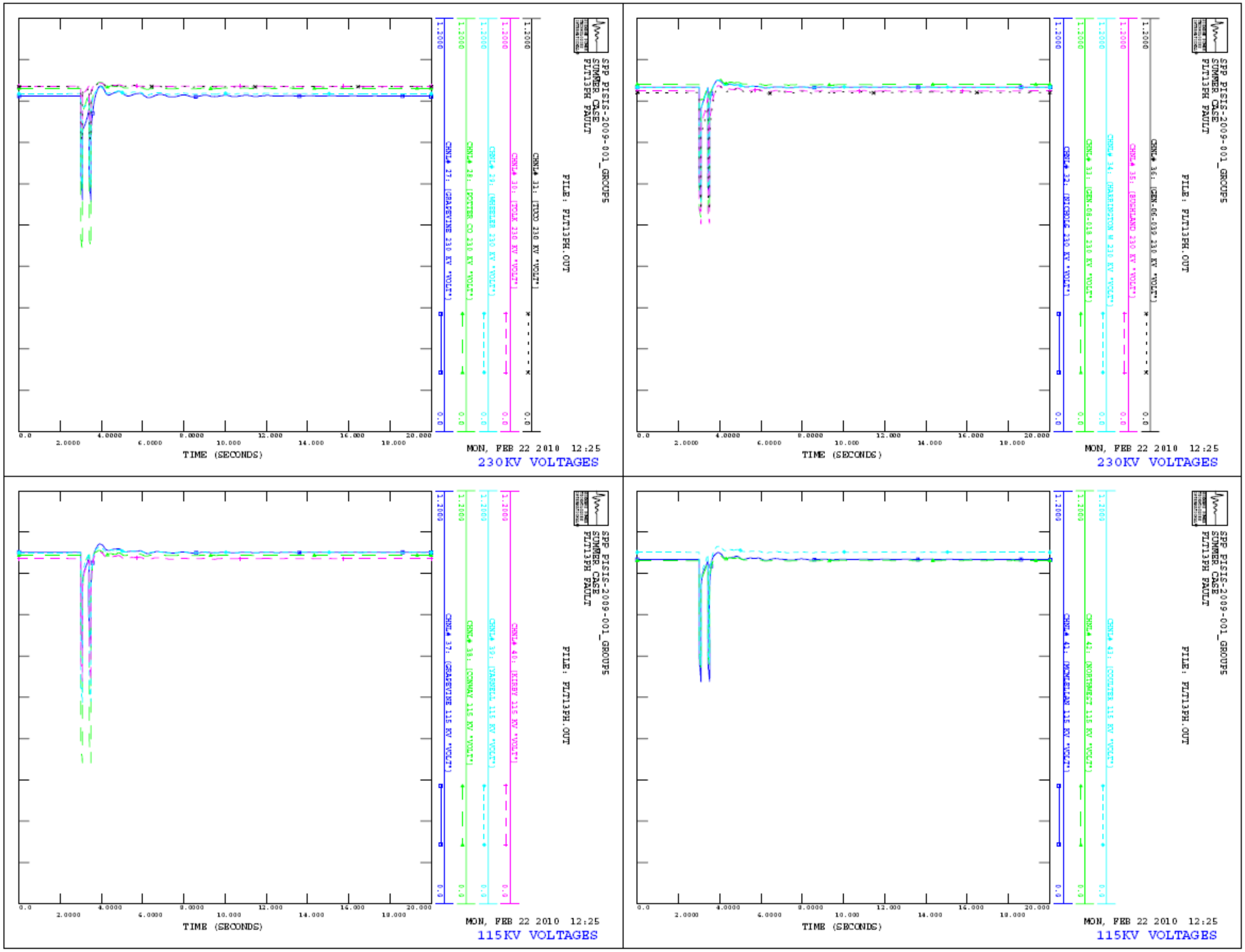
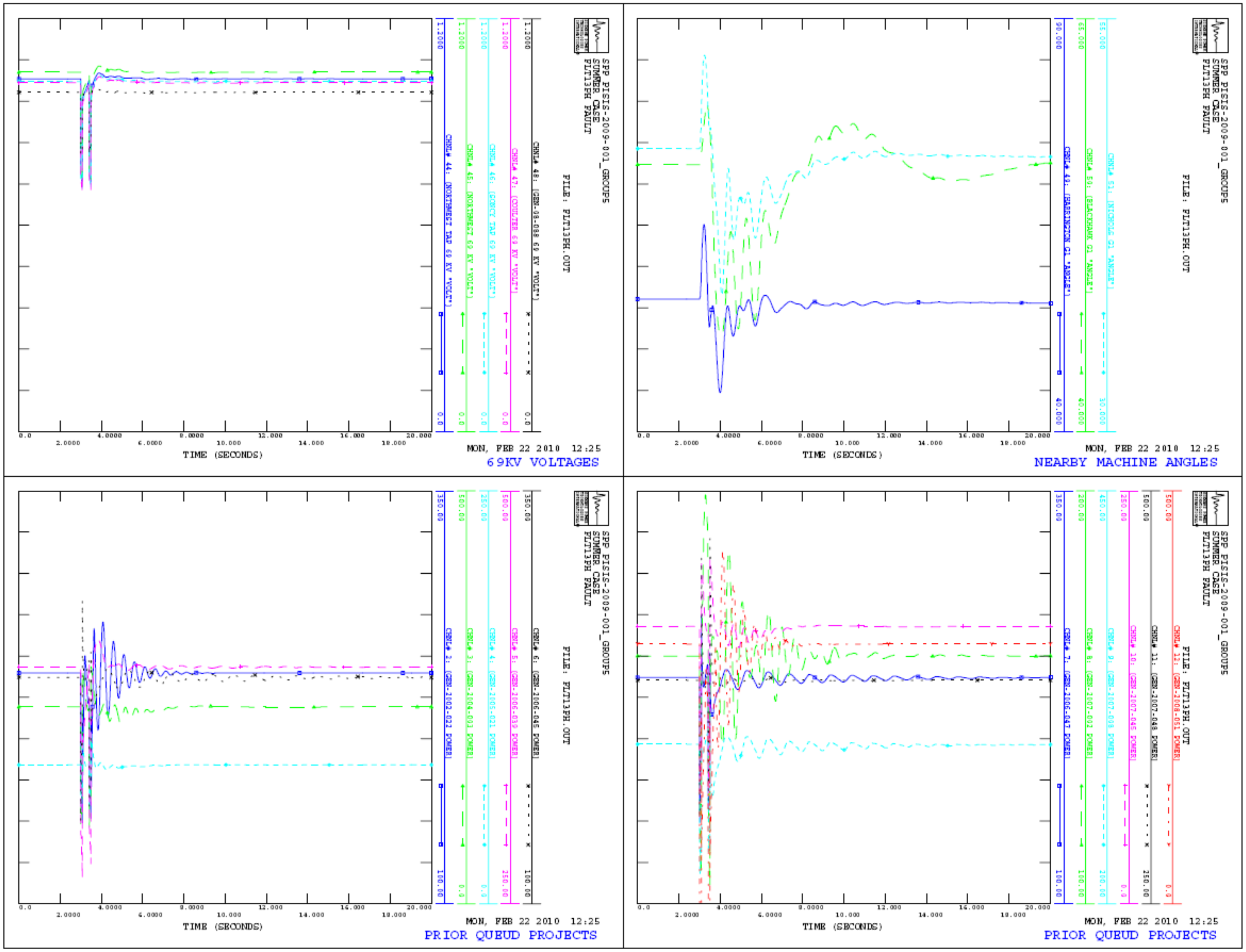


Figure 2: System Responses for FLT01-3PH (cont'd)



N: Stability Study for Group 6

O: Stability Study for Group 7

P: Stability Study for Group 8

R25-10

Generator Interconnection Impact Study for PISIS-2009-001 - Group 8

Prepared for

Southwest Power Pool, Inc.

Submitted by:
Kavita Shenoi, Consultant
Bernardo Fernandes, Staff Consultant

Draft Report: March 05, 2010

Siemens PTI Project Number: P/23-115077

Siemens Energy, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of Southwest Power Pool, Inc. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor Southwest Power Pool, Inc., nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and Southwest Power Pool, Inc. from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Section
1

Introduction

1.1 Background

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Siemens PTI performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customers and SPP. The requests for interconnection were placed in accordance to SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

The purpose of this report is to present the results of the stability and power factor analysis performed to evaluate the impact of the proposed PISIS-2009-001 cluster of interconnections with regards to Group 8 projects on the Southwest Power Pool system. Eventual indicative solutions to the identified issues are proposed based on the impact of each generation interconnection on the Southwest Power Pool system.

The three projects in this cluster are connected to three different points of interconnection at different voltage levels, ranging from 138 kV to 345 kV. Section 2 describes all proposed wind projects in detail.

Transient stability analysis was performed using the package provided by SPP. It contains the latest stability database in PSS®E version 30.3.3. The stability package also includes the dynamic data for the previously queued projects.

1.2 Purpose

The steady state and stability study was carried out to:

(a) Determine the ability of the proposed generation facilities to remain in synchronism and within applicable planning standards following system faults with a) unsuccessful reclosing b) normally cleared faults.

(b) Determine the amount of transient support required from the costumer to meet the power factor requirement at the POI.

(c) Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

This page intentionally left blank.

Section

2

Model Development

The study has considered the 2010 Summer Peak and 2009 Winter Peak load flow models provided by SPP with the required interconnection generations modeled. The base cases also contain all the significant previously queued generation projects in the interconnection queue.

2.1 Power Flow Data

The Group 8 of PISIS-2009-001 contains three proposed wind generation projects. Table 2-1 presents the size of the projects, the Wind Turbine Generator (WTGs) manufacturers, the reactive capability of the wind farm as well as the points of interconnection and the PSS®E bus numbers in the power flow cases.

Table 2-1 – Details of the Interconnection Requests

Request	Size (MW)	Model	Reactive capability of wind farm		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
GEN-2008-071	151.2	Vestas V90 1.8MW	0 (*)	0 (*)	Newkirk (514759) 138kV	514759
GEN-2008-098	100.8	Vestas V90 1.8MW	0 (*)	0 (*)	Tap Wolf Creek–LaCygne 345kV line	572090
GEN-2009-005	200.1	Siemens SMK203 2.3MW	118.72	-118.72	Tap Emporia – Swissvale 345kV line	572070

(*) – For voltage control within 0.95 p.u. – 1.050 p.u.

The analysis was carried out using the database package provided by SPP which also includes the modeling data for the following previously queued projects, shown in Table 2-2:

Table 2-2 – Details of the Prior Queued Interconnection Requests

Request	Size	Wind Turbine Model	Point of Interconnection	Bus Number
GEN-2002-004	200	GE.1.5MW	Latham 345kV	532800
GEN-2004-010	300	Clipper 2.5MW	Latham 345kV	532800
GEN-2005-013	201	G.E. 1.5MW	Latham – Neosho 345kV	574000
GEN-2005-016	150	Gamesa 2MW	Latham – Neosho 345kV	574000
GEN-2007-025	300	Clipper 2.5MW	Wichita-Woodring 345kV	532781
GEN-2008-013	300	G.E. 1.5MW	Wichita – Woodring 345kV	210130
GEN-2008-021	1250	Nuclear Steam Turbine	Wolf Creek 345kV	532797
GEN-2008-038	150	G.E. 1.5MW	Tap Shidler – Pawhuska 138kV	570838

Request	Size	Wind Turbine Model	Point of Interconnection	Bus Number
GEN-2008-127	200	Siemens 2.3MW	Tap Sooner – Rose Hill 345kV	573039
GEN-2009-025	60	GE 1.5MW	Tap Deerck – Sincblk2 69KV	573049

Figures 2-1 to 2-4 present the points of interconnection for Group 8 and surrounding buses, showing line flows and voltage profile for the load flow models considered in the study for summer and winter peak scenarios respectively.

Figure 2-1 - Group 8 Points of Interconnection Surrounding Area – *Diagram1* Summer Peak

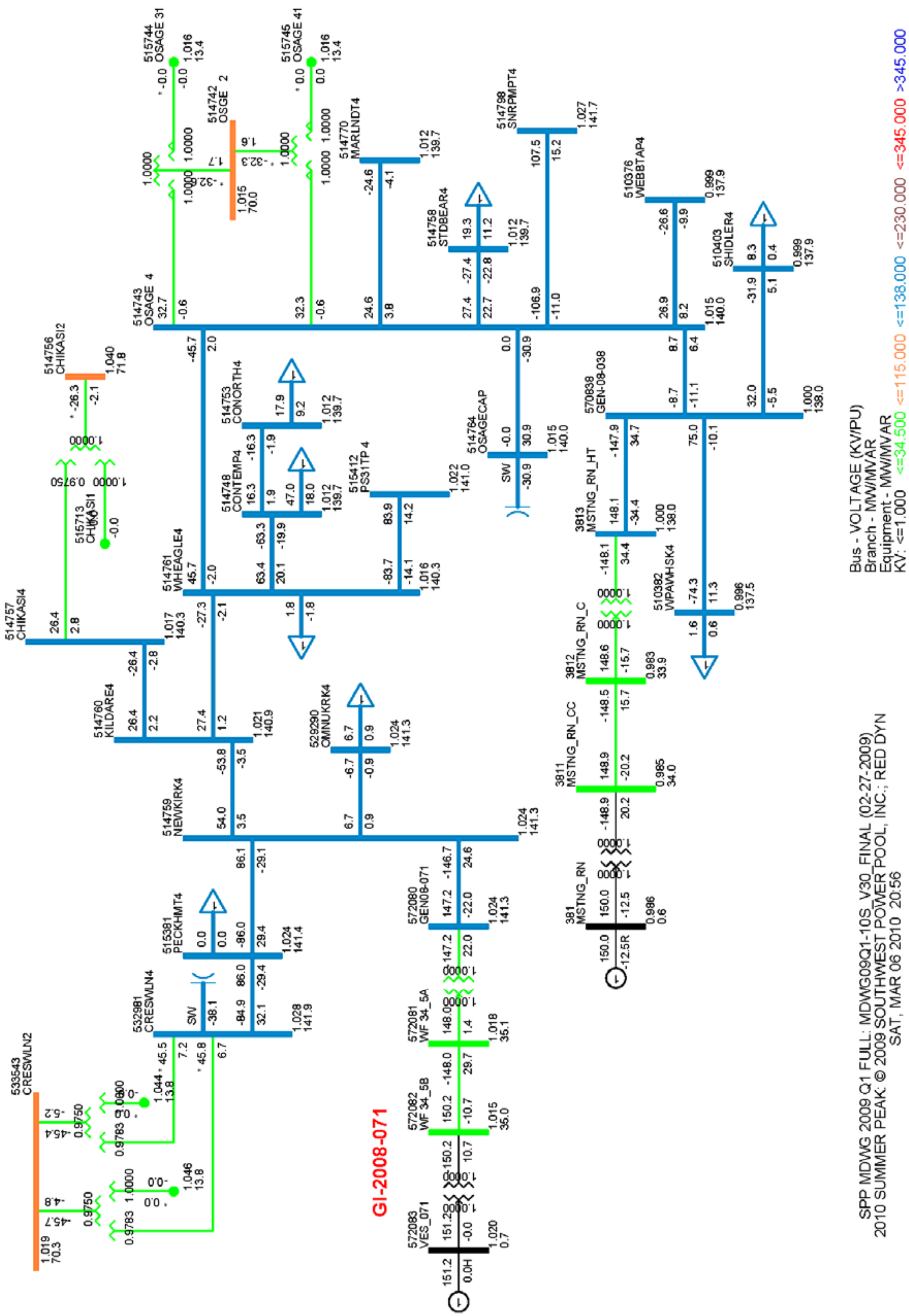


Figure 2-2 - Group 8 Points of Interconnection Surrounding Area – *Diagram2*
Summer Peak

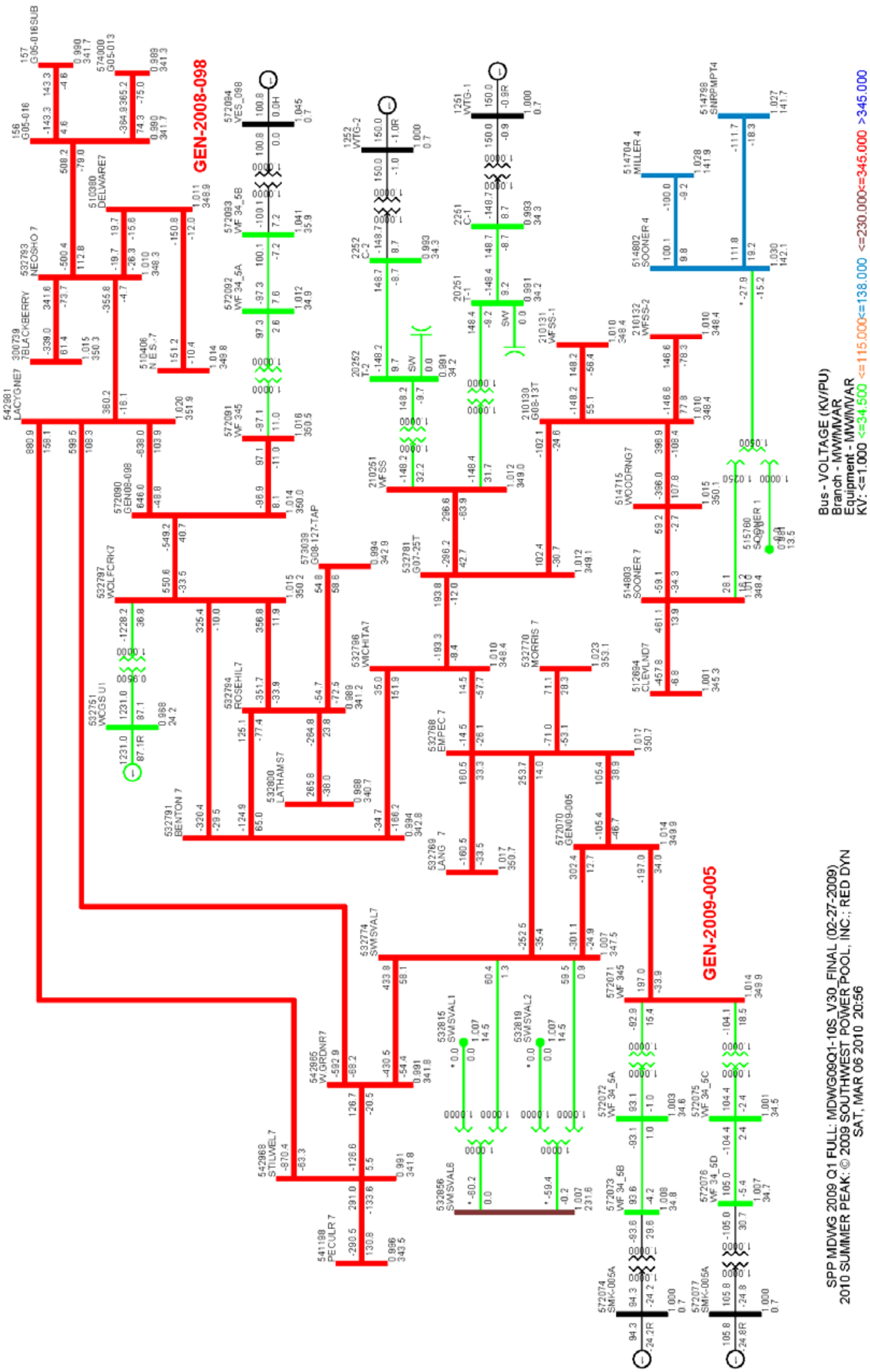


Figure 2-3 - Group 8 Points of Interconnection Surrounding Area – *Diagram1*
Winter Peak

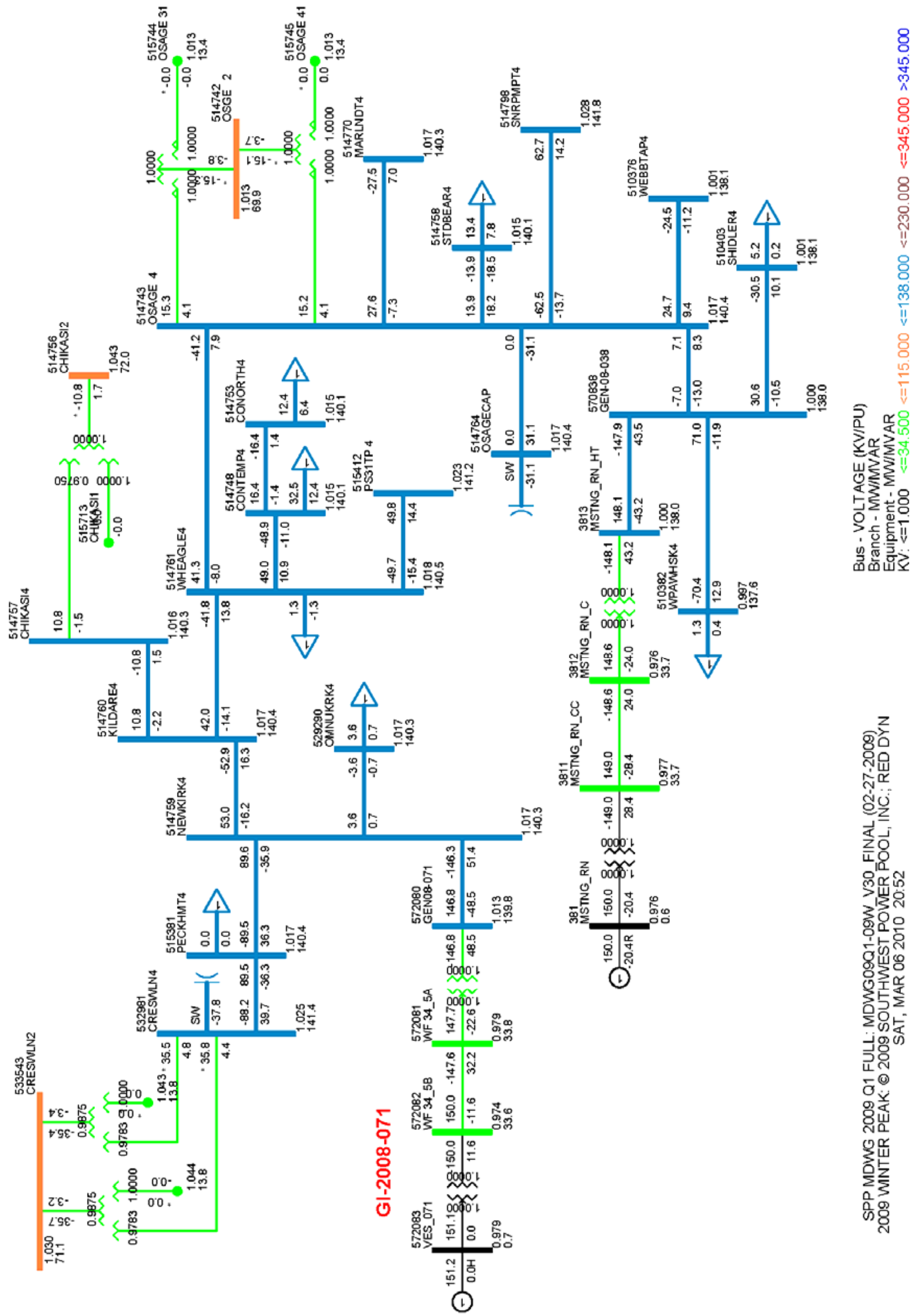
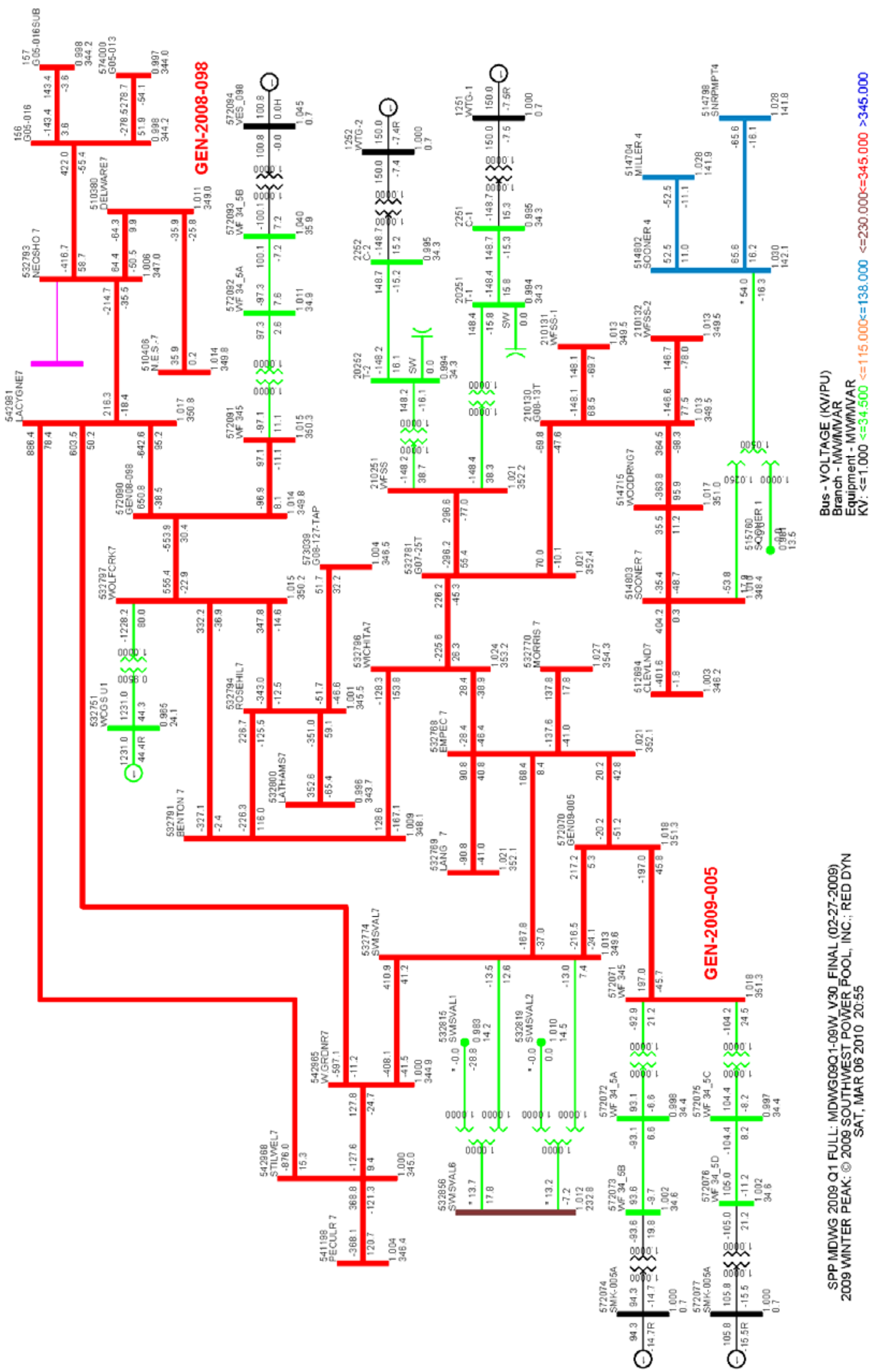


Figure 2-4 - Group 8 Points of Interconnection Surrounding Area – *Diagram2*
Winter Peak



Figures A-1 to A-3 in Appendix A present the single line diagrams showing, for each of the Group 8 interconnection requests, the modeling details and impedance data of the transformers and collector systems.

2.2 Stability Database

The transient stability analysis was performed using the data provided by SPP. Stability models for the Group 8 interconnection requests were already added to the dynamic database. All turbine parameters used in the simulation models are the default parameters in the wind turbine package. It is assumed that each wind turbine generators (WTGs) controls the voltage of its own bus.

The default voltage protection model set points recommended by the manufacturer were used. The wind units were modeled with their built-in voltage ride through capability. Also, the default frequency protection model set points recommended by the manufacturer were used.

The PSS®E dynamic models, documenting the model parameters of each of the Group 8 wind generation facilities are listed in Appendix B.

This page intentionally left blank.

Section

3

Methodology and Assumptions

The study considered the 2009 and 2010 power flow cases with the required interconnection generation requests modeled as described in Section 2. The base case also contains all the significant previous queued projects in the interconnection queue.

The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
520	AEPW
523	GRDA
524	OKGE
525	WFEC
536	WERE
540	MIPU
541	KACP

3.1 Methodology

3.1.1 Stability Simulations

The stability simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single line to ground faults in the neighborhood of PISIS-2009-001 – Group 8 Points of Interconnection were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The Group 8 projects were also evaluated on the matter of ability to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

3.1.2 Steady State Simulations

3.1.2.1 N-1 Contingency Analysis

A single line contingency analysis was performed to evaluate voltage violations, if any, caused by disturbances (tripping of the faulted line). The voltage at each POI was monitored for deviation from the base case voltage and the percentage deviation was documented.

During contingency analysis, a voltage deviation of greater than 1% at any of the monitored buses is noted. Similarly, it is noted whether the voltage drops below 0.95 per unit or rises above 1.05 per unit after a contingency.

3.1.2.2 Power Factor Analysis

The analysis will determine what power factor is necessary at the POI for each contingency.

If the required power factor at the POI is beyond the capability of the studied wind turbines to meet the requirement at the POI, capacitor banks will be considered.

A QV analysis was performed to determine the reactive support requirement at each project's POI. Mvar injections, tabulated for base case and contingency conditions, are used to determine the reactive power support required at each POI, in order to maintain the bus scheduled pre contingency voltages.

These tables are obtained through a series of AC load flow calculations. Starting with no reactive support at a bus, the voltage is computed for a series of power flows as the reactive support is changed in steps, until the power flow experiences convergence difficulties as the system approaches the voltage collapse point.

3.2 Disturbances for Stability Analysis

The stability simulations considered three-phase (3PH) faults and single line-to-ground (SLG) faults as described in Table 3-2:

Table 3-2: Disturbances for Stability Analysis

No.	Contingency Name	Description
1	FLT01-3PH	3 phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault..
2	FLT02-1PH	Single-phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles and reclose Benton 345 kV end back into the fault. d. Leave fault on for 3.6 cycles, then trip the line and remove the fault.

No.	Contingency Name	Description
3	FLT03-3PH	3 phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
4	FLT04-1PH	Single-phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles and reclose Rose Hill 345 kV end back into the fault. d. Leave fault on for 3.6 cycles, then trip the line and remove the fault.
5	FLT05-3PH	3 phase fault on the Wolf Creek (532797) – GEN-2008-098 (572090) 345kV line near GEN-2008-098. a. Apply fault at the GEN-2008-098 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
6	FLT06-1PH	Single phase fault on the Wolf Creek (532797) – GEN-2008-098 (572090) 345kV line near GEN-2008-098. a. Apply fault at the GEN-2008-098 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
7	FLT07-3PH	3 phase fault on the Stilwell (542968) – LaCygne (542981) 345kV line near Stilwell. a. Apply fault at the Stilwell 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 1200 cycles, and then re-close the Stilwell end of the line back into the fault. d. Leave fault on for 3.6 cycles, then trip the line and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Neosho (532793) – LaCygne (542981) 345kV line near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault..
10	FLT10-1PH	Single-phase fault on the Neosho (532793) – LaCygne (542981) 345kV line near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close Neosho 345 kV end back into the fault.. d. Leave the fault on for 3.6 cycles, then trip the line and remove the fault.
11	FLT11-3PH	3 phase fault on the West Gardner (542965) – LaCygne (542981) 345kV line near LaCygne. a. Apply fault at the LaCygne 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 1200 cycles, and then re-close the West Gardner end of the line back into the fault. d. Leave fault on for 3.6 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on the GEN-2008-098 (572090) to LaCygne (542981) 345kV line, near GEN-2008-098. a. Apply fault at the GEN-2008-098 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line.
14	FLT14-1PH	Single phase fault on the GEN-2008-098 (572090) to LaCygne (542981) 345kV line, near GEN-2008-098. a. Apply fault at the GEN-2008-098 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line.

No.	Contingency Name	Description
15	FLT15-3PH	3 phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line.
16	FLT16-1PH	Single-phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 3.6 cycles, then trip the line in (b) and remove fault.
17	FLT17-3PH	3 phase fault on the Sooner (514803) to Woodring (514715) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Sooner (514803) to Cleveland (512694) 345kV line, near Cleveland. a. Apply fault at the Cleveland 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill. a. Apply fault at the Rose Hill 345V bus. b. Clear fault after 4 cycles by tripping the faulted line and remove the fault.
22	FLT22-1PH	Single-phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill. a. Apply fault at the Rose Hill 345V bus. b. Clear fault after 4 cycles by tripping the faulted line. c. Wait 30 cycles, and then re-close the Rose Hill end of the line in (b) back into the fault. d. Leave fault on for 4 cycles, then trip the line in (b) and remove fault.
23	FLT23-3PH	3 phase fault on the GEN-2008-038 (570838) to Shidler (510403) 138kV line, near Shidler. a. Apply fault at the Shidler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	*Single phase fault and sequence like previous*
25	FLT25-3PH	3 phase fault on the Emporia (532768) – GEN-2009-005 (572070) 345kV line near GEN-2009-005. a. Apply fault at the GEN-2009-005 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.

No.	Contingency Name	Description
26	FLT26-1PH	Single phase fault on the Emporia (532768) – GEN-2009-005 (572070) 345kV line near GEN-2009-005. a. Apply fault at the GEN-2009-005 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault. c. Wait 300 cycles and reclose d. Clear fault after 3.6 cycles
27	FLT27-3PH	3 phase fault on the Swissvale (532774) – GEN-2009-005 (572070) 345kV line near GEN-2009-005. a. Apply fault at the GEN-2009-005 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
28	FLT28-1PH	Single phase fault on the Swissvale (532774) – GEN-2009-005 (572070) 345kV line near GEN-2009-005. a. Apply fault at the GEN-2009-005 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault. c. Wait 300 cycles and reclose d. Clear fault after 3.6 cycles
29	FLT29-3PH	3 phase fault on the Swissvale (532774) – West Gardner (542965) 345kV line near Swissvale. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
30	FLT30-3PH	3 phase fault on the Swissvale (532774) – 345/230kV autotransformer. a. Apply fault at the Swissvale 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted transformer.
31	FLT31-3PH	3 phase fault on the Northeastern (510406) to Delaware (510380) 345kV line, near Delaware. a. Apply fault at the Delaware 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	*Single phase fault and sequence like previous*
33	FLT33-3PH	3 phase fault on the Emporia (532768) – Morris County (532770) 345kV line near Emporia. a. Apply fault at the Emporia 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
34	FLT34-1PH	Single phase fault on the Emporia (532768) – Morris County (532770) 345kV line near GEN-Emporia. a. Apply fault at the Emporia 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault. c. Wait 300 cycles and reclose d. Clear fault after 3.6 cycles
35	FLT35-3PH	3 phase fault on the Creswell (515381) to Newkirk (514759) 138kV line, near Newkirk. a. Apply fault at the Newkirk 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	*Single phase fault and sequence like previous*

No.	Contingency Name	Description
37	FLT37-3PH	3 phase fault on the Chikasia 138/69kV autotransformer near the 138kV bus (514757). a. Apply fault at the Chikasia 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	*Single phase fault and sequence like previous*
39	FLT39-3PH	3 phase fault on the Kildare (514760) to Newkirk (514759) 138kV line, near Newkirk. a. Apply fault at the Newkirk 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT40-1PH	*Single phase fault and sequence like previous*
41	FLT41-3PH	3 phase fault on the Osage (514743) to Webb City Tap (510376) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-1PH	*Single phase fault and sequence like previous*
43	FLT43-3PH	3 phase fault on the Sooner (514802) to Sooner Pump Tap (514798) 138kV line, near Sooner. a. Apply fault at the Sooner 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-1PH	*Single phase fault and sequence like previous*
45	FLT45-3PH	3 phase fault on the Sooner (514802) to Miller (514704) 138kV line, near Sooner. a. Apply fault at the Sooner 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT46-1PH	*Single phase fault and sequence like previous*
47	FLT47-3PH	3 phase fault on the Emporia (532768) – Wichita (532796) 345kV line near Emporia. a. Apply fault at the Emporia 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.
48	FLT48-1PH	Single phase fault on the Emporia (532768) – Wichita (532796) 345kV line near Emporia. a. Apply fault at the Emporia 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault. c. Wait 300 cycles and reclose d. Clear fault after 3.6 cycles
49	FLT49-3PH	3 phase fault on the Emporia (532768) – Lang (532769) 345kV line near Emporia. a. Apply fault at the Emporia 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line and remove the fault.

In order to simulate single line to ground faults, equivalent reactance to be applied at the faulted buses were calculated. Table 3-3 presents the equivalent reactance obtained for the summer peak case and Table 3-4 presents the equivalent reactance for the winter peak case.

Table 3-3: Equivalent Reactance – Line to Ground Faults
Summer Peak

BUS	Equivalent Reactance (Mvar)
510380	4200
510403	1050
512694	5100
514715	6050
514743	2375
514757	875
514759	1125
514802	4500
532768	6250
532774	6350
532793	5600
532794	6050
532797	5200
542968	8250
542981	9200
572070	5150
572090	4600
573039	4450

Table 3-4: Equivalent Reactances – Line to Ground Faults
Winter Peak

BUS	Equivalent Reactance (Mvar)
510380	3975
510403	1050
512694	5000
514715	5750
514743	2125
514757	850
514759	1050
514802	4325
532768	5400
532774	5900
532793	4350
532794	5350
532797	5000
542968	7750
542981	8700
572070	4650

The following Figures 3-1 and 3-2 show the fault locations within the study area.

Figure 3-1 – Fault Locations in the Study Area – *Diagram1*

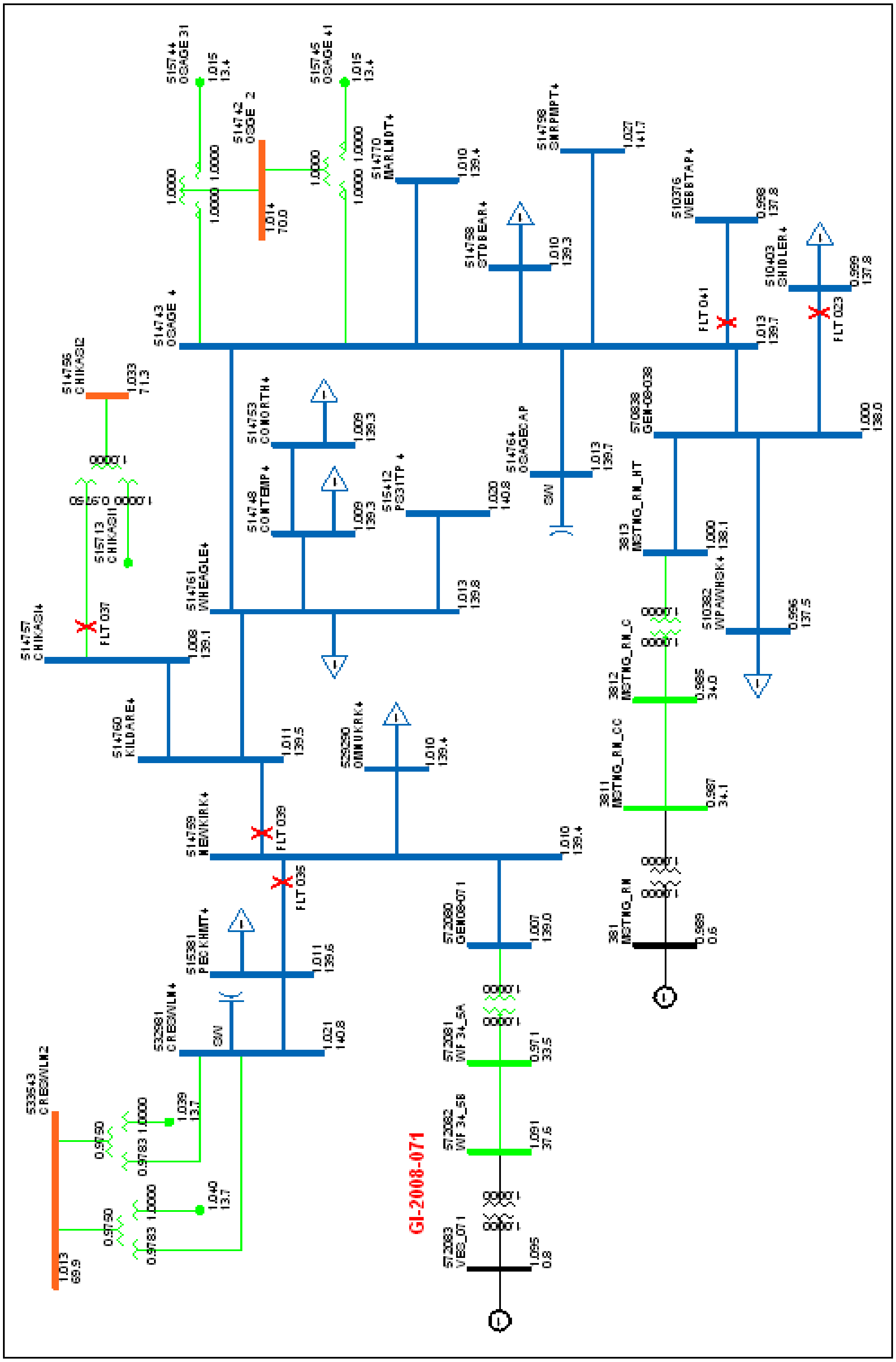
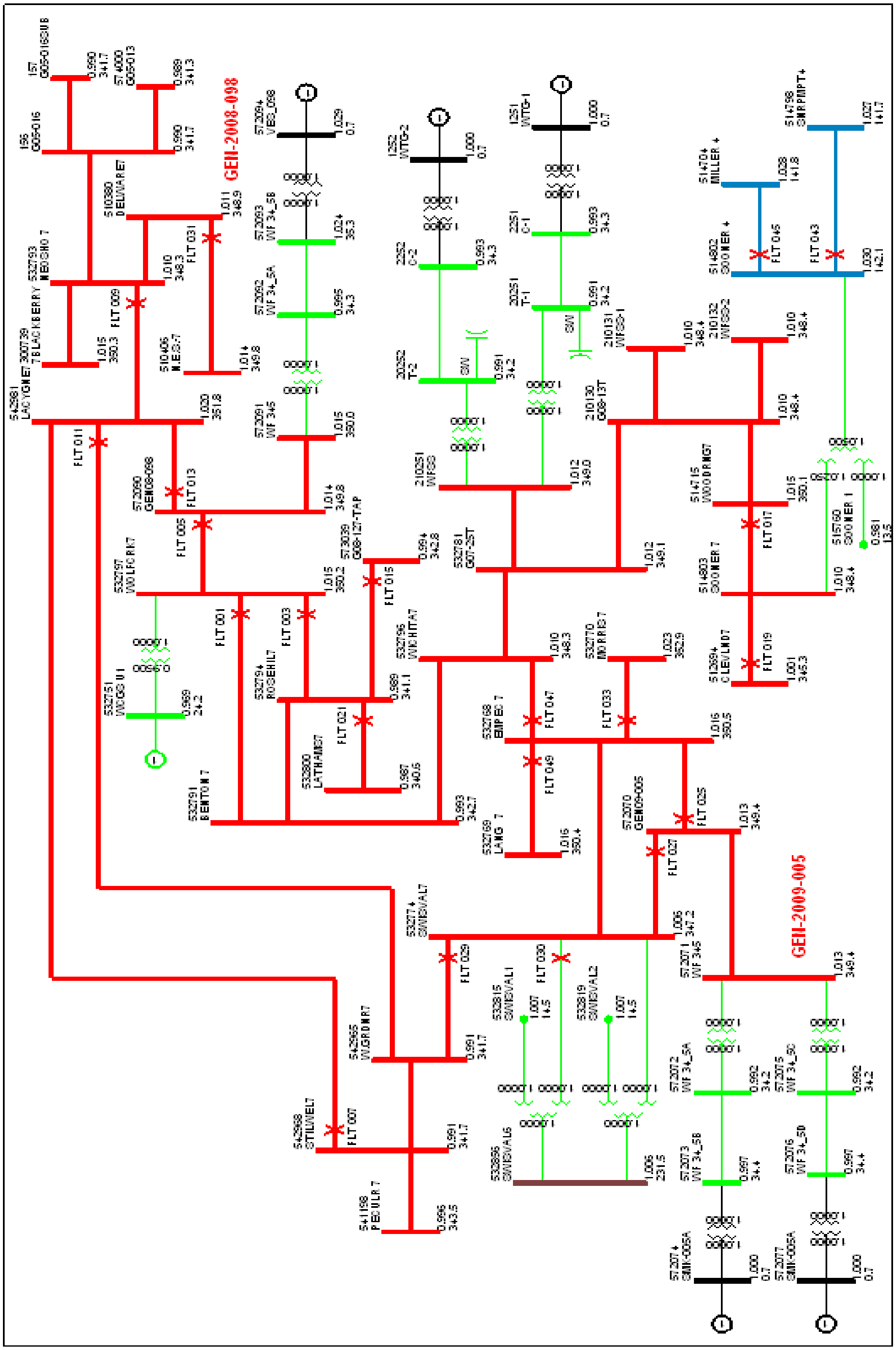


Figure 3-2 – Fault Locations in the Study Area – *Diagram2*



Section
4

Analysis Performed

4.1 Steady State Performance

Tables 4-1 and 4-2 summarize the voltage violations observed under different contingencies for the Summer Peak and Winter Peak cases in the steady state. The tables list the voltage deviations at the Points of Interconnection of the proposed study projects of Group 8, as well as the prior queued projects. Note that only the contingencies that cause a voltage criteria violation or have an impact of at least 1% on the voltages are listed.

The complete set of results for both summer peak and winter peak scenarios are presented in Appendix C.

Table 4-1: Results Obtained – Steady State Analysis – Summer Peak Base Case

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
210130	G08-13T	345	-	1.0100	-
514759	NEWKIRK4	138	-	1.0038	-
532781	G07-25T	345	-	1.0118	-
532797	WOLFCRK7	345	-	1.0150	-
532800	LATHAMS7	345	-	0.9873	-
570838	GEN-08-038	138.0	-	1.0017	-
572070	GEN09-005	345	-	1.0130	-
572090	GEN08-098	345	-	1.0139	-
573039	G08-127-TAP	345	-	0.9936	-
573049	2009-025T	69	-	1.0347	-
574000	G05-013	345	-	0.9891	-
FLT 05					
572090	GEN08-098	345	1.0328	1.0139	1.86%
FLT 13					
532800	LATHAMS7	345	0.9753	0.9873	-1.22%
573039	G08-127-TAP	345	0.9831	0.9936	-1.06%
574000	G05-013	345	0.9773	0.9891	-1.19%
FLT 15					
573039	G08-127-TAP	345	1.0107	0.9936	1.72%

FLT 21					
532800	LATHAMS7	345	0.9430	0.9873	-4.49%
574000	G05-013	345	0.9464	0.9891	-4.32%
FLT 25					
572070	GEN09-005	345	1.0028	1.0130	-1.007%
FLT 35					
514759	NEWKIRK4	138	0.9792	1.0038	-2.45%
FLT 39					
514759	NEWKIRK4	138	0.9664	1.0038	-3.73%

Table 4-2: Results Obtained – Steady State Analysis – Winter Peak Base Case

Bus #	Bus Name	KV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
210130	G08-13T	345	-	1.0127	-
514759	NEWKIRK4	138	-	1.0095	-
532781	G07-25T	345	-	1.0207	-
532797	WOLFCRK7	345	-	1.015	-
532800	LATHAMS7	345	-	0.9954	-
570838	GEN-08-038	138.0	-	1.0178	-
572070	GEN09-005	345	-	1.0133	-
572090	GEN08-098	345	-	1.0035	-
573039	G08-127-TAP	345	-	1.0408	-
573049	2009-025T	69	-	0.9963	-
574000	G05-013	345	-	1.0127	-
FLT 05					
532800	LATHAMS7	345	0.9837	0.9954	-1.18%
572090	GEN08-098	345	1.0238	1.0133	1.04%
573039	G08-127-TAP	345	0.9926	1.0035	-1.09%
574000	G05-013	345	0.9850	0.9963	-1.13%
FLT 13					
532800	LATHAMS7	345	0.9805	0.9954	-1.50%
573039	G08-127-TAP	345	0.9898	1.0035	-1.37%
574000	G05-013	345	0.9818	0.9963	-1.46%
FLT 15					
573039	G08-127-TAP	345	1.0136	1.0035	1.007%
FLT 21					
532800	LATHAMS7	345	0.9043	0.9954	-9.15%
574000	G05-013	345	0.9085	0.9963	-8.81%
FLT 39					
514759	NEWKIRK4	138	0.9565	1.0095	-5.25%

There are several contingencies for which the voltage impact is greater than 1% for both the summer and winter peak power flow cases. The winter peak scenario is more stressed leading to greater voltage deviations for critical contingencies, compared to the summer peak scenario. However, the voltage profile of most POIs and surrounding buses remains within the limits. The exceptions are:

- The outage of the 345 kV line between Rose Hill and Latham substations (FLT 21) results in voltage below 0.95 per unit at Latham and G05-013 345 kV substations, during both the scenarios. The percent deviation at Latham and G05-13 in the winter case is around 9%.

- For the loss of the 138 kV line from Newkirk to Kildare (FLT 39) the voltage dip at Newkirk is around 4 and 5% for summer and winter peak scenarios, respectively. Therefore some reactive support is required even in the steady state.

The 138 kV Newkirk bus is the Point of Interconnection of the project GEN-2007-071 and its voltage is significantly affected by this project. The voltage at the POI and generator buses is below 1.0 per unit even under system intact conditions in the winter scenario. That is in part due to the high reactive consumption in the GEN-2007-071 collector system. Further, a large voltage deviation (5%) occurs around Newkirk for the loss of the 138-kV line from Newkirk to Kildare as seen from Table 4-2 and the bullet above. This issue is resolved by connecting reactive support at the 34.5 kV bus at GEN-2008-71 (Bus 572081). The reactive support also helps raise the voltage at the POI and the generator bus above 1.0 per unit in the base case.

It is important to note that the total reactive support necessary for this project is specified along the next subsection.

4.2 Power Factor Analysis

A QV analysis was performed to determine the amount of reactive support required to maintain the scheduled voltages at the points of interconnection of each one of the proposed wind facilities. The contingencies described in Table 3-2 were evaluated in steady state conditions for summer and winter peak base cases, with variable Mvar injection at the POIs.

Table 4-3 presents the Mvar requirements and the associated power factor that the projects must be able to provide under contingencies for each one of the wind facilities in Group 8.

Table 4-3: Mvar Requirements and Power Factor at the POI for the Proposed Projects Interconnection

Project	Point of Interconnection	V Scheduled (p.u)	Project Injection at POI in Base Case (Mvar)	QV Injection (Mvar)	Project Requirement (Net Mvar at POI)	Contingency	Power Factor at POI
GEN-2008-071	Newkirk 138kV	1.000	-51.4	23.3	-28.1	FLT39 (WP)	0.983 (leading)
GEN-2008-098	Tap Wolf Creek–LaCygne 345kV	1.014	-8.1	55.3	47.2	FLT3 (SP)	0.910 (lagging)
GEN-2009-005	Tap Emporia – Swissvale 345kV	1.013	-34.0	36.22	2.22	FLT25 (SP)	1.000

The Mvar requirements are calculated for both the summer peak and winter peak cases and the value tabulated in Table 4-3 is the highest between the two scenarios. For the project GEN-2008-071, the voltage at the POI in the winter peak scenario is 0.996 per unit. Therefore, the scheduled POI voltage for this case is considered as 1.0 per unit.

QV Tables, showing the Mvar injection for each voltage level in base case and contingencies conditions, are presented in Appendix D for both summer peak and winter peak scenarios. The values chosen are the highest between the two scenarios.

4.3 Dynamic Results

The stability analysis was carried out using both Summer Peak and Winter Peak load flow models.

In order to determine the impact of the project on the overall system dynamics as well as to determine the requirements to meet the FERC Order 661-A Guidelines, 49 contingencies listed in Table 3-2 were simulated. The results obtained are described in this sub-section.

The results obtained from the stability simulations show that none of the contingencies led to generation trip due to LVRT issues.

The results also indicate that, for both scenarios, Gen2008-098 require reactive support in order to present a satisfactory dynamic behavior under the outage of the 138 kV line between Newkirk and Kildare. A 30 Mvar capacitor needs to be connected at the 34.5 kV bus on the Customer's side of GEN-2008-071 to prevent adverse impacts on the dynamic system performance.

Additionally, in the winter peak case, the generator Buzz_2G (Bus # 923 – generation = 20 MW) tripped after 10 seconds for every contingency studied. This is because the voltage at the generator is at 1.070 per unit in the power flow case and it's over voltage relay is set such that it trips the generator after 10 seconds for voltage over 1.05 per unit. However, this generator is not in the monitored areas for this study and therefore it was ignored.

The results obtained show:

- The new proposed projects, did not trip during any of the contingencies tested. That is, no trips occurred due to LVRT.
- All the generators in the monitored areas were stable and remained in synchronism during all contingencies and the system conditions considered.
- Acceptable damping and voltage recovery was observed, within applicable standards.
- In the winter peak case, the generator Buzz_2G (Bus 923) generating 20 MW, tripped after 10 seconds for every contingency studied. This is because the voltage at the generator is at 1.070 per unit in the power flow case and it's over voltage relay is set such that it trips the generator after 10 seconds for voltage over 1.05 per unit. However, this generator is not in the monitored areas for this study and therefore it was ignored.

Additional plots of selected system variables documenting the stability simulations are included in Appendix E.

Section

5

Conclusions

The three projects of PISIS-2009-001 Group 8 have been evaluated to determine the system requirements to meet FERC Order 661-A Guidelines for Low Voltage Ride Through (LVRT) and therefore, for them to deliver their full power to the SPP transmission system.

Steady state and stability analysis were carried out to evaluate the system performance under contingencies.

In general the Group 8 interconnection requests have significant impact on the voltage profile of the monitored system, in the base case conditions as well as under contingencies. The outage of the 345 kV line from Rose Hill to Latham results in significant voltage criteria violations during the winter scenario. Similarly, the loss of the 138 kV line between Newkirk and Kildare causes 5% voltage drop around the 138 kV Newkirk bus in the same peak case.

During stability analysis for this particular contingency, the results indicate that, for both scenarios, Gen2008-098 require reactive support in order to present a satisfactory dynamic behavior under the outage of the 138 kV line between Newkirk and Kildare. A 30 Mvar shunt capacitor connected at the 34.5 kV bus on the Customer's side of GEN-2008-071is required to prevent adverse impacts on the dynamic system performance.

The power factor analysis determined the amount of reactive support required to maintain the scheduled voltages at each one of the points of interconnection under contingency conditions. The amount of reactive support indicated by Table 4-3 must be provided by each interconnection request using the wind turbine generator (WTG) capabilities and/or adding capacitor banks to the system.

This page intentionally left blank.

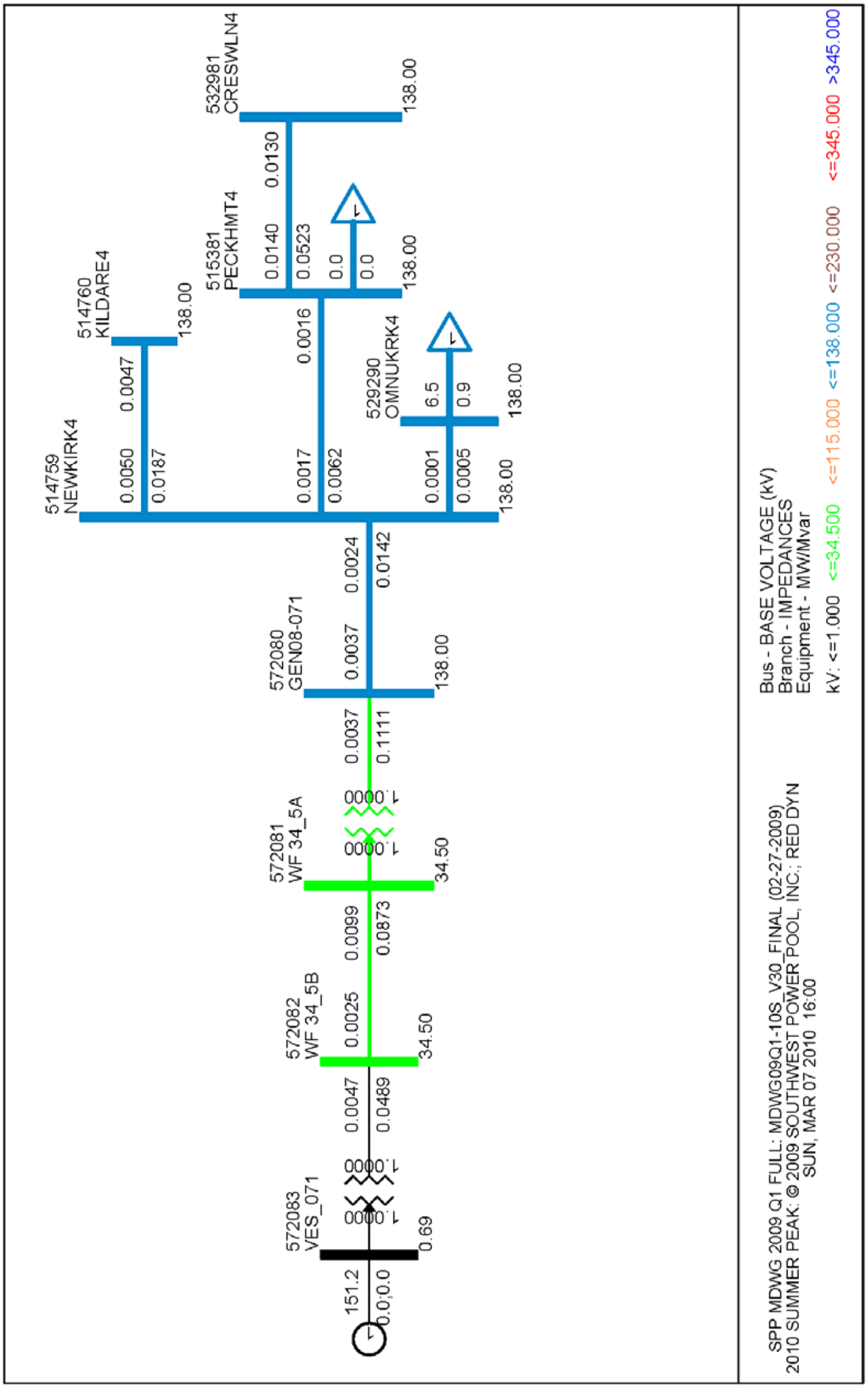
Appendix

A

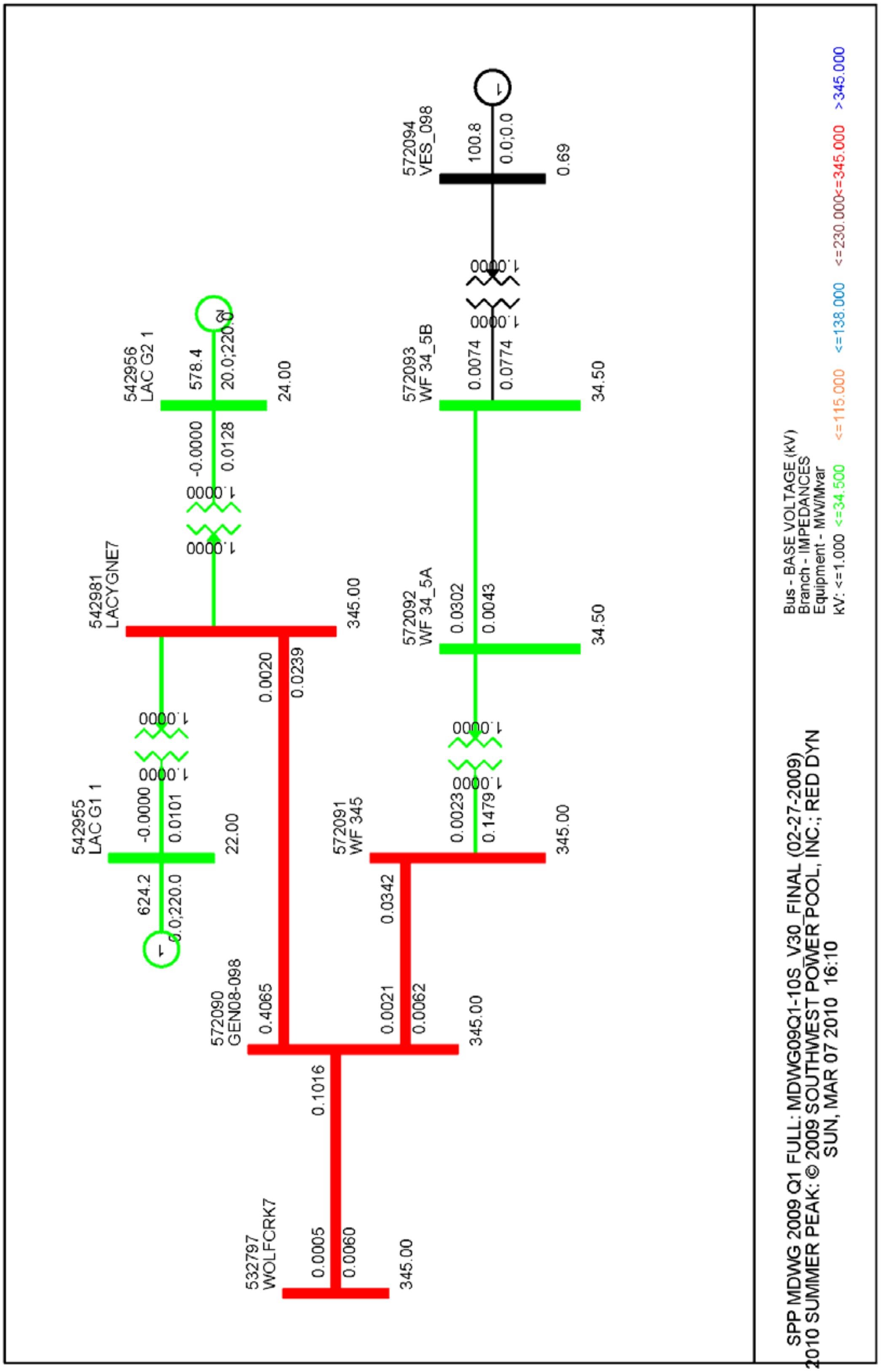
WTG Single Line Diagrams

This appendix contains single line diagrams for each of the Group 8 projects, showing the modeling details and impedance data of the transformers and collector systems.

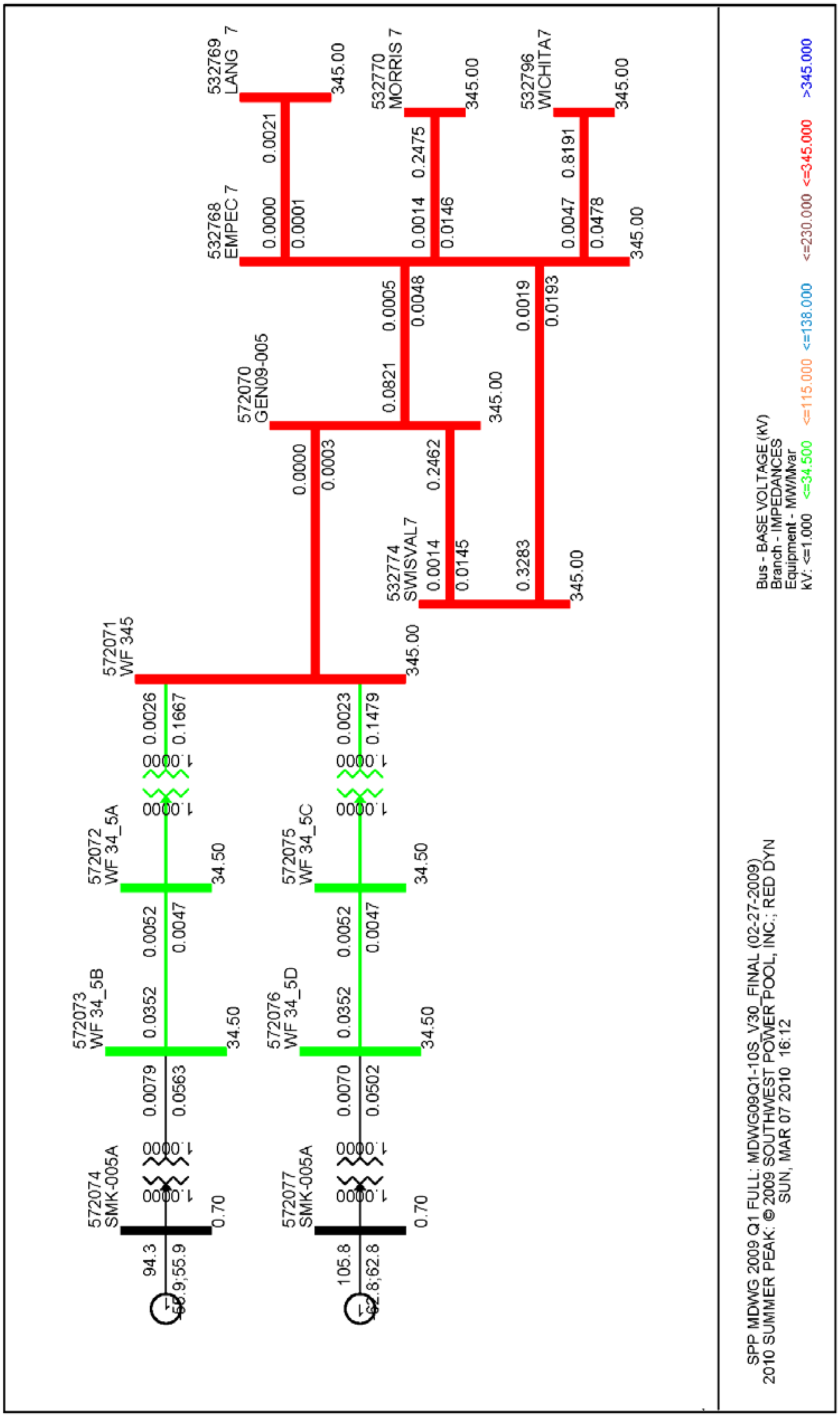
A.1 Gen-2008-071



A.2 Gen-2008-098



A.3 Gen-2009-005



Q: Stability Study for Group 9

POWER SYSTEMS DIVISION
GRID SYSTEMS CONSULTING

System Impact Study for SPP PISIS-2009-001 Group 9

FINAL REPORT

REPORT NO.: 2010-E4200-01R1
Issued On: February 11, 2010
Revised On: February 19, 2010

Prepared for:
Southwest Power Pool, Inc.

ABB Inc.
Power Systems Division
Grid Systems Consulting
940 Main Campus Drive, Suite 300
Raleigh, NC 27606

Legal Notice

This document, prepared by ABB Inc., is an account of work sponsored by Southwest Power Pool, Inc. (SPP). Neither SPP nor ABB Inc, nor any person or persons acting on behalf of either party: (i) makes any warranty or representation, expressed or implied, with respect to the use of any information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights, or (ii) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in this document.

ABB Inc – Grid Systems Consulting

Technical Report

Southwest Power Pool, Inc.	**No.** 2010-E4200-01R1	
System Impact Study for SPP PISIS-2009-001 Group 9	Date: 02/11/2010	# Pages 30

Author(s):	**Reviewed by:**	**Approved by:**
Sheng Yang	Amit Kekare	Willie Wong

Executive Summary

Southwest Power Pool, Inc. (SPP) has commissioned ABB Inc. to perform a system impact study for 150 MW of wind-based generation (known as PISIS-2009-001 Group 9) on the SPP system. The proposed wind farm project is located in East Nebraska. Below are the details of the PISIS-2009-001 Group 9 wind farm project:

Request	Size	Wind Turbine Technology	Point of Interconnection	County
GEN-2006-044N02	150	GE 1.5 MW	Tap Columbus (640133) – Ft Randall (652509) 230kV. Bus # 570886	Madison, Nebraska

The main objectives of this study were

1) To determine the power factor requirements for the proposed wind farm
2) To determine the impact of proposed GEN-2006-044N02 (150 MW) generation on system stability and the nearby transmission system and generating stations.
3) To validate the compliance with FERC LVRT requirement for wind farm.

To achieve these objectives the following analyses were performed on the 2010 Summer Peak and 2009 Winter Peak system conditions with GEN-2006-044N02 in-service

- Power factor analysis for the selected contingencies.
- Transient stability analysis under various local and regional contingencies.
- LVRT performance under selected contingencies near POI.

Following is the summary of study findings:

Power factor analysis

The power factor analysis was performed to determine the power factor requirements of the wind farm. The wind farm is required to provide 99.71% power factor lagging at the point of interconnection.

Stability Analysis

The stability analysis was performed to determine the impact, if any, of the proposed PISIS-2009-001 Group 9 project (GEN-2006-044N02) on the stability of the SPP system.

The system was **STABLE** following all simulated 3-phase and single-phase faults. **NONE** of previously installed wind farm monitored and the proposed Group 9 GEN-2006-044N02 wind farm project tripped following all simulated faults.

FERC Order 661A Compliance

Selected faults were simulated at the Point of Interconnection (POI) of the proposed GEN-2006-044N02 wind farm to determine the compliance with FERC 661 – A post-transition period LVRT standard. The results indicated that the proposed project meets the FERC LVRT requirement for wind farms.

The results of this analysis 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 model change, the results provided in this report may not apply.

Rev No.	Revision Description	Date	Authored by	Reviewed by	Approved by
0	Draft Report	02/11/10	S. Yang	A. Kekare	W. Wong
1	Draft Report	02/19/10	S. Yang	A. Kekare	W. Wong

DISTRIBUTION:
Charles Hendrix – Southwest Power Pool, Inc.
Ray Offenbacker – Southwest Power Pool, Inc.
Juliano Schramm Freitas – Southwest Power Pool, Inc.

TABLE OF CONTENTS

1 INTRODUCTION

Southwest Power Pool, Inc. (SPP) has commissioned ABB Inc. to perform a system impact study for 150 MW of wind-based generation (known as PISIS-2009-001 Group 9) on the SPP system. The proposed wind farm is located in Madison County, Nebraska. Figure 1-1 shows the locations of the project.

The study evaluated the impact of the PISIS-2009-001 Group 9 project (GEN-2006-044N02) on the stability of the SPP system. The scope of this study was limited to the transient stability analysis.

The main objectives of this study were

1) To determine the power factor requirements of the proposed wind farm.
2) To determine the impact of proposed GEN-2006-044N02 (150 MW) generation on system stability and the nearby transmission system and generating stations.
3) To validate the compliance with FERC LVRT requirement for wind farms.

To achieve these objectives the following analyses were performed on the 2010 Summer Peak and 2009 Winter Peak system conditions with GEN-2006-044N02 in-service

- Power factor analysis for the selected contingencies.
- Transient stability analysis under various local and regional contingencies.
- LVRT performance under selected contingencies near POI.

The study was performed on 2010 Summer Peak and 2009 Winter Peak cases, provided by SPP. This report documents the methods, analysis and results of the system impact study.

Table 1-1: List of Group 6 Projects

Request	Size	Wind Turbine Model	Point of Interconnection	County
GEN-2006-044N02	150	GE 1.5 MW	Tap Columbus (640133) – Ft Randall (652509) 230kV. Bus # 570886	Madison, Nebraska

1.1 REPORT ORGANIZATION

This report is organized as follows:

Section 2: Description of GEN-2006-044N02
Section 3: Study methodology
Section 4: Model Development
Section 5: Power Factor Analysis Results
Section 6: Stability Analysis Results
Section 7: Conclusions

The detailed study results are compiled in separate Appendices.

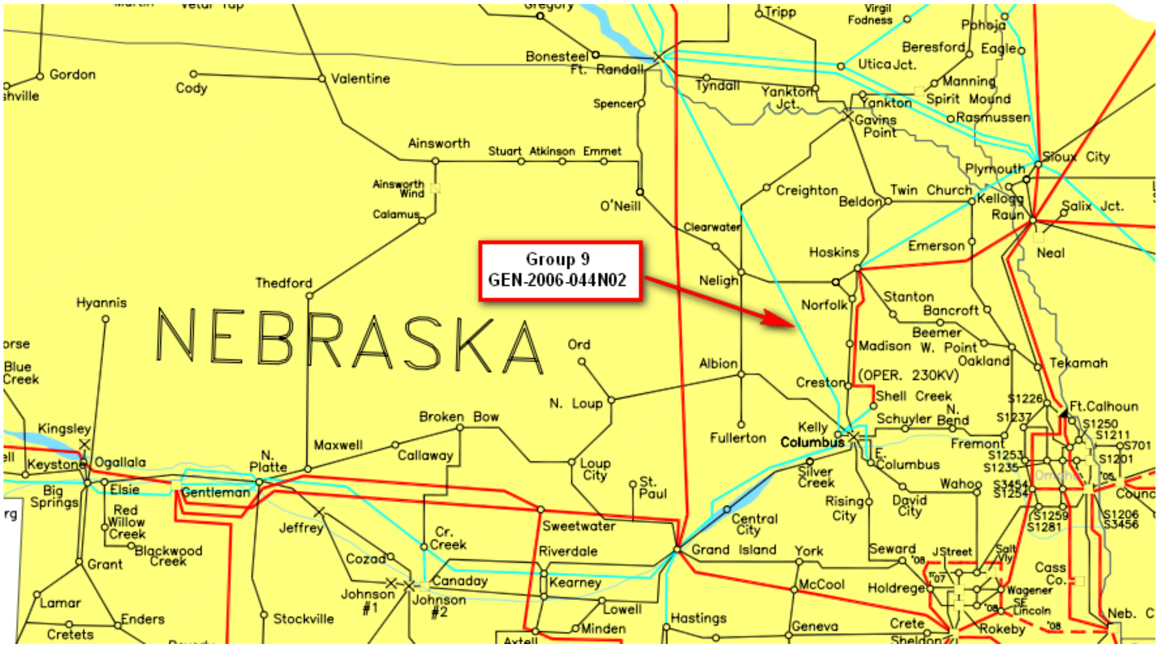


Figure 1-1: Group 9 Project GEN-2006-044N02 Location

2 DESCRIPTION OF GEN-2006-044N02

The details of load flow and dynamic data for the wind farm project are included in the Appendix A.

GEN-2006-044N02:

- Wind farm rating: 150 MW
- Interconnection:
  - Voltage: 230 kV
  - Location: Interconnection via a 230 kV radial transmission line into the existing 230 kV interconnection bus (POI #570886) on Columbus – Ft Randall 230 kV line in Madison County, Nebraska
  - Transformer: One (1) step-up transformer connecting to the 230 kV
    - MVA: 105 MVA
    - Voltage: 230/34.5 kV
    - Z: 8 % on 105 MVA; X/R=15
- Wind Turbines:
  - Number: One hundred (100)
  - Manufacturer: GE
  - Type: Doubly-fed Induction Generator
  - Machine Terminal voltage: 575 V
  - Rated Power: 1.5 MW
  - Frequency: 60 Hz
  - Generator Step-up Transformer
    - MVA: 1.75 MVA
    - High voltage: 34.5 kV,
    - Low voltage: 0.575 kV
    - Z: 5.75% on 1.75 MVA; X/R=7.5
- Fault Ride-through: Default manufacturer under/over voltage and frequency protection.
- PSSE Model Used: gewt_p303cvf_w51.lib

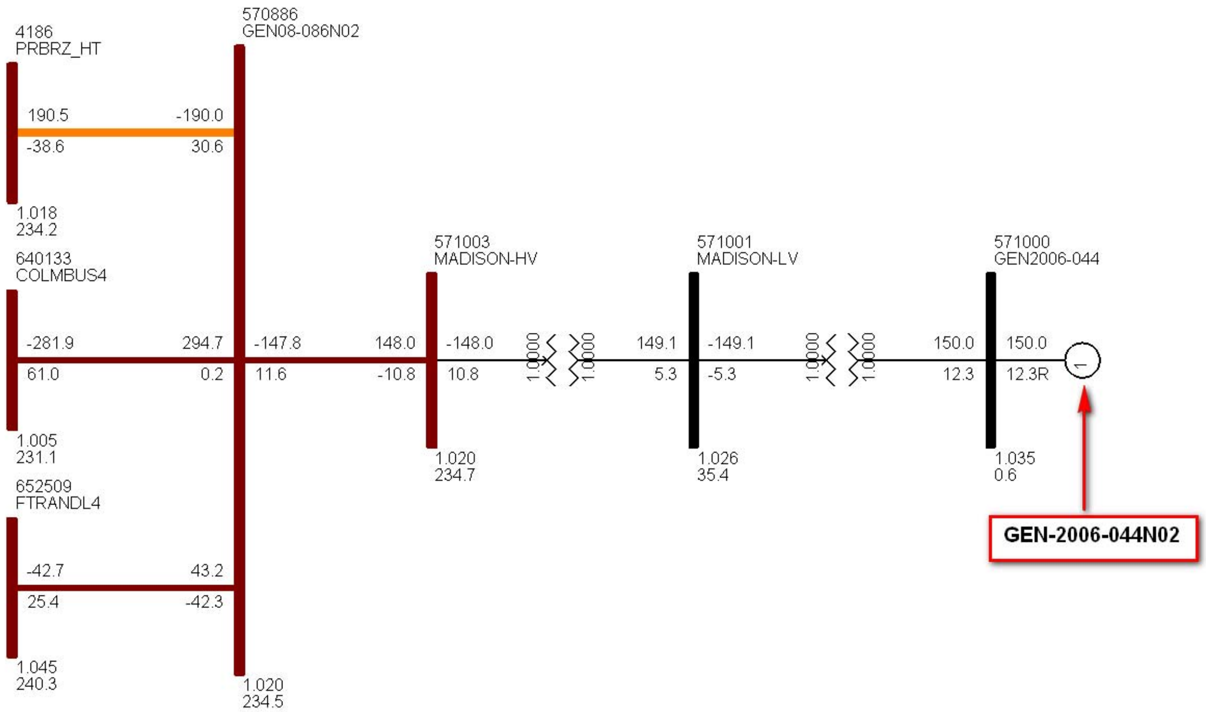


Figure 2-1: One-line Diagram for GEN-2006-044N02 Project

3 STUDY METHODOLOGY

3.1 POWER FACTOR ANALYSIS

SPP requires the generation interconnection projects to maintain a voltage schedule at the Point of Interconnection (POI) of at least 1.0 for pre-contingency and post-contingency conditions.

The purpose of the power factor analysis was to determine the reactive power requirements to maintain the required voltage schedule at the Point of Interconnection (POI) in system intact and contingency conditions.

Following steps were taken to perform the power factor analysis:

- A VAR generator with large capacity (+/- 9999 Mvar) was modeled at the POI of the subject wind farm. The VAR generator was set to hold the POI voltage consistent with the voltage schedule in the provided base case or 1.00 p.u. (whichever was higher). The reactive power capability of the wind farm was set to zero.
- A list of selected contingencies in the vicinity of the subject wind farm project was simulated. The results were used to identify the most-limiting contingency from steady state voltage and power factor perspective.
- The worst case contingency was taken to determine the reactive power requirements

It is important to note that the reactive power compensation identified in this analysis was primarily to meet steady state criteria. The need for dynamic reactive power support, if any, will be determined during transient stability analysis.

3.2 TRANSIENT STABILITY ANALYSIS

The purpose of the transient stability analysis was to determine the impact, if any, of the GEN-2006-044N02 wind farm project on the system stability and the nearby transmission system and generating stations.

Using Planning Standards approved by NERC, the following stability definition was applied in the Transient Stability Analysis:

“Power system stability is defined as that condition in which the differences of the angular positions of synchronous machine rotors become constant following an aperiodic system disturbance.”

Stability analysis was performed using Siemens-PTI’s PSS/E^{TM} dynamics program V30.3.3. Three-phase and single-line-to-ground (SLG) faults were simulated for the specified duration and synchronous machine rotor angles and wind turbine generator speeds were monitored to check whether synchronism is maintained following fault removal.

For three-phase faults, a fault admittance of –j2E9 was used (essentially infinite admittance or zero impedance). The PSS/E dynamics program only simulates the positive sequence network. Unbalanced faults (like single-phase line faults) involve the positive, negative, and zero sequence networks. For unbalanced faults, the equivalent fault admittance was inserted in the PSS/E positive sequence model between the faulted bus and ground to simulate the effect of the negative and zero sequence networks. For a single-line-to-ground (SLG) fault, the fault admittance equals the inverse of the sum of the positive, negative and zero sequence Thevenin impedances at the faulted bus. Since PSS/E inherently models the positive sequence fault impedance, the sum of the negative and zero sequence Thevenin impedances needs to be added and entered as the fault impedance at the faulted bus. The fault impedance was estimated to give a positive sequence voltage at the fault location of approximately 60% of pre-fault voltage, which is a typical value.

Another important aspect of the stability analysis was to determine the ability of the wind generators to stay connected to the grid during disturbances. This is primarily determined by their low-voltage ride-through capabilities – or lack thereof – as represented in the models by low-voltage trip settings. The Federal Energy Regulatory Commission (FERC) Post-transition period LVRT standard for Interconnection of Wind generating plants includes a Low Voltage Ride Through (LVRT) requirement. The key features of LVRT requirements are:

- A wind generating plant must remain in-service during three-phase faults with normal clearing (maximum 9 cycles) and single-line-to-ground faults with delayed clearing, and have subsequent post-fault recovery to pre-fault voltage unless the clearing of the fault effectively disconnects the generator from the system.
- The maximum clearing time the wind generating plant shall be required to withstand a three-phase fault shall be 9 cycles after which, if the fault remains following the location-specific normal clearing time for three-phase faults, the wind generating plant may disconnect from the transmission system. A wind generating plant shall remain interconnected during such a fault on transmission system for a voltage level as low as zero volts, as measured at the high voltage side of the GSU connected at POI.

These criteria were used to evaluate the LVRT capabilities of the GEN-2006-044N02 Project.

4 MODEL DEVELOPMENT

Two power flow cases – “PISIS_10SP-G9.sav” and “PISIS_09WP-G9.sav” – representing the 2010 Summer Peak and 2009 Winter Peak system conditions were provided by SPP. The base cases included the GEN-2006-044N02 (150 MW) wind farm project. These cases were used for performing the studies.

Figure 4-1 and Figure 4-2 show the one-line diagram in the local area of GEN-2006-044N02 project for 2010 Summer Peak and 2009 Winter Peak system conditions respectively.

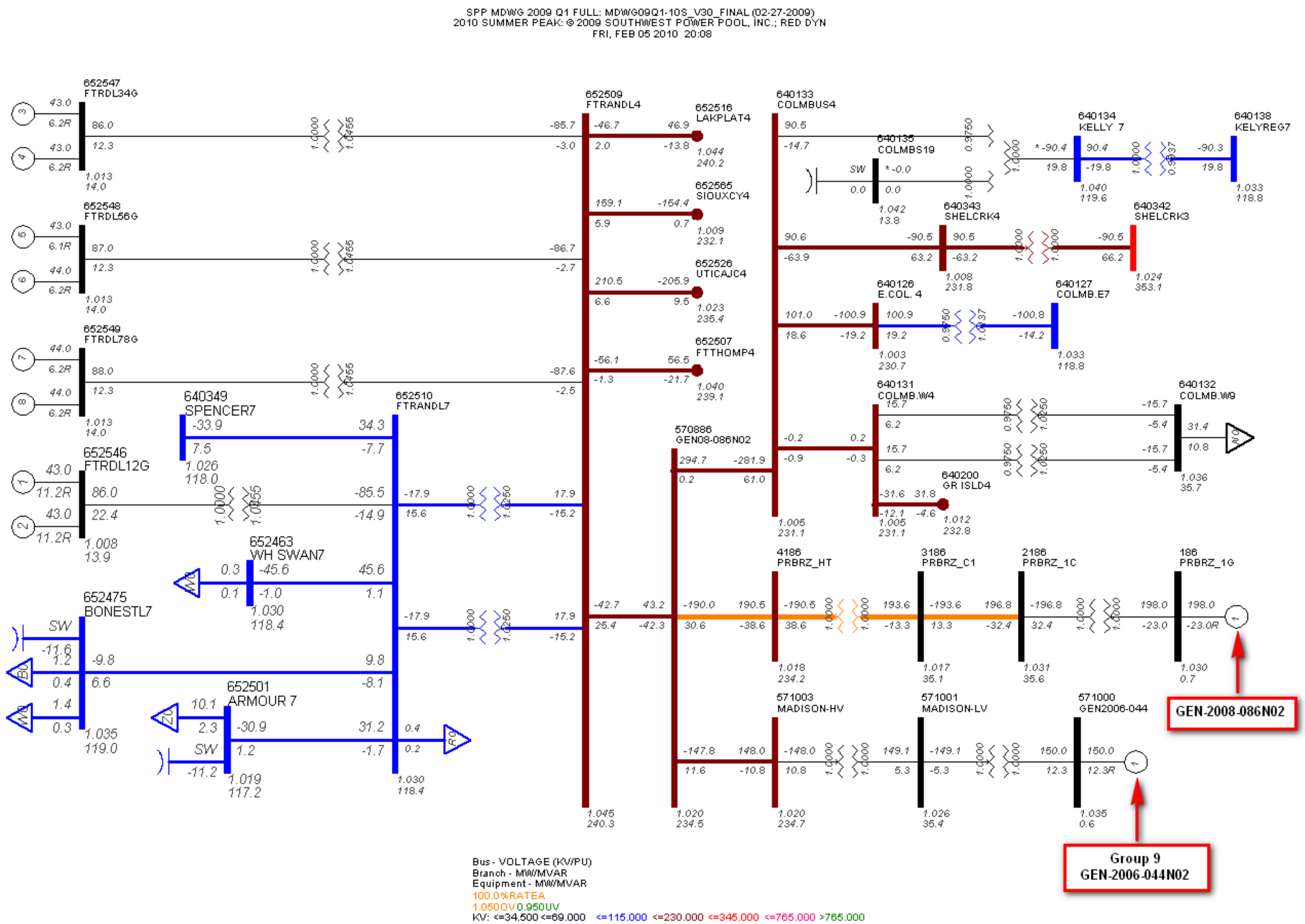


Figure 4-1: One-line Diagram of the local area with GEN-2006-044N02 (2010 Summer Peak)

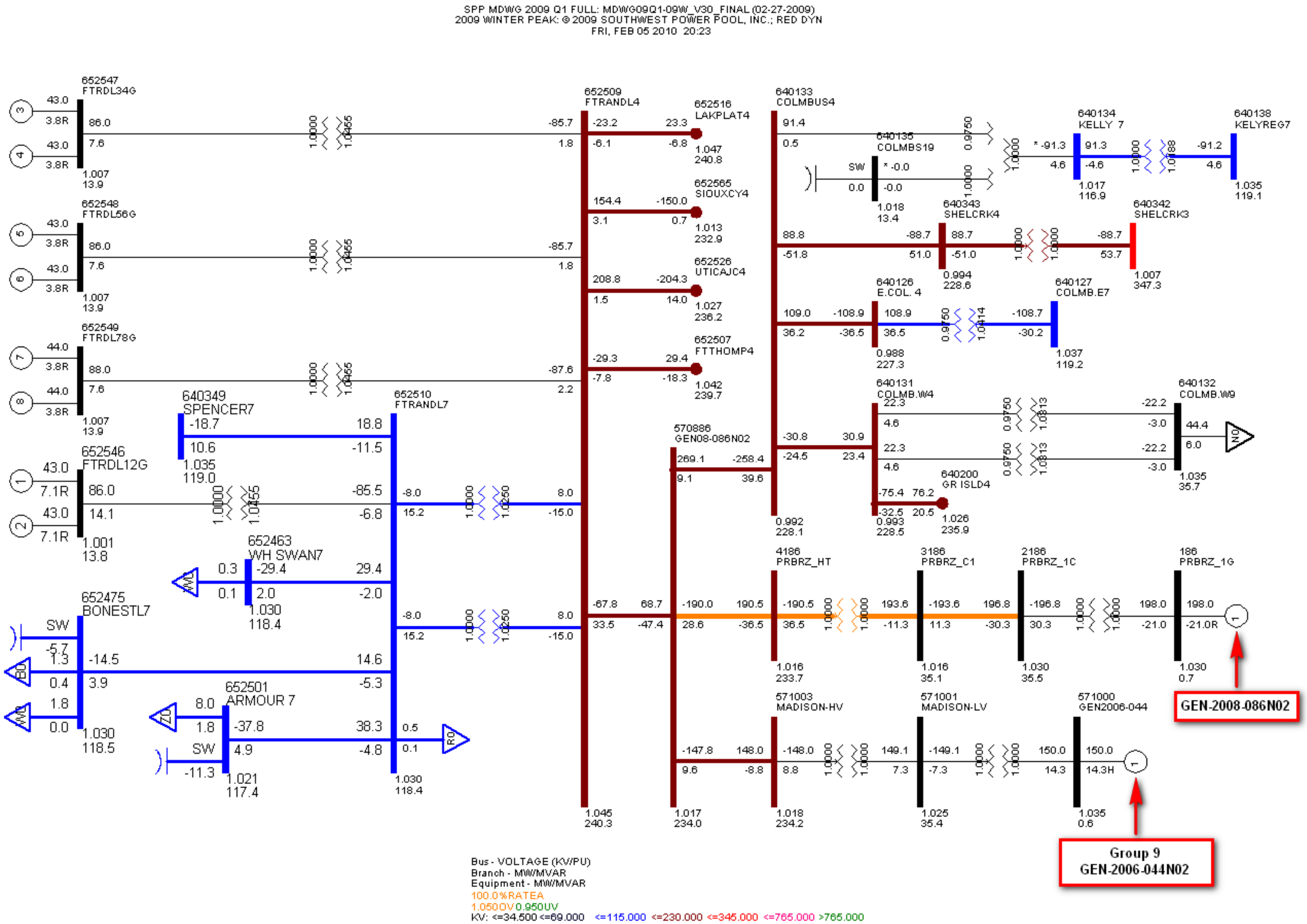


Figure 4-2: One-line Diagram of the local area with GEN-2006-044N02 (2009 Winter Peak)

5 POWER FACTOR ANALYSIS RESULTS

Table 5-1 lists the contingencies simulated for Power Factor analysis.

Table 5-1: List of contingencies simulated for Power Factor Analysis

Contingency	Contingency Description
CONT_01	570644 GEN-06-044N 115 - 640293 NELIGH 7 115 ckt 1
CONT_02	640054 ALBION 7 115 - 640318 PETRSBG7 115 ckt 1
CONT_03	640293 NELIGH 7 115 - 640113 CLRWATR7 115 ckt 1 640113 CLRWATR7 115 - 640305 ONEILL 7 115 ckt 1
CONT_04	640305 ONEILL 7 115 - 640349 SPENCER7115 ckt 1 640349 SPENCER7 115.00 - 652510 FTRANDL7 115 ckt 1
CONT_05	640084 BLMFLD 7 115 - 652511 GAVINS 7 115 ckt 1
CONT_06	640343 SHELCRK4 230 - 640133 COLMBUS4 230 ckt 1
CONT_07	640131 COLMB.W4 230 - 640133 COLMBUS4 230 ckt 1
CONT_08	640126 E.COL. 4 230 - 640133 COLMBUS4 230 ckt 1
CONT_09	570886 GEN08-086N02 230 - 640133 COLMBUS4 230 ckt 1
CONT_10	570886 GEN08-086N02 230 - 652509 FTRANDL4 230 ckt 1
CONT_11	652509 FTRANDL4 230 - 652507 FTTHOMP4 230 ckt 1
CONT_12	652509 FTRANDL4 230 - 652526 UTICAJC4 230 ckt 1
CONT_13	652509 FTRANDL4 230 - 652516 LAKPLAT4 230 ckt 1
CONT_14	652509 FTRANDL4 230 - 652565 SIOUXCY4 230 ckt 1
CONT_15	640133 COLMBUS4 230 - 640134 KELLY 7 115 ckt 1 640134 KELLY 7 115 - 640135 COLMBUS19 13.5 ckt 1

5.1 POWER FACTOR ANALYSIS RESULTS FOR GEN-2006-044N02

The proposed GEN-2006-044N02 wind farm (150 MW) will be comprised of GE 1.5 MW wind turbine generators. These wind turbine generators are doubly-fed induction generators with a reactive power capability of lead/lag 0.90 p.f. The wind turbine generators were modeled in voltage control mode.

Next, as described in section 3.1 a VAR generator was modeled at the POI (GEN08-086N02 230 kV). The VAR generator was set to hold the 230 kV POI voltage consistent with the pre-contingency voltage schedule in the provided base cases or 1.0 p.u. (whichever was higher). The reactive power capability of the wind farm was set to zero.

The contingencies from Table 5-1 were repeated on 2010 Summer Peak and 2009 Winter Peak system conditions. Table 5-2 lists the VARs provided by the VAR generator at POI following the simulated contingencies.

Table 5-2: VAR generator output at the GEN-2006-044N02 POI (MVAR)

	Summer	Summer	Summer	Winter	Winter	winter
Contingency	**MW at POI**	**Mvar at POI**	**PF requirement**	**MW at POI**	**Mvar at POI**	**PF requirement**
SYSTEM INTACT (ALL LINES IN-SERVICE)	337.8	-41.6	99.25% leading	337.8	-33.6	99.51% leading
CONT_01	337.8	-42.0	99.24% leading	337.8	-33.6	99.51% leading
CONT_02	337.8	-39.4	99.33% leading	337.8	-32.4	99.54% leading
CONT_03	337.8	-40.5	99.29% leading	337.8	-32.8	99.53% leading
CONT_04	337.8	-40.3	99.30% leading	337.8	-33.1	99.52% leading
CONT_05	337.8	-42.1	99.23% leading	337.8	-33.7	99.51% leading
CONT_06	337.8	-26.5	99.69% leading	337.8	-25.7	99.71% leading
CONT_07	337.8	-41.4	99.26% leading	337.8	-25.1	99.73% leading
CONT_08	337.8	-45.4	99.11% leading	337.8	-35.8	99.44% leading
CONT_09	337.8	-25.6	99.71% leading	337.8	-33.0	99.53% leading
CONT_10	**337.8**	**10.0**	**99.96% lagging**	**337.8**	**25.8**	**99.71% lagging**
CONT_11	337.8	-43.7	99.17% leading	337.8	-34.4	99.49% leading
CONT_12	337.8	-28.4	99.65% leading	337.8	-22.3	99.78% leading
CONT_13	337.8	-43.4	99.18% leading	337.8	-34.2	99.49% leading
CONT_14	337.8	-31.4	99.57% leading	337.8	-25.4	99.72% leading
CONT_15	337.8	-40.9	99.27% leading	337.8	-34.2	99.49% leading

The results indicated that the '*CONT_10*' involving loss of GEN-2006-044N02 POI – Ft Randall 230 kV line will yield the maximum reactive power output for 2010 Summer Peak and 2009 Winter Peak conditions. The resulting power factor requirement for generators interconnected to this bus is 99.71% lagging (supplying vars).

6 STABILITY ANALYSIS RESULTS

6.1 STABILITY ANALYSIS RESULTS

Stability simulations were performed to examine the transient behavior of the PISIS-2009-001 Group 9 (GEN-2006-044N02) and its impact on the SPP system. A number of three-phase and single phase faults with re-closing were simulated. The fault clearing times and re-closing times used for the simulations are given in Table 6-1.

Table 6-1: Fault Clearing Times

Faulted bus kV level	Normal Clearing
115/230	5/5.5/6 cycles

Table 6-2 lists all the faults simulated for transient stability analysis.

Fifteen (15) three-phase faults with normal clearing and one (1) single-line-to-ground stuck PCB fault were simulated. For all cases analyzed, the initial disturbance was applied at t = 0.1 seconds. The breaker clearing was applied at the appropriate time following this fault inception.

Table 6-2: List of Simulated Faults for Group 9 GEN-2006-044N02

Fault No.	Fault Name	Description
1	FLT01-3PH	3 phase fault on the GEN-2006-044N (570644) to Neligh (640293) 115kV line, near GEN-2006-044N. a. Apply fault at the GEN-2006-044N 115kVbus. b. Clear fault after 6.5 cycles by tripping the faulted line.
2	FLT02-3PH	3 phase fault on the Albion (640054) to Petersburg (640318) 115kV line, near Petersburg. a. Apply fault at the Petersburg 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
3	FLT03-3PH	3 phase fault on the Clearwater (640113) to Neligh (640293) 115kV line, near Neligh. a. Apply fault at the Neligh 115kVbus. b. Clear fault after 6.5 cycles by tripping the faulted lines (Neligh-Clearwater-O'Neill 115 kV).
4	FLT04-3PH	3 phase fault on the O'Neill (640305) to Spencer (640349) 115kV line, near O'Neill. a. Apply fault at the O'Neill 115kVbus. b. Clear fault after 6.5 cycles by tripping the faulted lines (O'Neill-Spencer-Ft.Randall 115 kV).
5	FLT05-3PH	3 phase fault on the Bloomfield (640084) to Gavins (652511) 115kV line, near Bloomfield. a. Apply fault at the Bloomfield 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
6	FLT06-3PH	3 phase fault on the Shell Creek (640343) to Kelly (640133) 230kV line, near Columbus a. Apply fault at the Kelly 230kV bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
7	FLT07-3PH	3 phase fault on the Columbus West (640131) to Kelly (640133) 230kV line, near Columbus a. Apply fault at the Kelly 230kV bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
8	FLT08-3PH	3 phase fault on the East Columbus (640126) to Kelly (640133) 230kV line, near Columbus a. Apply fault at the Kelly 230kV bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
9	FLT09-3PH	3 phase fault on the GEN-2008-086N02 (570886) to Kelly (640133) 230kV line, near GEN-2008-086N02 a. Apply fault at the GEN-2008086N02 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
10	FLT10-3PH	3 phase fault on the GEN-2008-086N02 (570886) to Fort Randall (652509) 230kV line, near GEN-2008-086N02 a. Apply fault at the GEN-2008086N02 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.

Fault No.	Fault Name	Description
11	FLT11-3PH	3 phase fault on the Fort Randall (652509) to Fort Thompson (652507) 230kV line, near GEN-Fort Randall a. Apply fault at the Ft. Randall 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
12	FLT12-3PH	3 phase fault on the Fort Randall (652509) to Utica Jct (652526) 230kV line, near Fort Randall a. Apply fault at the Fort Randall 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
13	FLT13-3PH	3 phase fault on the Fort Randall (652509) to Lake Platt (652516) 230kV line, near Fort Randall a. Apply fault at the Fort Randal 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
14	FLT14-3PH	3 phase fault on the Fort Randall (652509) to Sioux City (652565) 230kV line, near Fort Randall a. Apply fault at the Fort Randal 230V bus. b. Clear fault after 6.0 cycles by tripping the faulted line.
15	FLT15-3PH	3 phase fault on the Kelly 230/115 kV auto at the 115kV (640134) a. Apply fault at the Columbus 115kV bus. b. Clear fault after 5.5 cycles by tripping autotransformer.
16	FLT16-1PH	SLG fault on Kelly – Columbus West 230 kV line. Stuck PCB at Kelly. a. Apply fault on Kelly 230 kV bus. b. Clear Columbus West end of line at 6.0 cycles. Leave fault on open-ended line. c. Clear Kelly 230 kV bus and fault at 14.5 cycles.

Table 6-3 summarizes the stability analysis results for 2010 Summer Peak and 2009 Winter Peak system conditions. The plots for all the stability simulations are included in Appendix C.

Table 6-3: Results of stability analysis

FAULT	2010 Summer Peak		2009 Winter Peak	
	Without Group 9	With Group 9	Without Group 9	With Group 9
FLT01-3PH	---	STABLE	---	STABLE
FLT02-3PH	---	STABLE	---	STABLE
FLT03-3PH	---	STABLE	---	STABLE
FLT04-3PH	---	STABLE	---	STABLE
FLT05-3PH	---	STABLE	---	STABLE
FLT06-3PH	---	STABLE	---	STABLE
FLT07-3PH	---	STABLE	---	STABLE
FLT08-3PH	---	STABLE	---	STABLE
FLT09-3PH	---	STABLE	---	STABLE
FLT10-3PH	---	STABLE	---	STABLE
FLT11-3PH	---	STABLE	---	STABLE
FLT12-3PH	---	STABLE	---	STABLE
FLT13-3PH	---	STABLE	---	STABLE
FLT14-3PH	---	STABLE	---	STABLE
FLT15-3PH	---	STABLE	---	STABLE
FLT16-1PH	---	STABLE	---	STABLE

The system was STABLE following all simulated 3-phase and single-phase faults. NONE of previously installed wind farm monitored and the proposed Group 9 GEN-2006-044N02 wind farm project tripped following all simulated faults.

6.2 FERC LVRT Compliance

As explained in section 2, the proposed PISIS-2009-001 Group 9 (GEN-2006-044N02 wind farm project) was modeled with the low voltage ride through capacity. To determine the compliance of the wind farm projects total of four (4) faults were simulated. Faults were simulated at the POI of the wind farm project and normally cleared by tripping one transmission element. Table 6-4 lists the faults simulated for LVRT analysis.

Table 6-4: List of faults for FERC LVRT compliance

Fault Name	Description
LVRT01-3PH	3 phase fault on the GEN-2006-044N02 POI (570886) to Kelly (640133) 230kV line, near the GEN-2006-044N02 POI. a. Apply fault at the GEN-2006-044N02 POI 230kV bus. b. Clear fault after 9 cycles by tripping the faulted line.
LVRT02-1PH	Single phase fault on the GEN-2006-044N02 POI (570886) to Kelly (640133) 230kV line, near the GEN-2006-044N02 POI. a. Apply fault at the GEN-2006-044N02 POI 230kV bus. b. Clear fault after 15 cycles by tripping the faulted line.
LVRT03-3PH	3 phase fault on the GEN-2006-044N02 POI (570886) to Ft Randall (652509) 230kV line, near the GEN-2006-044N02 POI. a. Apply fault at the GEN-2006-044N02 POI 230kV bus. b. Clear fault after 9 cycles by tripping the faulted line.
LVRT04-1PH	Single phase fault on the GEN-2006-044N02 POI (570886) to Ft Randall (652509) 230kV line, near the GEN-2006-044N02 POI. a. Apply fault at the GEN-2006-044N02 POI 230kV bus. b. Clear fault after 15 cycles by tripping the faulted line.

Table 6-5 lists the results of LVRT analysis. The results of the simulations indicated that the GEN-2006-044N02 wind farm project meets the FERC LVRT criteria for the interconnection of the wind farm generation (FERC Order 661 – A). Plots for all the LVRT simulations are included in Appendix D.

Table 6-5: Results of analysis for FERC LVRT compliance

Fault Name	2010 Summer Peak	2009 Winter Peak
LVRT01-3PH	STABLE	STABLE
LVRT02-1PH	STABLE	STABLE
LVRT03-3PH	STABLE	STABLE
LVRT04-1PH	STABLE	STABLE

Figure 6-1 through Figure 6-4 show the responses of GEN-2006-044N02 and the POI voltage following the simulated four LVRT faults for the 2010 Summer Peak condition.

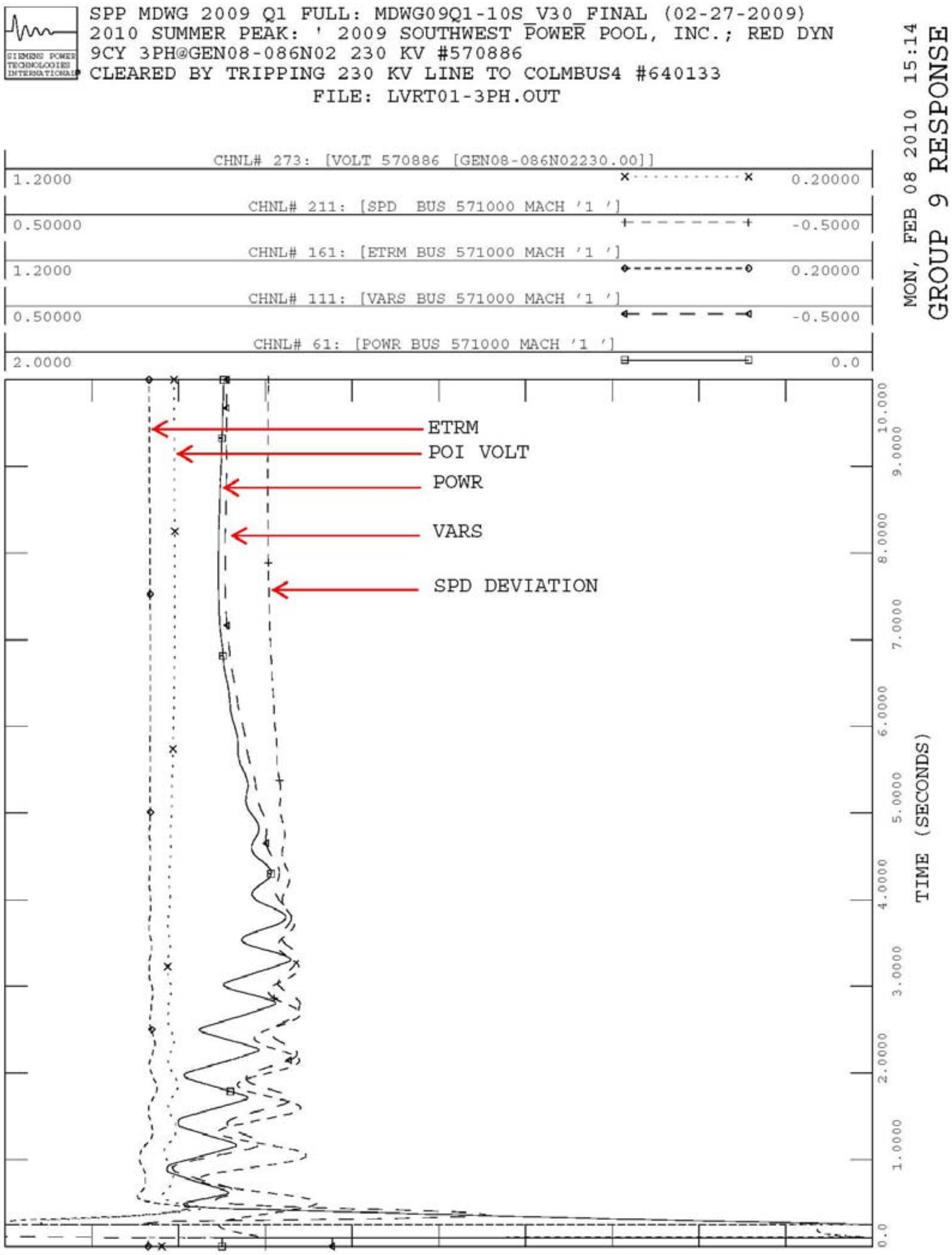


Figure 6-1: GEN-2006-044N02 Machine Responses and POI Voltage for LVRT01-3PH

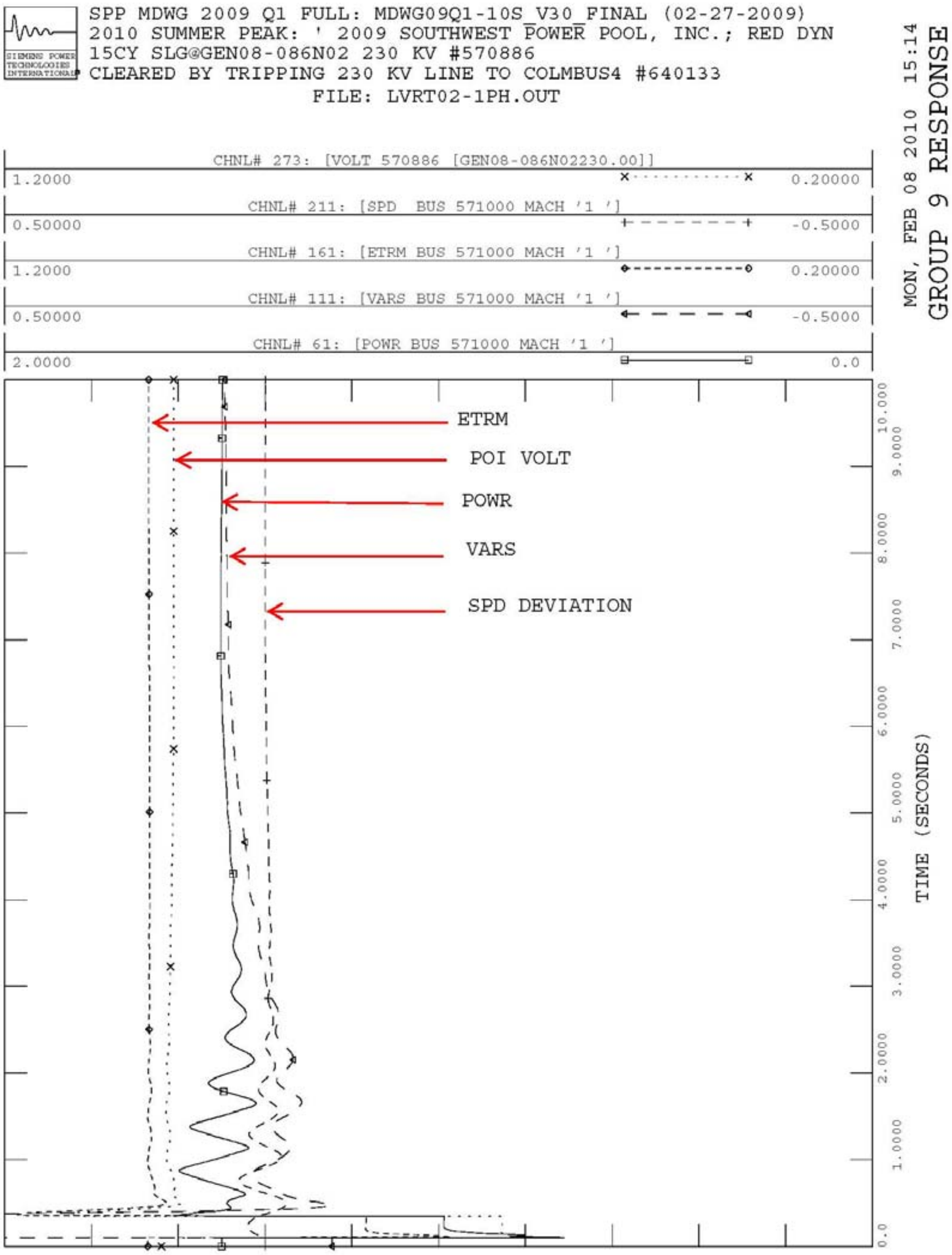


Figure 6-2: GEN-2006-044N02 Machine Responses and POI Voltage for LVRT02-1PH

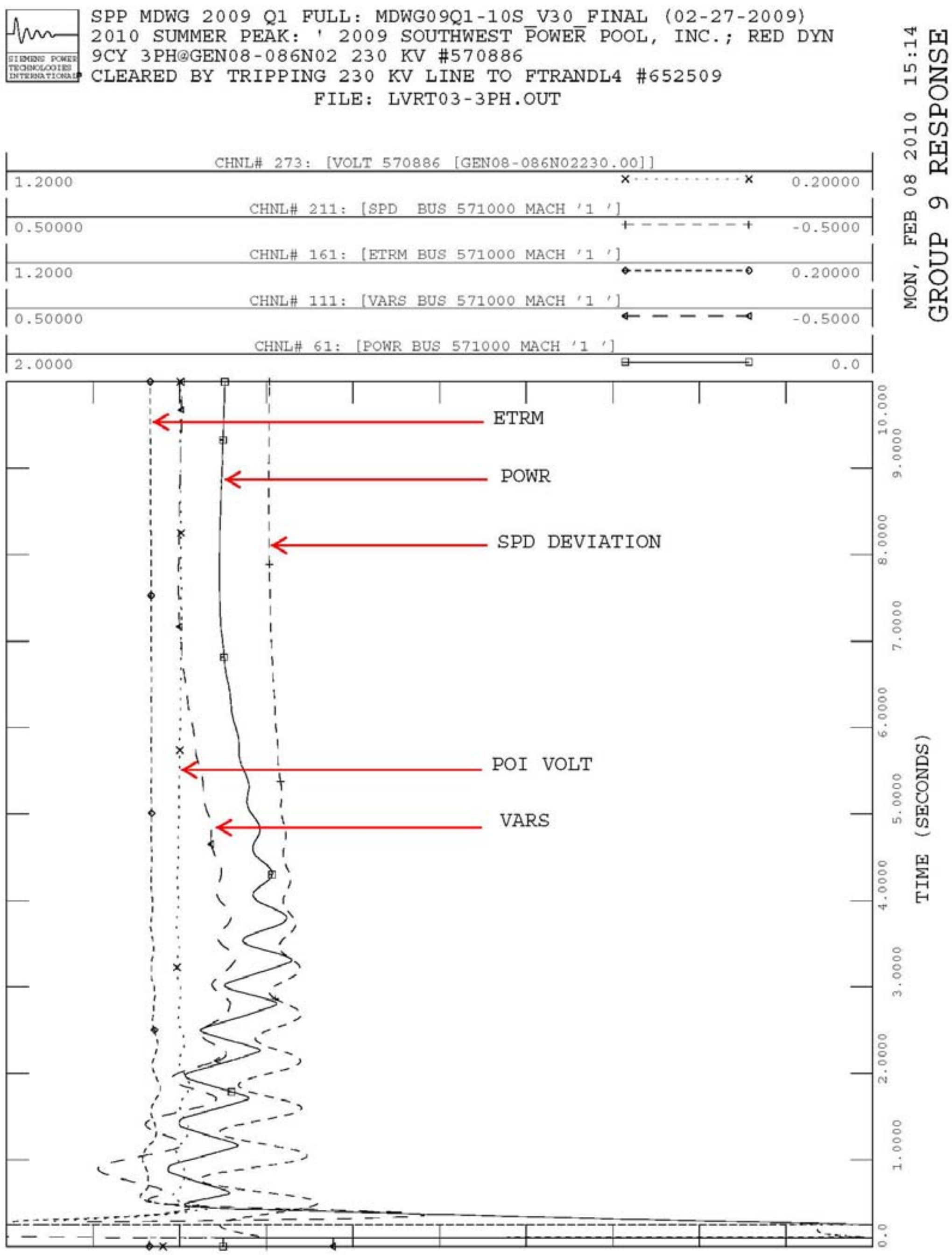


Figure 6-3: GEN-2006-044N02 Machine Responses and POI Voltage for LVRT03-3PH

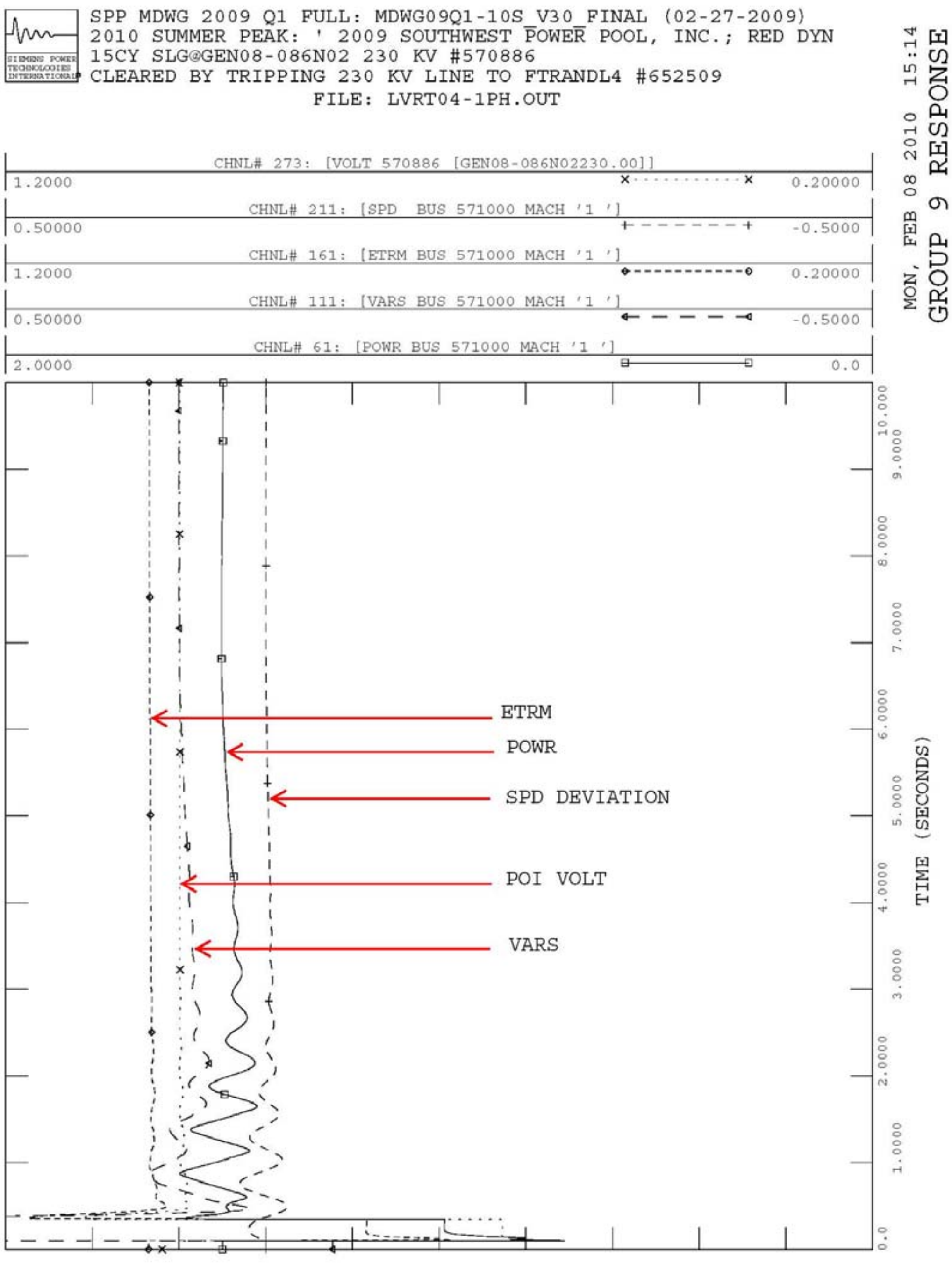


Figure 6-4: GEN-2006-044N02 Machine Responses and POI Voltage for LVRT04-1PH

7 CONCLUSIONS

The main objectives of this study were

1) To determine the power factor requirements for the wind farm
2) To determine the impact of proposed GEN-2006-044N02 (150 MW) generation on system stability and the nearby transmission system and generating stations.
3) To validate the compliance with FERC LVRT requirement.

The study was performed on 2010 Summer Peak and 2009 Winter Peak cases, provided by SPP.

To achieve these objective the following analyses were performed on the 2010 Summer Peak and 2009 Winter Peak system conditions

- Power factor Analysis for the selected contingencies.
- Transient Stability analysis under various local and regional contingencies.
- LVRT performance under selected contingencies near POI.

Following is the summary of study findings:

Power factor analysis

The power factor analysis was performed to determine the power factor requirement for the wind farm. The wind farm will need to be able to provide 99.71% lagging (supplying vars) at the point of interconnection.

Stability Analysis

The stability analysis was performed to determine the impact, if any, of the proposed PISIS-2009-001 Group 9 project (GEN-2006-044N02) on the stability of the SPP system. The system was **STABLE** following all simulated 3-phase and single-phase faults. **NONE** of previously installed wind farm monitored and the proposed Group 9 GEN-2006-044N02 wind farm project tripped following all simulated faults.

FERC Order 661A Compliance

Selected faults were simulated at the Point of Interconnection (POI) of the proposed GEN-2006-044N02 wind farm to determine the compliance with FERC 661 – A post-transition period LVRT standard. The results indicated that the proposed project meets the FERC LVRT requirement for wind farms.

The results of this analysis 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 model change, the results provided in this report may not apply.

APPENDIX A LOAD FLOW AND STABILITY DATA IN PSSE FORMAT FOR GEN-2006-044N02

Loadflow Data

```
570886,'GEN08-086N02', 230.0000,1,    0.000,    0.000, 640, 686,1.02045,   7.0734,   1
571000,'GEN2006-044 ',  0.5750,2,    0.000,    0.000, 640, 686,1.03500,  16.2375, 640
571001,'MADISON-LV  ',  34.5000,1,    0.000,    0.000, 640, 686,1.02600,  13.5865, 640
571003,'MADISON-HV  ', 230.0000,1,    0.000,    0.000, 640, 686,1.02117,   7.3901, 640
0 / END OF BUS DATA, BEGIN LOAD DATA
0 / END OF LOAD DATA, BEGIN GENERATOR DATA
571000,'1 ',  150.000,   11.631,   14.300,  -14.300,1.03500,    0,  167.000,  0.00000,
0.80000,  0.00000,  0.00000,1.00000,1,  100.0,  150.000,    0.000, 640,1.0000
0 / END OF GENERATOR DATA, BEGIN BRANCH DATA
570886,-571003,'1 ',  0.00080,  0.00383,  0.00000,   0.00,    0.00,    0.00,  0.00000,
0.00000,  0.00000,  0.00000,1,  0.00, 640,1.0000
0 / END OF BRANCH DATA, BEGIN TRANSFORMER DATA
571001,571000,    0,'1 ',1,2,1,  0.00000,  0.00000,2,'          ',1, 640,1.0000
   0.00770,  0.05790,  175.00
1.00000,  0.000,  0.000,    0.00,    0.00,    0.00, 0,     0, 1.10000, 0.90000, 1.10000,
0.90000,  33, 0, 0.00000, 0.00000
1.00000,  0.000
571003,571001,    0,'1 ',1,2,1,  0.00000,  0.00000,2,'          ',1, 640,1.0000
   0.00532,  0.07982,  105.00
1.00000,  0.000,  0.000,    0.00,    0.00,    0.00, 0,     0, 1.10000, 0.90000, 1.10000,
0.90000,  33, 0, 0.00000, 0.00000
1.00000,  0.000
0 / END OF TRANSFORMER DATA, BEGIN AREA DATA
0 / END OF AREA DATA, BEGIN TWO-TERMINAL DC DATA
0 / END OF TWO-TERMINAL DC DATA, BEGIN VSC DC LINE DATA
0 / END OF VSC DC LINE DATA, BEGIN SWITCHED SHUNT DATA
0 / END OF SWITCHED SHUNT DATA, BEGIN IMPEDANCE CORRECTION DATA
0 / END OF IMPEDANCE CORRECTION DATA, BEGIN MULTI-TERMINAL DC DATA
0 / END OF MULTI-TERMINAL DC DATA, BEGIN MULTI-SECTION LINE DATA
0 / END OF MULTI-SECTION LINE DATA, BEGIN ZONE DATA
0 / END OF ZONE DATA, BEGIN INTER-AREA TRANSFER DATA
0 / END OF INTER-AREA TRANSFER DATA, BEGIN OWNER DATA
0 / END OF OWNER DATA, BEGIN FACTS DEVICE DATA
0 / END OF FACTS DEVICE DATA
```

Dynamics Data

```
PLANT MODELS

 REPORT FOR ALL MODELS                    BUS 571000 [GEN2006-044 0.5750] MODELS


 ** GEWTG **   BUS X-- NAME --X   BASEKV MC  C O N S     S T A T E S        VAR
ICON
            571000    GEN2006-0 0.5750 1   44339-44354   17604-17606   10421-10425
1539-1540

   PRATE     XEQ       VLVPL1    VLVPL2    GLVPL1   GLVPL2
   1.5000       0.8    0.5000    0.9000    1.0000    1.1100

   VHVRCR1   VHVRCR2   CURHVRCR1 CURHVRCR2 VLVACR1
   1.0500    1.2000    1.0000    2.0000    0.4000

   VLVACR2   LLVACR1   LLVACR2   RIp_LVPL  T_LVPL
   0.8000    0.0000    1.0000    5.0000    0.0200


 NUMBER OF AGGREGATED ORIGINAL WT UNITS:  100


 ** GEWTE OF GEWTG **  BUS X-- NAME --X BASEKV MC       C O N S       S T A T E S     VAR
ICON
                       571000 GEN2006-044  0.5750 1   91791-91841   35178-35192   15943-
15945    5055-5061

   TFV      KPV        KIV       RC        XC        TFP       KPP
   0.1500   18.0000    5.0000    0.0000    0.0000    0.0500    3.0000

   KIP       PMX       PMN       QMX      QMN        IPMAX     TRV
   0.6000    1.1200    0.0400    0.4360   -0.4360    1.1000    0.0200

   RPMX      RPMN      T_POWER   KQi      VMINCL     VMAXCL    KVi
   0.4500   -0.4500    5.0000    0.1000    0.9000    1.1000   40.0000

   XIQmin    XIQmax    Tv        Tp       Fn         TPav
   0.5000    1.4500    0.0500    0.0500    1.0000    0.1500

   FRa       FRb       FRc       FRd
   0.9600    0.9960    1.0040    1.0400

   PFRa      PFRb      PFRc      PFRd
   1.0000    0.9500    0.9500    0.4000

   PFRmax    PFRmin    TW        T_LVPL   V_LVPL
   1.0000    0.2000    1.0000    0.2500   -1.0000

   SPDW1     SPDWMX    SPDWMN    SPD_LOW  WTTHRES
  11.0000   25.0000    3.0000   -0.9000    8.0000

   EBST      KDBR      Pdbr_MAX
   0.2500   10.0000    1.0000

   ImaxTD    Iphl      Iqhl
   1.7000    1.1100    1.2500



 Remote controlled Bus #    571000
               VARFLG =  1 PFAFLG =  0
               APCFLG =  0 FRFLG =  0
               PQFLAG =  1
```

```
 **   GEWTT **  BUS X-- NAME --X BASEKV MC    C O N S     S T A T E S     V A R S
ICON
            571000    GEN2006-0 0.5750 1  116483-116487  44191-44194   20553-20555
5336

     H           DAMP          Htfrac       Freq1       DSHAFT
    4.9400       0.0000       0.8770       1.8000       1.5000

  ** WGUSTC ** BUS X-- NAME --X     BASEKV MC    C O N S       V A R S        ICONS
            571000     GEN2006-044  0.5750 1  134147-134152  29331-29334   15601-15603

  T1G          TG        MAXG        T1R       T2R        MAXR
  9999.000     5.000    30.000  9999.000  9999.000    30.000
               Wind generator Bus # 571000
               Wind Generator ID        1


 ** GEWTA for GEWTG **      BUS X-- NAME --X BASEKV MC    C O N S        STATE
VAR         ICON
                       571000 GEN2006-044  0.5750 1  134153-134161   45736-45736   29335-
29338   15604-15606

     Lambda_Max      Lambda_Min   PITCH_MAX    PITCH_MIN      Ta         RHO
      20.0000       0.0000      27.0000      -4.0000       0.0000       1.2250

       Radius      GB_RATIO        SYNCHR
      35.2500      72.0000        1200.0000


               Wind Generator Bus # 571000
               Wind Generator ID        1


 ** GEWTP for GEWTG **  BUS X-- NAME --X BASEKV MC    C O N S         STATE         VAR
ICON
                       571000 GEN2006-044  0.5750 1  134162-134171   45737-45739   29339-
29341   15607-15609

        Tp             Kpp        Kip            Kpc          Kic
       0.3000     150.0000      25.0000       3.0000      30.0000
         TetaMin    TetaMax   RTetaMin   RTetaMax     PMX
         -4.0000    27.0000  -10.0000   10.0000    1.0000


               Wind Generator Bus # 571000
               Wind Generator ID        1


 ** GEWTPT ** BUS X-- NAME --X    BASEKV MC       V A R S       ICONS
            571000    GEN2006-044  0.57501       29342-29358   15610-15611


               Wind generator Bus # 571000
               Wind Generator ID        1
```

APPENDIX B Results of Power Factor Analysis

APPENDIX B.1 GEN-2006-044N02 POI voltage without VAR generator

Contingency	Contingency Description	GEN-2006-044N02 POI VOLTAGE (#570886)	
		SUMMER PEAK	WINTER PEAK
SYSTEM INTACT		1.0197	1.01732
CONT_01	570644 GEN-06-044N 115 - 640293 NELIGH 7 115 ckt 1	1.0198	1.01736
CONT_02	640054 ALBION 7 115 - 640318 PETRSBG7 115 ckt 1	1.01908	1.01687
CONT_03	640293 NELIGH 7 115 - 640113 CLRWATR7 115 ckt 1 640113 CLRWATR7 115 - 640305 ONEILL 7 115 ckt 1	1.01936	1.01705
CONT_04	640305 ONEILL 7 115 - 640349 SPENCER7115 ckt 1 640349 SPENCER7 115.00 - 652510 FTRANDL7 115 ckt 1	1.01931	1.01716
CONT_05	640084 BLMFLD 7 115 - 652511 GAVINS 7 115 ckt 1	1.01983	1.01738
CONT_06	640343 SHELCRK4 230 - 640133 COLMBUS4 230 ckt 1	1.01525	1.01292
CONT_07	640131 COLMB.W4 230 - 640133 COLMBUS4 230 ckt 1	1.01963	1.01341
CONT_08	640126 E.COL. 4 230 - 640133 COLMBUS4 230 ckt 1	1.02079	1.01799
CONT_09	570886 GEN08-086N02 230 - 640133 COLMBUS4 230 ckt 1	1.00946	1.01513
CONT_10	**570886 GEN08-086N02 230 - 652509 FTRANDL4 230 ckt 1**	**0.98256**	**0.9679**
CONT_11	652509 FTRANDL4 230 - 652507 FTTHOMP4 230 ckt 1	1.02029	1.01764
CONT_12	652509 FTRANDL4 230 - 652526 UTICAJC4 230 ckt 1	1.01536	1.01292
CONT_13	652509 FTRANDL4 230 - 652516 LAKPLAT4 230 ckt 1	1.02019	1.01759
CONT_14	652509 FTRANDL4 230 - 652565 SIOUXCY4 230 ckt 1	1.01654	1.01414
CONT_15	640133 COLMBUS4 230 - 640134 KELLY 7 115 ckt 1	1.01947	1.01755

APPENDIX C PLOTS FOR STABILITY SIMULATIONS

APPENDIX D PLOTS FOR LVRT SIMULATIONS

R: Stability Study for Group 10

S: Stability Study for Group 11

Report R24-10

Generator Interconnection Impact study: PISIS-2009-001- Group 11

Prepared for

Southwest Power Pool, Inc.

Submitted by:
Edrissa Cham, Consultant
Bernardo Fernandes, Senior Consultant

Draft Report: March 05, 2010

Siemens PTI Project Number: P/23-115078 -B-1

Siemens Energy, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of Southwest Power Pool, Inc. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor Southwest Power Pool, Inc., nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and Southwest Power Pool, Inc. from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Section

1

Introduction

1.1 Background

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Siemens PTI performed the Impact Study *"Generator Interconnection Impact Study for PISIS-2009-001 - Group 11"* to satisfy the Impact Study Agreement executed by the customers. The requests for interconnection were placed with SPP in accordance to SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

The purpose of this report is to present the results of the stability and power factor analysis performed to evaluate the impact of the Project on the Southwest Power Pool system. Eventual indicative solutions to the identified issues are proposed based on the impact of the Project on the Southwest Power Pool system.

The Point of Interconnection of the Project (to be known hereafter as POI) is located in Control Area MIDW (531) at the 345 kV level of Smoky Hill, between Smoky Hill 230 KV and Summit 345 KV. Section 2 describes the Project in detail.

Transient stability analysis was performed using the package provided by SPP. It contains the latest stability database in PSS®E version 30.3.3. The stability package also includes the dynamic data for the prior queued projects.

1.2 Purpose

The steady state and stability study was carried out to:

1. Determine the ability of the proposed generation facilities to remain in synchronism and within applicable planning standards following two types of system faults tested a) unsuccessful reclosing b) Normally Cleared faults.
2. Determine the amount of transient support required from the costumer to meet the power factor requirement at the POI.
3. Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage).

This page intentionally left blank.

Section

2

Model Development

The study considered the 2010 Summer Peak and 2009 Winter Peak load flow models with the required interconnection generation modeled. The base cases also contain all the significant prior queued generation interconnection projects in the interconnection queue.

2.1 Power Flow Data

Table 2-1 below presents the size of the Project, the Wind Turbine Generator (WTGs) manufacturer, the reactive capability of the wind farm as well as the point of interconnection and the PSS®E bus numbers in the load flow models.

Table 2-1 – Details of the Interconnection Requests

Request	Size (MW)	Model	Reactive Capability of Wind Farm		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
GEN-2008-061	149.4	Vestas V90 1.8 MW	0 (*)	0 (*)	Smoky Hills 345kV	560078

(*) – For voltage control within 0.95 p.u. – 1.050 p.u.

The analysis was carried out using the database package provided by SPP which also includes the modeling data for the previously queued projects shown in Table 2-2:

Table 2-2 – Details of the Prior Queue Interconnection Requests

Request	Size (MW)	Model	Point of Interconnection	Point of Interconnection
GEN-2003-006A	200	Vestas V90 3.0 MW	Elm Creek 230 kV	539639
GEN-2003-019	250	GE 1.5 MW	Smoky Hills 230 kV	530592
GEN-2006-031	75	Gas	Knoll 115 kV	530561
GEN-2006-032	200	Gamesa 2.0 MW	South Hays 230 kV	530582
GEN-2008-092	200	GE 1.5 MW	Knoll 230 kV	530558
GEN-2009-011	50	Gamesa 2.0 MW	Tap Plainville - Phillipsburg 115 KV	570911

Figures 2-1 to 2-2 present the surrounding area of the Project's POI, showing the line flows and voltage profile for the load flow models considered in the study for summer and winter peak scenarios, respectively.

Figure 2-1 – GEN-2008-061 Point of Interconnection Surrounding Area – *Diagram 1* Summer Peak

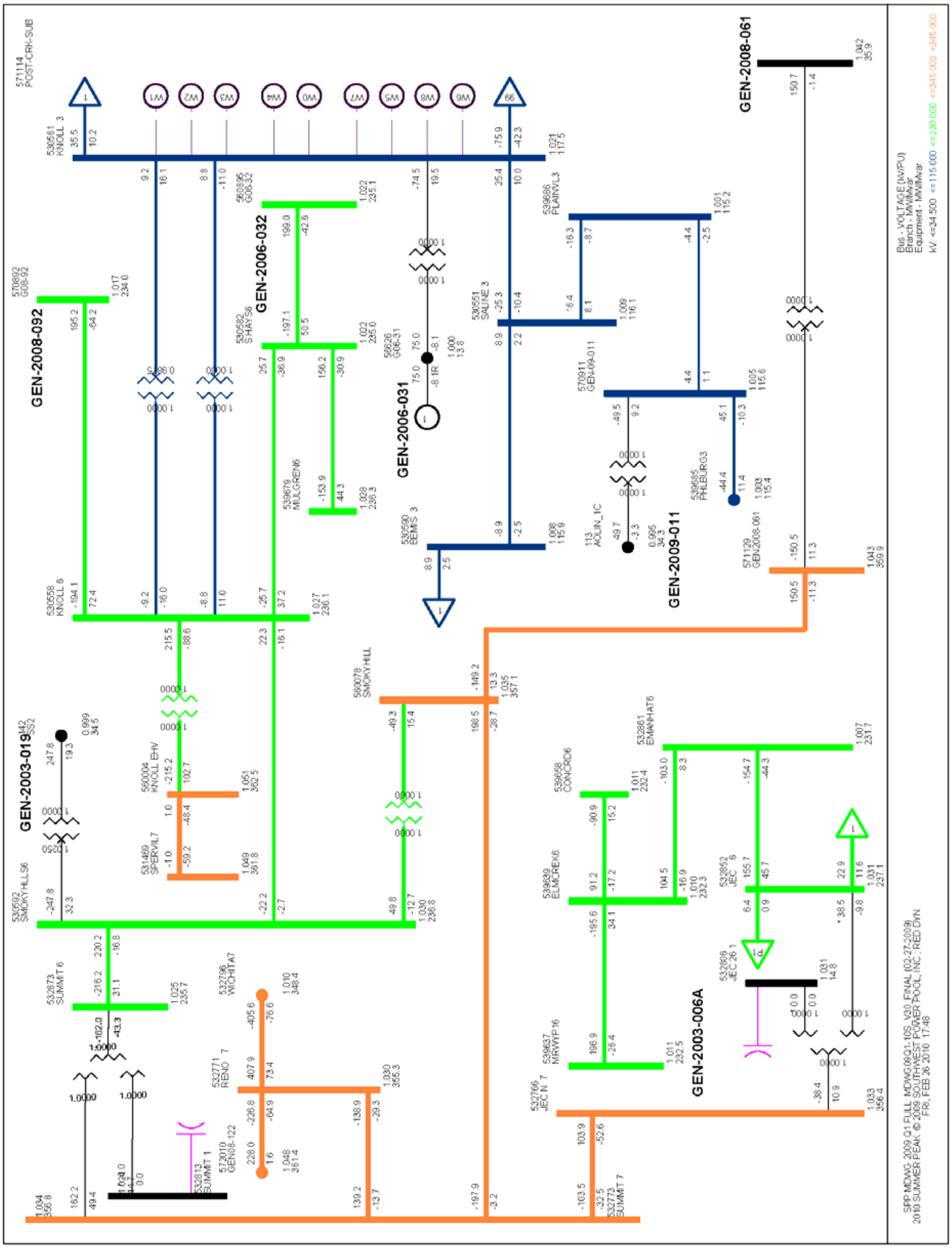
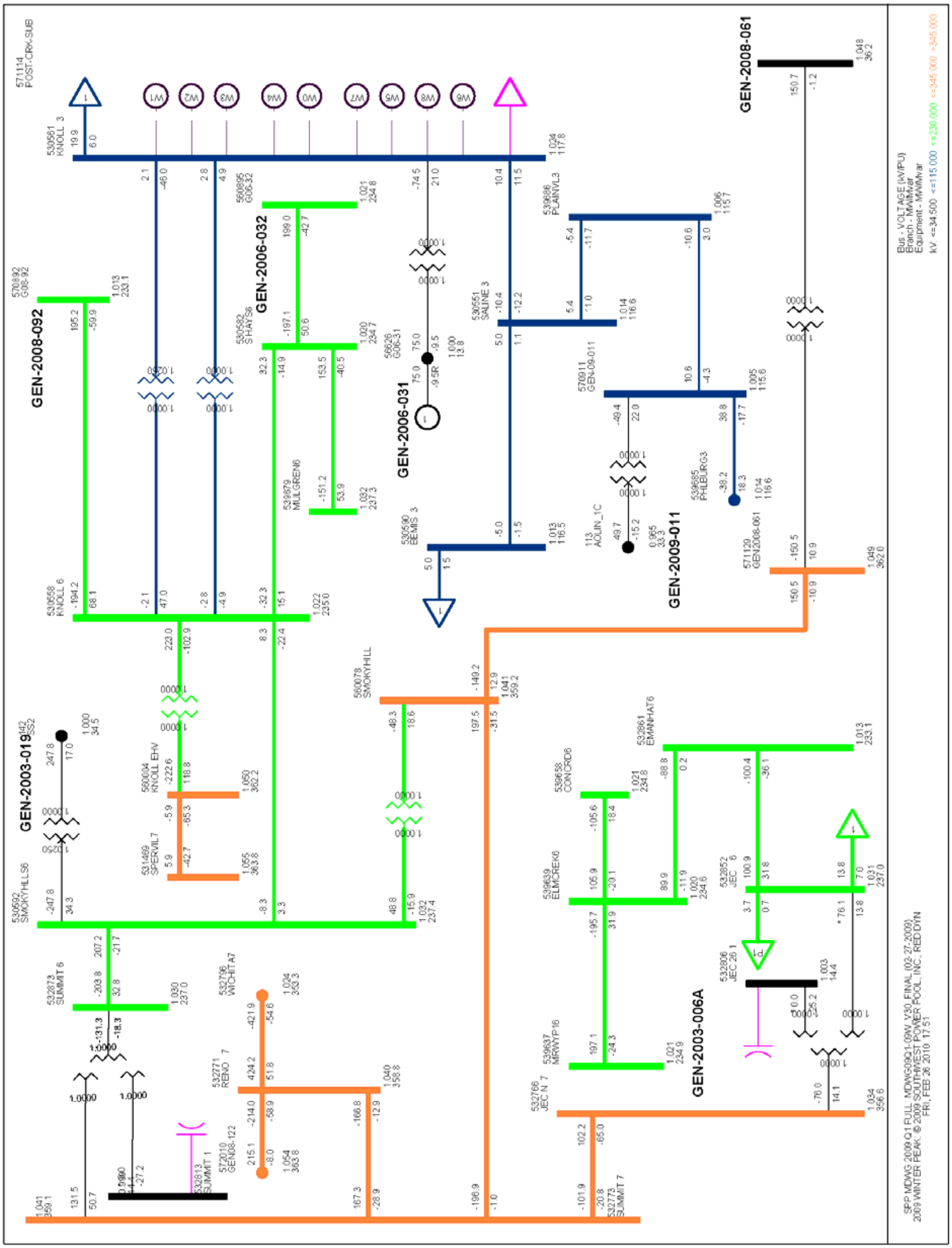


Figure 2-2 – GEN-2008-061 Point of Interconnection Surrounding Area – Diagram 2 Winter Peak



Figures A-1 in Appendix A present the single line diagrams showing, for each of the Group 11 project, the modeling details and impedance data of the transformers and collector systems.

2.2 Stability Database

The transient stability analysis was performed using the data provided by SPP. All turbine parameters used in the simulation models are the default parameters in the wind turbine package. It is assumed that each wind turbine generators (WTGs) controls the voltage of its own bus.

The default voltage protection model set points recommended by the manufacturer were used, that is, the wind units were modeled with their built-in voltage ride through capability. Also, the default frequency protection model set points recommended by the manufacturer were used.

The Project was modeled using information about the 34.5 KV collector system. The Project's wind turbines in close proximity were modeled using an equivalent wind turbine.

The PSS®E dynamic models output list is shown in Appendix B, documenting the model parameters of one of the seven equivalent wind turbines modeled in the stability study. All of the equivalent wind turbines have the same model parameters.

Section

3

Methodology and Assumptions

The study considered the 2010 Summer Peak and 2009 Winter Peak power flow cases with the Project modeled as described in Section 2. The base case also contains all the significant prior queued projects in the interconnection queue.

The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
520	AEPW
524	OKGE
525	WFEC
526	SPS
531	MIDW
534	SUNC
536	WERE
539	MKEC
640	NPPD
645	OPPD
650	LES

3.1 Methodology

3.1.1 Stability Simulations

The stability simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single line to ground faults in the neighborhood of PISIS-2009-001 – Group 11 Point of Interconnection were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The Group 11 project were also evaluated on the matter of ability to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

3.1.2 Steady State Simulations

3.1.2.1 N-1 Contingency Analysis

An N-1 contingency analysis was performed to evaluate voltage violations, if any, caused by disturbances (tripping of the faulted line). The voltages at the Project's and prior queued requests' POIs were monitored for deviations from the base case voltage following a contingency and the percentage deviations were documented.

During contingency analysis, voltages of any monitored bus found to be outside the range of the post-contingency criteria and / or having more than 1% of project impact were reported.

3.1.2.2 Power Factor Analysis

The analysis will determine what power factor is necessary at the POI for each contingency.

If the required power factor at the POI is beyond the capability of the studied wind turbines to meet the requirement at the POI, capacitor banks will be considered.

A QV analysis was performed to determine the reactive support requirement at each project's POI. Mvar injections, tabulated for base case and contingency conditions, are used to determine the reactive power support required at each POI, in order to maintain the bus scheduled pre contingency voltages.

These tables are obtained through a series of AC load flow calculations. Starting with no reactive support at a bus, the voltage is computed for a series of power flows as the reactive support is changed in steps, until the power flow experiences convergence difficulties as the system approaches the voltage collapse point.

3.2 Disturbances for Stability Analysis

The faults are defined as single line to ground, and three phase faults. The fault clearing includes reclosing for selected contingencies.

For faults with unsuccessful line reclosing, the complete fault clearing process includes the following sequence of events:

1) Line fault, cleared after 5 cycles by tripping the both line terminals

2) After 20 cycles the line is reclosed under fault conditions (unsuccessful reclosing)

3) The fault is cleared by tripping both ends of the faulted line, again 5 cycles later.

For faults with normal clearing, the fault is cleared by tripping the both line terminals after 5 cycles.

The disturbances evaluated are listed in the following Table 3-2:

Table 3-2: Disturbances for Stability Analysis

#	Fault Location	Fault Type	Fault Clearing
1	At Setab end of 345 KV line to Holcomb	3PH	Trip Setab - Holcomb 345kV line
2	At Setab end of 345 KV line to Holcomb	SLG	Trip Setab - Holcomb 345kV line
3	At Setab end of 345 KV line to Mingo	3PH	Trip Setab – Mingo 345 kV
4	At Setab end of 345 KV line to Mingo	SLG	Trip Setab – Mingo 345 kV
5	At Setab 345 KV end of 115/345 kV transformer	3PH	Trip Setab 115/345 KV transformer
6	At Setab 345 KV end of 115/345 kV transformer	SLG	Trip Setab 115/345 KV transformer
7	At Mingo end of 345 KV line to Red Willow	3PH	Trip Mingo –Red Willow 345 KV line
8	At Mingo end of 345 KV line to Red Willow	SLG	Trip Mingo –Red Willow 345 KV line
9	At Mingo 345 kV end of 115/345 kV transformer	3PH	Trip Mingo 115/345 kV transformer
10	At Mingo 345 kV end of 115/345 kV transformer	SLG	Trip Mingo 115/345 kV transformer
11	At Gentleman end of 345 KV line to Sweetwater	3PH	Trip Gentleman – Sweetwater 345 KV line
12	At Gentleman end of 345 KV line to Sweetwater	SLG	Trip Gentleman – Sweetwater 345 KV line
13	At Holcomb end of 345 KV line to GEN-2007-040	3PH	Trip Holcomb – Gen-2007-040 345 KV line
14	At Holcomb end of 345 KV line to GEN-2007-040	SLG	Trip Holcomb – Gen-2007-040 345 KV line
15	At Holcomb 345 kV end of 115/345 kV transformer	3PH	Trip Holcomb 115/345 kV transformer
16	At Holcomb 345 kV end of 115/345 kV transformer	SLG	Trip Holcomb 115/345 kV transformer
17	At Finney end of 345 KV line to GEN-2003-013	3PH	Trip Finney – GEN-2003-013 345 KV line
18	At Finney end of 345 KV line to GEN-2003-013	SLG	Trip Finney – GEN-2003-013 345 KV line
19	At Spearville end of 345 KV line to Knoll	3PH	Trip Spearville - Knoll 345 KV line
20	At Spearville end of 345 KV line to Knoll	SLG	Trip Spearville - Knoll 345 KV line
21	At Spearville end of 345 KV line to Comanche	3PH	Trip Spearville - Comanche 345 kV line
22	At Spearville end of 345 KV line to Comanche	SLG	Trip Spearville - Comanche 345 kV line

#	Fault Location	Fault Type	Fault Clearing
23	At Sweetwater end of 345 KV line to Axtell	3PH	Trip Sweetwater - Axtell 345 kV line
24	At Sweetwater end of 345 KV line to Axtell	SLG	Trip Sweetwater - Axtell 345 kV line
25	At Knoll end of 345 KV line to Axtell	3PH	Trip Knoll - Axtell 345 kV line
26	At Knoll end of 345 KV line to Axtell	SLG	Trip Knoll - Axtell 345 kV line
27	At Smoky Hills end of 230 KV line to Knoll	3PH	Trip Knoll – Smoky Hills 230 KV line
28	At Smoky Hills end of 230 KV line to Knoll	SLG	Trip Knoll – Smoky Hills 230 KV line
29	At Smoky Hills end of 230 KV line to Summit	3PH	Trip Summit – Smoky Hills 230 KV line
30	At Smoky Hills end of 230 KV line to Summit	SLG	Trip Summit – Smoky Hills 230 KV line
31	At Knoll end of 230 KV line to South Hays	3PH	Trip Knoll - South Hays 230 KV line
32	At Knoll end of 230 KV line to South Hays	SLG	Trip Knoll - South Hays 230 KV line
33	At Knoll 230kV end of 230/345 KV transformer	3PH	Trip Knoll 230/345 KV transformer
34	At Knoll 230kV end of 230/345 KV transformer	SLG	Trip Knoll 230/345 KV transformer
35	At Knoll 230 kV end of 115/230 KV transformer	3PH	Trip Knoll 115/230 KV transformer
36	At Knoll 230 kV end of 115/230 KV transformer	SLG	Trip Knoll 115/230 KV transformer
37	At Knoll end of 115 KV line to Saline	3PH	Trip Knoll – Saline 115 KV line
38	At Knoll end of 115 KV line to Saline	SLG	Trip Knoll – Saline 115 KV line
39	At Knoll end of 115 KV to Redline	3PH	Trip Knoll – Redline 115 KV
40	At Knoll end of 115 KV to Redline	SLG	Trip Knoll – Redline 115 KV
41	At South Hays end of 230 KV line to Mullergren	3PH	Trip South Hays - Mullergren 230kV line
42	At South Hays end of 230 KV line to Mullergren	SLG	Trip South Hays - Mullergren 230kV line
43	At Mullergren end of 230 KV line to Circle	3PH	Trip Mullergren - Circle 230kV line
44	At Mullergren end of 230 KV line to Circle	SLG	Trip Mullergren - Circle 230kV line
45	At Summit end of 230 KV line to Hope	3PH	Trip Summit - Hope 230 kV line
46	At Summit end of 230 KV line to Hope	SLG	Trip Summit - Hope 230 kV line
47	At Summit end of 230 KV line to E. McPherson	3PH	Trip Summit - E. McPherson 230 kV line

#	Fault Location	Fault Type	Fault Clearing
48	At Summit end of 230 KV line to E. McPherson	SLG	Trip Summit - E. McPherson 230 kV line
49	At Summit 230 kV end of 230/345 KV transformer	3PH	Trip Summit 230/345 kV transformer
50	At Summit 230 kV end of 230/345 KV transformer	SLG	Trip Summit 230/345 kV transformer
51	At Summit end of 345 KV line to JEC	3PH	Trip Summit - JEC 345 kV line
52	At Summit end of 345 KV line to JEC	SLG	Trip Summit - JEC 345 kV line
53	At Knoll end of 115 KV line to N Hays	3PH	Trip Knoll - N Hays 115 kV line
54	At Knoll end of 115 KV line to N Hays	SLG	Trip Knoll - N Hays 115 kV line
55	At Phillipsburg end of 115 KV line to GEN-2009-011	3PH	Trip GEN-2009-011 - Philipsburg 115 kV line
56	At Philipsburg end of 115 KV line to GEN-2009-011	SLG	Trip GEN-2009-011 - Philipsburg 115 kV line
57	At Philipsburg end of 115 KV line to Smith Center	3PH	Trip Smith Center – Philipsburg 115 kV line
58	At Philipsburg end of 115 KV line to Smith Center	SLG	Trip Smith Center – Philipsburg 115 kV line
59	At Philipsburg end of 115 KV to Rhoades	3PH	Trip Rhoades - Philipsburg 115 kV line
60	At Philipsburg end of 115 KV to Rhoades	SLG	Trip Rhoades - Philipsburg 115 kV line
61	At Rhoades end of 115 KV to Graham	3PH	Trip Rhoades - Graham 115 kV line
62	At Rhoades end of 115 KV to Graham	SLG	Trip Rhoades - Graham 115 kV line
63	At Ionia end of 115 KV to Smith Center	3PH	Trip Smith Center – Ionia 115 KV line
64	At Ionia end of 115 KV to Smith Center	SLG	Trip Smith Center – Ionia 115 KV line
65	At Smith Center end of 115 KV to Glen Elder	3PH	Trip Smith Center - Glen Elder 115 KV line
66	At Smith Center end of 115 KV to Glen Elder	SLG	Trip Smith Center - Glen Elder 115 KV line
67	At Rolling Hills end of 115 KV line to Pioneer Tap	3PH	Trip Pioneer Tap - Rolling Hills 115 kV line
68	At Rolling Hills end of 115 KV line to Pioneer Tap	SLG	Trip Pioneer Tap - Rolling Hills 115 kV line
69	At Pioneer Tap end of 115 KV to Mullergren	3PH	Trip Pioneer Tap – Mullergren 115 kV line
70	At Pioneer Tap end of 115 KV to Mullergren	SLG	Trip Pioneer Tap – Mullergren 115 kV line
71	At E Manhattan end of 230 KV line to Elm Creek	3PH	Trip E Manhattan - Elm Creek 230 kV line

#	Fault Location	Fault Type	Fault Clearing
72	At E Manhattan end of 230 KV line to Elm Creek	SLG	Trip E Manhattan - Elm Creek 230 kV line
73	At Sumitt end of 345 KV line to Smoky Hills	3PH	Trip Smoky Hills - Summit 345 kV line
74	At Sumitt end of 345 KV line to Smoky Hills	SLG	Trip Smoky Hills - Summit 345 kV line
75	At Smoky Hills 230 KV end of 230/345 transformer	3PH	Trip Smoky Hills 230/345 kV transformer

In order to simulate single line to ground faults, equivalent reactances were determined to be applied at the buses. Table 3-3 presents the equivalent reactances obtained:

Table 3-3: Equivalent Reactances – Single Line to Ground Faults
Summer and Winter Peak Scenarios

Contingency #	BUS	Equivalent Reactance (Mvar)
2	531465	2800
4	531465	2800
6	531465	2800
8	531451	2100
10	531451	2100
12	640183	4300
14	531449	4100
16	531449	4100
18	523853	4100
20	531469	5700
22	531469	5700
24	640374	3200
26	560004	2600
28	530592	1550
30	530592	1550
32	530558	2350

Contingency #	BUS	Equivalent Reactance (Mvar)
34	530558	2350
36	530558	2350
38	530561	1600
40	530561	1600
42	530582	2000
44	539679	1850
46	532873	2700
48	532873	2700
50	532873	2700
52	532773	3400
54	530561	1600
56	539685	390
58	539685	390
60	539685	390
62	531373	325
64	539647	320
66	539693	390
68	539643	250
70	539643	300
72	532861	1700
74	532773	3400

Figures 3-1 to 3-4 present the fault locations within the study area.

Figure 3-1 – Fault Locations in the Study Area – *Diagram1*

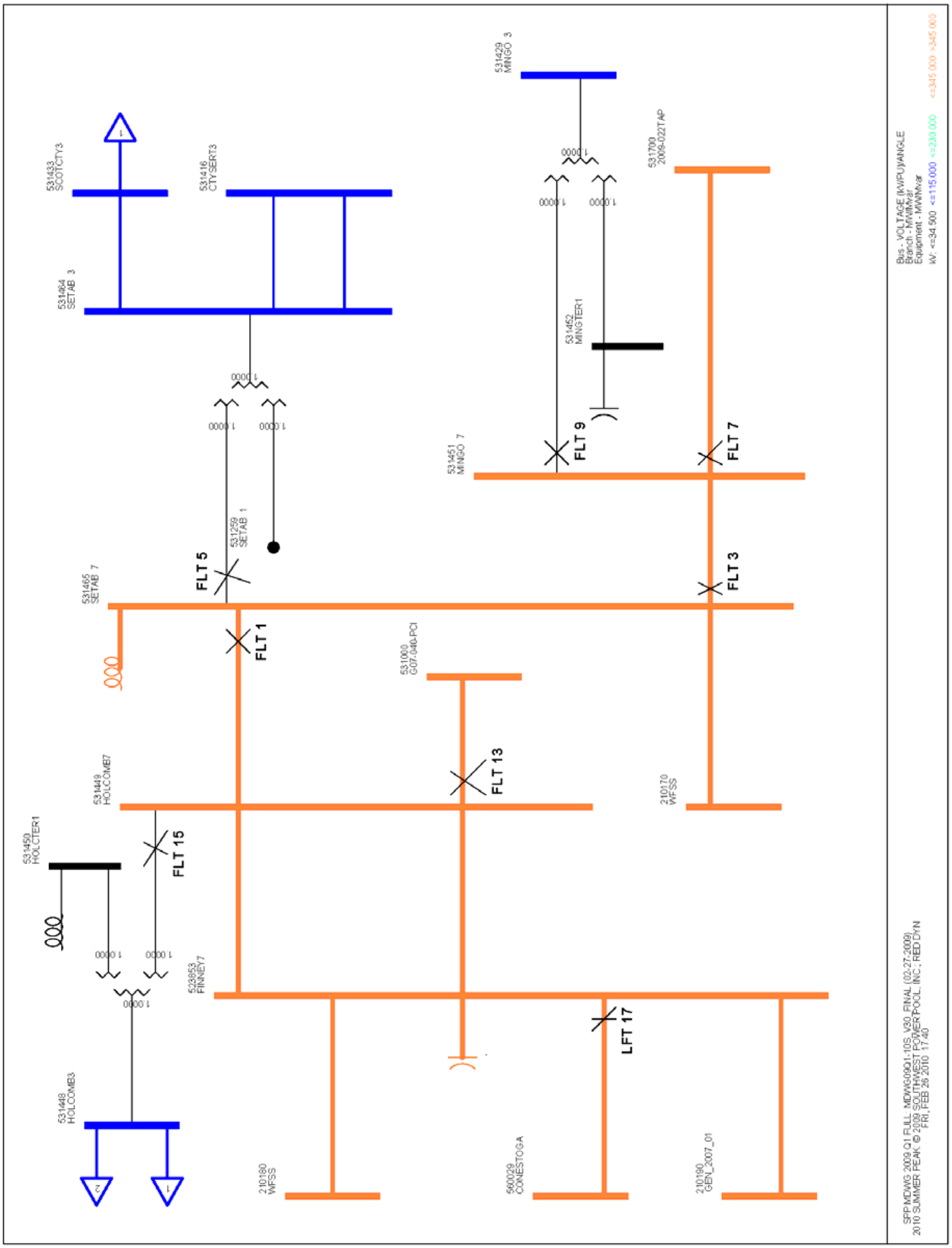


Figure 3-2 – Fault Locations in the Study Area – *Diagram2*

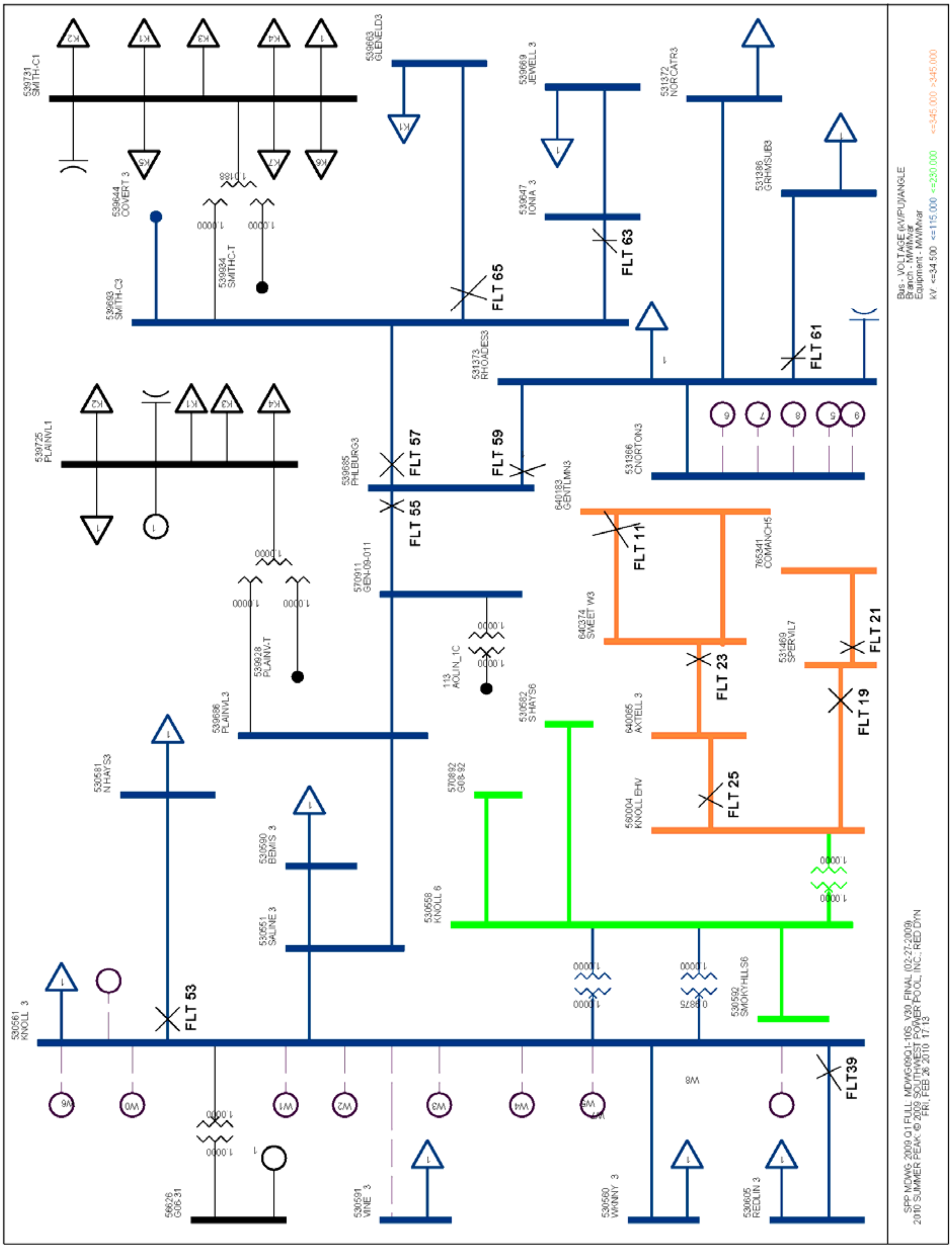


Figure 3-3 – Fault Locations in the Study Area – *Diagram 3*

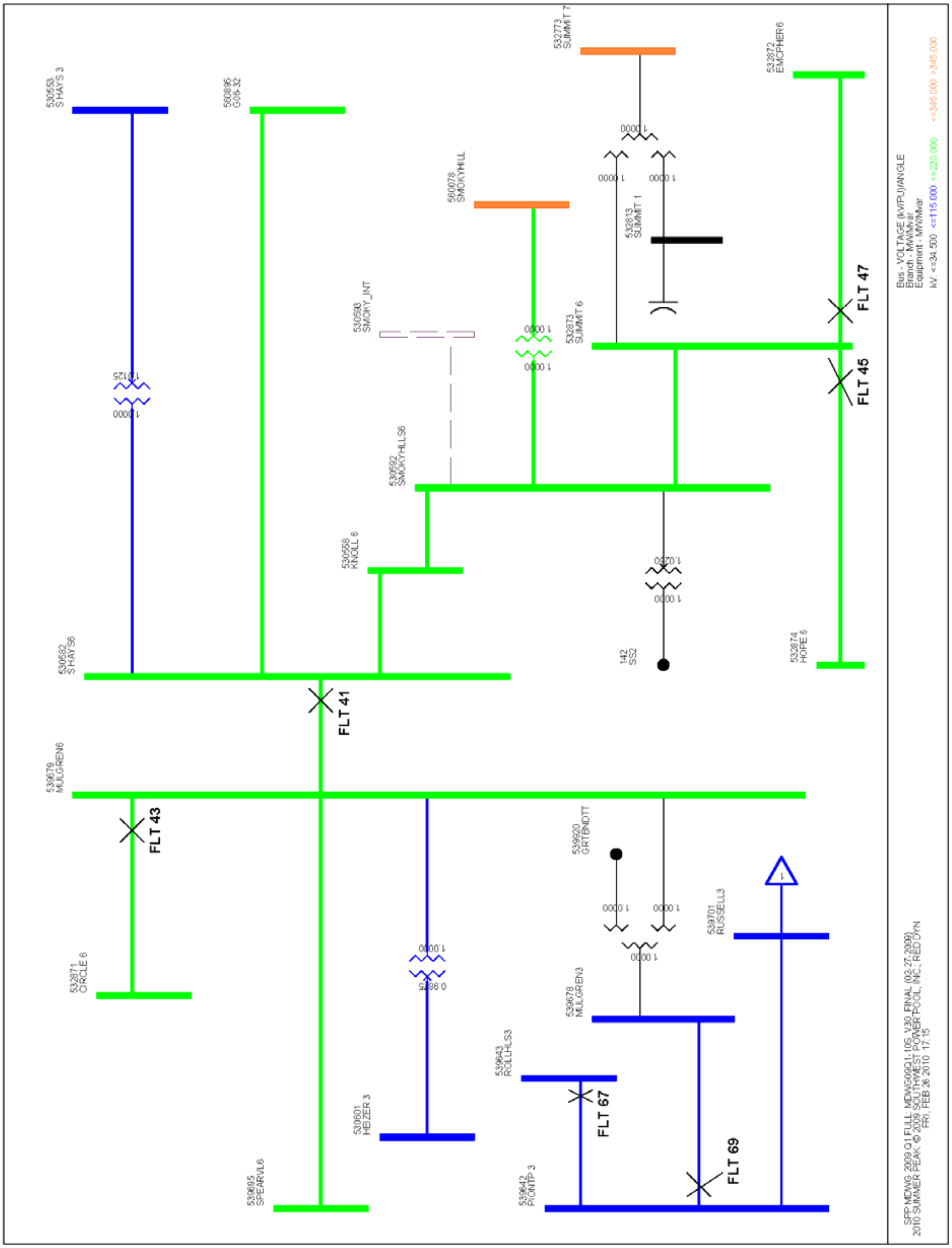
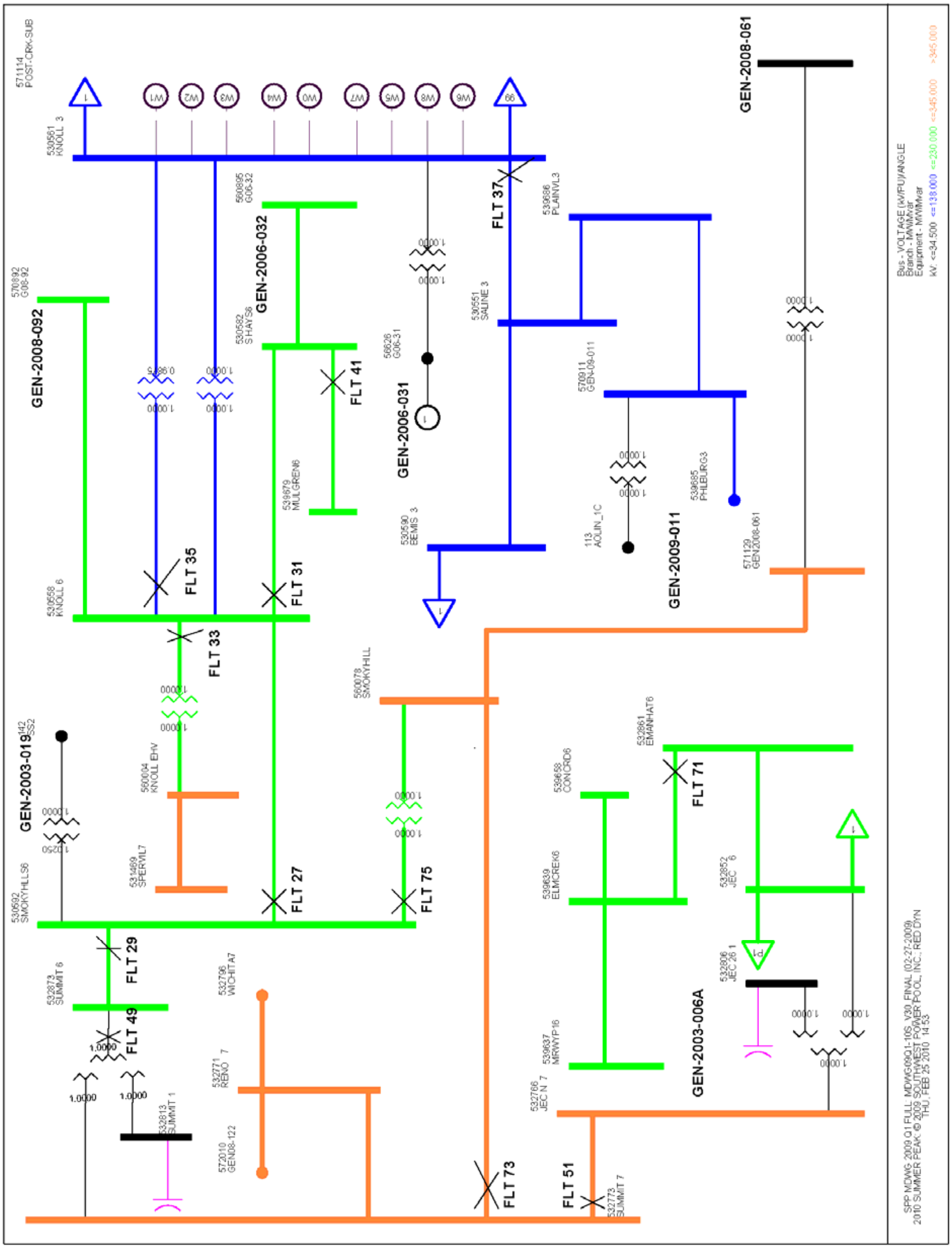


Figure 3-4 – Fault Locations in the Study Area – *Diagram 4*



This page intentionally left blank.

Section

4

Analysis Performed

4.1 Steady State Performance

Table 4-1 and Table 4-2 summarize the results obtained from the steady state analysis for summer peak and winter peak base cases, respectively. The tables list the voltage deviations at the POI of the Project, as well as the prior queued projects. Note that only the contingencies that cause a voltage criterion violation and / or have an impact of at least 1% in the POI's voltages are listed.

The complete set of results for both summer peak and winter peak scenarios are presented in Appendix C.

Table 4-1: Results Obtained – Steady State Analysis – Summer Peak

Bus #	Bus Name	Base kV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
530558	KNOLL 6	230.0	-	*1.0267*	-
530561	KNOLL 3	115.0	-	*1.0215*	-
530582	SOUTH HAYS 6	230.0	-	*1.0216*	-
530592	SMOKY HILLS	230.0	-	*1.0299*	-
539639	ELM CREEK 6	230.0	-	*1.0104*	-
560078	SMOKY HILLS	345.0	-	*1.0352*	-
570911	GEN-09-011	115.0	-	*1.0050*	-
FLT 29					
560078	SMOKY HILLS	345.0	*1.0239*	*1.0352*	*-1.13*
FLT 31					
530582	SOUTH HAYS 6	230.0	*1.0032*	*1.0216*	*-1.84*
FLT 33					
530558	KNOLL 6	230.0	*1.0025*	*1.0267*	*-2.42*
530561	KNOLL 3	115.0	*1.0036*	*1.0215*	*-1.79*
530582	SOUTH HAYS 6	230.0	*0.9983*	*1.0216*	*-2.33*
530592	SMOKY HILLS	230.0	*1.0168*	*1.0299*	*-1.31*
FLT 41					
530582	SOUTH HAYS 6	230.0	*1.0110*	*1.0216*	*-1.06*
FLT 71					
539639	ELM CREEK 6	230.0	*0.9894*	*1.0104*	*-2.10*

Bus #	Bus Name	Base kV	Contingency Voltage	Base Voltage	% Deviation
FLT 73					
530592	SMOKY HILLS	230.0	*1.0085*	*1.0299*	*-2.14*
560078	SMOKY HILLS	345.0	*1.0084*	*1.0352*	*-2.68*

Table 4-2: Results Obtained – Steady State Analysis – Winter Peak Base Case

Bus#	Bus Name	kV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
530558	KNOLL 6	230.0	-	*1.0219*	-
530561	KNOLL 3	115.0	-	*1.0243*	-
530582	SOUTH HAYS 6	230.0	-	*1.0204*	-
530592	SMOKY HILLS	230.0	-	*1.0324*	-
539639	ELM CREEK 6	230.0	-	*1.0205*	-
560078	SMOKY HILLS	345.0	-	*1.0413*	-
570911	GEN-09-011	115.0	-	*1.0050*	-
FLT 19					
530558	KNOLL 6	230.0	*1.0082*	*1.0219*	*-1.37*
530561	KNOLL 3	115.0	*1.0131*	*1.0243*	*-1.12*
530582	SOUTH HAYS 6	230.0	*1.0079*	*1.0204*	*-1.25*
FLT 29					
560078	SMOKY HILLS	345.0	*1.0300*	*1.0413*	*-1.13*
FLT 33					
530558	KNOLL 6	230.0	*0.9921*	*1.0219*	*-2.98*
530561	KNOLL 3	115.0	*1.0013*	*1.0243*	*-2.30*
530582	SOUTH HAYS 6	230.0	*0.9915*	*1.0204*	*-2.89*
530592	SMOKY HILLS	230.0	*1.0172*	*1.0324*	*-1.52*
FLT 41					
530558	KNOLL 6	230.0	*1.0101*	*1.0219*	*-1.18*
530561	KNOLL 3	115.0	*1.0143*	*1.0243*	*-1.00*
530582	SOUTH HAYS 6	230.0	*1.0063*	*1.0204*	*-1.41*
FLT 71					
539639	ELM CREEK 6	230.0	*0.9847*	*1.0205*	*-3.58*
FLT 73					
530592	SMOKY HILLS	230.0	*1.0093*	*1.0324*	*-2.31*
560078	SMOKY HILLS	345.0	*1.0093*	*1.0413*	*-3.20*

In both summer and winter peak scenarios, some contingencies caused voltage rise or drop equal to or greater than 0.01 p.u. However, there are no voltage criteria violations at the POIs, that is all of the bus voltages are within the range of 09.5 -1.05 pu. The main findings of the steady state analysis are given below:

- For both summer and winter peak cases, the loss of Knoll 230/345 KV transformer (FLT 33) resulted to significant voltage drops at Knoll and South Hays substations. This is mainly because following the contingency, the loadings of the lines at Knolls and South Hays increase significantly, thus resulting to voltage drops.

- For both summer peak and winter peak cases, the loss of E Manhattan to Elm Creek 230 KV line (FLT 71) resulted to significant voltage drop at Elm Creek 6 230 KV. This is mainly because following the contingency, the loading of Elm Creek 6 to Concord 230 KV line increases significantly.

- For both summer peak and winter peak cases, the loss of Smoky Hills to Summit 345 KV line (FTL 73) resulted to significant voltage drop at Smoky Hills substation. This is mainly because following the contingency, all of the power that was flowing through Smoky Hills to Summit 345 KV line, has been re-routed to Smoky Hills 230/345 KV transformer, thus increasing the loading at Smoky Hills transmission lines.

However, none of these contingencies cause violations at the Project's or prior queued requests' POIs and surrounding areas.

4.2 Power Factor Analysis

A QV analysis was performed to determine the amount of reactive power needed to be provided by the Project in order to maintain the scheduled voltage at the POI. The contingencies described in Table 3-2 were evaluated in steady state conditions for summer and winter peak base cases, with variable Mvar injection at the POI.

Table 4-3 presents the Mvar needed to be provided by the Project and the associated power factor that the Project must be able to provide under contingencies.

Table 4-3: Mvar Requirements and Power Factor of the Project at the POI

Project	Point of Interconnection	V Scheduled (p.u)	Project Injection at POI in Base Case (Mvar)	QV Injection (Mvar)	Project Requirement (Net Mvar at POI)	Contingency	Power Factor at POI (lagging)
GEN-2008-061	Smoky Hills 345 kV	1.041	-13.0	38.0	25.0	FLT 29	0.986

In order to control the Project's POI voltage at1.041 p.u, the amount of reactive support required by the Project is 25 Mvar.

QV Tables showing the injected Mvar for each voltage level in base case and contingencies are presented in Appendix D for both summer peak and winter peak scenarios. The values chosen are the highest between the two scenarios. The Project's reactive absorption in base case (13 Mvar) is then subtracted from the chosen values to get the Project's Mvar requirement at the POI.

4.3 Stability Results

The stability analysis was carried out using both summer peak and winter peak load flow models.

In order to determine the impact of the project on the overall system dynamics as well as to determine the requirements to meet the FERC Order 661-A Guidelines, 75 contingencies listed in Table 3-2 were simulated.

Gen-2008-061 does not trip due to LVRT issues under the contingencies studied, therefore the Group 11 wind generation project do not have an adverse impact on the SPP system dynamic performance.

Additionally, for both summer and winter peak cases, GP wind project (bus # 543116) tripped due to low voltage following contingencies 19 and 21. Since this project is not part of the prior queued requests associated with the study, no solution will be attempted to mitigate this issue. However, contingencies 19 and 21 were resimulated for both the summer and winter peak cases with GP wind project's voltage and frequency protection disabled. The results shows satisfactory dynamic behavior.

Besides the issue mentioned above, the results obtained show:

- The Project, did not trip during any of the contingencies tested, that is, no trips occurred due to LVRT or frequency protection.
- No trips were identified in the prior queued wind projects.
- All synchronous generators in the monitored areas were stable and remained in synchronism during all contingencies and the system conditions considered.
- Acceptable damping and voltage recovery was observed, within applicable standards.

Additional plots of selected system variables documenting the stability simulations are included in Appendix E.

Section

5

Conclusions

The projects of PISIS-2009-001 Group 11 have been evaluated to determine the impact of the proposed cluster of interconnections on the Southwest Power Pool system.

Steady state and stability analysis were carried out to evaluate the system performance under contingencies. Also to identify the system requirements to meet the FERC Order 661-A Guidelines for Low Voltage Ride Through (LVRT) and therefore, to allow the group 11 project to deliver their full power to the SPP transmission system.

In general, the Project has more than 1% impact on the voltage profile of the monitored system, under contingencies. No voltage criteria violations were identified through the simulations performed, although a couple of significant voltage deviations that are more that 3% were identified in the winter peak case:

- FLT 71: -3.58 % Elm Creek 6 230 kV
- FLT 73: -3.20% Smoky Hills (POI) 345 kV

The power factor analysis determined the amount of reactive support needed to be provided by the Project in order to maintain the scheduled voltage at the POI. The amount of reactive support indicated in Table 4-3 must be provided by the Project using the wind turbine generator (WTG) reactive capabilities and/or adding capacitor banks to the system.

The stability results indicate that the Project did not trip during the contingencies tested, that is, no trips occurred due to LVRT or frequency protection. Moreover, the Project has no adverse impact on the stability of the SPP system, for system conditions tested.

This page intentionally left blank.

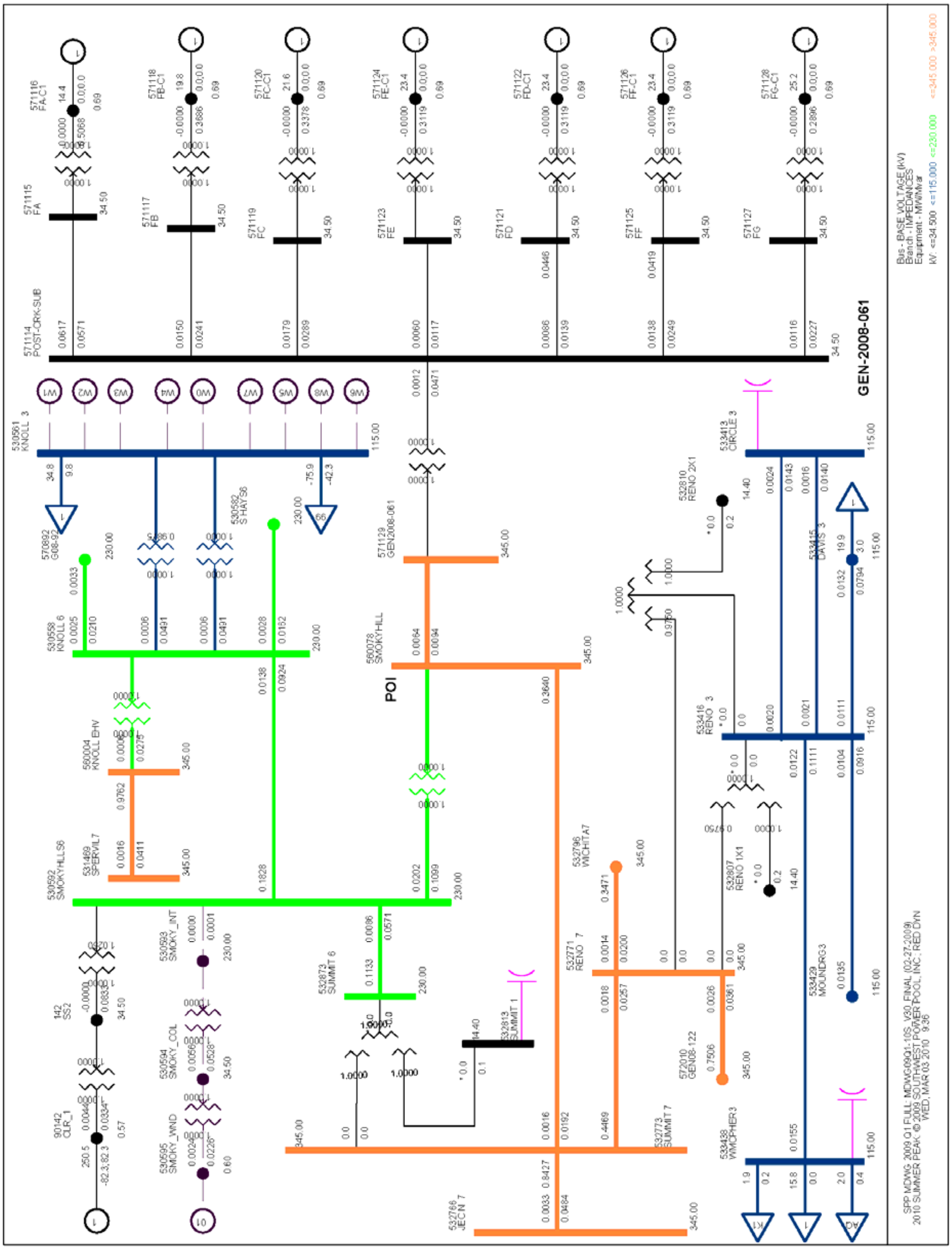
Appendix

A

WTG Single Line Diagrams

This appendix contains single line diagrams for the Group 11 project, showing the modeling details and impedance data of the transformers and collector systems.

A.1 Gen-2008-061



T: Stability Study for Group 12

U: Stability Study for Group 13

SPP PISIS-2009-001 Group 13
Preliminary Impact Study

Draft Report for

Southwest Power Pool

Prepared by:
Excel Engineering, Inc.

February 10, 2010

Principal Contributors:

Shu Liu, P.E.
William Quaintance, P.E.

TABLE OF CONTENTS

List of Figures

List of Tables

0. Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of **Arkansas**.

William Quaintance
Arkansas Registration Number 13865

1. Background and Scope

The PISIS-2009-001 Group 13 Preliminary Impact Study is a generation interconnection study performed by Excel Engineering, Inc. for its non-affiliated client, Southwest Power Pool (SPP). Its purpose is to study the impacts of interconnecting the project shown in Table 1-1. The in-service date assumed for the generation addition was 2010.

Table 1-1. Interconnection Requests Evaluated

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2009-031	149.5	Siemens SMK203 2.3MW	St Joseph (541199) – Cooper (640139) 345kV

The previously-queued requests shown in Table 1-2 were included in this study. All these previously-queued requests were dispatched at 100% of rated capacity.

Table 1-2. Nearby Interconnection Requests Already in the Queue

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2006-014	300	G.E. 1.5MW	WFarms 161kV (89572)
GEN-2006-017	300	Clipper 2.5MW	WFarms 161kV (89572)
GEN-2007-015	135	GE 1.5MW	Humboldt-Kelley 161kV. Bus # 540007
GEN-2007-017	100	G.E. 1.5 MW	WFarms 161kV (89572)
GEN-2007-053	110	Gamesa 2.0MW	WFarms 161kV (89572)
GEN-2008-119O	60	G.E. 1.5MW	Humboldt-Kelley 161kV. Bus # 640500
GEN-2008-129	641/675	Combined Cycle	Pleasant Hill 161kV
AECI -1	400	G.E. 1.5MW	Cooper – Fairport 345kV
AECI -2	300	G.E. 1.5 MW	Maryville 161kV

The study included a stability analysis for the proposed interconnection request. Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping disabled. Since the interconnection request in this group is wind project, a power factor analysis was performed.

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on Excel's knowledge of the electric power system and on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is sensitive to the assumptions made with respect to other generation additions and transmission improvements being contemplated by other entities.

Changes in the assumptions of the timing of other generation additions or transmission improvements will affect this study's conclusions.

2. Executive Summary

The PISIS-2009-001 Group 13 Preliminary Impact Study evaluated the impacts of interconnecting project GEN-2009-031 to the SPP electric system.

No stability problems were found during summer or winter peak conditions due to the addition of this generator.

Power factor requirements were determined, and the study plant must install sufficient reactive power resources to meet these requirements listed in Table 4-2. The reactive power resources need not be dynamically controlled. However, any change in wind turbine model or controls could change the stability results, possibly resulting in a need for a dynamically controlled reactive power supply.

With the assumptions described in this report, PISIS-2009-001 Group 13 should be able to connect without causing any stability problems on the SPP transmission grid.

3. Study Development and Assumptions

3.1 Simulation Tools

The Siemens Power Technologies, Inc. PSS/E power system simulation program Version 30.3.3 was used in this study.

3.2 Models Used

SPP provided its latest stability database cases for both summer and winter peak seasons. The study plant's PSS/E model had been developed prior to this study and was included in the power flow case and the dynamics database. As a result, no additional generator modeling was required. Power flow and dynamic model data for the study plants are provided in Appendix D.

A power flow one-line diagram of the study project in summer peak conditions is shown in Figure 3-1. As the figure shows, the plant model includes explicit representation of the substation transformer(s) from transmission voltage to 34.5 kV. The remainder of the wind farm is represented by one lumped equivalent including a generator, a step-up transformer, and a collector system impedance.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

3.3 Monitored Facilities

All generators in Areas 130, 330, 531, 534, 536, 540, 541, 640, and 645 were monitored.

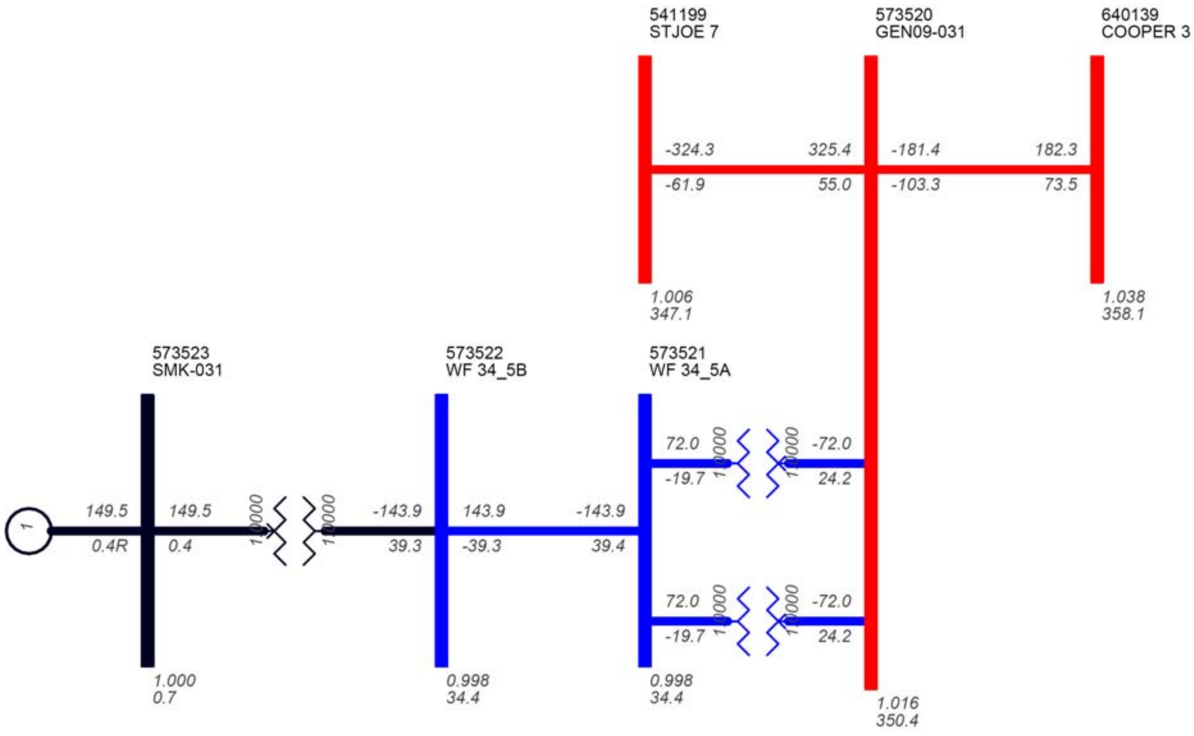


Figure 3-1. Power Flow One-line for GEN-2009-031 and adjacent equipment (SP)

3.4 Performance Criteria

The wind generators must comply with the FERC Order 661A on low voltage ride through for wind farms. Therefore, the wind generators should not trip off line for faults at the Point of Interconnection. If a wind generator trips off line, an appropriately sized SVC or STATCOM device may need to be specified to keep the wind generator on-line for the fault. SPP was consulted to determine if the addition of an SVC or STATCOM is warranted for the specific condition.

Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping disabled to check for stability issues.

3.5 Performance Evaluation Methods

Since the interconnection request is a wind project, a power factor analysis was performed. The power factor analysis consisted of modeling a var generator in each wind farm holding a voltage schedule at the POI. The voltage schedule was set equal to the higher of the voltage with the wind farm off-line or 1.0 per unit.

If the required power factor at the POI is beyond the capability of the studied wind turbines, then capacitor banks would be considered. Factors used in sizing capacitor banks would include two requirements of FERC Order 661A: the ability of the wind farm to ride through low voltage with and without capacitor banks and the ability of the wind farm to recover to pre-fault voltage. If a wind generator trips on high voltage, a leading power factor may be required.

Stability analysis was performed for each proposed interconnection request. Faults were simulated on transmission lines at the POIs and on other nearby transmission equipment. The faults in Table 3-1 were run for each case (three phase and single phase as noted).

Table 3-1. Fault Definitions for PISIS-2009-001 Group 13

Cont. No.	Contingency Name	Description
1	FLT01-3PH	3 phase fault on the GEN-2009-031 (573520) to Cooper (640139) 345kV line, near GEN-2009-031. a. Apply fault at the GEN-2009-031 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the GEN-2009-031 (573520) to St Joseph (541199) 345kV line, near GEN-2009-031. a. Apply fault at the GEN-2009-031 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on the Fairport (300039) to AECI wind farm (145) 345kV line, near Fairport. a. Apply fault at the Fairport 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Fairport (300039) to St Joseph (541199) 345kV line, near Fairport. a. Apply fault at the Fairport 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Iatan (542982) to St Joseph (541199) 345kV line, near St Joseph. a. Apply fault at the St Joseph 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT11-3PH	3 phase fault on the Nashua (542980) to St Joseph (541199) 345kV line, near St Joseph. a. Apply fault at the St Joseph 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Contingency Name	Description
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on the Fairport 345/161kV autotransformer on the 345kV bus (300039). a. Apply fault at the Fairport 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
14	FLT14-1PH	*Single phase fault and sequence like previous*
15	FLT15-3PH	3 phase fault on the St. Joseph 345/161kV autotransformer on the 345kV bus (541199). a. Apply fault at the St Joseph 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
16	FLT16-1PH	*Single phase fault and sequence like previous*
17	FLT17-3PH	3 phase fault on the Boonville (635630) to Cooper (640139) 345kV line, near Cooper. a. Apply fault at the Cooper 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Moore (640277) to Cooper (640139) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the Nebraska City (645458) to Cooper (640139) 345kV line, near Cooper. a. Apply fault at the Cooper 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
22	FLT22-1PH	*Single phase fault and sequence like previous*
29	FLT29-3PH	3 phase fault on the Pleasant Hill (541200) to Sibley (541201) 345kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-1PH	*Single phase fault and sequence like previous*
31	FLT31-3PH	3 phase fault on the Pleasant Hill (541200) to Peculiar (541198) 345kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	*Single phase fault and sequence like previous*
35	FLT35-3PH	3 phase fault on the Sibley (541201) to Hawthorn (542972) 345kV line, near Sibley. a. Apply fault at the Sibley 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	*Single phase fault and sequence like previous*
37	FLT37-3PH	3 phase fault on the Hawthorn (542972) to Nashua (542980) 345kV line, near Hawthorn. a. Apply fault at the Hawthorn 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	*Single phase fault and sequence like previous*

Cont. No.	Contingency Name	Description
43	FLT43-3PH	3 phase fault on the Iatan (542982) to Nashua (542980) 345kV line, near Iatan. a. Apply fault at the Iatan 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-1PH	*Single phase fault and sequence like previous*
45	FLT45-3PH	3 phase fault on the Iatan (542982) to Stranger Creek (532772) 345kV line, near Iatan. a. Apply fault at the Iatan 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
46	FLT46-1PH	*Single phase fault and sequence like previous*
47	FLT47-3PH	3 phase fault on the Stranger Creek (532772) to Hoyt (532765) 345kV line, near Stranger Creek. a. Apply fault at the Stranger Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
48	FLT48-1PH	*Single phase fault and sequence like previous*
49	FLT49-3PH	3 phase fault on the Craig (542977) to Stranger Creek (532772) 345kV line, near Craig. a. Apply fault at the Craig 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
50	FLT50-1PH	*Single phase fault and sequence like previous*
51	FLT51-3PH	3 phase fault on the West Gardner (542965) to Craig (542977) 345kV line, near West Gardner. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT52-1PH	*Single phase fault and sequence like previous*
53	FLT53-3PH	3 phase fault on the West Gardner (542965) to Swissvale (532774) 345kV line, near West Gardner. a. Apply fault at the West Gardner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
54	FLT54-1PH	*Single phase fault and sequence like previous*
55	FLT55-3PH	3 phase fault on the Stilwell (542968) to West Gardner (542965) 345kV line, near Stilwell. a. Apply fault at the Stilwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
56	FLT56-1PH	*Single phase fault and sequence like previous*
57	FLT57-3PH	3 phase fault on the Stilwell (542968) to Lacygne (542981) 345kV line, near Stilwell. a. Apply fault at the Stilwell 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
58	FLT58-1PH	*Single phase fault and sequence like previous*

Cont. No.	Contingency Name	Description
59	FLT59-3PH	3 phase fault on the Lacygne (542981) to West Gardner (542965) 345kV line, near Lacygne. a. Apply fault at the Lacygne 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT60-1PH	*Single phase fault and sequence like previous*

4. Results and Observations

4.1 Stability Analysis Results

All faults were run for both summer and winter peak conditions. If a previously-queued generator tripped for any of these faults, the voltage and frequency tripping was disabled, and the fault was re-run to check for system stability. No tripping occurred in this study.

Table 4-1 summarizes the overall results for all faults run. Figure 4-1 and Figure 4-2 show representative summer peak season plots for faults at the POIs for the study project. Complete sets of plots for both summer and winter peak seasons for each fault are included in Appendices A and B.

The system remains stable for all simulated faults. All study projects stay on-line for all simulated faults.

Table 4-1. Summary of Stability Results

Cont. No.	Contingency Name	Description	Summer Peak Results	Winter Peak Results
1	FLT01-3PH	3 phase fault on the GEN-2009-031 (573520) to Cooper (640139) 345kV line, near GEN-2009-031.	O.K.	O.K.
2	FLT02-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
3	FLT03-3PH	3 phase fault on the GEN-2009-031 (573520) to St Joseph (541199) 345kV line, near GEN-2009-031.	O.K.	O.K.
4	FLT04-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
5	FLT05-3PH	3 phase fault on the Fairport (300039) to AECI wind farm (145) 345kV line, near Fairport.	O.K.	O.K.
6	FLT06-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
7	FLT07-3PH	3 phase fault on the Fairport (300039) to St Joseph (541199) 345kV line, near Fairport.	O.K.	O.K.
8	FLT08-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
9	FLT09-3PH	3 phase fault on the Iatan (542982) to St Joseph (541199) 345kV line, near St Joseph.	O.K.	O.K.
10	FLT10-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
11	FLT11-3PH	3 phase fault on the Nashua (542980) to St Joseph (541199) 345kV line, near St Joseph.	O.K.	O.K.
12	FLT12-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
13	FLT13-3PH	3 phase fault on the Fairport 345/161kV autotransformer on the 345kV bus (300039).	O.K.	O.K.
14	FLT14-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
15	FLT15-3PH	3 phase fault on the St. Joseph 345/161kV autotransformer on the 345kV bus (541199).	O.K.	O.K.
16	FLT16-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
17	FLT17-3PH	3 phase fault on the Boonville (635630) to Cooper (640139) 345kV line, near Cooper.	O.K.	O.K.
18	FLT18-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
19	FLT19-3PH	3 phase fault on the Moore (640277) to Cooper (640139) 345kV line, near Moore.	O.K.	O.K.

Cont. No.	Contingency Name	Description	Summer Peak Results	Winter Peak Results
20	FLT20-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
21	FLT21-3PH	3 phase fault on the Nebraska City (645458) to Cooper (640139) 345kV line, near Cooper.	O.K.	O.K.
22	FLT22-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
29	FLT29-3PH	3 phase fault on the Pleasant Hill (541200) to Sibley (541201) 345kV line, near Pleasant Hill.	O.K.	O.K.
30	FLT30-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
31	FLT31-3PH	3 phase fault on the Pleasant Hill (541200) to Peculiar (541198) 345kV line, near Pleasant Hill.	O.K.	O.K.
32	FLT32-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
35	FLT35-3PH	3 phase fault on the Sibley (541201) to Hawthorn (542972) 345kV line, near Sibley.	O.K.	O.K.
36	FLT36-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
37	FLT37-3PH	3 phase fault on the Hawthorn (542972) to Nashua (542980) 345kV line, near Hawthorn.	O.K.	O.K.
38	FLT38-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
43	FLT43-3PH	3 phase fault on the Iatan (542982) to Nashua (542980) 345kV line, near Iatan.	O.K.	O.K.
44	FLT44-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
45	FLT45-3PH	3 phase fault on the Iatan (542982) to Stranger Creek (532772) 345kV line, near Iatan.	O.K.	O.K.
46	FLT46-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
47	FLT47-3PH	3 phase fault on the Stranger Creek (532772) to Hoyt (532765) 345kV line, near Stranger Creek.	O.K.	O.K.
48	FLT48-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
49	FLT49-3PH	3 phase fault on the Craig (542977) to Stranger Creek (532772) 345kV line, near Craig.	O.K.	O.K.
50	FLT50-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
51	FLT51-3PH	3 phase fault on the West Gardner (542965) to Craig (542977) 345kV line, near West Gardner.	O.K.	O.K.
52	FLT52-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
53	FLT53-3PH	3 phase fault on the West Gardner (542965) to Swissvale (532774) 345kV line, near West Gardner.	O.K.	O.K.
54	FLT54-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
55	FLT55-3PH	3 phase fault on the Stilwell (542968) to West Gardner (542965) 345kV line, near Stilwell.	O.K.	O.K.
56	FLT56-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
57	FLT57-3PH	3 phase fault on the Stilwell (542968) to Lacygne (542981) 345kV line, near Stilwell.	O.K.	O.K.
58	FLT58-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.
59	FLT59-3PH	3 phase fault on the Lacygne (542981) to West Gardner (542965) 345kV line, near Lacygne.	O.K.	O.K.
60	FLT60-1PH	*Single phase fault and sequence like previous*	O.K.	O.K.

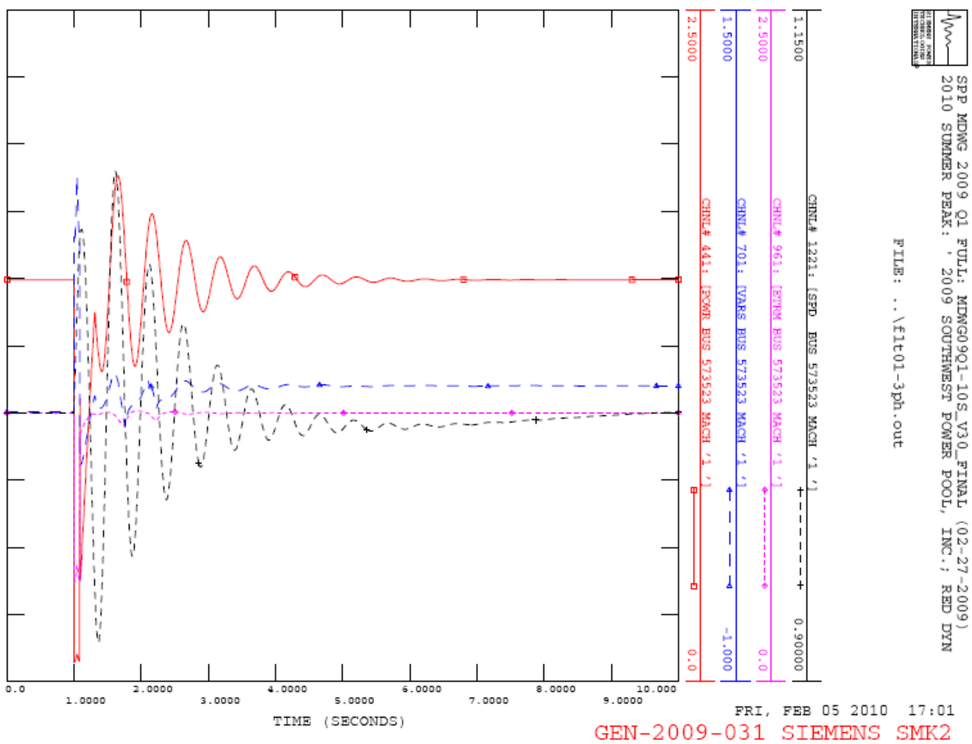


Figure 4-1. GEN-2009-031 Plot for Fault 1 – 3-Phase Fault on the GEN-2009-031 to Cooper 345 kV line, near GEN-2009-031

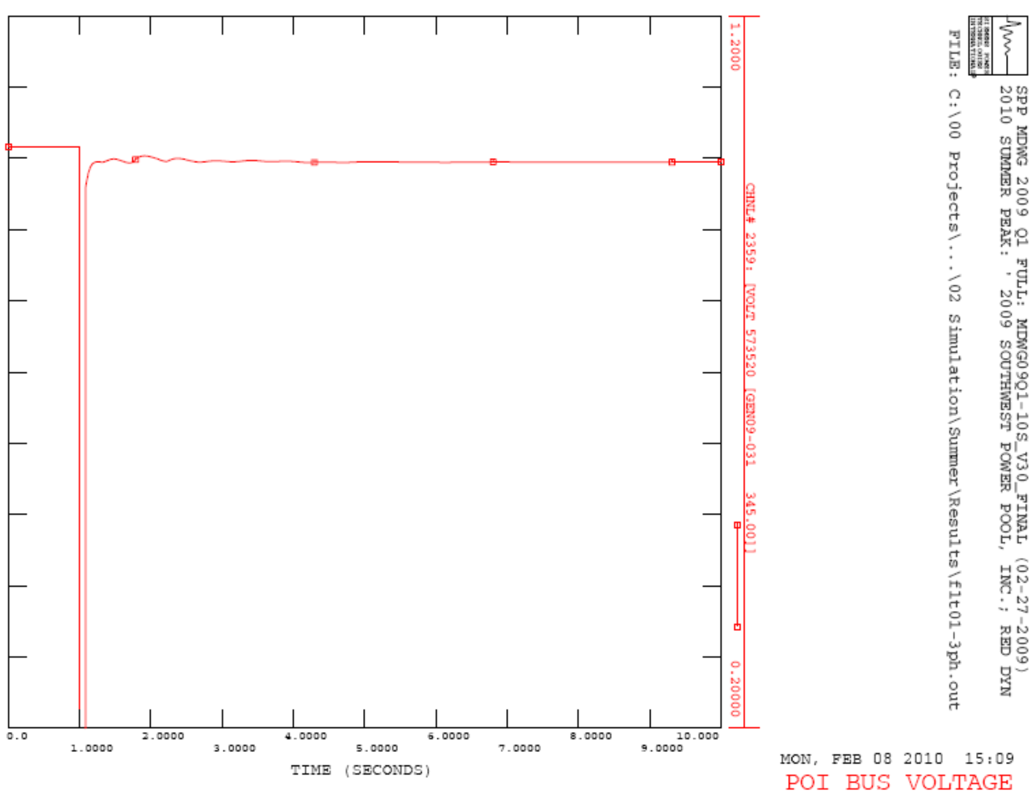


Figure 4-2. POI Voltage Plot for Fault 1 – 3-Phase Fault on the GEN-2009-031 to Cooper 345 kV line, near GEN-2009-031

4.2 Generator Performance

The study project performs well for all faults, with no tripping evident.

Prior-queued project GEN-2007-053 uses Gamesa 2.0 MW wind turbines. The power and speed of these generators oscillates long after a fault is cleared. See for example the plot for fault 1 in Figure 4-3 below. It is not known if these oscillations would occur in the actual wind turbine generators or if this is simply an inaccuracy of the Gamesa wind turbine dynamic model. It is not expected that these oscillations are due to the addition of the study project GEN-2009-031.

The other prior-queued projects perform well for all faults, with no tripping evident.

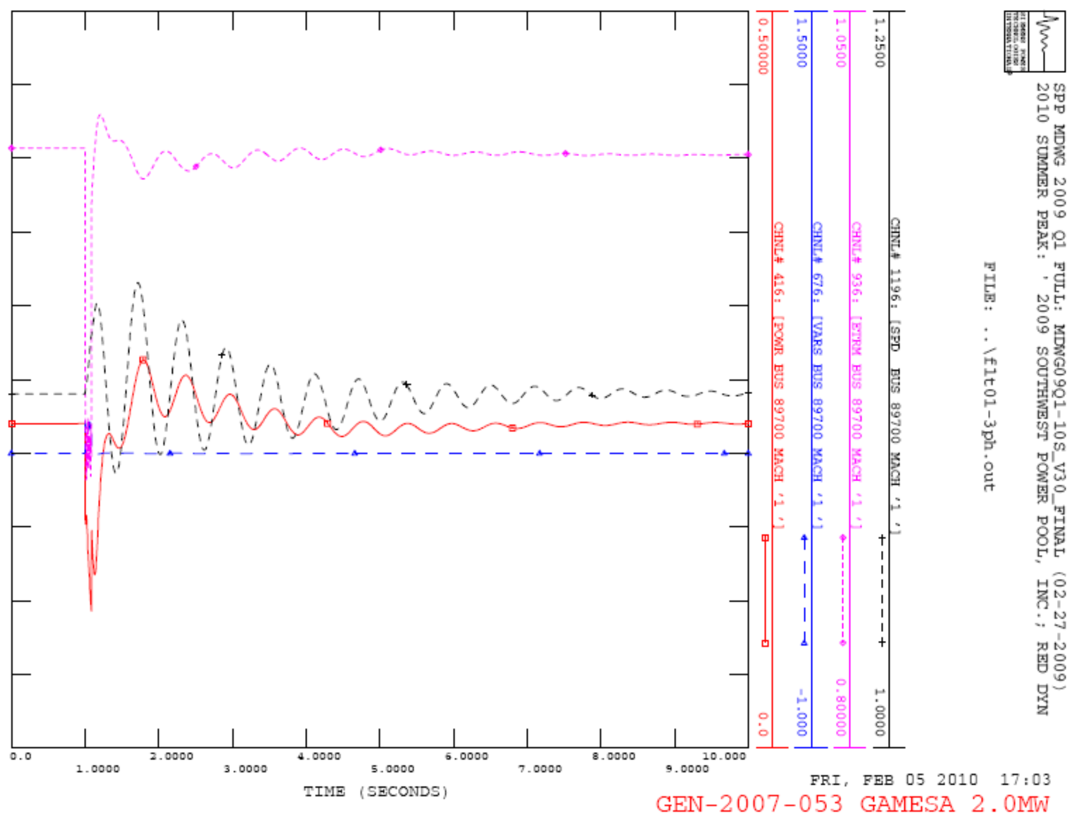


Figure 4-3. GEN-2007-053 Plot for Fault 1 – 3-Phase Fault on the GEN-2009-031 to Cooper 345 kV line, near GEN-2009-031

4.3 Power Factor Requirements

All stability faults were tested as power flow contingencies to determine the power factor requirements for the wind farm study project to maintain scheduled voltage at its respective point of interconnection (POI). The voltage schedules are set equal to the voltages at the POIs before the project is added, with a minimum of 1.0 per unit. Fictitious reactive power sources were added to the study project to maintain scheduled voltage during all studied contingencies. The MW and Mvar injections from the study project at the POI were recorded and the resulting power factors were calculated for all contingencies for summer peak and winter peak cases. The most leading and most lagging power factors determine the minimum power factor range capability that the study project must install before commercial operation.

If more than one study project shared a single POI (none in this case), the projects were grouped together and a common power factor requirement was determined for those study projects. This ensures that none of the study projects is required to provide more or less than its fair share of the reactive power requirements at a single POI. *Prior-queued* projects at the same POI, if any, were not grouped with the study projects because their interconnection requirements were determined in previous studies.

Per FERC and SPP Tariff requirements, if the power factor needed to maintain scheduled voltage were less than 0.95 lagging, then the requirement would be set to 0.95 lagging. This limit was reached for GEN-2009-031. Much greater reactive power supply would be needed to meet the voltage schedules under some contingencies, but only 0.95 lagging will be required. The limit for leading power factor requirement is also 0.95. This limit was reached for GEN-2009-031.

The final power factor requirements are shown in Table 4-2 below. These are only the minimum power factor ranges. A project developer may install more capability than this if desired.

The full details for each contingency in summer and winter peak cases are given in Appendix C.

Table 4-2. Power Factor Requirements [1]

Project	MW	Turbine	POI	Final PF Requirement	
				Lagging [2]	Leading [3]
GEN-2009-031	150	Siemens SMK203 2.3MW	St Joseph (541199) – Cooper (640139) 345kV	0.950	0.950

Notes:
1. For each plant, the table shows the minimum required power factor capability at the point of interconnection that must be designed and installed with the wind farm. The power factor capability at the POI includes the net effect of the wind turbine generators, transformer and collector line impedances, and any reactive compensation devices installed on the plant side of the meter. Installing more capability than the minimum requirement is acceptable.
2. Lagging is when the generating plant is supplying reactive power to the transmission grid. In this situation, the alternating current sinusoid “lags” behind the alternating voltage sinusoid, meaning that the current peaks shortly after the voltage.
3. Leading is when the generating plant is taking reactive power from the transmission grid. In this situation, the alternating current sinusoid “leads” the alternating voltage sinusoid, meaning that the current peaks shortly before the voltage.

5. Conclusions

The PISIS-2009-001 Group 13 Preliminary Impact Study evaluated the impacts of interconnecting the project shown below.

Table 5-1. Interconnection Requests Evaluated

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2009-031	149.5	Siemens SMK203 2.3MW	St Joseph (541199) – Cooper (640139) 345kV

No stability problems were found during summer or winter peak conditions due to the addition of these generators.

Power factor requirements were determined, and the study plant must install sufficient reactive power resources to meet these requirements listed in Table 4-2. The reactive power resources need not be dynamically controlled. However, any change in wind turbine model or controls could change the stability results, possibly resulting in a need for a dynamically controlled reactive power supply.

With the assumptions described in this report, PISIS-2009-001 Group 13 should be able to connect without causing any stability problems on the SPP transmission grid.

Appendix A – Summer Peak Plots

See attachment.

Appendix B – Winter Peak Plots

See attachment.

Appendix C – Power Factor Details

See attachment.

Appendix D – Project Model Data

See attachment.

U: Stability Study for Group 13

V: Stability Study for Group 14

Pterra Consulting

DRAFT Technical Report R112-10

Impact Study for Generation Interconnection Request PISIS-2009-001 (Group 14)

Submitted to

Southwest Power Pool

February 2010

This page intentionally left blank

Contents

This page intentionally left blank

Legal Notice

This report was prepared by Pterra, LLC as an account of work undertaken under the authorization of Southwest Power Pool. Pterra, LLC and Southwest Power Pool do not:

1. Make any warranty or representation, expressed or implied, with respect to the use of any information contained in this report, or that the use of any information, apparatus, method, or process disclosed in the report may not infringe privately owned rights.
2. Assume any liabilities with respect to the use of or for damage resulting from the use of any information, apparatus, method, or process disclosed in this report.

The report is confidential and proprietary to Pterra, LLC and Southwest Power Pool and may not be copied, duplicated, or loaned or transferred to a third party without the express written permission of Pterra, LLC or Southwest Power Pool.

Executive Summary

This report presents the results of impact study comprising of power factor and stability analyses of the proposed interconnection wind farm projects PISIS-2009-001 (Group 14). The group 14 contains study projects: GEN-2008-033, GEN-2008-034 and GEN-2008-046, which are described in Section 1.

The analysis was conducted through the Southwest Power Pool ("SPP") Tariff. Power factor analysis and transient stability simulations were conducted with all three projects in service at their full output.

Two base cases for 2010 summer peak and 2009 winter peak conditions, each comprising of a power flow and corresponding dynamics database, were provided by SPP. The three projects are already modeled in the base cases.

The results of the Power Factor analysis showed that the study projects must maintain a power factor range in which they are supplying or absorbing vars at the point of interconnection in accordance with the requirements in Section 2.

Fifty (50) faults were considered for the transient stability simulations which included 3-phase faults as well as 1-phase to ground faults at the locations defined by SPP. The results of the simulations showed no angular or voltage instability problems for the faults. The study finds that the interconnection of the three proposed projects does not impact stability performance of the SPP system for the contingencies tested on the supplied base cases.

Section 1. Introduction

1.1. Project Overview

This report presents the results of impact study comprising of power factor and stability analyses of the proposed interconnection projects under PISIS-2009-001 (Group 14) as described in Table 1-1:

Table 1-1 Projects Included Under PISIS-2009-001 (Group 14)

Project #	Request	Size	Wind Turbine Model	Point of Interconnection
1	GEN-2008-033	100.8	Vestas V90 1.8MW	Tap Jollyville – Arbuckle 138kV
2	GEN-2008-034	100.8	Vestas V90 1.8MW	Tap Jollyville – Arbuckle 138kV
3	GEN-2008-046	349.2	Vestas V90 1.8MW	Sunnyside 345kV

Figures 1-1 and 1-2 show the interconnection diagrams of the Project to SPP's system as modeled in the power flow cases. GEN-2008-033 and GEN-2008-034 have the same point of interconnection as shown in Figures 1-1.

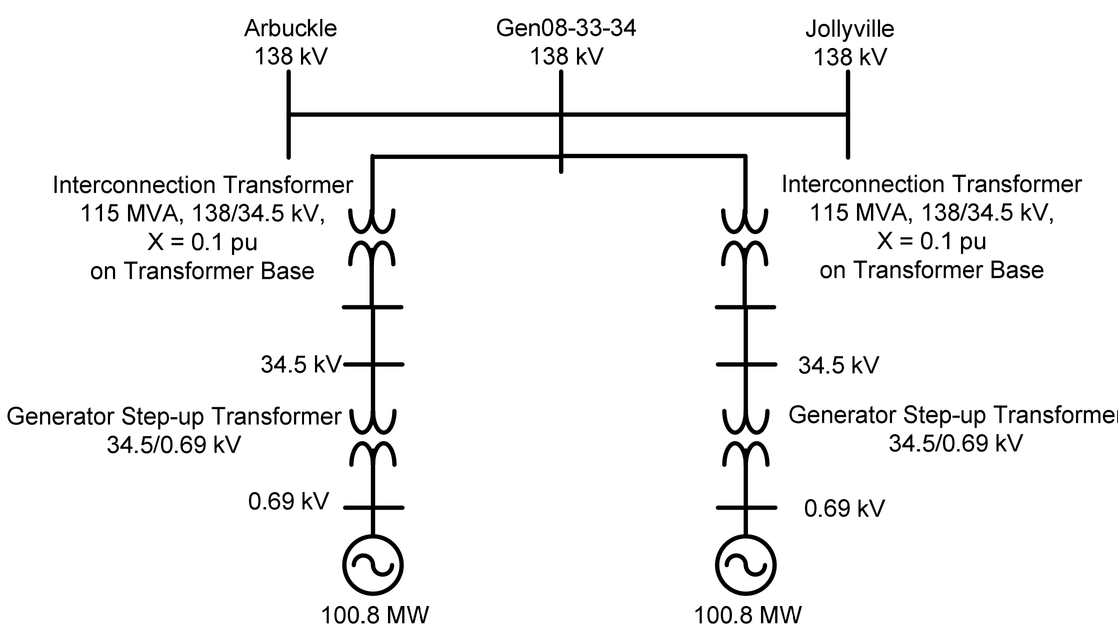


Figure 1-1 Power Flow Model for GEN-2008-033 and GEN-2008-034

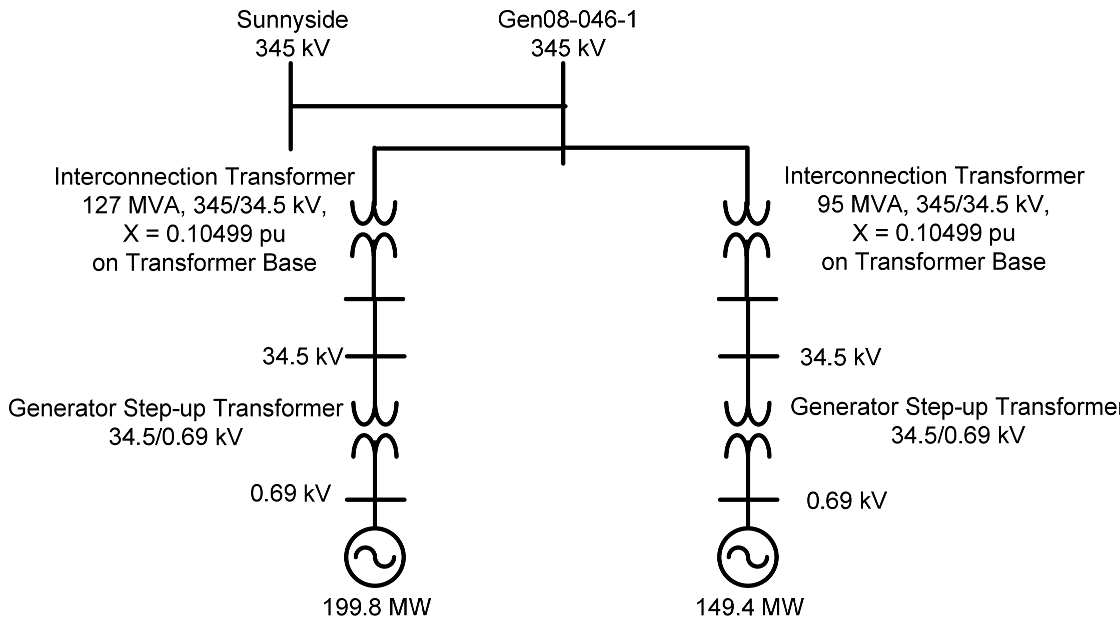


Figure 1-2 Power Flow Model for GEN-2008-046

1.2. Objectives

The objectives of the study are to conduct power factor analysis and to determine the impact on system stability of interconnecting the proposed wind farms to SPP's transmission system.

Section 2. Power Factor Analysis

2.1. Methodology

Power factor analysis was conducted for the Project using a methodology which is summarized as follows:

1. Model a VAR generator at the Project's 345 or 138 kV bus, whichever is applicable. The VAR generator is set to hold a voltage schedule at the POI consistent with the voltage schedule in the provided power flow cases for summer and winter or 1.0 pu voltage, whichever is higher.

2. Steady state contingency analysis is conducted to determine the power factor necessary at the POI for each contingency.

3. According to the contingency analysis results, determine whether capacitors are required for the Project or not.

4. If the required power factor at the POI is beyond the capability of the studied wind turbines to meet (at the POI) capacitor banks are considered. The preference is to locate the capacitance banks is on the 34.5 kV Customer side. Factors to sizing capacitor banks include:

   4.1. The ability of the wind farm to meet FERC Order 661A (low voltage ride through) with and without capacitor banks.

   4.2. The ability of the wind farm to meet FERC Order 661A (wind farm recovery to pre-fault voltage).

   4.3. If wind farms trips on high voltage, power factor lower than unity may be required.

2.2. Analysis

Analysis was performed for each proposed project with all three projects in service. A VAR generator was modeled at each point of interconnection and was set to hold a voltage schedule at the POI consistent with the voltage schedule in the provided power flow cases. These voltages are summarized in the Table 2-1.

No changes were made in the base cases provided other than the addition of the VAR generators. Contingency analysis was run for 25 contingencies.

Table 2-1 Pre-contingency Voltages at POI

Request	Point of Interconnection	Size (MW)	Base Case Voltage (p.u.)	
			Summer Peak	Winter Peak
GEN-2008-033	Tap Jollyville – Arbuckle 138kV	100.8	1.024	1.018
GEN-2008-034	Tap Jollyville – Arbuckle 138kV	100.8	1.024	1.018
GEN-2008-046	Sunnyside 345kV	349.2	1.03	1.025

2.2.1. GEN-2008-033 and GEN-2008-034

The VAR generator either supplies or absorbs reactive power at different contingencies as summarized in Table 2-2. The highest values (marked in yellow in the table) obtained are as follows:

1. For the summer case, the VAR generator supplies 48.9 MVar for the outage of Sunnyside345/138kV autotransformer from bus (515135) to bus (515136) to bus (515762) and absorbs 4.4 MVar for the loss of Russett (515120) to S Brown (521044) to S Brown (505602) 138kV line
2. For the winter case, the VAR generator supplies 33.8 MVar for the outage of Sunnyside345/138kV autotransformer from bus (515135) to bus (515136) to bus (515762) and absorbs 4.9 MVar for the loss of Oaklaw (515123) to Arbuckle (515117) 138kV line

Table 2-2 VAR Generator Output in Summer and Winter Peak Cases for GEN-2008-033 AND GEN-2008-034

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Summer Peak Case Gen-2008-033 and GEN-2008-034					
FLT00	Base Case	1.0000	lag	-199	0
FLT01-3PH	GEN-2008-033 (571004) to Arbuckle (515117) 138kV line	0.9978	lag	-199	-13.3
FLT03-3PH	GEN-2008-033 (571004) to Jollyville (515118) 138kV line	1.0000	lag	-199	-1
FLT05-3PH	Carter (515138) to Ardmore West (515372) 138kV line	0.9994	lag	-199	-6.8
FLT07-3PH	Carter (515138) to Chicksaw (515171) 138kV line	0.9999	lag	-199	-2.4
FLT09-3PH	Total (515165) to Chicksaw (515171) 138kV line	0.9996	lag	-199	-5.9
FLT11-3PH	Fndition (515162) to Chicksaw (515171) 138kV line	1.0000	lag	-199	-1.7
FLT13-3PH	Millckt (515121) to Arbuckle (515117) 138kV line	1.0000	lead	-199	1.6
FLT15-3PH	Oaklaw (515123) to Arbuckle (515117) 138kV line	1.0000	lead	-199	0.4
FLT17-3PH	Blue River (515133) to Arbuckle (515117) 138kV line	0.9996	lag	-199	-5.8
FLT19-3PH	Berrywin (515173) to Arbuckle (515117) 138kV line	1.0000	lag	-199	-1.7
FLT21-3PH	Vanoss (515174) to Arbuckle (515117) 138kV line	0.9996	lag	-199	-5.4

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Summer Peak Case Gen-2008-033 and GEN-2008-034					
FLT23-3PH	Seminole 345/115kV autotransformer on the 345kV bus (515045) to bus (515044) to bus 515756.	1.0000	lead	-199	0.9
FLT25-3PH	Sunnyside (515135) to Rocky Point (515164) 138kV line	0.9981	lag	-199	-12.3
FLT27-3PH	Sunnyside (515135) to Lone Grove (515144) 138kV line	0.9999	lag	-199	-2.9
FLT29-3PH	Sunnyside (515135) to Poolville (515130) 138kV line	1.0000	lag	-199	-1.6
FLT31-3PH	Sunnyside345/138kV autotransformer on the 138kV bus (515135) to bus (515136) to bus (515762)	0.9711	lag	-199	-48.9
FLT33-3PH	Sunnyside345/138kV autotransformer on the 345kV bus (515136)) to bus (515135) to bus (515762)	0.9711	lag	-199	-48.9
FLT35-3PH	Sunnyside (515136) to Pittsburgh (510907) 345kV line	0.9996	lag	-199	-5.5
FLT37-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9994	lag	-199	-6.7
FLT39-3PH	Sunnyside (515136) to Hugo (521157) 345kV line	0.9995	lag	-199	-6.5
FLT41-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9994	lag	-199	-6.7
FLT43-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-199	0.9
FLT45-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-199	0.9
FLT47-3PH	Russett (515120) to Glasses (515147) 138kV line	1.0000	lead	-199	1.4
FLT49-3PH	Russett (515120) to S Brown (521044) to S Brown (505602) 138kV line	0.9998	lead	-199	4.4

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Winter Peak Case Gen-2008-033 and GEN-2008-034					
FLT00	Base Case	1.0000	lag	-199	0
FLT01-3PH	GEN-2008-033 (571004) to Arbuckle (515117) 138kV line	0.9961	lag	-199	-17.6
FLT03-3PH	GEN-2008-033 (571004) to Jollyville (515118) 138kV line	1.0000	lead	-199	1.3
FLT05-3PH	Carter (515138) to Ardmore West (515372) 138kV line	1.0000	lead	-199	0.9
FLT07-3PH	Carter (515138) to Chicksaw (515171) 138kV line	0.9999	lag	-199	-2.7
FLT09-3PH	Total (515165) to Chicksaw (515171) 138kV line	0.9998	lag	-199	-3.8
FLT11-3PH	Fndition (515162) to Chicksaw (515171) 138kV line	1.0000	lag	-199	-1.1
FLT13-3PH	Millckt (515121) to Arbuckle (515117) 138kV line	1.0000	lead	-199	0.7
FLT15-3PH	Oaklaw (515123) to Arbuckle (515117) 138kV line	0.9997	lead	-199	4.9
FLT17-3PH	Blue River (515133) to Arbuckle (515117) 138kV line	0.9996	lag	-199	-5.9
FLT19-3PH	Berrywin (515173) to Arbuckle (515117) 138kV line	1.0000	lag	-199	-0.7
FLT21-3PH	Vanoss (515174) to Arbuckle (515117) 138kV line	0.9987	lag	-199	-10.2

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Winter Peak Case Gen-2008-033 and GEN-2008-034					
FLT23-3PH	Seminole 345/115kV autotransformer on the 345kV bus (515045) to bus (515044) to bus 515756.	1.0000	lead	-199	0.4
FLT25-3PH	Sunnyside (515135) to Rocky Point (515164) 138kV line	0.9994	lag	-199	-6.8
FLT27-3PH	Sunnyside (515135) to Lone Grove (515144) 138kV line	1.0000	lag	-199	-1.8
FLT29-3PH	Sunnyside (515135) to Poolville (515130) 138kV line	1.0000	lag	-199	-1.4
FLT31-3PH	Sunnyside345/138kV autotransformer on the 138kV bus (515135) to bus (515136) to bus (515762)	0.9859	lag	-199	-33.8
FLT33-3PH	Sunnyside345/138kV autotransformer on the 345kV bus (515136)) to bus (515135) to bus (515762)	0.9859	lag	-199	-33.8
FLT35-3PH	Sunnyside (515136) to Pittsburgh (510907) 345kV line	0.9993	lag	-199	-7.4
FLT37-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9990	lag	-199	-8.7
FLT39-3PH	Sunnyside (515136) to Hugo (521157) 345kV line	0.9992	lag	-199	-8
FLT41-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9990	lag	-199	-8.7
FLT43-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-199	0.7
FLT45-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-199	0.7
FLT47-3PH	Russett (515120) to Glasses (515147) 138kV line	1.0000	lag	-199	-1.8
FLT49-3PH	Russett (515120) to S Brown (521044) to S Brown (505602) 138kV line	1.0000	lag	-199	-0.1

2.2.2. GEN-2008-046

The VAR generator either supplies or absorbs reactive power at different contingencies as summarized in Table 2-3. The highest values obtained are as follows:

1. For the summer case, the VAR generator supplies 22.5 MVar for the outage of Sunnyside (515136) to Hugo (521157) 345kV line and absorbs 7.1 MVar for the loss of Total (515165) to Chicksaw (515171) 138kV line
2. For the winter case, the VAR generator supplies 29.1 MVar for the outage of Sunnyside (515136) to Lawton Eastside (511468) 345kV line and absorbs 26 MVar for the loss of Sunnyside345/138kV autotransformer from bus (515135) to bus (515136) to bus (515762)

Table 2-3 VAR Generator Output in Summer and Winter Peak Cases for GEN-2008-046

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Summer Peak Case GEN-2008-046					
FLT00	Base Case	1.0000	lag	-345	0
FLT01-3PH	GEN-2008-033 (571004) to Arbuckle (515117) 138kV line	0.9998	lag	-345	-6.5
FLT03-3PH	GEN-2008-033 (571004) to Jollyville (515118) 138kV line	0.9999	lag	-345	-4.1
FLT05-3PH	Carter (515138) to Ardmore West (515372) 138kV line	1.0000	lead	-345	3.2
FLT07-3PH	Carter (515138) to Chicksaw (515171) 138kV line	1.0000	lag	-345	-2
FLT09-3PH	Total (515165) to Chicksaw (515171) 138kV line	0.9998	lead	-345	7.1
FLT11-3PH	Fndition (515162) to Chicksaw (515171) 138kV line	1.0000	lag	-345	-0.3
FLT13-3PH	Millckt (515121) to Arbuckle (515117) 138kV line	0.9999	lag	-345	-5
FLT15-3PH	Oaklaw (515123) to Arbuckle (515117) 138kV line	1.0000	lead	-345	0.5
FLT17-3PH	Blue River (515133) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-1.8
FLT19-3PH	Berrywin (515173) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-3.3
FLT21-3PH	Vanoss (515174) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-2.6
FLT23-3PH	Seminole 345/115kV autotransformer on the 345kV bus (515045) to bus (515044) to bus 515756.	1.0000	lag	-345	0
FLT25-3PH	Sunnyside (515135) to Rocky Point (515164) 138kV line	0.9998	lead	-345	6.9
FLT27-3PH	Sunnyside (515135) to Lone Grove (515144) 138kV line	1.0000	lag	-345	-2.9
FLT29-3PH	Sunnyside (515135) to Poolville (515130) 138kV line	1.0000	lag	-345	-0.1
FLT31-3PH	Sunnyside345/138kV autotransformer on the 138kV bus (515135) to bus (515136) to bus (515762)	0.9998	lead	-345	6.8
FLT33-3PH	Sunnyside345/138kV autotransformer on the 345kV bus (515136)) to bus (515135) to bus (515762)	0.9998	lead	-345	6.8
FLT35-3PH	Sunnyside (515136) to Pittsburgh (510907) 345kV line	0.9980	lag	-345	-21.6
FLT37-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9984	lag	-345	-19.6
FLT39-3PH	Sunnyside (515136) to Hugo (521157) 345kV line	0.9979	lag	-345	-22.5
FLT41-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9984	lag	-345	-19.6
FLT43-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	0.9999	lead	-345	4.4
FLT45-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	0.9999	lead	-345	4.4
FLT47-3PH	Russett (515120) to Glasses (515147) 138kV line	1.0000	lead	-345	0.9
FLT49-3PH	Russett (515120) to S Brown (521044) to S Brown (505602) 138kV line	1.0000	lead	-345	2

Cont._ Name	Cont-Description	PF @ POI	PF	MW @ POI	MVAR @ POI
Winter Peak Case GEN-2008-046					
FLT00	Base Case	1.0000	lag	-345	0
FLT01-3PH	GEN-2008-033 (571004) to Arbuckle (515117) 138kV line	0.9996	lag	-345	-9.9
FLT03-3PH	GEN-2008-033 (571004) to Jollyville (515118) 138kV line	1.0000	lag	-345	-3.2
FLT05-3PH	Carter (515138) to Ardmore West (515372) 138kV line	1.0000	lag	-345	-1.4
FLT07-3PH	Carter (515138) to Chicksaw (515171) 138kV line	1.0000	lag	-345	-2.5
FLT09-3PH	Total (515165) to Chicksaw (515171) 138kV line	0.9999	lead	-345	4.1
FLT11-3PH	Fndition (515162) to Chicksaw (515171) 138kV line	1.0000	lag	-345	-0.4
FLT13-3PH	Millckt (515121) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-3.1
FLT15-3PH	Oaklaw (515123) to Arbuckle (515117) 138kV line	1.0000	lead	-345	1
FLT17-3PH	Blue River (515133) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-1.5
FLT19-3PH	Berrywin (515173) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-2.3
FLT21-3PH	Vanoss (515174) to Arbuckle (515117) 138kV line	1.0000	lag	-345	-3.1
FLT23-3PH	Seminole 345/115kV autotransformer on the 345kV bus (515045) to bus (515044) to bus 515756.	1.0000	lag	-345	-0.2
FLT25-3PH	Sunnyside (515135) to Rocky Point (515164) 138kV line	1.0000	lead	-345	2.5
FLT27-3PH	Sunnyside (515135) to Lone Grove (515144) 138kV line	1.0000	lag	-345	-1.8
FLT29-3PH	Sunnyside (515135) to Poolville (515130) 138kV line	1.0000	lag	-345	-0.5
FLT31-3PH	Sunnyside345/138kV autotransformer on the 138kV bus (515135) to bus (515136) to bus (515762)	0.9972	lead	-345	26
FLT33-3PH	Sunnyside345/138kV autotransformer on the 345kV bus (515136)) to bus (515135) to bus (515762)	0.9972	lead	-345	26
FLT35-3PH	Sunnyside (515136) to Pittsburgh (510907) 345kV line	0.9969	lag	-345	-27.4
FLT37-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9965	lag	-345	-29.1
FLT39-3PH	Sunnyside (515136) to Hugo (521157) 345kV line	0.9968	lag	-345	-27.8
FLT41-3PH	Sunnyside (515136) to Lawton Eastside (511468) 345kV line	0.9965	lag	-345	-29.1
FLT43-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-345	3.1
FLT45-3PH	Anadarko (511541) to Lawton Eastside (511468) 345kV line	1.0000	lead	-345	3.1
FLT47-3PH	Russett (515120) to Glasses (515147) 138kV line	1.0000	lag	-345	-0.6
FLT49-3PH	Russett (515120) to S Brown (521044) to S Brown (505602) 138kV line	1.0000	lag	-345	0

2.3. Conclusions

The results of the Power Factor analysis showed that the study projects must maintain a power factor range in which they are supplying or absorbing vars at the point of interconnection in accordance with the requirements in Section 2.

Section 3. Stability Analysis

3.1. Assumptions

The following assumptions were adopted for the dynamic simulations:

1. Constant maximum and uniform wind speed for the entire period of study.
2. Wind turbine control models with their default values.
3. Under/over voltage/frequency protection use manufacturer settings.

3.2. Faults Simulated

Fifty (50) faults were considered for the transient stability simulations which included three phase faults as well as single phase line faults at the locations defined by SPP. Single-phase line faults were simulated by applying a fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice. projects shown in Table 1-1 and units in areas 520, 524, 525, 526, 531, 534, and 536were monitored in the simulations.

Table 3-1 shows the list of simulated faults. It also shows the fault clearing time and the time delay before re-closing for all the study contingencies.

Table 3-1 List of Simulated Faults

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the GEN-2008-033 (571004) to Arbuckle (515117) 138kV line, near GEN-2008-033. a. Apply fault at the GEN-GEN-2008-033 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the GEN-2008-033 (571004) to Jollyville (515118) 138kV line, near GEN-2008-033. a. Apply fault at the GEN-GEN-2008-033 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
5	FLT05-3PH	3 phase fault on the Carter (515138) to Ardmore West (515372) 138kV line, near Ardmore West. a. Apply fault at the Ardmore West 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Carter (515138) to Chicksaw (515171) 138kV line, near Chicksaw. a. Apply fault at the Chicksaw 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Total (515165) to Chicksaw (515171) 138kV line, near Chicksaw. a. Apply fault at the Chicksaw 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT11-3PH	3 phase fault on the Fndition (515162) to Chicksaw (515171) 138kV line, near Chicksaw. a. Apply fault at the Chicksaw 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on the Millckt (515121) to Arbuckle (515117) 138kV line, near Arbuckle. a. Apply fault at the Arbuckle 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	*Single phase fault and sequence like previous*
15	FLT15-3PH	3 phase fault on the Oaklaw (515123) to Arbuckle (515117) 138kV line, near Arbuckle. a. Apply fault at the Arbuckle 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
17	FLT17-3PH	3 phase fault on the Blue River (515133) to Arbuckle (515117) 138kV line, near Arbuckle. a. Apply fault at the Arbuckle 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Berrywin (515173) to Arbuckle (515117) 138kV line, near Arbuckle. a. Apply fault at the Arbuckle 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT -3PH	3 phase fault on the Vanoss (515174) to Arbuckle (515117) 138kV line, near Arbuckle. a. Apply fault at the Arbuckle 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT – 1PH	*Single phase fault and sequence like previous*
23	FLT -3PH	3 phase fault on the Seminole 345/115kV autotransformer on the 345kV bus (515045) to bus (515044) to bus 515756. a. Apply fault at Seminole 345kV. b. Clear fault after 5 cycles by tripping the faulted line.
24	FLT – 1PH	*Single phase fault and sequence like previous*
25	FLT -3PH	3 phase fault on the Sunnyside (515135) to Rocky Point (515164) 138kV line, near Sunnyside. a. Apply fault at the Sunnyside 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT – 1PH	*Single phase fault and sequence like previous*
27	FLT -3PH	3 phase fault on the Sunnyside (515135) to Lone Grove (515144) 138kV line, near Sunnyside. a. Apply fault at the Sunnyside 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT – 1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
29	FLT -3PH	3 phase fault on the Sunnyside (515135) to Poolville (515130) 138kV line, near Sunnyside. a. Apply fault at the Sunnyside 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT – 1PH	*Single phase fault and sequence like previous*
31	FLT -3PH	3 phase fault on the Sunnyside345/138kV autotransformer on the 138kV bus (515135) to bus (515136) to bus (515762) a. Apply fault at the Sunnyside 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
32	FLT – 1PH	*Single phase fault and sequence like previous*
33	FLT -3PH	3 phase fault on the Sunnyside345/138kV autotransformer on the 345kV bus (515136)) to bus (515135) to bus (515762) a. Apply fault at the Sunnyside 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
34	FLT – 1PH	*Single phase fault and sequence like previous*
35	FLT -3PH	3 phase fault on the Sunnyside (515136) to Pittsburgh (510907) 345kV line, near Sunnyside. a. Apply fault at the Sunnyside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT – 1PH	*Single phase fault and sequence like previous*
37	FLT -3PH	3 phase fault on the Sunnyside (515136) to Lawton Eastside (511468) 345kV line, near Sunnyside. a. Apply fault at the Sunnyside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT – 1PH	*Single phase fault and sequence like previous*
39	FLT -3PH	3 phase fault on the Sunnyside (515136) to Hugo (521157) 345kV line, near Sunnyside. a. Apply fault at the Sunnyside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT – 1PH	*Single phase fault and sequence like previous*
41	FLT -3PH	3 phase fault on the Sunnyside (515136) to Lawton Eastside (511468) 345kV line, near Sunnyside a. Apply fault at the Sunnyside 345kV bus. b. Clear fault after 5 cycles c. Trip the Sunnyside - Lawton Eastside 345kV line d. Trip the Sunnyside – Hugo 345kV line

Cont. No.	Cont. Name	Description
42	FLT – 1PH	*Single phase fault and sequence like previous*
43	FLT -3PH	3 phase fault on the Anadarko (511541) to Lawton Eastside (511468) 345kV line, near Anadarko a. Apply fault at the Lawton Eastside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT – 1PH	*Single phase fault and sequence like previous*
45	FLT -3PH	3 phase fault on the Anadarko (511541) to Lawton Eastside (511468) 345kV line, near Lawton Eastside. a. Apply fault at the Lawton Eastside 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT – 1PH	*Single phase fault and sequence like previous*
47	FLT -3PH	3 phase fault on the Russett (515120) to Glasses (515147) 138kV line, near Russett. a. Apply fault at the Russett 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT – 1PH	*Single phase fault and sequence like previous*
49	FLT -3PH	3 phase fault on the Russett (515120) to S Brown (505602) 138kV line, near Russett. a. Apply fault at the Russett 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT – 1PH	*Single phase fault and sequence like previous*

Simulations were performed with a 0.5-second steady-state run followed by the appropriate disturbance as described in Table 3-1. Simulations were run for a minimum 10-second duration to confirm proper machine damping.

3.3. Simulation Results

The simulations conducted in the study did not find any angular or voltage instability problems for the 50 faults. The study finds that the interconnection of the three proposed projects does not impact stability performance of the SPP system for the contingencies tested on the supplied base cases.

Section 4. Conclusions

The findings of the impact study for the proposed interconnection projects under projects PISIS-2009-001 (Group 14) containing GEN-2008-033 and GEN-2008-034 and GEN-2008-046, considered at 100% of their proposed installed capacities are as follows:

1. The results of the Power Factor analysis showed that the study projects must maintain a power factor range in which they are supplying or absorbing vars at the point of interconnection in accordance with the requirements in Section 2.

2. For the three proposed projects, the stability simulations with 50 specified faults did not show any angular or voltage instability problems in the SPP system. The study finds that these interconnections do not impact stability performance of the SPP system for the contingencies tested on the base cases provided.

W: Stability Study for Group 15

R15-10

Generator Interconnection Impact Study for PISIS-2009-001 - Group 15

Prepared for

Southwest Power Pool, Inc.

Submitted by:
Ravi Mulugu, Consultant
Bernardo Fernandes, Staff Consultant

Draft Report: March 05, 2010

Siemens PTI Project Number: P/23-115079-B-1

Siemens Energy, Inc.
Siemens Power Technologies International
400 State Street • P.O. Box 1058
Schenectady, New York 12301-1058 US
Tel: 518-395-5000 • Fax: 518-346-2777
www.usa.siemens.com/PTI

SIEMENS

This page intentionally left blank.

Contents

Legal Notice

This document was prepared by Siemens Energy, Inc., Siemens Power Technologies International (Siemens PTI), solely for the benefit of Southwest Power Pool, Inc. Neither Siemens PTI, nor parent corporation or its or their affiliates, nor Southwest Power Pool, Inc., nor any person acting in their behalf (a) makes any warranty, expressed or implied, with respect to the use of any information or methods disclosed in this document; or (b) assumes any liability with respect to the use of any information or methods disclosed in this document.

Any recipient of this document, by their acceptance or use of this document, releases Siemens PTI, its parent corporation and its and their affiliates, and Southwest Power Pool, Inc. from any liability for direct, indirect, consequential or special loss or damage whether arising in contract, warranty, express or implied, tort or otherwise, and irrespective of fault, negligence, and strict liability.

This page intentionally left blank.

Section

1

Introduction

1.1 Background

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Siemens PTI performed the following Impact Study to satisfy the Impact Study Agreement executed by the requesting customers and SPP. The requests for interconnection were placed in accordance to SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

The purpose of this report is to present the results of the stability and power factor analysis performed to evaluate the impact of the proposed PISIS-2009-001 cluster of interconnections with regard to Group 15 projects on the Southwest Power Pool system. Eventual indicative solutions to the identified issues are proposed based on the impact of each generation interconnection on the Southwest Power Pool system.

Two projects in this cluster are connected to two different points of interconnection at different voltage levels, 115 kV and 345 kV. Section 2 describes the proposed wind farms projects in detail.

Transient stability analysis was performed using the package provide by SPP. It contains the latest stability database in PSS®E version 30.3.3. The stability package also includes the dynamic data for the previously queued projects.

1.2 Purpose

The steady state and stability study was carried out to:

(a) Determine the ability of the proposed generation facility to remain in synchronism and within applicable planning standards following system faults with unsuccessful reclosing.

(b) Determine the amount of transient support required from the costumer to meet the power factor requirement at the POI.

(c) Determine the ability of the wind farm to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

This page intentionally left blank.

Section

2

Model Development

The study has considered the 2010 Summer Peak and 2009 Winter Peak load flow models provided by SPP with the required interconnection generations modeled. The base cases also contain all the significant previous queued generation interconnection projects in the interconnection queue.

2.1 Power Flow Data

The Group 15 of PISIS-2009-001 contains two proposed wind generation projects. Table 2-1 presents the size of the wind generation projects, the Wind Turbine Generator (WTG) manufacturers, the reactive capability of the wind farm as well as the point of interconnection and the PSS®E bus number in the load flow models.

Table 2-1 – Details of the Interconnection Requests

Request	Size (MW)	Model	Reactive Capability of Wind Farm		Point of Interconnection	Bus Number
			Max (Mvar)	Min (Mvar)		
GEN-2008-121N01	401.4	Vestas V90 1.8MW	0	0	Pauline (640312) – Moore (640277) 345kV	572120
GEN-2008-123N	89.7	Siemens SMK203 2.3 MW	53.22	-53.22	Pauline (640312) – Guide Rock (640206)	572050

The analysis was carried out using the database package provided by SPP which also includes the modeling data for the previously queued projects, as shown in Table 2-2. The prior queued generators along with those identified in the scope are set to operate at 100% of their Pmax in both the summer and winter cases.

Table 2-2 – Details of the Prior Queued Interconnection Requests

Request	Size (Gross)	Wind Turbine Model	Point of Interconnection
Sheldon Unit #1	121 MW	N/A	640019
Sheldon Unit #2	136 MW	N/A	640020
Hallam CT #1	52 MW	N/A	640021
Cooper Unit #1	874.4 MW	N/A	640009

Request	Size (Gross)	Wind Turbine Model	Point of Interconnection
Beatrice Power Station Unit #1	80 MW	N/A	640022
Beatrice Power Station Unit #2	80 MW	N/A	640023
Beatrice Power Station Unit #3	90 MW	N/A	640024
Hebron CT #1	52 MW	N/A	640012
Fairbury #1	11 MW	N/A	640170
Fairbury #2	4.3 MW	N/A	640170
Crete #1	15.7 MW	N/A	640154
Energy Center Unit #1	84 MW	N/A	641086
Energy Center Unit #2	232 MW	N/A	641089
Platte Generation Station Unit #1	108.4 MW	N/A	642067

Figures 2-1 and 2-2 present the surrounding area of the Group 15 point of interconnection, showing the line flows and voltage profile for the load flow models considered in the study for summer and winter peak scenarios, respectively.

Figure 2-1 - Group 15 Point of Interconnection Surrounding Area – Summer Peak

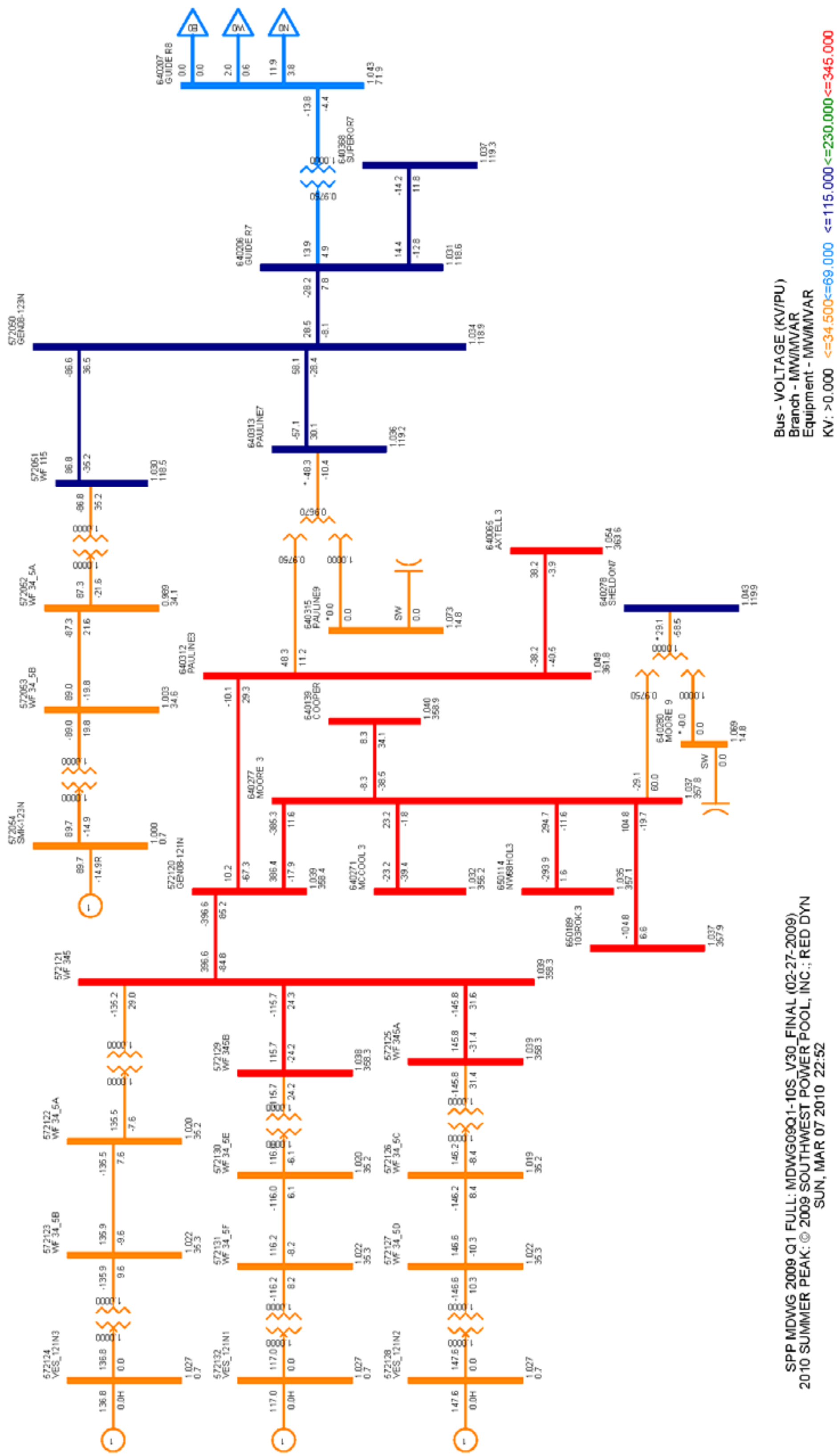
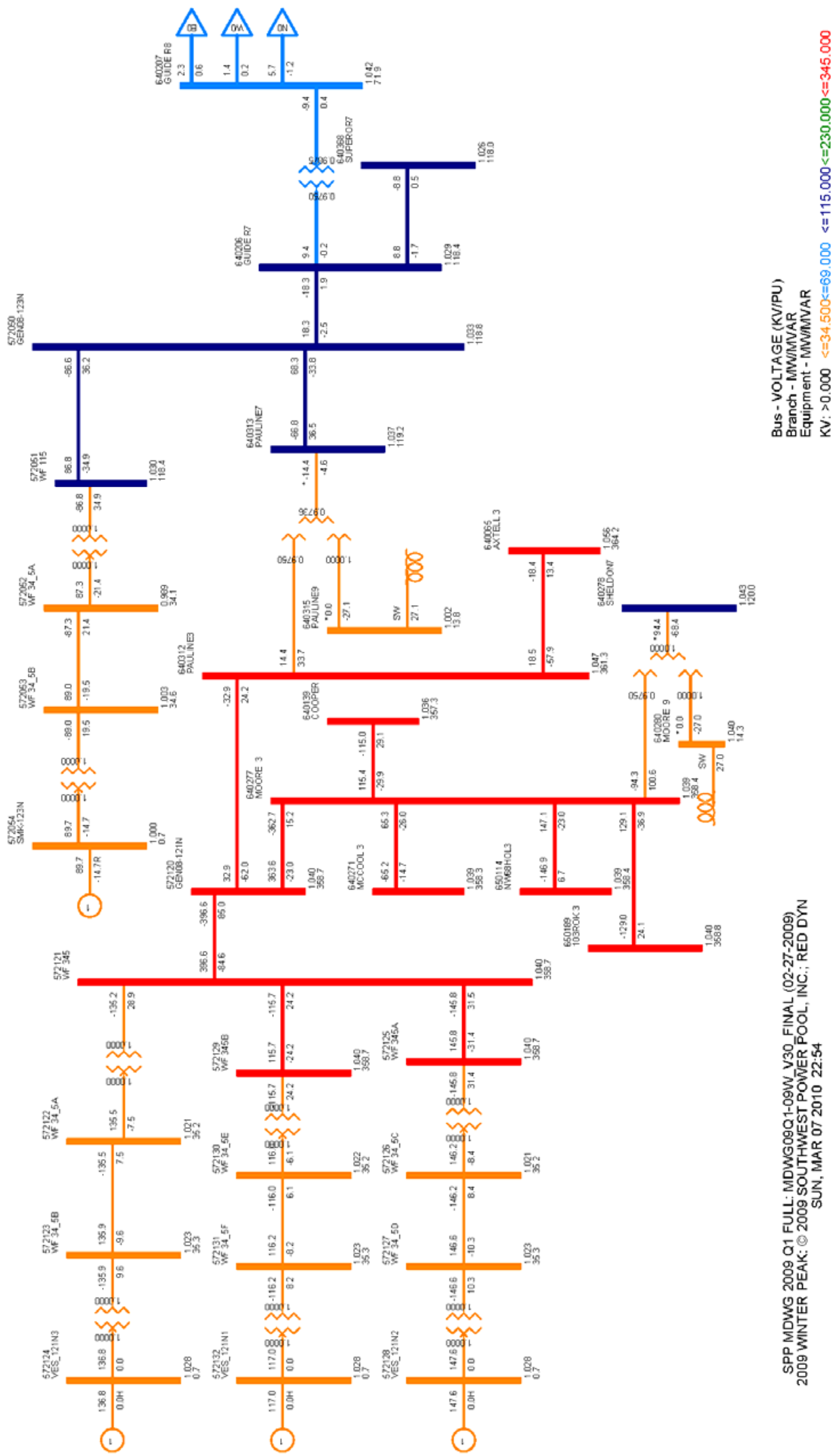


Figure 2-2 - Group 15 Points of Interconnection Surrounding Area – Winter Peak



Figures A-1 to A-2 in Appendix A present the single line diagrams showing, for the two Group 15 projects, the modeling details and impedance data of the transformers and collector systems.

2.2 Stability Database

The transient stability analysis was performed using the data provided by SPP. Stability models for the Group 15 interconnection requests were already added to the dynamic database. All turbine parameters used in the simulation models are the default parameters in the wind turbine package. It is assumed that each wind turbine generators (WTGs) would be controlling the voltage of its own bus.

The default voltage protection model set points recommended by the manufacturer were used. The wind units were modeled with their built-in voltage ride through capability. Also, the default frequency protection model set points recommended by the manufacturer were used.

The PSS®E dynamic models output list is shown in Appendix B, documenting the model parameters for the Group 15 wind turbines modeled in the stability study.

Section

3

Methodology and Assumptions

The study considered the 2010 summer peak and 2009 winter peak power flow cases with the required interconnection generation requests modeled as described in Section 2. The base case also contains all the significant previous queued projects in the interconnection queue.

The monitored areas in this study are shown in Table 3-1.

Table 3-1 – Areas of Interest

Area Number	Area Name
531	MIDW
534	SUNC
536	WERE
540	MIPU
541	KACP
640	NPPD
645	OPPD
650	LES
652	WAPA

3.1 Methodology

3.1.1 Stability Simulations

The stability simulations were performed using the PSS®E version 30.3.3 with the latest stability database provided by SPP. Three-phase faults and single line to ground faults in the neighborhood of PISIS-2009-001 – Group 15 Points of Interconnection were simulated. Any adverse impact on the system stability was documented and further investigated with appropriate solutions to determine whether a static or dynamic VAR device is required or not.

The group 15 projects were also evaluated on the matter of ability to meet FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) with and without additional reactive support.

3.1.2 Steady State Simulations

3.1.2.1 N-1 Contingency Analysis

An N-1 contingency analysis was performed to evaluate voltage violations, if any, caused by disturbances (tripping of the faulted line). The voltages at each POI were monitored for deviations from the base case voltage and the percentage deviations were documented.

The summer peak and winter peak load flow cases were adjusted to ensure there are no relevant pre contingency voltage criteria violations. During contingency analysis, voltages of any monitored bus found to be outside the range of the post-contingency criteria and having more than 1% of project impact were reported.

3.1.2.2 Power Factor Analysis

The analysis will determine what power factor is necessary at the POI for each contingency.

If the required power factor at the POI is beyond the capability of the studied wind turbines to meet the requirement at the POI, capacitor banks will be considered.

A QV analysis was performed to determine the reactive support requirement at each project's POI. Mvar injections, tabulated for base case and contingency conditions, are used to determine the reactive power support required at each POI, in order to maintain the bus scheduled pre contingency voltages.

These tables are obtained through a series of AC load flow calculations. Starting with no reactive support at a bus, the voltage is computed for a series of power flows as the reactive support is changed in steps, until the power flow experiences convergence difficulties as the system approaches the voltage collapse point.

3.2 Disturbances for Stability Analysis

The stability simulations considered three-phase (3PH) faults and single line-to-ground (SLG) faults. For three phase faults the fault is cleared by tripping the faulted line within 4.5 to 6.5 cycles. The SLG faults comprised stuck breaker conditions, which the complete clearing process includes the following sequence of events:

1) Line fault, one end of the line terminals cleared after 4.5 to 6.5 cycles

2) After 8 -11.5 cycles the fault is cleared by tripping the other terminal of the faulted line and a neighboring line

The disturbances evaluated are listed in the following Table 3-2:

Table 3-2: Disturbances for Stability Analysis

#	Fault Location	Fault Type	Clearing	Fault Clearing
1	At GEN-2008-121N end of 345kV line to Moore	3PH	Clear in 4.5 cycles	trip GEN-2008-121N - Moore 345kV line
2	At GEN-2008-121N end of 345kV line to Pauline	3PH	Clear in 4.5 cycles	trip GEN-2008-121N - Pauline 345kV line
3	At Moore end of 345kV line to Cooper	3PH	Clear in 4.5 cycles	trip Moore - Cooper 345kV line
4	At Moore end of 345kV line to McCool	3PH	Clear in 4.5 cycles	trip Moore - McCool 345kV line
5	At Moore end of 345kV line to NW68HOL3	3PH	Clear in 4.5 cycles	trip Moore - NW68HOL3 345kV line
6	At Moore end of 345kV line to 103ROK	3PH	Clear in 4.5 cycles	trip Moore - 103ROK 345kV line
7	At Moore end of 345/115kV autotransformer	3PH	Clear in 5.5 cycles	trip Moore 345/115kV autotransformer
8	At Pauline end of 345/115kV autotransformer	3PH	Clear in 5.5 cycles	trip Pauline 345/115kV autotransformer
9	At Pauline end of 345kV line to Axtell	3PH	Clear in 4.5 cycles	trip Pauline - Axtell 345kV line
10	At Pauline end of 115kV line to GEN-2008-123N	3PH	Clear in 6.5 cycles	trip Pauline - GEN-2008-123N 115kV line
11	At Guide Rock end of 115kV line to GEN-2008-123N	3PH	Clear in 6.5 cycles	trip Guide Rock - GEN-2008-123N 115kV line
12	At Pauline end of 115kV line to Hastings	3PH	Clear in 6.5 cycles	trip Pauline - Hastings 115kV line
13	At Pauline end of 115kV line to Hildreth	3PH	Clear in 6.5 cycles	trip Pauline - Hildreth 115kV line
14	At North Hebron end of 115kV line to Carlton Jct	3PH	Clear in 6.5 cycles	trip North Hebron - Carlton Jct 115kV line
15	At North Hebron end of 115kV line to Fairbury	3PH	Clear in 6.5 cycles	trip North Hebron - Fairbury 115kV line
16	At GEN-2008-121N end of 345kV line to Moore with prior outage of Pauline 345/115 kV transformer	3PH	Clear in 4.5 cycles	trip GEN-2008-121N - Moore 345kV line with Prior Outage
17	At N. Hebron end of 115 kV to Carleton Junction with prior outage of GEN-2008-123N to Pauline 115 kV line	3PH	Clear in 6.5 cycles	trip N. Hebron - Carleton Junction 115 kV with Prior Outage
18	At BPS end of 115 kV line to Sheldon	3PH	Clear in 6.5 cycles	trip BPS - Sheldon 115 kV line
19	At Beatrice end of 115 kV line to Harbine	3PH	Clear in 6.5 cycles	trip Beatrice - Harbine 115 kV line
20	At BPS end of 115 kV to Sheldon with Prior Outage of BPS to Clatonia 115 kV line	3PH	Clear in 6.5 cycles	trip BPS - Sheldon 115 kV with Prior Outage

#	Fault Location	Fault Type	Clearing	Fault Clearing
21	At Sheldon end of 115 kV line to LES 20th & Pioneers	3PH	Clear in 6.5 cycles	trip Sheldon - LES 20th & Pioneers 115 kV line
22	At Cooper end of 345 kV line to St. Joe	3PH	Clear in 4.5 cycles	trip Cooper - St. Joe 345 kV line
23	At Cooper end of 345 kV line to Fairport	3PH	Clear in 4.5 cycles	trip Cooper - Fairport 345 kV line
24	At Cooper end of 345 kV line to Atchison	3PH	Clear in 4.5 cycles	trip Cooper - Atchison 345 kV line
25	At Cooper end of 345 kV line to S3458	3PH	Clear in 4.5 cycles	trip Cooper - S3458 345 kV line
26	At Cooper 345/161 kV transformer	3PH	Clear in 5.5 cycles	trip Cooper 345/161 kV transformer
27	At Energy Center end of 115 kV line to Sutton	3PH	Clear in 6.5 cycles	trip Energy Center - Sutton 115 kV line
28	At Energy Center end of 115 kV line to Hastings	3PH	Clear in 6.5 cycles	trip Energy Center - Hastings 115 kV line
29	At Moore end of 345 kV line to McCool	SLG	STB Clearing	trip McCool – Moore 345 kV line and Moore – NW68th & Holdrege 345 kV
30	At Moore end of 345 kV line to McCool	SLG	STB Clearing	trip McCool – Moore 345 kV line and Moore – 103rd & Rokeby 345 kV
31	At Moore end of 345 kV line to Cooper	SLG	STB Clearing	trip Cooper – Moore 345 kV line and Moore 345/115 kV transformer
32	At Cooper end of 345 kV line to Fairport	SLG	STB Clearing	trip Cooper – Fairport – St. Joe 345 kV line, and Cooper – S3458 345 kV line
33	At Cooper end of 345 kV line to GEN09-031	SLG	STB Clearing	trip Cooper – GEN09-031 345 kV line, and Cooper – Boonvil 345 kV line
34	At Beatrice end of 115 kV line to Steinauer	SLG	STB Clearing	trip Beatrice – Steinauer – Humboldt 115 kV line, and Beatrice – BPS 115 kV
35	At Beatrice end of 115 kV line to Harbine	SLG	STB Clearing	trip Beatrice – Harbine 115 kV, Beatrice – BPS 115 kV ckt 1, and Beatrice – Beatrice South 115 kV

The stability study also evaluated the prior outage of the following transmission facilities

- Each Segment of the Pauline – Moore 345 kV line.
- Each Segment of the Pauline – Guide Rock 115 kV line.

A select set of faults as shown below in Table 3-3 were evaluated for each prior outage to ensure stability criteria is met following the addition of the proposed generation interconnection.

Table 3-3: Disturbances with prior outages for Stability Analysis

#	Fault Location	Prior Outage	Fault Type	Clearing	Fault Clearing
1	At Moore end of 345kV line to NW68HOL3	Pauline - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Moore - NW68HOL3 345kV line
2	At Moore end of 345kV line to 103ROK	Pauline - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Moore- 103ROK3 345kV line
3	At Moore 345 kV end of 345/115kV autotransformer	Pauline - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Moore 345/115 kV Xfmr
4	At Pauline 345 kV end of 345/115kV autotransformer	Pauline - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Pauline 345/115 kV Xfmr
5	At Pauline 345 kV end of 345/115kV autotransformer	Moore - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Pauline 345/115 kV Xfmr
6	At Pauline end of 345kV line to Axtell	Moore - GEN08-121N 345 kV line	3PH	Clear in 4.5 Cycles	trip Pauline - Axtell 345 kV line
7	At Guide Rock end of 115kV line to Superior	Pauline - GEN08-123N 115 kV line	3PH	Clear in 6.5 Cycles	trip Guide Rock - Superior 115 kV line
8	At Pauline 115 kV end of 345/115kV autotransformer	Guide Rock - GEN08-123N 115 kV line	3PH	Clear in 6.5 Cycles	trip Pauline 345/115 kV Xfmr
9	At Pauline 115 kV end of 115/69 kV Xfmr	Guide Rock - GEN08-123N 115 kV line	3PH	Clear in 6.5 Cycles	trip Pauline 115/69 kV Xfmr

In order to simulate single line to ground faults, equivalent reactances were determined to be applied at the buses. Table 3-4 presents the equivalent reactances obtained for the summer peak case and Table 3-5 presents the equivalent reactance for the winter peak case.:

Table 3-4: Equivalent Reactances – Line to Ground Faults – Summer Peak

BUS	Equivalent Reactance (Mvar)
640277	6800
640139	7900
640076	1500

Table 3-5: Equivalent Reactances – Line to Ground Faults – Winter Peak

BUS	Equivalent Reactance (Mvar)
640277	6300
640139	7500
640076	1400

The following Figures 3-1 and 3-2 present the fault locations within the study area.

Figure 3-1 – Fault Locations in the Study Area – *Diagram1*

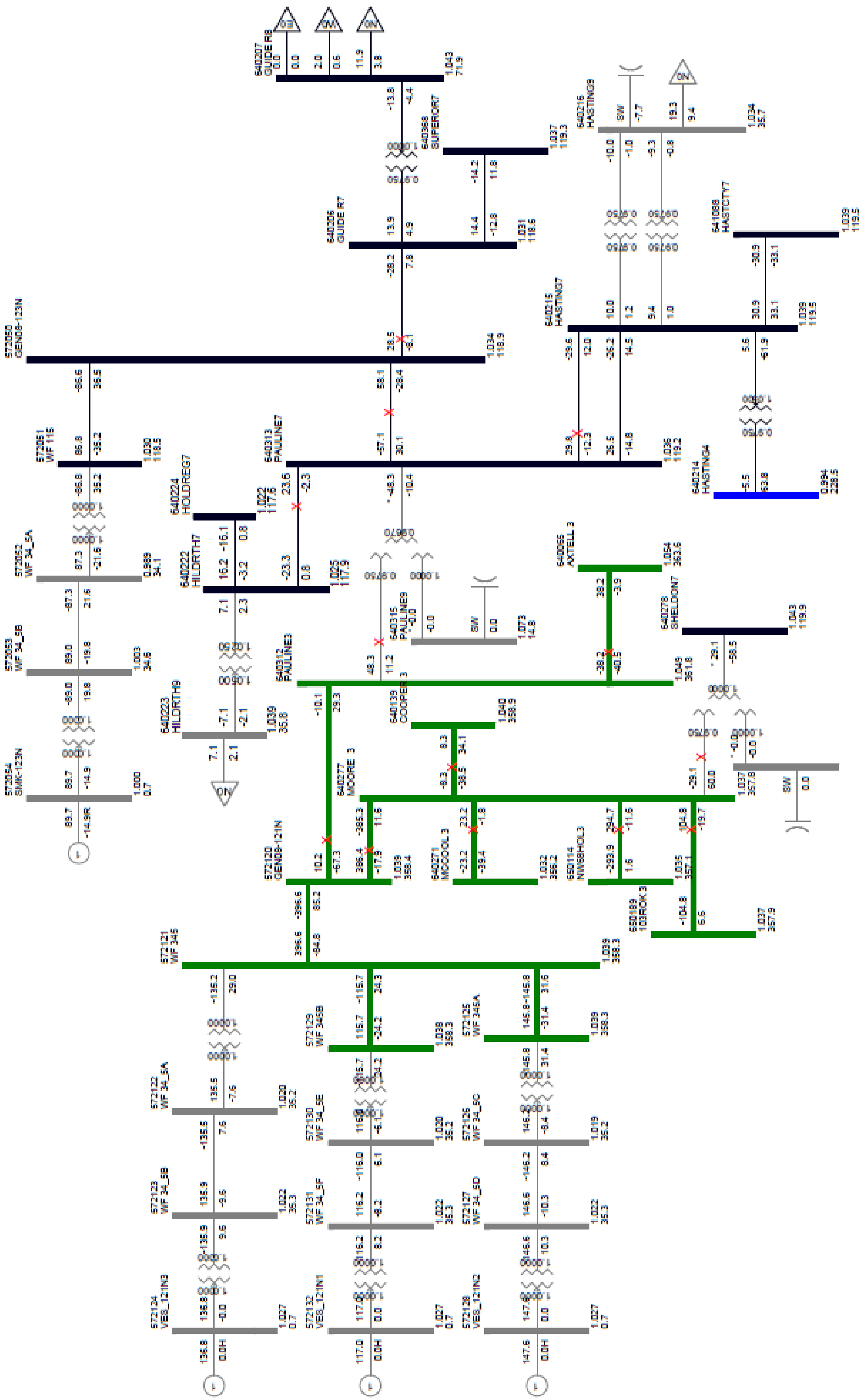
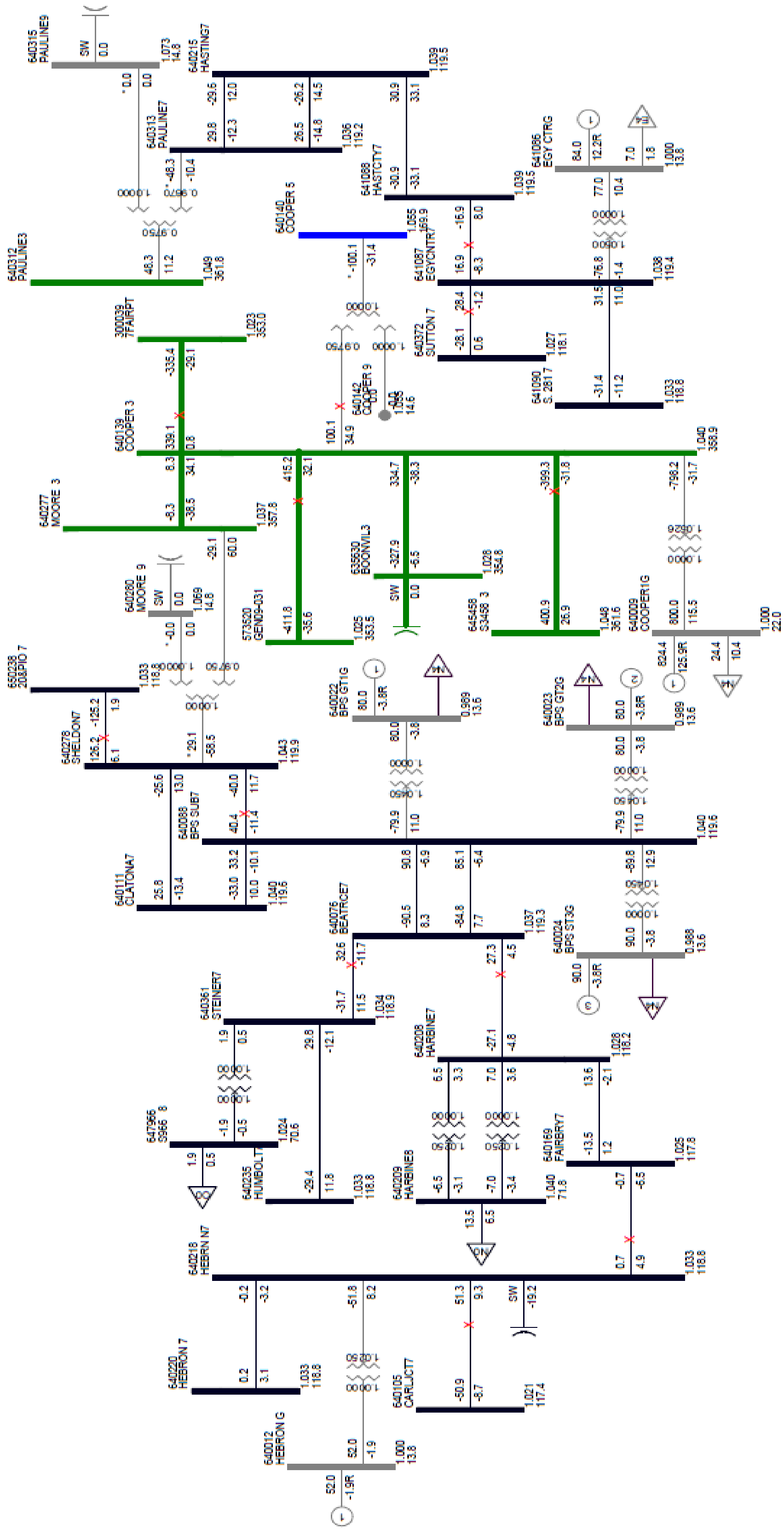


Figure 3-2 – Fault Locations in the Study Area – *Diagram2*



Section

4

Analysis Performed

4.1 Steady State Performance

Table 4-1 and Table 4-2 summarize the results obtained from the steady state analysis for Summer Peak and Winter Peak base cases, respectively. The tables list the voltage deviations at the Points of Interconnection of the proposed study projects of Group 3, as well as the prior queued projects. Note that the tables list only the contingencies that cause violation in the voltage criteria or have an impact of at least 1% in the POI's voltages.

The complete set of results for both summer peak and winter peak scenarios are presented in Appendix C.

Table 4-1: Results Obtained – Steady State Analysis – Summer Peak Base Case

Bus #	Bus Name	Base kV	Contingency Voltage	Base Voltage	% Deviation
Base Case					
572050	GEN08-123N	115.0	-	1.0333	-
572120	GEN08-121N	345.0	-	1.0387	-
640009	COOPER1G	22.0	-	1.0000	-
640012	HEBRON G	13.8	-	1.0000	-
640019	SHELDN1G	13.8	-	1.0000	-
640020	SHELDN2G	13.8	-	1.0000	-
640021	SHELDONG	13.8	-	1.0000	-
640022	BPS GT1G	13.8	-	0.9887	-
640023	BPS GT2G	13.8	-	0.9886	-
640024	BPS ST3G	13.8	-	0.9879	-
640154	CRETE G	34.5	-	1.0386	-
640170	FAIRBRYG	34.5	-	1.0401	-
641086	EGY CTRG	13.8	-	1.0000	-
642067	PLATTE1G	13.8	-	1.0090	-
FLT 01					
572050	GEN08-123N	115.0	1.0221	1.0333	-1.08%
572120	GEN08-121N	345.0	1.0050	1.0387	-3.24%
FLT 02					
572120	GEN08-121N	345.0	1.0273	1.0387	-1.10%

Bus #	Bus Name	Base kV	Contingency Voltage	Base Voltage	% Deviation
			FLT 10		
572050	GEN08-123N	115.0	1.0025	1.0333	-2.98%
			FLT 14		
640012	HEBRON G	13.8	1.0156	1.0000	1.56%
640170	FAIRBRYG	34.5	1.0589	1.0401	1.81%
			FLT 16		
572120	GEN08-121N	345.0	0.9738	1.0396	-6.33%

Table 4-2: Results Obtained – Steady State Analysis – Winter Peak Base Case

Bus #	Bus Name	Base kV	Contingency Voltage	Base Voltage	% Deviation
			Base Case		
572050	GEN08-123N	115.0	-	1.0327	-
572120	GEN08-121N	345.0	-	1.0398	-
640009	COOPER1G	22.0	-	1.0000	-
640012	HEBRON G	13.8	-	1.0000	-
640019	SHELDN1G	13.8	-	1.0000	-
640020	SHELDN2G	13.8	-	1.0000	-
640021	SHELDONG	13.8	-	1.0000	-
640022	BPS GT1G	13.8	-	0.9821	-
640023	BPS GT2G	13.8	-	0.9820	-
640024	BPS ST3G	13.8	-	0.9813	-
640154	CRETE G	34.5	-	1.0384	-
640170	FAIRBRYG	34.5	-	1.0440	-
641086	EGY CTRG	13.8	-	1.0000	-
642067	PLATTE1G	13.8	-	1.0090	-
			FLT 01		
572050	GEN08-123N	115.0	1.0197	1.0327	-1.26%
572120	GEN08-121N	345.0	0.9971	1.0398	-4.11%
			FLT 02		
572120	GEN08-121N	345.0	1.0292	1.0398	-1.02%
			FLT 10		
572050	GEN08-123N	115.0	0.9966	1.0327	-3.50%
			FLT 16		
572120	GEN08-121N	345.0	0.9828	1.0430	-5.77%
			FLT 17		
640022	BPS GT1G	13.8	0.9999	0.9865	1.36%
640023	BPS GT2G	13.8	0.9998	0.9865	1.35%
640024	BPS ST3G	13.8	0.9990	0.9858	1.34%

There are several contingencies for which the voltage impact is greater than 1% for both the summer and winter peak power flow cases. However, the voltage profile for the two POIs and surrounding buses remains within the limits. The most severe contingencies are:

- The outage of the 345 kV line between Gen2008-121N and Pauline 3 substations (FLT 1) results in voltage deviations of 3% at the Project bus in summer peak and 4% in winter peak.
- For the loss of the 115 kV line from Pauline 7 to Gen-2008-123N (FLT 10) causes a voltage dip at the Project bus of 3.0 and 3.5 % in summer and winter peak cases, respectively.
- The contingency FLT 16 is also the outage of the 345 kV line between Gen2008-121N and Pauline 3 substations, but considering the prior outage of Pauline 345/115 kV transformer. This contingency leads to a voltage drop of 6.3% at Project bus in the worst case (summer peak).

4.2 Power Factor Analysis

A QV analysis was performed to determine the amount of reactive support required to maintain the scheduled voltages at the points of interconnection of each one of the proposed wind facilities. The contingencies described in Table 3-2 were evaluated in steady state conditions for summer and winter peak base cases, with variable Mvar injection at the POIs.

Table 4-3 presents for each one of the proposed wind facilities in Group 15, the Mvar requirements and the associated power factor that the projects must be able to provide under contingencies.

Table 4-3: Mvar Requirements and Power Factor at the POI for the Proposed Projects Interconnection

Project	Point of Interconnection	V Scheduled (p.u)	Project Injection at POI in Base Case (Mvar)	QV Injection (Mvar)	Project Requirement (Net Mvar at POI)	Contingency	Power Factor at POI
GEN-2008-121N01	Pauline – Moore 345kV	1.039	84.8	65.08	-19.72	FLT 02 (SP)	0.999 (leading)
GEN-2008-123N	Pauline – Guide Rock 115 kV	1.047	18.9	17.62	-1.28	FLT 01 (WP)	1.000

QV Tables, showing the Mvar injection for each voltage level in base case and contingencies conditions, are presented in Appendix D for both summer peak and winter peak scenarios. The values chosen are the highest between the two scenarios.

4.3 Dynamic Results

The stability analysis was carried out using both Summer Peak and Winter Peak load flow models.

In order to determine the impact of the project on the overall system dynamics as well as to determine the requirements to meet the FERC Order 661-A Guidelines, 35 contingencies listed in Table 3-2 were simulated. The results obtained are described in this sub-section.

None of the units, neither in the Study group nor in the prior interconnection queue trip due to LVRT of frequency protection under the contingencies studied. Also, all other generators in the monitored areas were stable and remained in synchronism.

Additionally, a stability analysis was performed to evaluate the system performance under two prior outages conditions: each Segment of the Pauline – Moore 345 kV line and each Segment of the Pauline – Guide Rock 115 kV line.

The contingencies described in Table 3-3 were simulated. The results obtained show:

- The GEN-2008-121N and GEN-2008-123N projects present a satisfactory dynamic behavior, that is no trips due to LVRT of frequency protection under 8 out of 9 additional contingencies studied.
- The exception is FLT6A: the outage of the 345 kV line between Pauline and Axtell substations (under the prior outage of Moore to Gen08-121 345 kV line). This contingency causes a voltage collapse as the only path to 400 MW from Gen-2008-121N is through Pauline 345/115 kV transformer. As a consequence Gen-2008-121N presents non damped oscillations.

Figure 4-1 shows the dynamic performance of Gen-2008-121N for FLT 6A, under the prior outage of Moore to Gen08-121 345 kV line. The attempts to address the issue included reactive support from Gen-2008-121N. However capacitor banks at the project's costumer side (34.5 kV) did not lead to a satisfactory dynamic behavior. SVCs at the 34.5 kV buses also didn't improve the dynamic performance

As the results have shown that the lack of transmission supersedes the benefits of the reactive support provided by Gen-2008-121N, a generation constraint was attempted. Figure 4-2 shows the dynamic performance of Gen-2008-121N in summer peak and under the same fault conditions, when the Project is limited to a maximum size of 311.4 MW. However, in winter peak scenario the project is constrained even further, having its maximum size limited to 298.8 MW, which means 166 WTGs instead of 233 in the original conception.

Figure 4-1: Gen-2008-121N Dynamic Performance for FLT6A – Summer Peak Scenario Original Conception of 233 WTGs

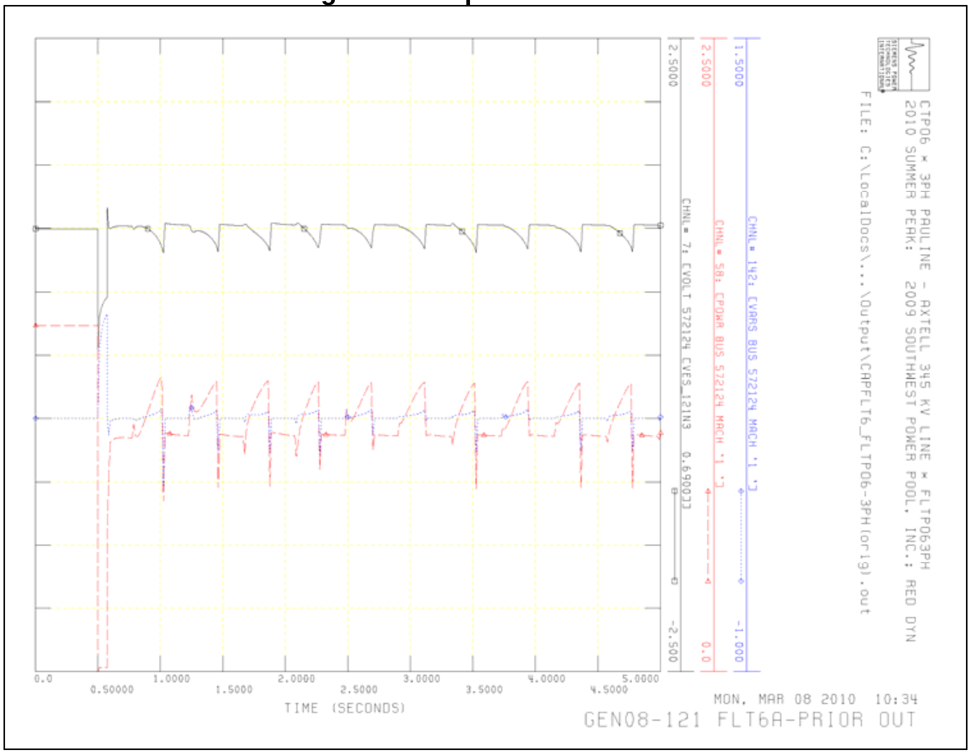
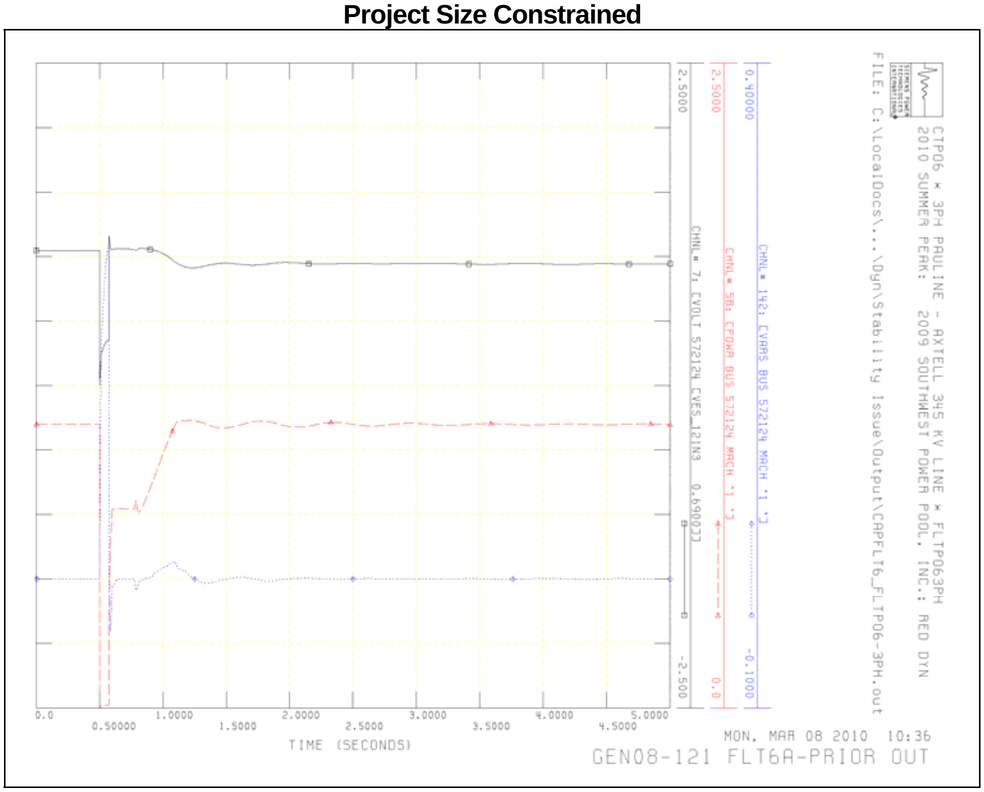


Figure 4-2: Gen-2008-121N Dynamic Performance for FLT6A – Summer Peak Scenario Project Size Constrained



When Gen-2008-121N is limited to 298.8 (166 x 1.8 MW) the project presents an adequate dynamic performance under the contingencies and prior outage conditions tested.

The stability plots for both the summer and winter cases are included in Appendix E1 and E2, respectively. The prior outage conditions are presented in Appendix E.3

Section

5

Conclusions

The two projects of PISIS-2009-001 Group 15 have been evaluated to determine the impact of the proposed cluster of interconnections on the Southwest Power Pool system.

Steady state and stability analysis were carried out to evaluate the system performance under contingencies. Also to identify the system requirements to meet the FERC Order 661-A Guidelines for Low Voltage Ride Through (LVRT) and therefore, to allow the Group 15 projects to deliver their full power to the SPP transmission system.

In general the Group 15 projects have impact on the voltage profile of the monitored system, under contingency conditions. However, no voltage criteria violations were identified through the simulations performed.

The power factor analysis determined the amount of reactive support required to maintain the scheduled voltages at each one of the points of interconnection. The amount of reactive support indicated by Table 4-3 must be achieved by each interconnection request using the wind turbine generator (WTG) capabilities and/or adding capacitor banks to the system.

Gen-2008-121N has an adverse impact on the stability of the SPP system, for the outage of the 345 kV line between Pauline and Axtell substations (under the prior outage of Moore to Gen08-121 345 kV line). This contingency causes a voltage collapse as the only path to 400 MW from the project is through Pauline 345/115 kV transformer.

However, the results indicate that when Gen-2008-121N maximum size is limited to 298.8 MW (166 x 1.8 MW), the project presents an adequate dynamic performance under the contingencies and prior outage conditions tested, and therefore no longer has an adverse impact on the stability of the SPP system.

This page intentionally left blank.

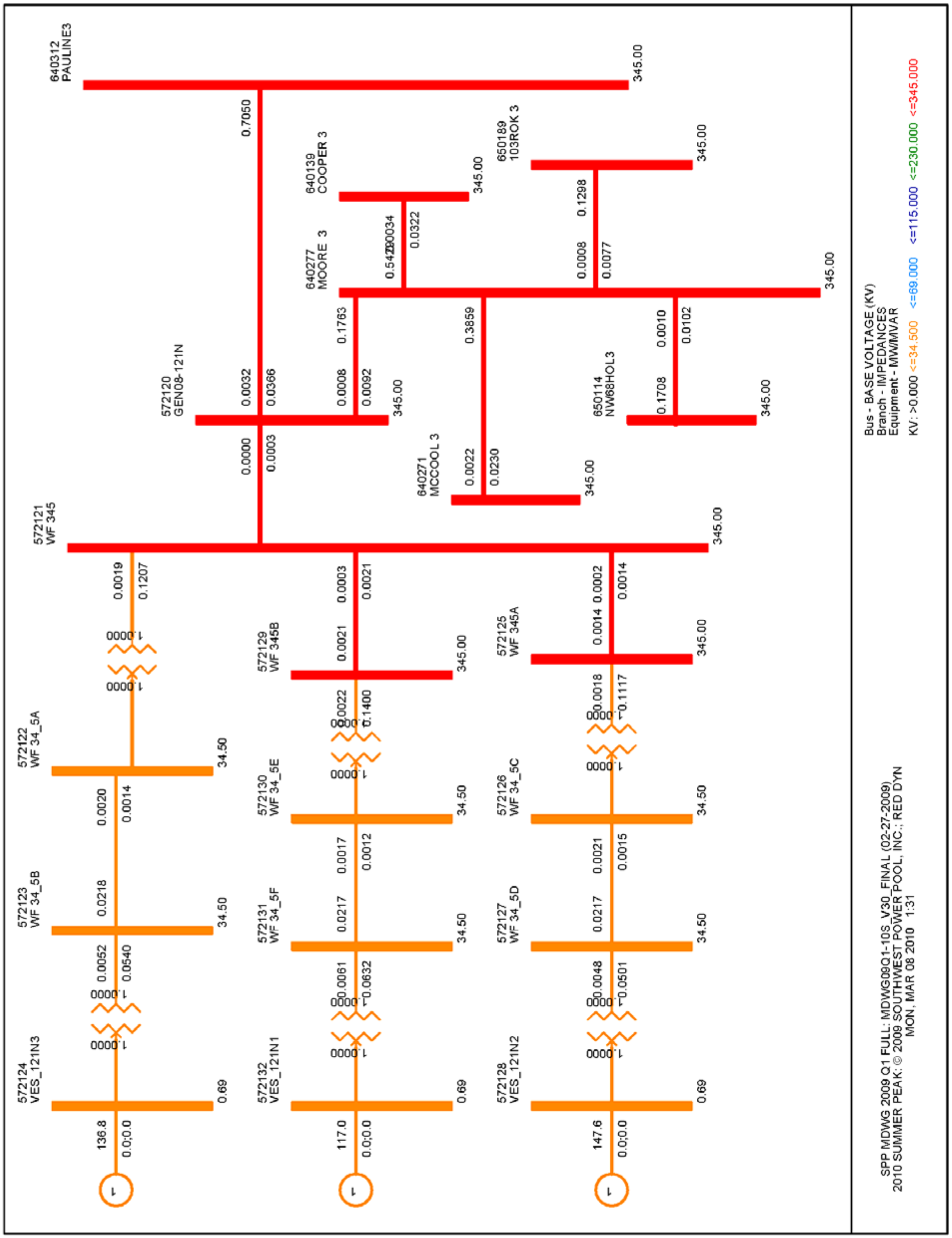
Appendix

A

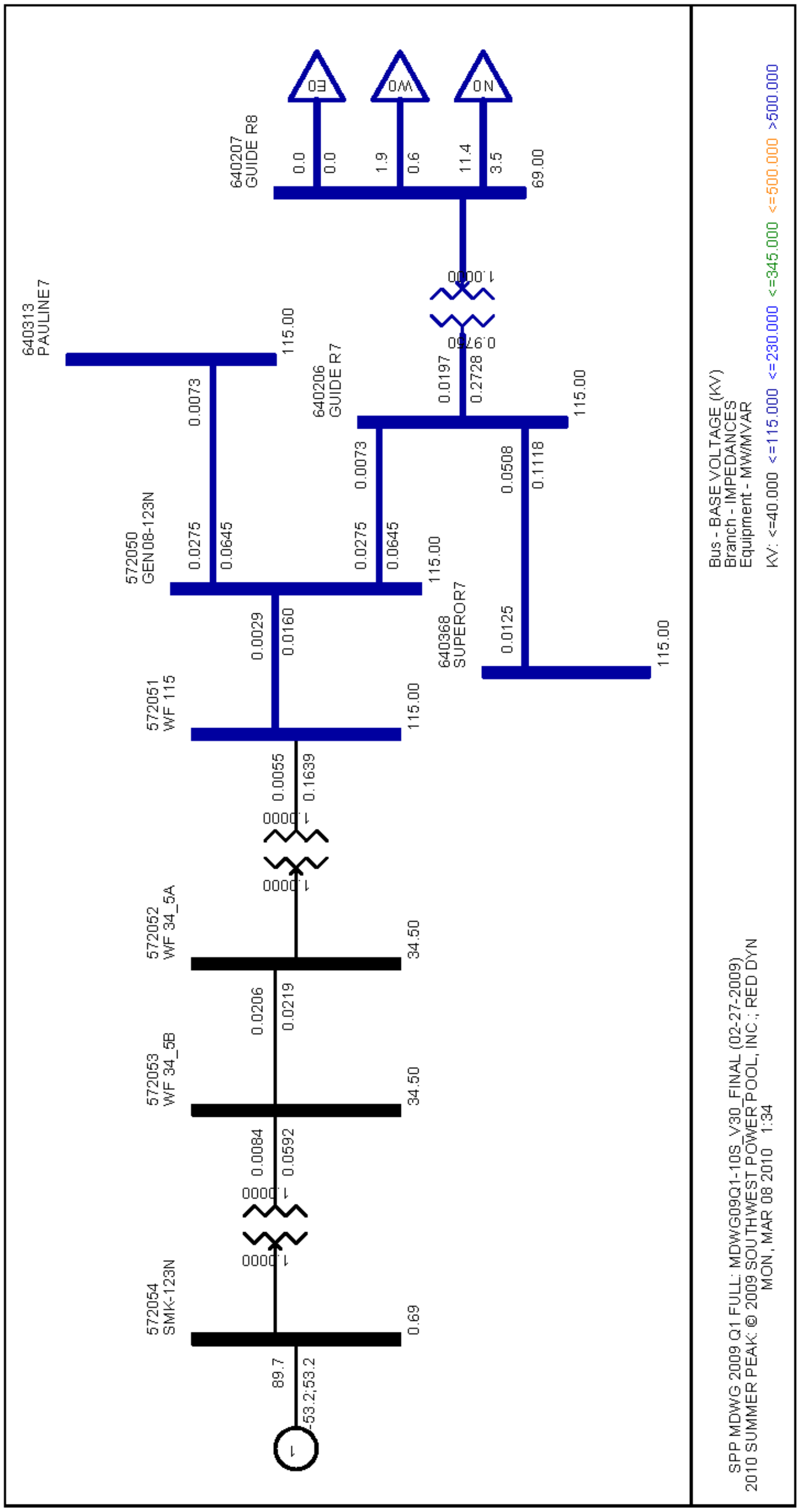
WTG Single Line Diagrams

This appendix contains the single line diagram, showing the modeling details of the Group 15 projects.

A.1 GEN-2008-121N01



A.2 GEN-2008-123N



This page intentionally left blank.