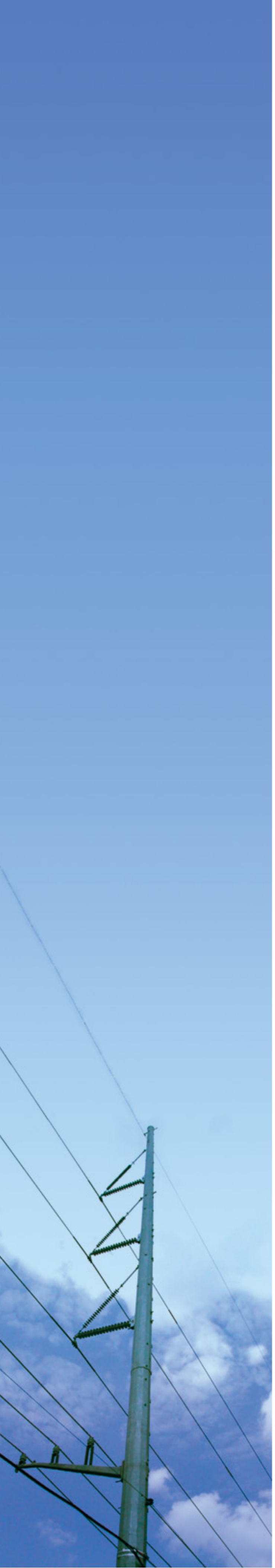

Definitive Interconnection System Impact Study for Generation Interconnection Requests

Southwest Power Pool
Engineering Department
Tariff Studies – Generation Interconnection

(DISIS-2009-001 Study)
January 2010

Re-posted
February 5, 2010

SPP RESTRICTED

Executive Summary

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Definitive Interconnection System Impact Study (DISIS) 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 DISIS-2009-001 Interconnection Customers. This Impact Study analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling 2,679 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 DISIS 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, 2,679 MW of nameplate generation may be interconnected with transmission system reinforcements within the SPP transmission system. Dynamic Stability Analysis and additional powerflow analysis for power factor requirements 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. Dynamic Stability Analysis has determined that the transmission system will remain stable with the assigned Network Upgrades and Interconnection Facilities to the DISIS.

The total estimated minimum cost for interconnecting the DISIS-2009-001 interconnection customers is $215,000,000. These costs are shown in Appendix E and F. Interconnection Service to DISIS-2009-001 interconnection customers is also contingent upon higher queued customers paying for certain required network upgrades. The in service date for the DISIS 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.

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

[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.

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.

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Introduction

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Definitive Interconnection System Impact Study (DISIS) 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 DISIS-2009-001 Interconnection Customers. This Impact Study analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling 2,679 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 Definitive 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 DISIS-2009-001 Study

SPP has included all interconnection requests that submitted a Definitive 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.

In addition, SPP included GEN-2009-017 which is an interconnection into the Caprock system as an affected system. GEN-2009-017 was analyzed for its impacts upon the SPP Transmission System. The report for GEN-2009-017 will be posted separately.

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

[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.

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.

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 DISIS-2009-001 Customers have no potential cost for the below listed projects. <u>However, the DISIS-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 DISIS 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

[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

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 DISIS-2009-001 study and are assumed to be in service. The DISIS-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 DISIS-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)

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

[5] Based on Facility Study Posting November 2008

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.

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:

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

- 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 2,679 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 250.5 MW of new interconnection requests in addition to the 2,802 MW of prior queued interconnection requests. No new constraints were found in this area.

Cluster Group 2 (Hitchland Area)

The Hitchland area contained 0 MW of interconnection request in addition to the 2,482 MW of previous queued generation interconnection requests. No new constraints were found in this area.

Cluster Group 3 (Spearville Area)

The Spearville area contained 500.6 MW of interconnection requests and 1,832 MW of previous queued interconnection requests. Constraints were observed in the Judson Large area. To mitigate these issues, a second 115kV circuit from GEN-2008-079 – Judson Large - Judson Large – North

Judson Large – Spearville was added. In addition, a Spearville 230/115kV autotransformer was added. Also, the proposed point of interconnection for GEN-2008-124 at Spearville 230kV was considered infeasible due to the excessive amount of prior queued generation at this bus and lack of 230kV lines in the area. As a result, the point of interconnection was moved to the Spearville 345kV.

Cluster Group 4 (Mingo/NW Kansas Group)
The Mingo/NW Kansas group had 101.2 MW in addition to the 823 MW of previously queued generation in the area. No new constraints were found in this area.

Cluster Group 5 (Amarillo Area)
The Amarillo group had 322 MW of interconnection requests in addition to the 2,557 MW of previously queued interconnection requests in this area. No new constraints were found in this area. However, the interconnection requests in service dates in this group will be dependent upon the upgrades assigned to higher queued interconnection requests including the completion of the Conway- Wheeler – Anadarko 345kV line which as yet does not have an in service date.

Cluster Group 6 (South Panhandle/New Mexico)
The Group 6 study which includes GEN-2009-017 will be posted separately

Cluster Group 7 (Southwestern Oklahoma)
This group had 190 MW of interconnection requests in addition to the 1,548 MW of previous queued generation in the area. No new constraints were found in this area.

Cluster Group 8 (South Central Kansas/North Oklahoma)
This group had 446 MW of interconnection requests in addition to the 1,601 MW of previous queued generation in the area. Most constraints were observed due to higher queued generation in the immediate area that is in the AECI queue. AECI has not fully analyzed the mitigations for these higher queued projects at this time. SPP has assigned the mitigations assuming all higher queued projects on the AECI queue go into service. The new lines assigned went from the GEN-2008-038 facility to Barnsdall 138kV and to OG&E Osage 138kV.

Cluster Group 9 (Northeast Nebraska)
This group had 391 MW of interconnection requests in addition to the 207 MW of previous queued generation in the area. The major constraints were overloads on the Albion – Petersburg 115kV line and the Bloomfield – Gavins 115kV line. To mitigate these constraints, a 115kV line was modeled from Bloomfield – Beldon as well as a 115kV line from Petersburg – Madison.

Cluster Group 10 (North Nebraska)
This group had 176 MW of interconnection requests in addition to the 209 MW of previous queued generation in the area. The major constraints in the North Nebraska area included the Mission – St. Francis 115kV line, the St. Francis – Harmony115kV line, and the Harmony – Valentine 115kV line. A Cody – Gordon 115kV and a second Ainsworth – Stuart 115kV line were investigated as mitigations to these constraints. The determined mitigations were a 115kV lines from Valentine – Stuart and Stuart – O'neil due to the Cody – Gordon line not relieving all constraints.

Cluster Group 11 (North Kansas)
This group had 251 MW of interconnection requests in addition to the 725 MW of previous queued generation in the area. The major constraints for the North Kansas area included several 115kV lines in the area due to too much generation requested on the 115kV system at Knoll. As a result of the constraints, the proposed point of interconnection for GEN-2008-092 was moved to Knoll 230kV.

Cluster Group 12 (Northwest Arkansas)
This group had 60 MW of interconnection requests in addition to the 0 MW of previous queued generation in the area. No constraints were found in this area.

Cluster Group 13 (Kansas City Kansas)
This group had 80 MW of interconnection requests in addition to the 1,806 MW of previous queued generation in the area. The only constraint was a line trap on the Kansas City South – Longview 161kV line.

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 Excel Engineering Inc. (Excel). It was determined that all interconnection requests in the Woodward area will have a power factor requirement as listed in the study for Group 1 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 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)
There was no stability analysis conducted in the Hitchland area due to no requests in the area.

Cluster Group 3 (Spearville Area)
The Group 3 stability study was conducted by Excel Engineering Inc. (Excel). It was determined that all interconnection requests in the Spearville area will have a power factor requirement as listed in the study for Group 3 at the point of interconnection in accordance with FERC Order #661A.

With the power factor requirements 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 Pterra Consulting (Pterra). 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.

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 Power Technologies Inc. (PTI). The Amarillo area stability analysis revealed no new stability issues due to the addition of the study projects. It was determined that all interconnection requests in the Amarillo area are required to provide 96% leading and lagging power factor at the point of interconnection in accordance with FERC Order #661A.

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 (South Panhandle Area)
The Group 6 study which includes GEN-2009-017 will be posted separately.

Cluster Group 7 (Southwest Oklahoma)
The Group 7 stability analysis was conducted by Excel Engineering (Excel). The Southwest Oklahoma stability analysis revealed that GEN-2009-016 will require a STATCOM device of +/-10MVA in order to maintain stability for the outage of the GEN-2009-016 wind farm to Elk City 138kV line. It was determined that all interconnection requests in the southwest Oklahoma 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 7 will meet FERC Order #661A low voltage ride through (LVRT) requirements.

Cluster Group 8 (South Central Kansas)
The Group 8 stability analysis was conducted by Power Technologies Inc. (PTI). The South Central Kansas 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.

With the power factor requirements 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 partially by S&C Consulting Services and was finalized by SPP staff. The stability analysis has indicated that with the addition of the upgrades identified in the powerflow analysis, all interconnection requests are able to meet FERC #661A low voltage ride through requirements and a stable transmission system will be maintained.

It was determined that all interconnection requests in the northeast Nebraska area will have power factor requirements as required in the stability study. All interconnection requests will need to be able to provide reactive vars at the point of interconnection.

Cluster Group 10 (North Nebraska)

The Group 10 stability analysis was conducted by ABB Consulting Inc. (ABB). Analysis has indicated that with the addition of the upgrades identified in the powerflow analysis, all interconnection requests are able to meet the FERC #661A LVRT requirements and a stable transmission system will be maintained.

It was determined that all interconnection requests in the northeast Nebraska area will have power factor requirements as required in the stability study. All interconnection requests will need to be able to provide reactive vars at the point of interconnection.

Cluster Group 11 (North Kansas)

The Group 11 stability analysis was conducted by Pterra Consulting (Pterra). The North Kansas 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.

With the power factor requirements 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)

The Group 12 stability analysis was conducted by AMEC Environmental (AMEC). The Group 12 stability analysis revealed no stability issues with the study request. It was determined that the interconnection request in Group 12 will have power factor requirements as denoted in the study.

Cluster Group 13 (Kansas City Kansas)

The Group 13 stability analysis was conducted by Excel Engineering (Excel). The Group 13 requests is a fossil fuel unit that must meet the pro-forma power factor requirements of the LGIA. There were no stability issues identified in the study

Regional Maps with Proposed Upgrades

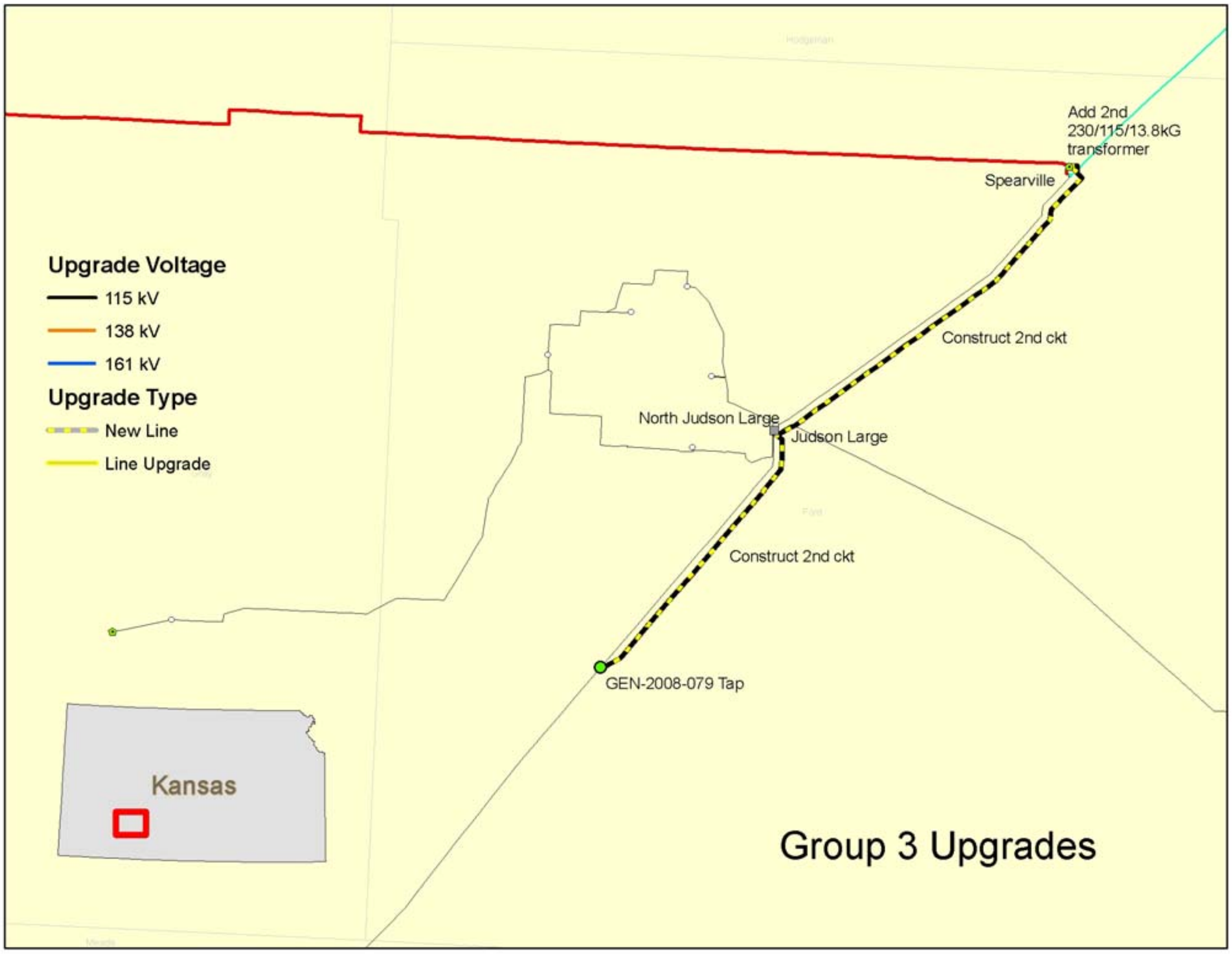


Figure 1 – Group 3 Proposed Major Line Upgrades

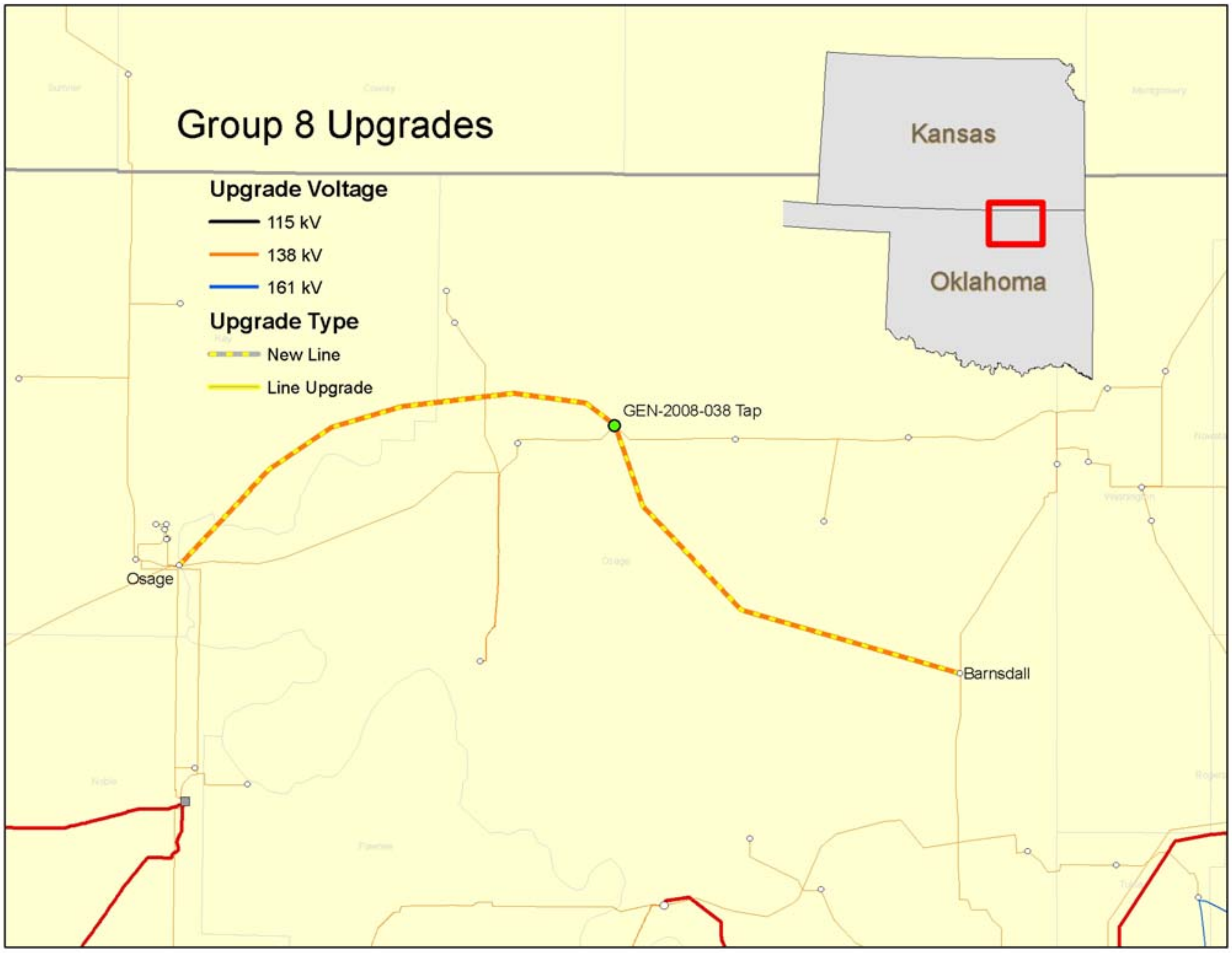


Figure 3 – Group 8 Proposed Major Line Upgrades

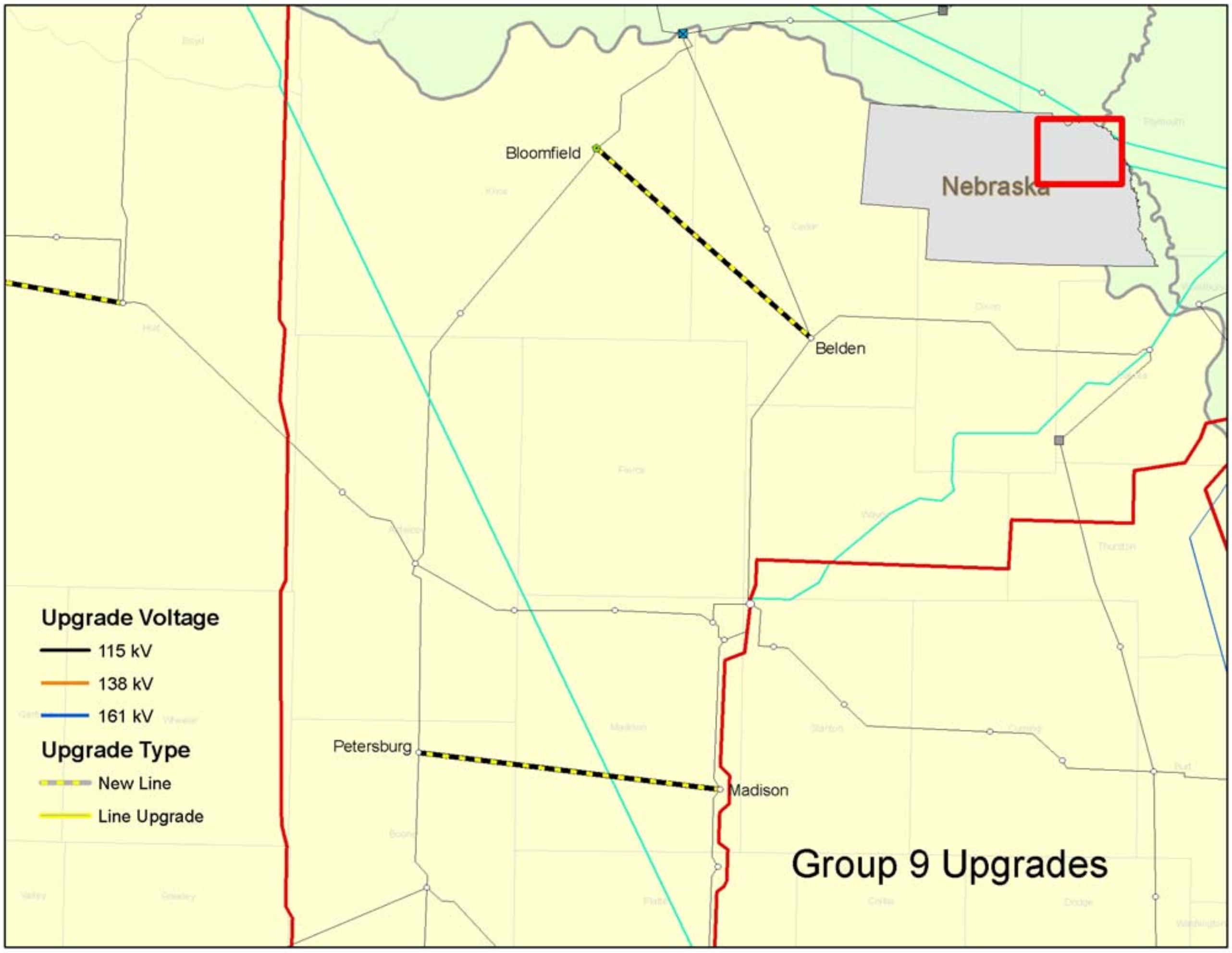


Figure 4 – Group 9 Proposed Major Line Upgrades

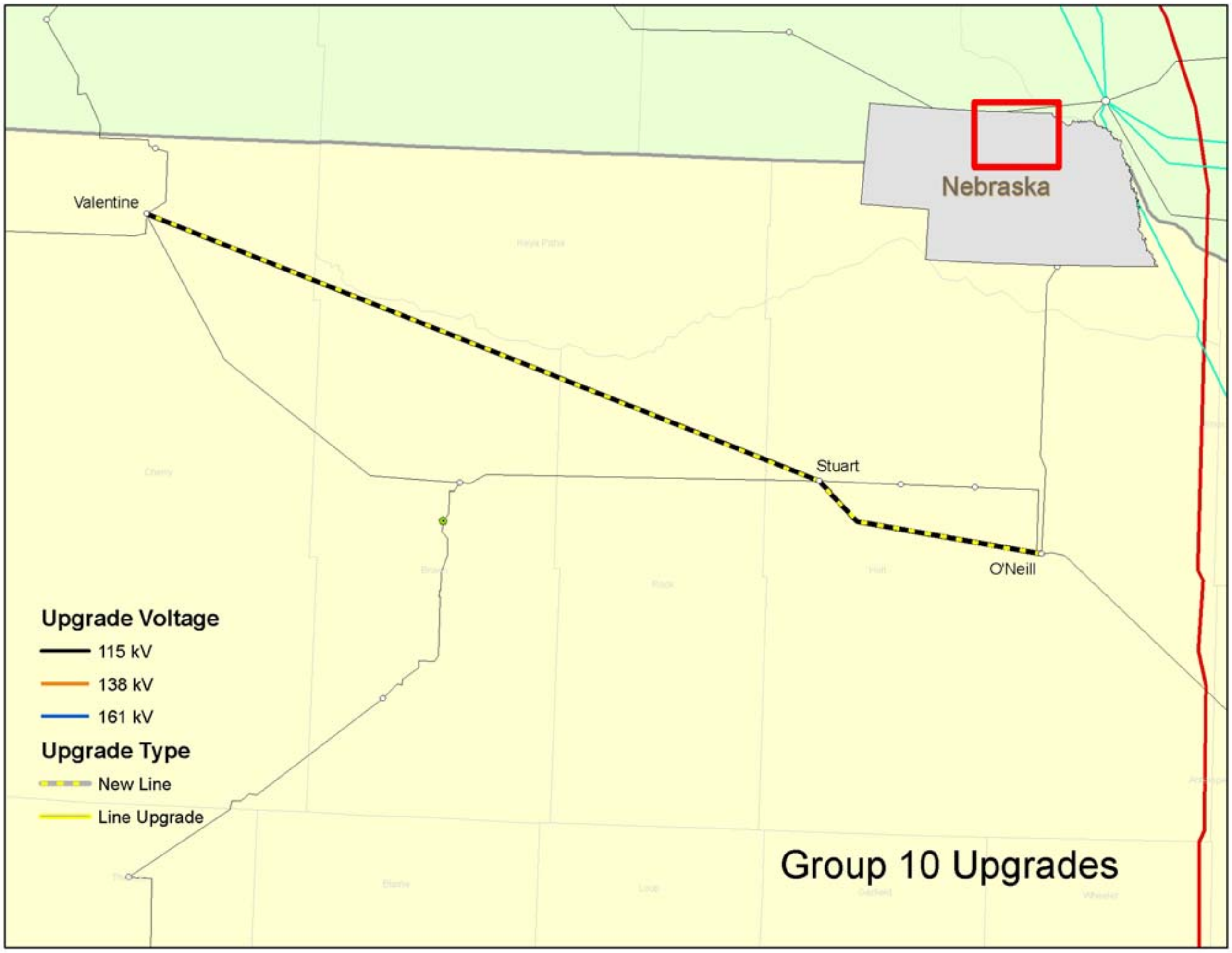


Figure 5 – Group 10 Proposed Major Line Upgrades

Conclusion

The minimum cost of interconnecting all of the interconnection requests included in this Impact Cluster Study is estimated at $215,000,000 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. These studies are being performed as part of the Interconnection System Facility Study that each customer has already executed.

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-2006-037N	100.5	NPPD	VALENTINE 115kV	VALENTINE 115kV	
GEN-2006-037N1	75	NPPD	BROKEN BOW 115kV	BROKEN BOW 115kV	1/1/2010
GEN-2006-044N	40.5	NPPD	TAP NELIGH-PETERSBURG 115kV	TAP NELIGH-PETERSBURG 115kV	1/1/2010
GEN-2007-011N06	75	NPPD	TAP NELIGH-PETERSBURG 115kV	PETERSBURG 115kV	1/1/2010
GEN-2007-011N09	75	NPPD	BLOOMFIELD 115kV	BLOOMFIELD 115kV	
GEN-2007-040	200	SUNC	Tap Holcomb – Spearville 345kV	Tap Holcomb – Spearville 345kV	12/15/2010
GEN-2008-021	42	WERE	WOLF CREEK 345kV	WOLF CREEK 345kV	5/16/2011
GEN-2008-023	150	AEPW	HOBART JUNCTION 138kV	HOBART JUNCTION 138kV	12/31/2012
GEN-2008-025	101.2	SUNC	RULETON 115kV	RULETON 115kV	11/1/2009
GEN-2008-029	250.5	OKGE	WOODWARD EHV 138kV	WOODWARD EHV 138kV	1/1/2010
GEN-2008-038	144	AEPW	TAP SHIDLER-WEST PAWHUSKA 138kV	TAP SHIDLER-WEST PAWHUSKA 138kV	12/1/2010
GEN-2008-051	322	SPS	POTTER 345kV	POTTER 345kV	12/31/2010
GEN-2008-079	100.5	MKEC	TAP JUDSON LARGE-CUDAHY 115kV	TAP JUDSON LARGE-CUDAHY 115kV	12/1/2010
GEN-2008-086N02	200	NPPD	TAP FT RANDALL-COLUMBUS 230kV	TAP FT RANDALL-COLUMBUS 230kV	
GEN-2008-092	201	MIDW	KNOLL 115kV	KNOLL 230kV	12/1/2011
GEN-2008-124	200.1	MKEK	SPEARVILLE 230kV	SPEARVILLE 345kV	11/30/2011
GEN-2008-127	200.1	WERE	TAP SOONER-ROSE HILL 345kV	TAP SOONER-ROSE HILL 345kV	10/31/2011
GEN-2008-129	80	MIPU	PLEASANT HILL 161kV	PLEASANT HILL 161kV	5/1/2009
GEN-2009-006	60	AEPW	SE FAYETTEVILLE 161kV	SE FAYETTEVILLE 161kV	12/31/2010
GEN-2009-011	50	SUNC	TAP PLAINVILLE-PHILLIPSBURG 115kV	TAP PLAINVILLE-PHILLIPSBURG 115kV	7/31/2011
GEN-2009-016	140	MKEC	FALCON ROAD 138kV	FALCON ROAD 138kV	12/1/2011
GEN-2009-017**	151.8	SPS	TAP PEMBROOK-STILES 138kV	TAP PEMBROOK-STILES 138kV	6/1/2011
GEN-2009-025	60	OKGE	KAYCOOP 69kV	TAP Deer Creek – Sinclair 69kV	12/31/2011
GROUPED TOTAL	**2,679.2**				

** Interconnection on Caprock Electric tested for impacts on SPP

***** 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-Line
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 Suspension
GEN-2005-015	150	SPS	Tuco - Oklaunion 345kV	On Suspension
GEN-2005-016	150	WFEC	Tap Latham - Neosho	12/31/2006
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	5/31/2008
GEN-2006-017	300	MIPU	Tap Maryville – Clarinda 161kV	On Suspension
GEN-2006-020	18.9	SPS	DWS Frisco Tap	IA Executed/On Schedule 12/31/2009
GEN-2006-020N	42	NPPD	Bloomfield 115kV	1/1/2009
GEN-2006-021	101	WPEK	Flat Ridge Tap 138kV	On-Line (100MW)
GEN-2006-022	150	WPEK	Ninnescah Tap 115kV	On Suspension

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
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	On-Line
GEN-2006-038N019	80	NPPD	Petersburg 115kV	5/1/2011
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 schedule for 2009
GEN-2006-044	370	SPS	*Hitchland 345kV	On Suspension
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 Schedule
GEN-2007-011N08	81	NPPD	Bloomfield 115kV	On-Line
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	12/31/2009
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-2007-043	300	AEPW	Tap Lawton Eastside – Cimarron 345kV	Under Study (ICS-2008-001)
GEN-2007-044	300	OKGE	*Tatonga 345kV	Under Study (ICS-2008-001)
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	170	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)

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
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-2008-119O	60	OPPD	Tap Humboldt – Kelly 161kV	On-Line
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 by AECI
AECI-2	99	AECI	Lathrop 161kV	Under Study by AECI
AECI-3	201	AECI	Osborn 161kV	Under Study by AECI
AECI-4	150	AECI	Tap Fairfax – Fairfax Tap 138kV	Under Study by AECI
AECI-5	100	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	**17,830.2**			

***** 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	170	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
	PRIOR QUEUED SUBTOTAL	**2,802**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Woodward	GEN-2008-029	250.5	OKGE	WOODWARD EHV 138kV
	WOODWARD SUBTOTAL	**250.5**		
	AREA SUBTOTAL	**3,052.5**		

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**		
	AREA SUBTOTAL	**2,481.9**		

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-2008-018	405	SUNC	Finney 345kV
	PRIOR QUEUED SUBTOTAL	**1,832**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Spearville	GEN-2007-040	200	SUNC	Tap Holcomb – Spearville 345kV
	GEN-2008-079	100.5	MKEC	Tap Judson Large – Cudahy 115kV
	GEN-2008-124	200.1	MKEK	Spearville 230kV
	SPEARVILLE SUBTOTAL	**500.6**		
	AREA SUBTOTAL	**2,332.6**		

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
	PRIOR QUEUED SUBTOTAL	**823**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Mingo	GEN-2008-025	101.2	SUNC	Ruleton 115kV
	MINGO/NW KANSAS SUBTOTAL	**101.2**		
	AREA SUBTOTAL	**924.2**		

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
	PRIOR QUEUED SUBTOTAL	**2,557**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
Amarillo	GEN-2008-051	322	SPS	**Potter** 345kV
	AMARILLO SUBTOTAL	**322**		
	AREA SUBTOTAL	**2,879**		

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-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
	PRIOR QUEUED SUBTOTAL	**1,238**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
S Pandle	GEN-2009-017	151.8	SPS	Tap Pembrook – Stiles 138kV
	SOUTH PANHANDLE/NM SUBTOTAL	**151.8**		
	AREA SUBTOTAL	**1,389.8**		

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
	PRIOR QUEUED SUBTOTAL	**1,547**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
SW Oklahoma	GEN-2008-023	150	AEPW	Hobart Junction 138kV
	GEN-2009-016	140	AEPW	Falcon Road 138kV
	SW OKLAHOMA SUBTOTAL	**190**		
	AREA SUBTOTAL	**1737**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
	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
	PRIOR QUEUED SUBTOTAL	**1,601**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
North Oklahoma	GEN-2008-021	42	WERE	Wolf Creek 345kV
	GEN-2008-038	144	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
	North OKLAHOMA SUBTOTAL	**446.1**		
	AREA SUBTOTAL	**2,047.1**		

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-2007-011N08	81	NPPD	Bloomfield 115kV
	PRIOR QUEUED SUBTOTAL	**207**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
NE Nebraska	GEN-2006-044N	40.5	NPPD	Tap Neligh – Petersburg 115kV
	GEN-2007-011N06	75	NPPD	Tap Neligh – Petersburg 115kV
	GEN-2007-011N09	75	NPPD	Bloomfield 115kV
	GEN-2008-086N02	200	NPPD	Tap Ft. Randall - Columbus
	NE NEBRASKA SUBTOTAL	**390.5**		
	AREA SUBTOTAL	**597.5**		

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
	Ainsworth	75	NPPD	Ainsworth Wind Tap 115kV
	GEN-2004-005N	30	NPPD	St. Francis 115kV
	GEN-2006-038N05	80	NPPD	Broken Bow 115kV
	PRIOR QUEUED SUBTOTAL	**209.3**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
North Nebraska	GEN-2006-037N	100.5	NPPD	Valentine 115kV
	GEN-2006-037N1	75	NPPD	Broken Bow 115kV
	NORTH NEBRASKA SUBTOTAL	**175.5**		
	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
	PRIOR QUEUED SUBTOTAL	**725**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
North Kansas	GEN-2008-092	201	MIDW	Knoll 115kV
	GEN-2009-011	50	MKEC	Tap Plainville – Phillipsburg 115kV
	NORTH KANSAS SUBTOTAL	**251**		
	AREA SUBTOTAL	**976**		

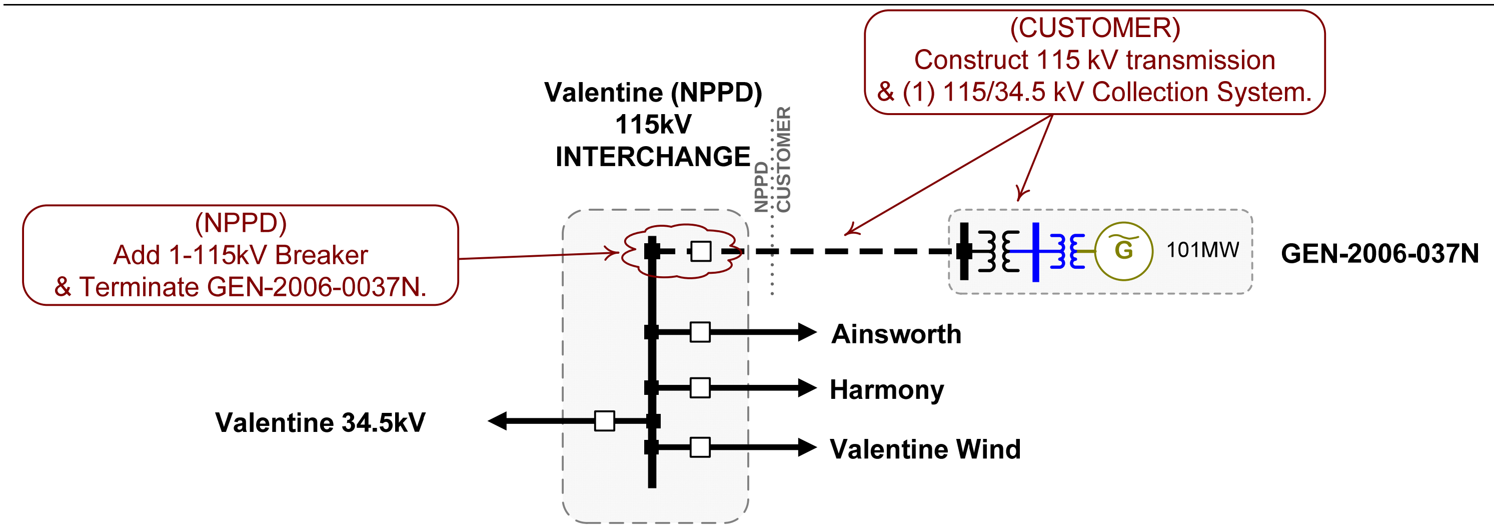
Cluster	Request	Amount	Area	Proposed Point of Interconnection
NW Arkansas	GEN-2009-006	60	AEPW	SE Fayetteville 161kV
NW ARKANSAS SUBTOTAL		**60**		
AREA SUBTOTAL		**60**		

Cluster	Request	Amount	Area	Proposed Point of Interconnection
	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
	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
PRIOR QUEUED SUBTOTAL		**1,806**		
Cluster	**Request**	**Amount**	**Area**	**Proposed Point of Interconnection**
NW Missouri	GEN-2008-129	80	MIPU	Pleasant Hill 161kV
KANSAS CITY KANSAS SUBTOTAL		**80**		
AREA SUBTOTAL		**1,886**		
*****CLUSTERED TOTAL (w/o PRIOR QUEUED)**		**2,679.2**		
*****CLUSTERED TOTAL (w/PRIOR QUEUED)**		**20,509.4**		

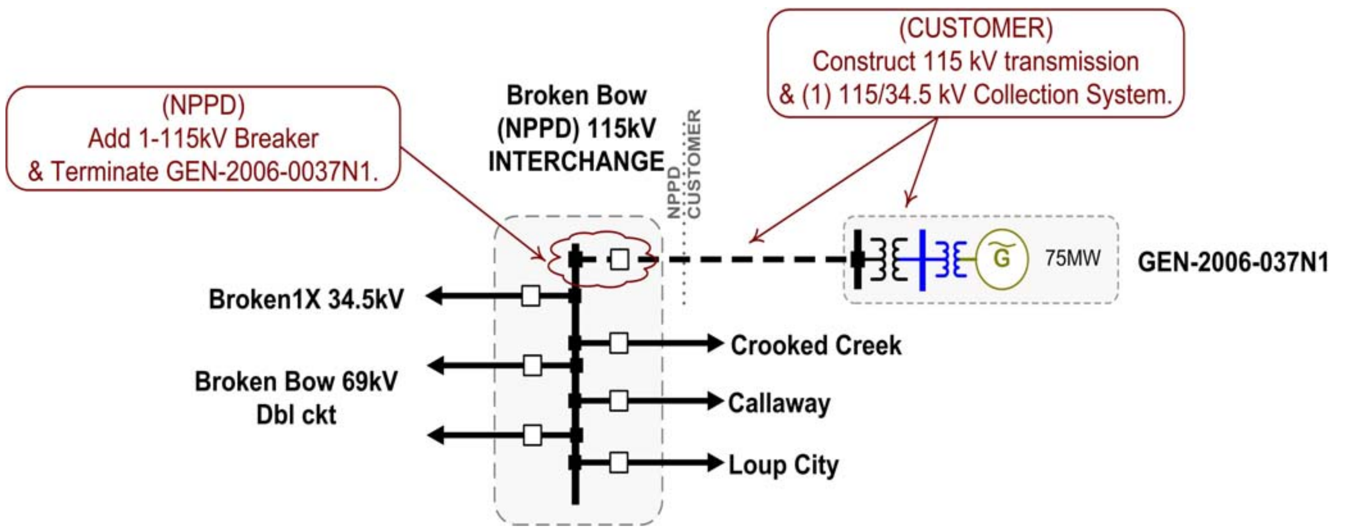
***** Planned Facility
^ Proposed Facility
****** Alternate requests - counted as one request for study purpose
*** Electrically Remote Interconnection Requests included in total

D: Proposed Point of Interconnection One line Diagrams

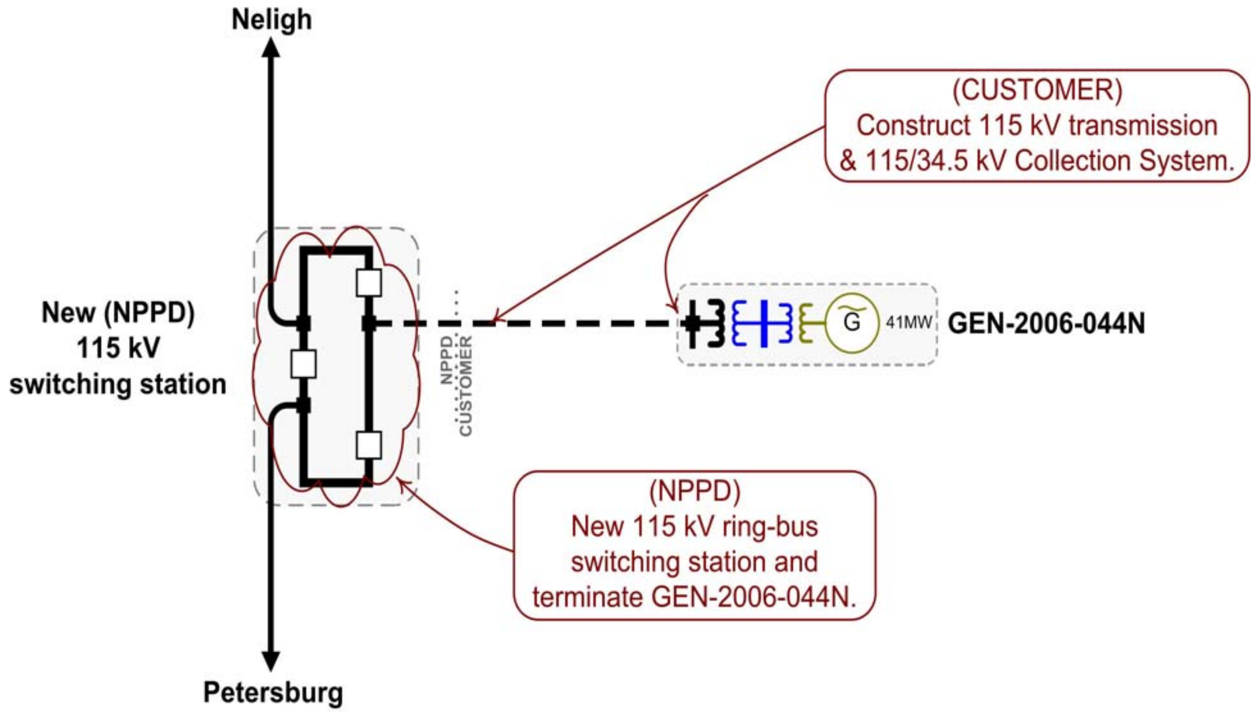
GEN-2006-037N



GEN-2006-037N1



GEN-2006-044N



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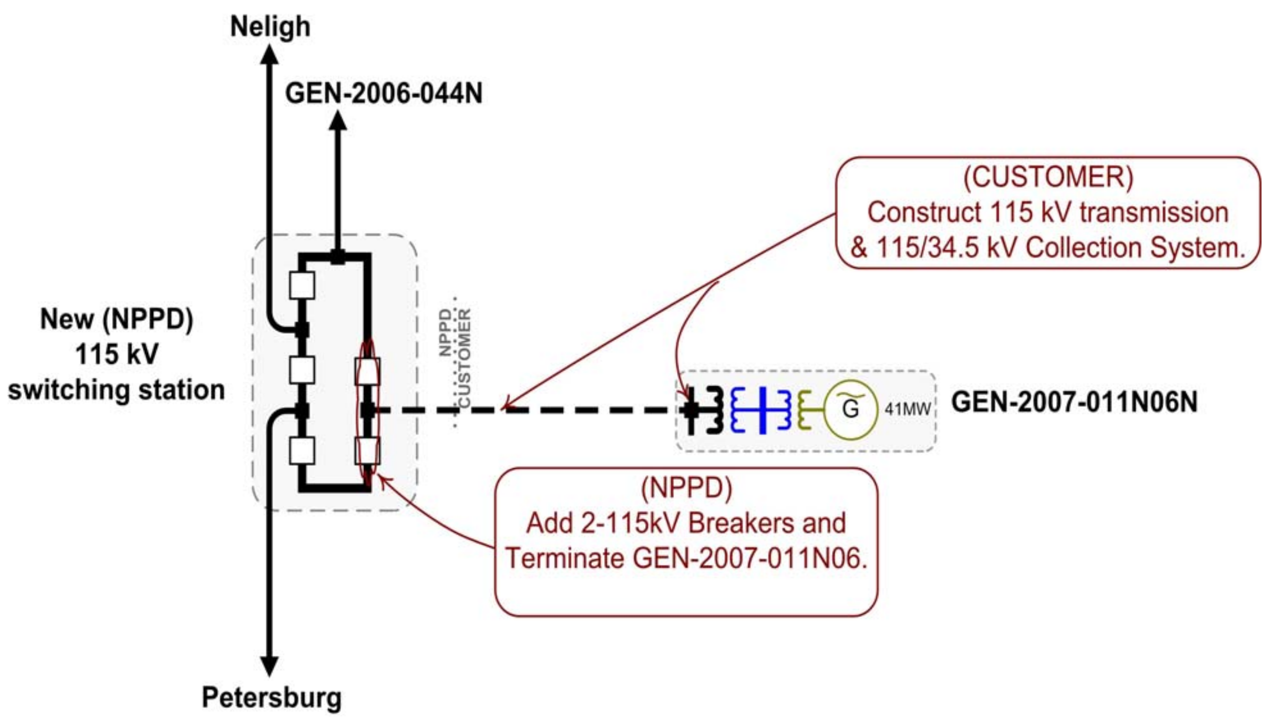

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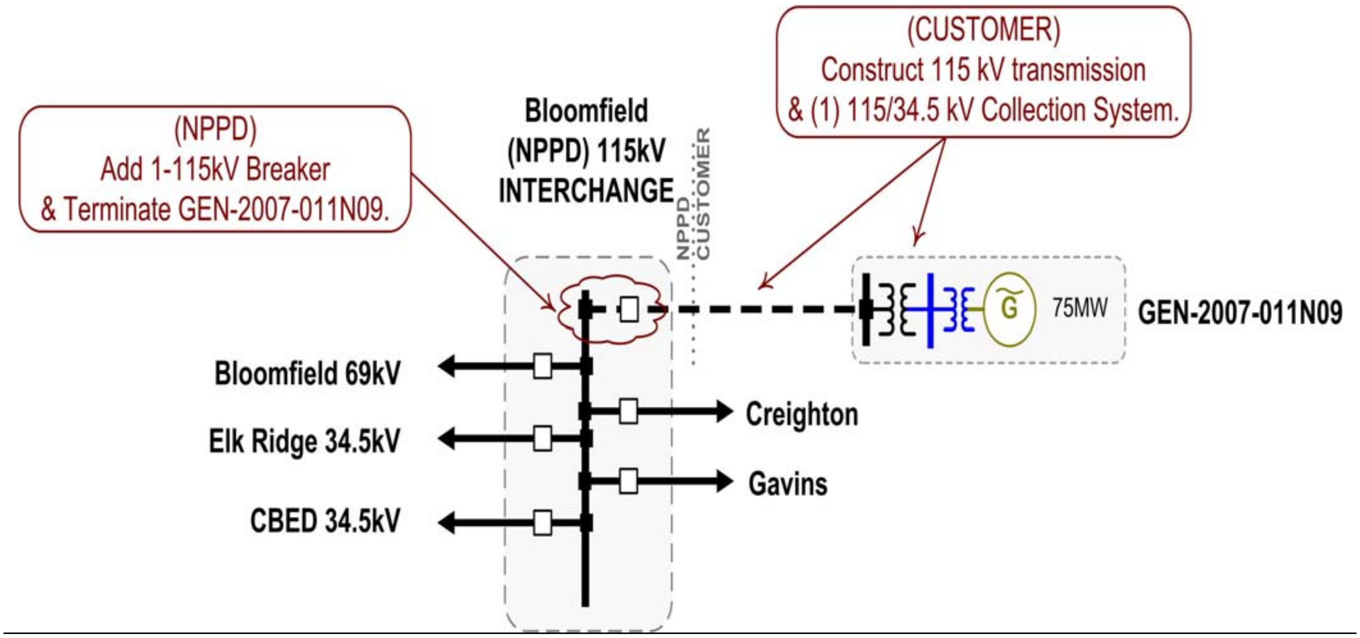
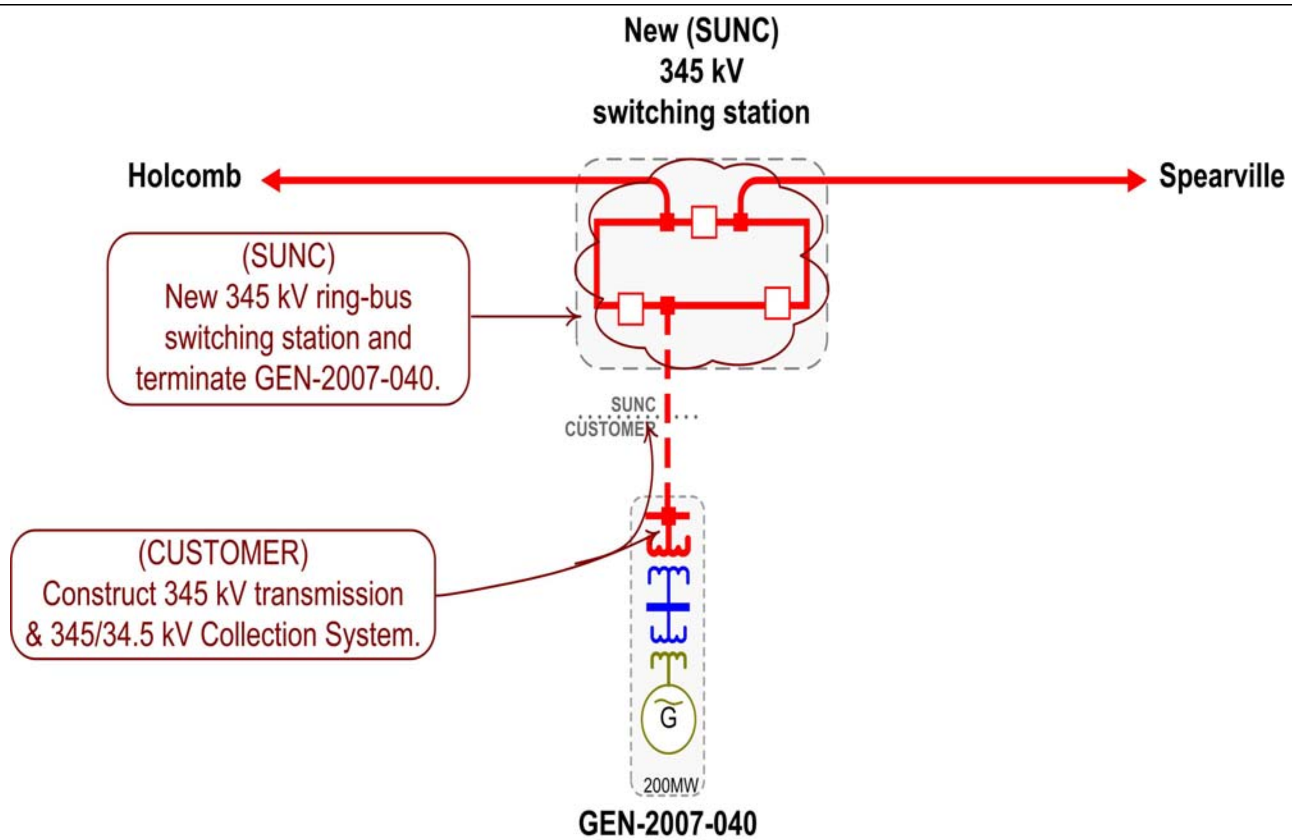


GEN-2007-040



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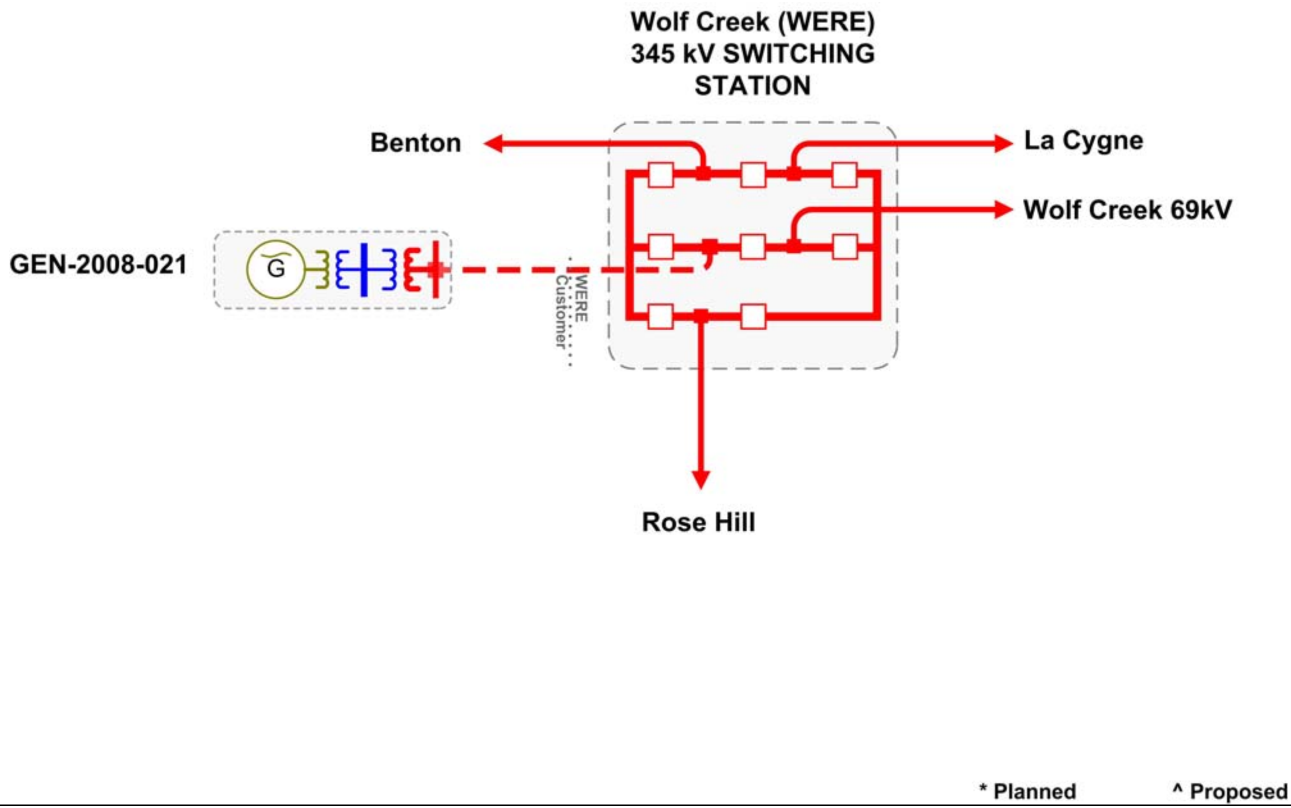

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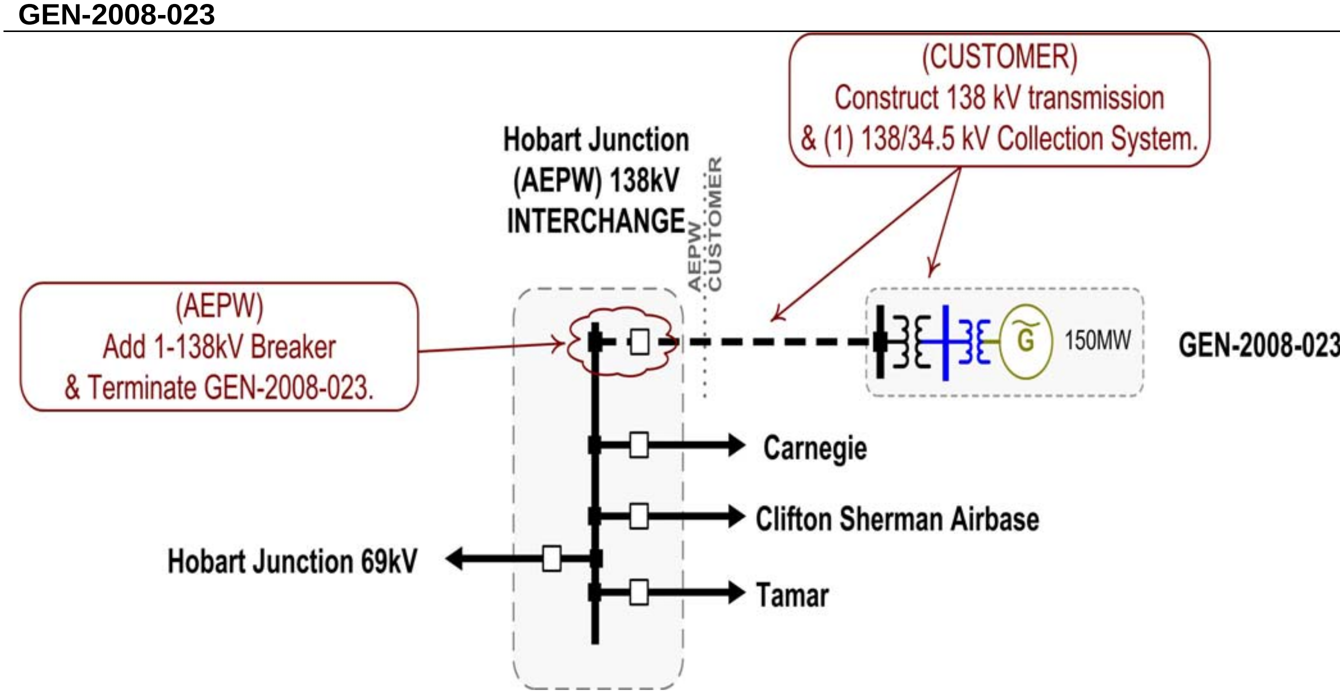

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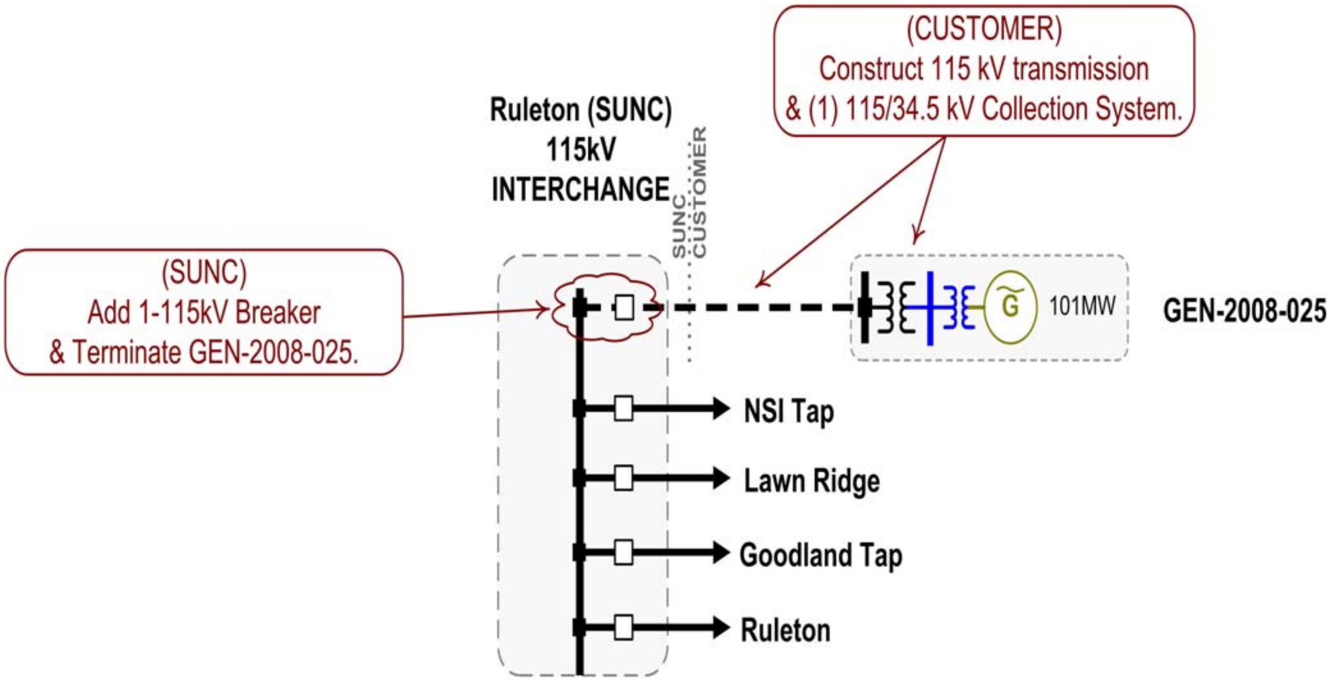

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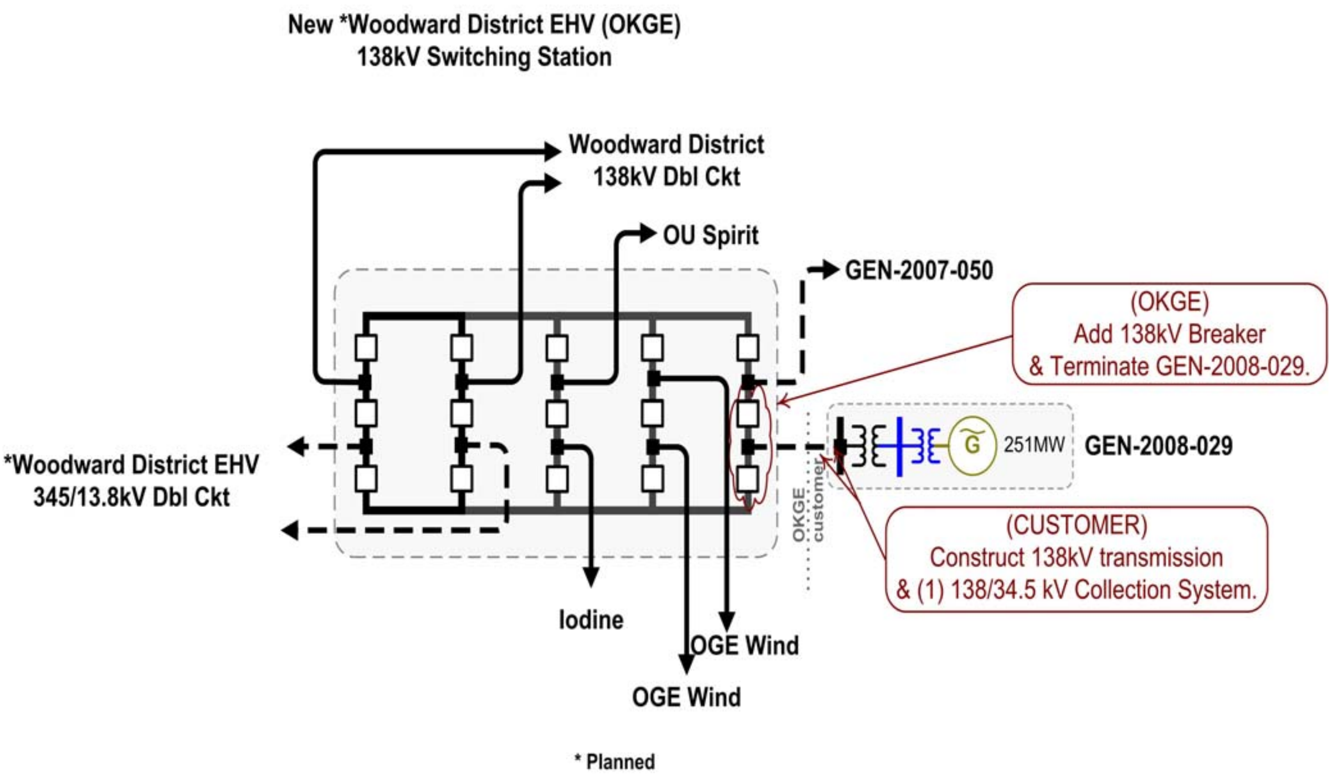

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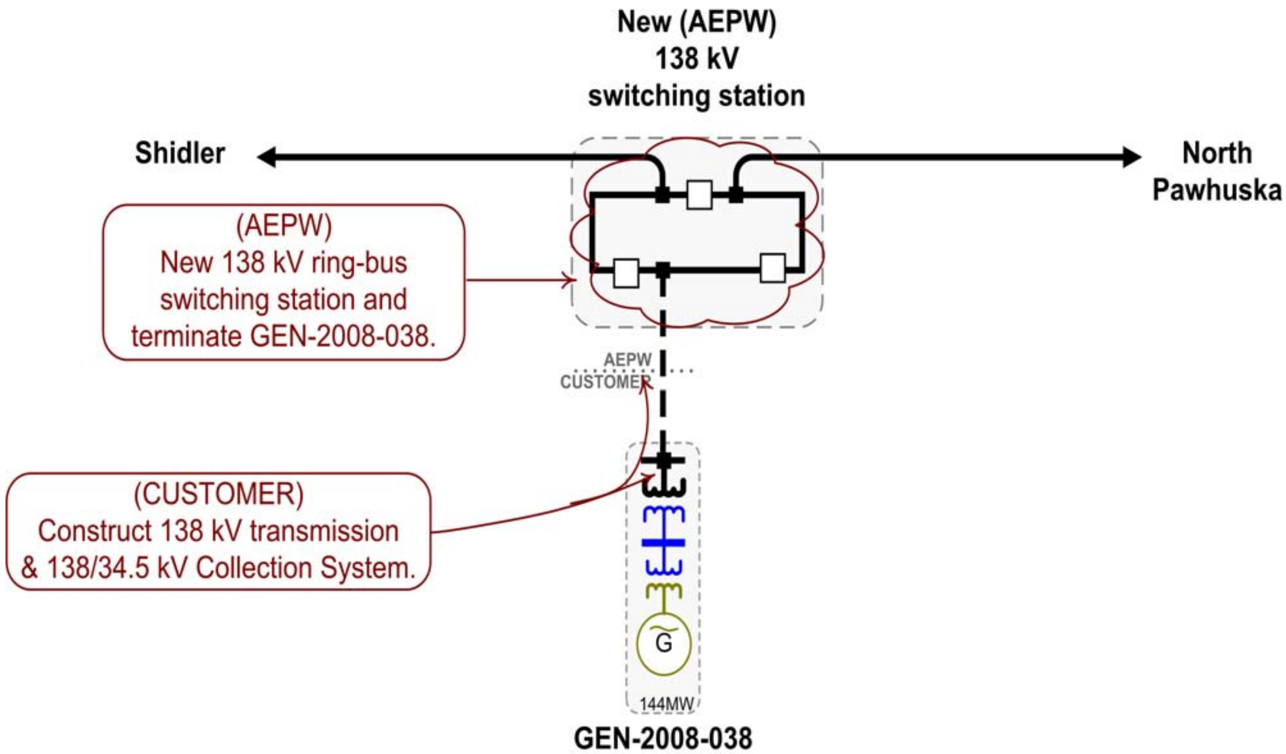

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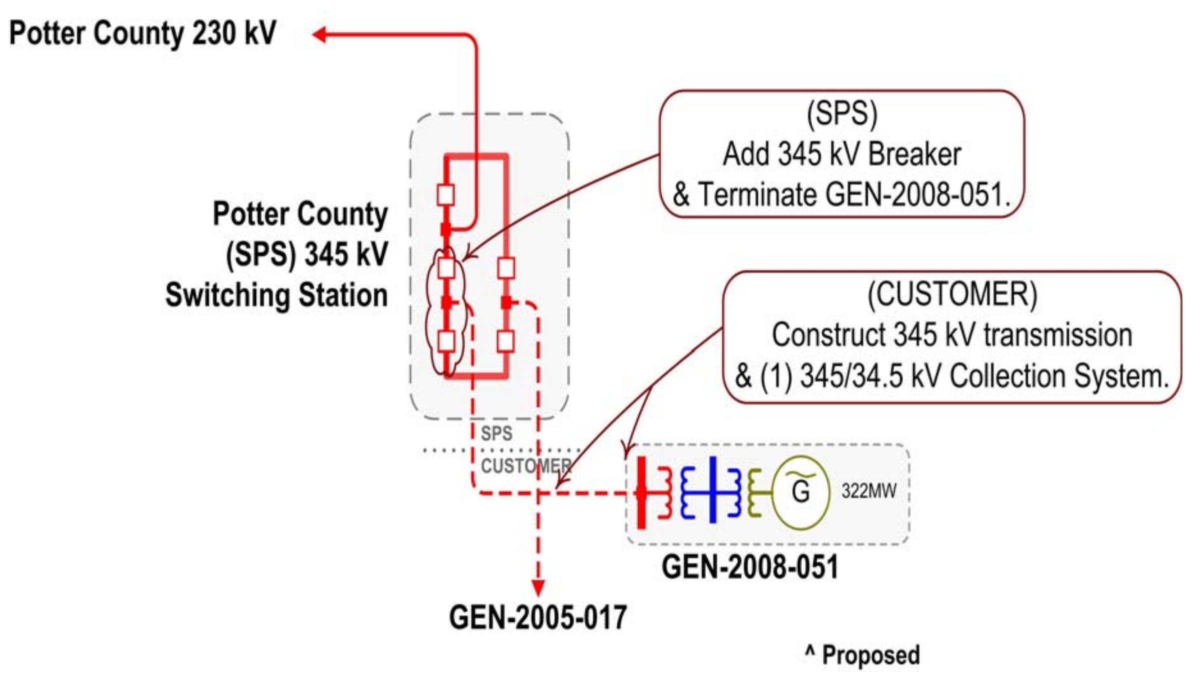

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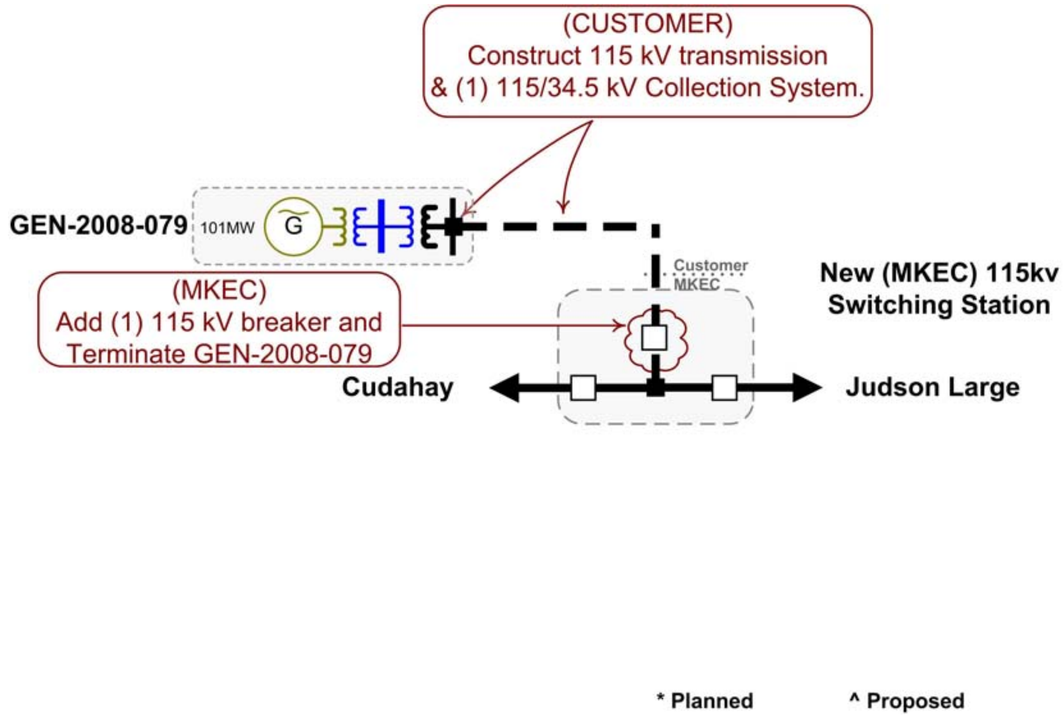

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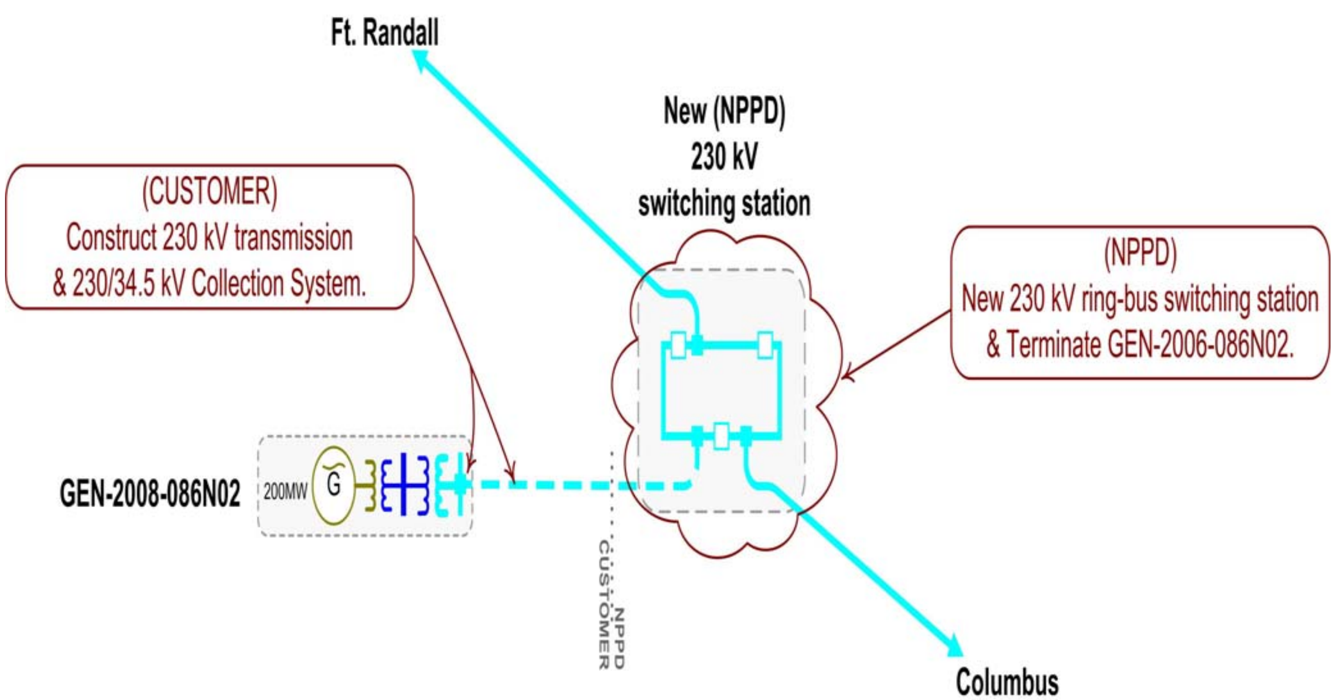

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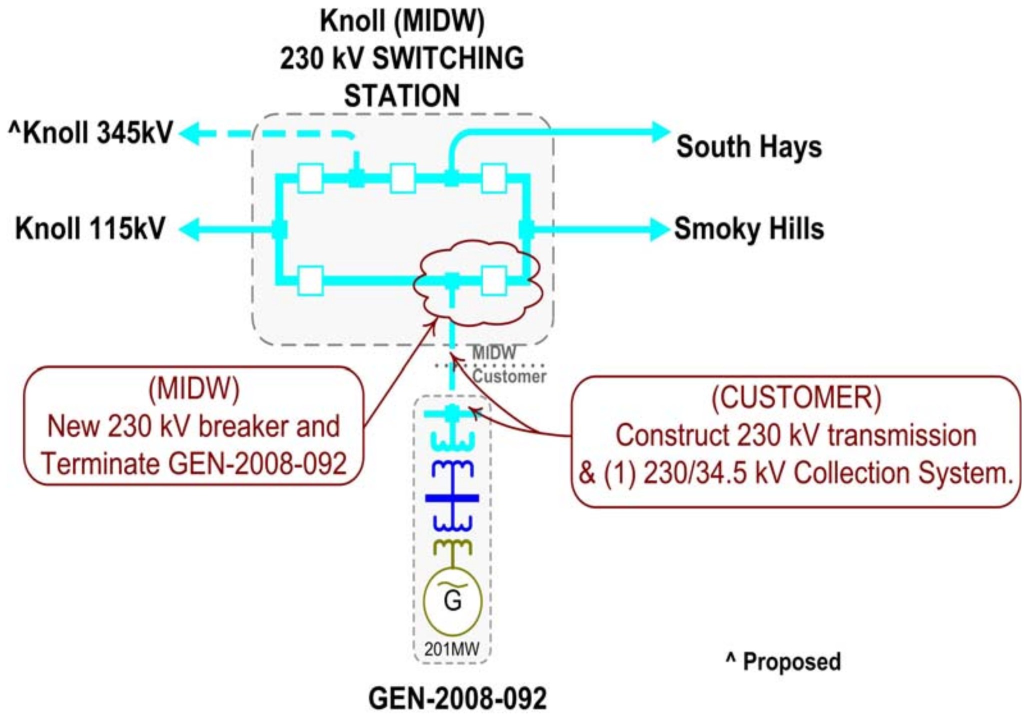

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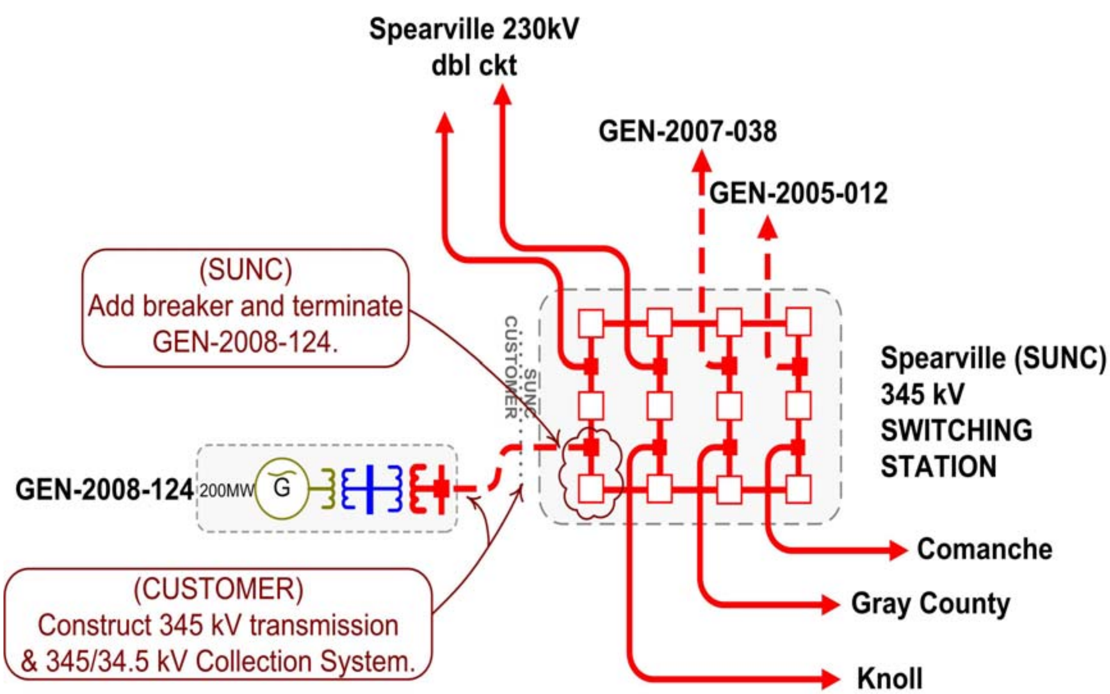
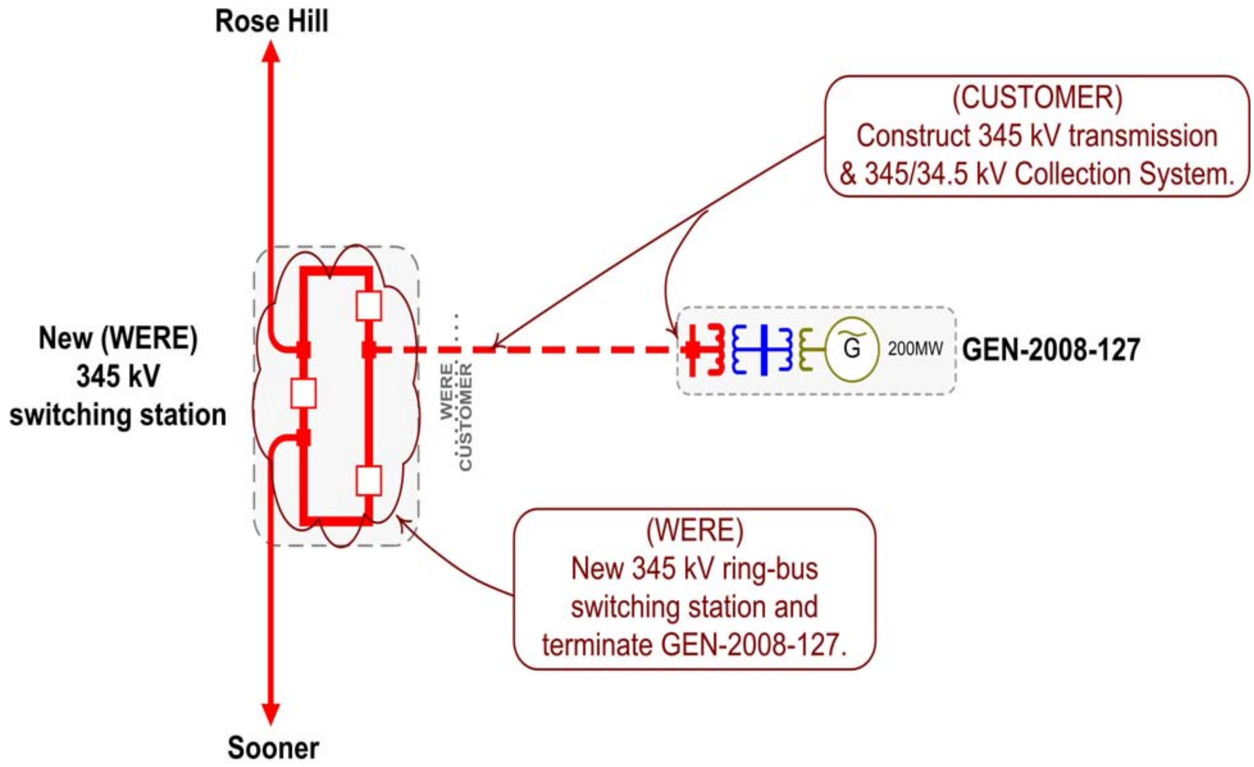
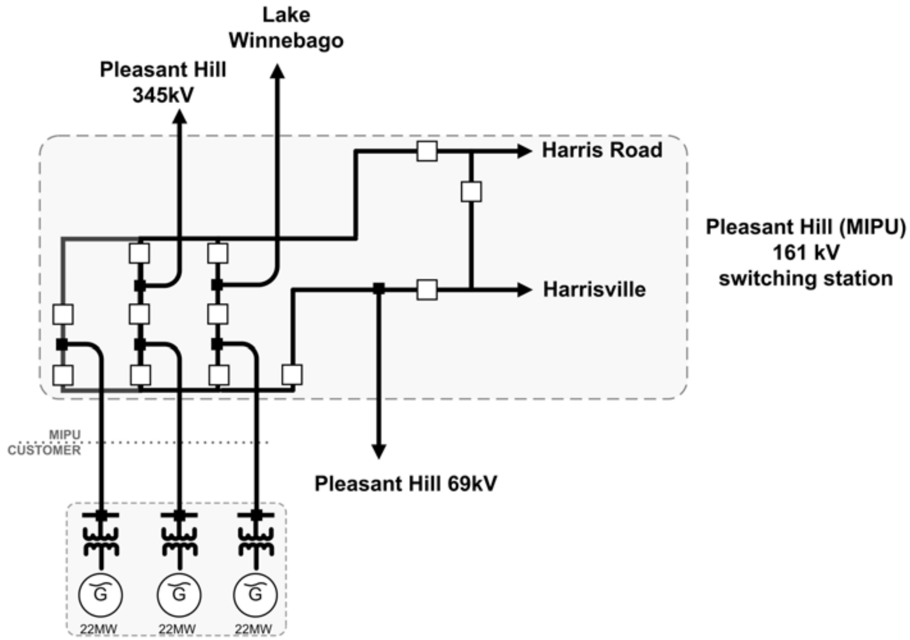


GEN-2008-127



GEN-2008-129



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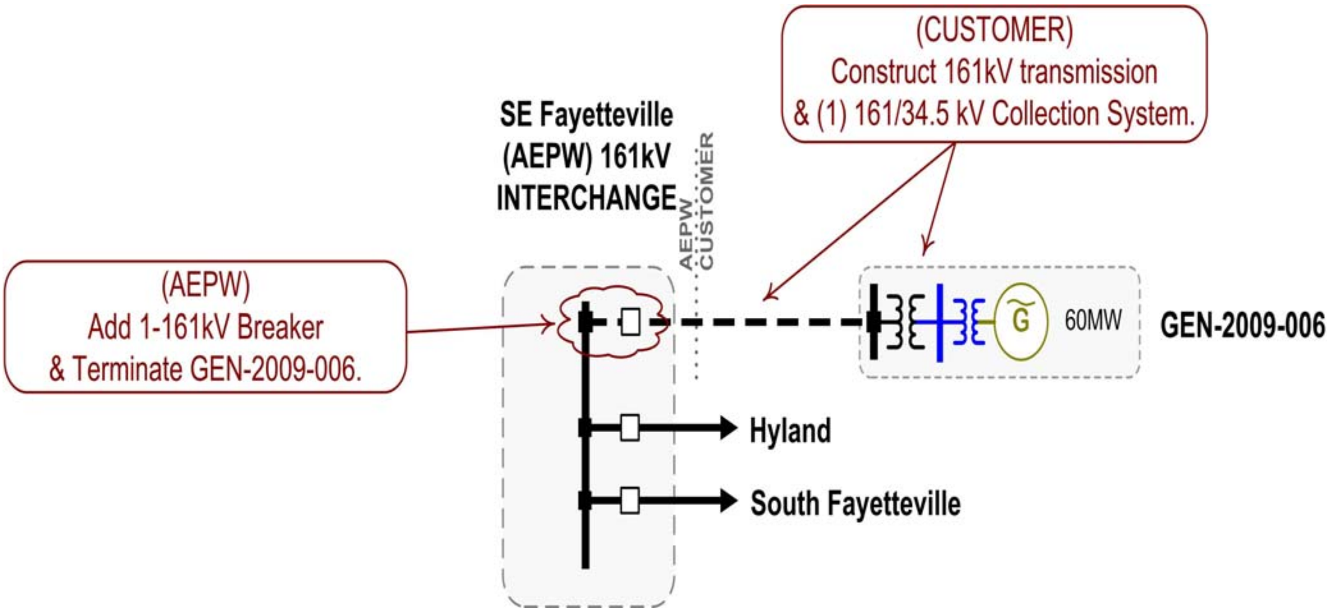
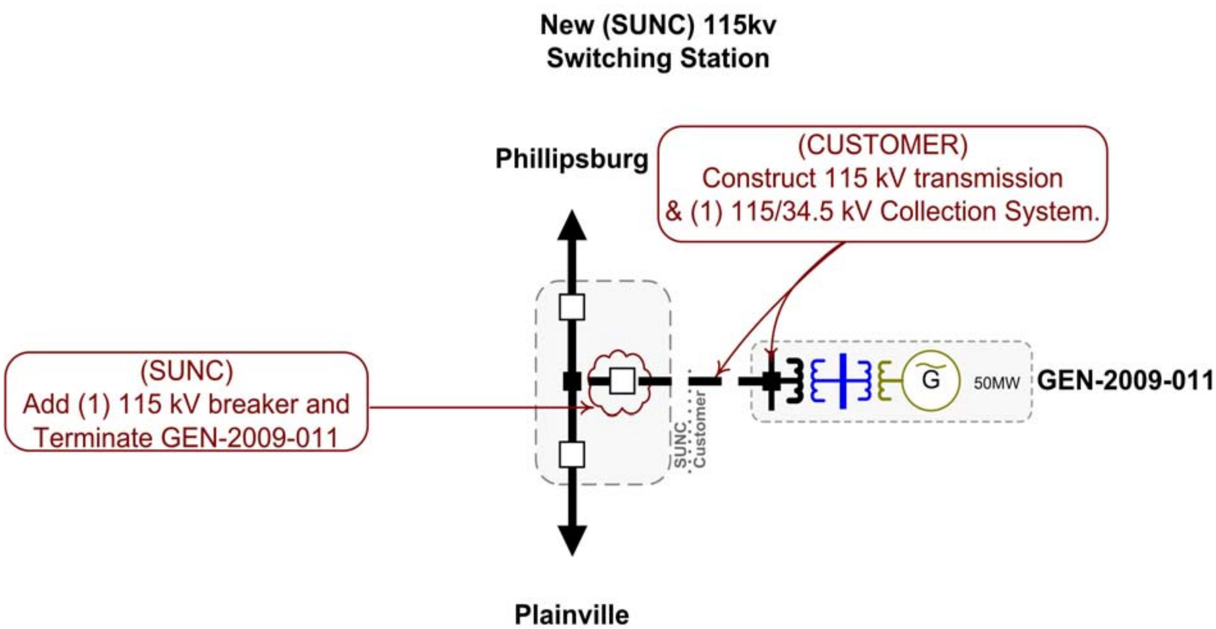
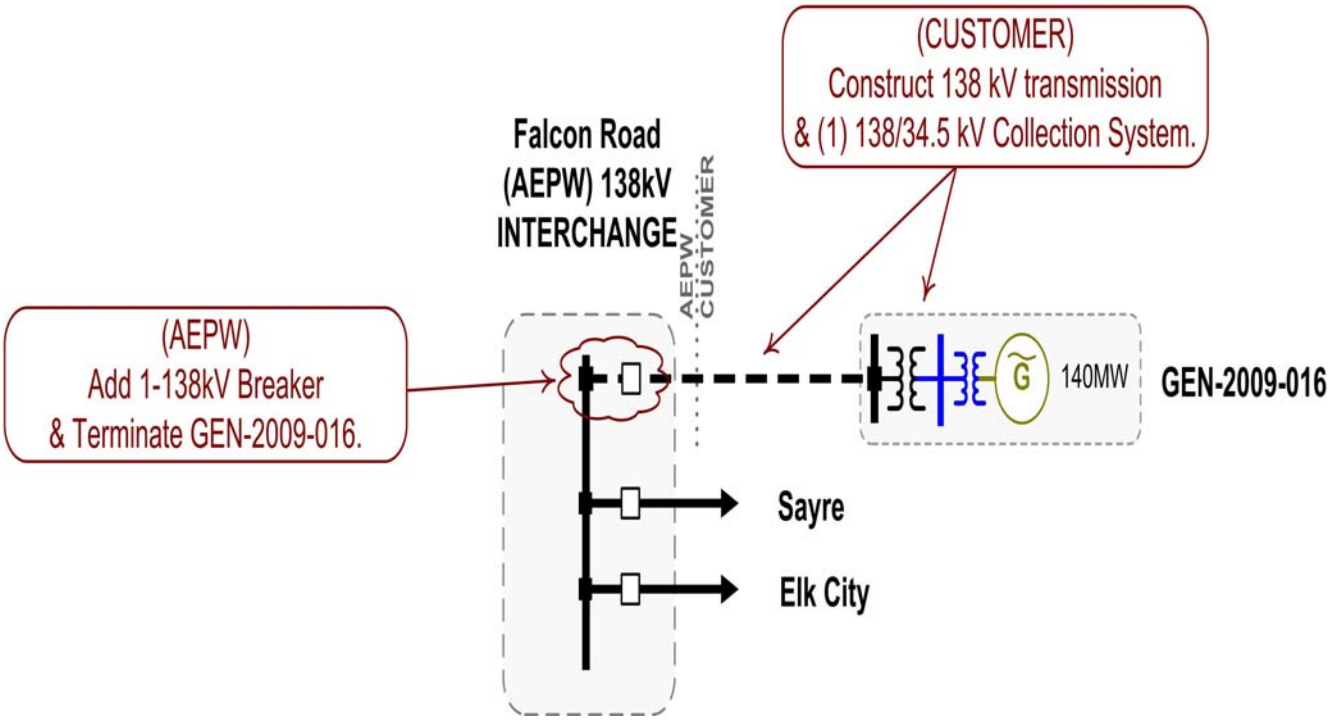


GEN-2009-011



* Planned ^ Proposed

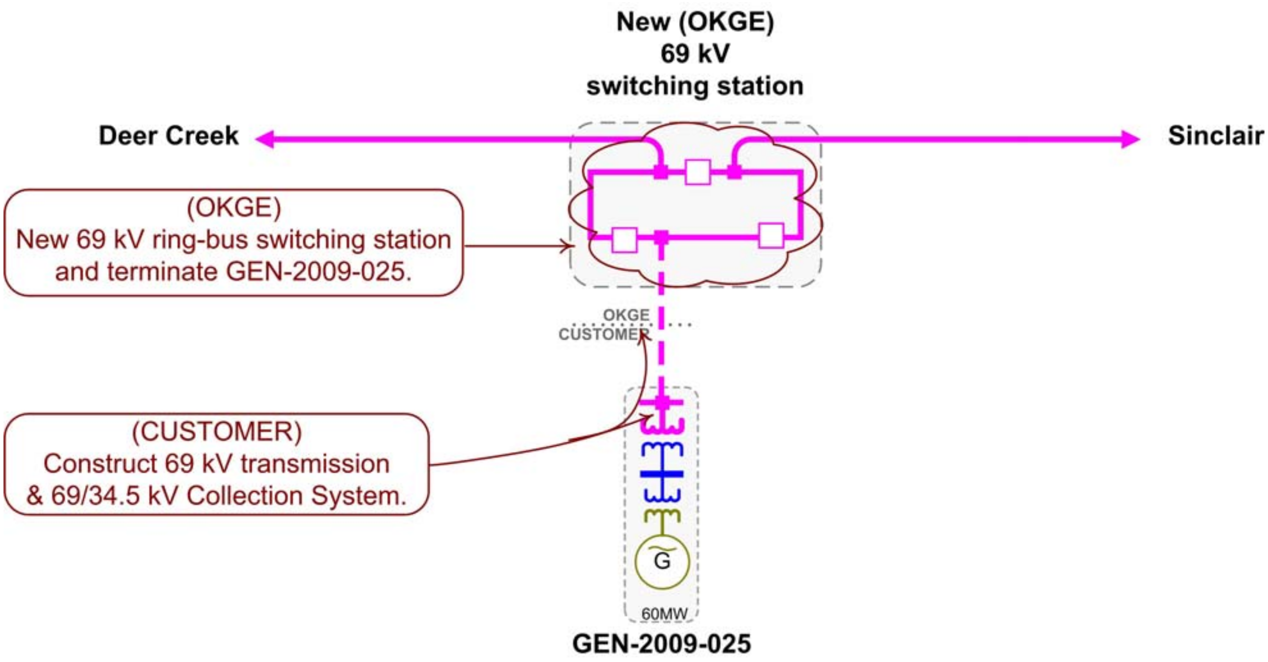
GEN-2009-016



GEN-2009-017

GEN-2009-017 to be posted separately

GEN-2009-025



New (OKGE)
69 kV
switching station
Deer Creek
Sinclair
(OKGE)
New 69 kV ring-bus switching station
and terminate GEN-2009-025.
OKGE
CUSTOMER
(CUSTOMER)
Construct 69 kV transmission
& 69/34.5 kV Collection System.
G
60MW
GEN-2009-025

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-2006-037N		
GEN-2006-037N Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Stuart - Oneil 115KV CKT 1 Construct approximately 35 miles of new 115kV	$13,437,807.40	$14,000,000.00
Valentine - Stuart 115KV CKT 1 Construct approximately 100 miles of new 115kV	$39,790,598.95	$40,000,000.00
Total	**$54,228,406.35**	
GEN-2006-037N01		
GEN-2006-037N1 Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Stuart - Oneil 115KV CKT 1 Construct approximately 35 miles of new 115kV	$562,192.60	$14,000,000.00
Valentine - Stuart 115KV CKT 1 Construct approximately 100 miles of new 115kV	$209,401.05	$40,000,000.00
Total	**$1,771,593.65**	
GEN-2006-044N		
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	$1,115,981.43	$18,000,000.00
GEN-2006-044N Interconnection Costs See Oneline Diagram	$1,500,000.00	$1,500,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	$4,489,550.75	$14,000,000.00
Total	**$7,105,532.18**	
GEN-2007-011N06		
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	$2,041,429.44	$18,000,000.00
GEN-2007-011N06 Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	$8,212,592.83	$14,000,000.00
Total	**$11,254,022.27**	
GEN-2007-011N09		
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	$14,483,931.46	$18,000,000.00
GEN-2007-011N09 Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	$1,297,856.42	$14,000,000.00
Total	**$16,781,787.88**	
GEN-2007-040		

Interconnection Request	Allocated Costs	E + C Costs
GEN-2007-040 Interconnection Costs See Oneline Diagram	$6,200,000.00	$6,200,000.00
GEN-2008-079 Tap - Judson Large 115KV CKT 2 Construct approximately 16 miles of new 115kV for 2nd circuit	$141,570.98	$6,400,000.00
Total	**$6,341,570.98**	
GEN-2008-021		
GEN-2008-021 Interconnection Costs See Oneline Diagram	$1.00	$1.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	$48,873.92	$32,000,000.00
Total	**$48,874.92**	
GEN-2008-023		
GEN-2008-023 Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Total	**$1,000,000.00**	
GEN-2008-025		
GEN-2008-025 Interconnection Costs See Oneline Diagram	$850,000.00	$850,000.00
Total	**$850,000.00**	
GEN-2008-029		
GEN-2008-029 Interconnection Costs See Oneline Diagram	$3,807,000.00	$3,807,000.00
Total	**$3,807,000.00**	
GEN-2008-038		
GEN-2008-038 Interconnection Costs See Oneline Diagram	$3,500,000.00	$3,500,000.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	$29,802,068.04	$32,000,000.00
GEN-2008-038 Tap - Osage (OKGE) 138KV CKT 1 Construct approximately 40 miles of new 138kV	$32,000,000.00	$32,000,000.00
Total	**$65,302,068.04**	
GEN-2008-051		
GEN-2008-051 Interconnection Costs See Oneline Diagram	$1,500,000.00	$1,500,000.00
Total	**$1,500,000.00**	
GEN-2008-079		
GEN-2008-079 Interconnection Costs See Oneline Diagram	$1,500,000.00	$1,500,000.00
GEN-2008-079 Tap - Judson Large 115KV CKT 2 Construct approximately 16 miles of new 115kV for 2nd circuit	$6,258,429.02	$6,400,000.00
Judson Large - North Judson Large 115KV CKT 2 Construct approximately 1 mile of new 115kV for 2nd circuit	$400,000.00	$400,000.00

Interconnection Request	Allocated Costs	E + C Costs
North Judson Large - Spearville 115KV CKT 2 Construct approximately 15 miles of new 115kV for 2nd circuit	$6,000,000.00	$6,000,000.00
Spearville (SPEARVL6-2) 230/115/13.8KV Transformer CKT 1 Add new 230/115/13.8kV transformer for 2nd circuit	$3,000,000.00	$3,000,000.00
Total	**$17,158,429.02**	
GEN-2008-086N02		
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	$358,657.67	$18,000,000.00
GEN-2008-086N02 Interconnection Costs See Oneline Diagram	$3,500,000.00	$3,500,000.00
Total	**$3,858,657.67**	
GEN-2008-092		
GEN-2008-092 Interconnection Costs See Oneline Diagram	$2,000,000.00	$2,000,000.00
Total	**$2,000,000.00**	
GEN-2008-124		
GEN-2008-124 Interconnection Costs See Oneline Diagram	$3,000,000.00	$3,000,000.00
Total	**$3,000,000.00**	
GEN-2008-127		
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	$601,148.29	$32,000,000.00
GEN-2008-127 Interconnection Costs See Oneline Diagram	$10,368,000.00	$10,368,000.00
Total	**$10,969,148.29**	
GEN-2008-129		
GEN-2008-129 Interconnection Costs See Oneline Diagram	$1.00	$1.00
KC South - Longview 161KV CKT 1 Replace terminal equipment to increase limit to conductor rating	$150,000.00	$150,000.00
Total	**$150,001.00**	
GEN-2009-006		
GEN-2009-006 Interconnection Costs See Oneline Diagram	$1,000,000.00	$1,000,000.00
Total	**$1,000,000.00**	
GEN-2009-011		
GEN-2009-011 Interconnection Costs See Oneline Diagram	$1,500,000.00	$1,500,000.00
Total	**$1,500,000.00**	
GEN-2009-016		
GEN-2009-016 Interconnection Costs See Oneline Diagram	$1,200,000.00	$1,200,000.00

Interconnection Request	Allocated Costs	E + C Costs
Total	**$1,200,000.00**	
GEN-2009-025		
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	$1,547,909.75	$32,000,000.00
GEN-2009-025 Interconnection Costs See Oneline Diagram	$2,500,000.00	$2,500,000.00
Total	**$4,047,909.75**	

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.

Appendix F. - Cost Allocation Per Request

(Including Previously Allocated Network Upgrades*)

Interconnection Request	Upgrade Type	Allocated Costs	E + C Costs
GEN-2006-037N			
GEN-2006-037N Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
Valentine - Stuart 115KV CKT 1 Construct approximately 100 miles of new 115kV	Current Study Allocation	$39,790,598.95	$40,000,000.00
Stuart - Oneil 115KV CKT 1 Construct approximately 35 miles of new 115kV	Current Study Allocation	$13,437,807.40	$14,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$54,228,406.35**	
GEN-2006-037N01			
GEN-2006-037N1 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
Stuart - Oneil 115KV CKT 1 Construct approximately 35 miles of new 115kV	Current Study Allocation	$562,192.60	$14,000,000.00
Valentine - Stuart 115KV CKT 1 Construct approximately 100 miles of new 115kV	Current Study Allocation	$209,401.05	$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
	Current Study Total	**$1,771,593.65**	
GEN-2006-044N			
GEN-2006-044N Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,500,000.00	$1,500,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	Current Study Allocation	$4,489,550.75	$14,000,000.00
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	Current Study Allocation	$1,115,981.43	$18,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$7,105,532.18**	
GEN-2007-011N06			
GEN-2007-011N06 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	Current Study Allocation	$8,212,592.83	$14,000,000.00

* 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
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	Current Study Allocation	$2,041,429.44	$18,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$11,254,022.27**	
GEN-2007-011N09			
GEN-2007-011N09 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	Current Study Allocation	$14,483,931.46	$18,000,000.00
Petersburg - Madison 115KV CKT 1 Construct approximately 35 miles of new 115kV	Current Study Allocation	$1,297,856.42	$14,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$16,781,787.88**	
GEN-2007-040			
GEN-2007-040 Interconnection Costs See Oneline Diagram	Current Study Allocation	$6,200,000.00	$6,200,000.00
GEN-2008-079 Tap - Judson Large 115KV CKT 2 Construct approximately 16 miles of new 115kV for 2nd circuit	Current Study Allocation	$141,570.98	$6,400,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
Stevens County - Gray County 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$58,200,000.00
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	Previously 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
Axtell - Knoll 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$6,341,570.98**	
GEN-2008-021			
GEN-2008-021 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1.00	$1.00

* 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-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	Current Study Allocation	$48,873.92	$32,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
	Current Study Total	**$48,874.92**	
GEN-2008-023			
GEN-2008-023 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
Midpoint(Wheeler) (WHEEL-MIDPT) 345/230/13.2KV Transformer CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$6,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Clinton Junction - Elk City 138KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$150,000.00
Sunnyside - Hugo 345KV CKT 1 Per 2006-AG3-AFS11	Previously Allocated		$120,000,000.00
	Current Study Total	**$1,000,000.00**	
GEN-2008-025			
GEN-2008-025 Interconnection Costs See Oneline Diagram	Current Study Allocation	$850,000.00	$850,000.00
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
Finney Switching Station - Holcomb 345KV CKT 2 Per GEN-2006-044 Facility Study	Previously Allocated		$6,299,839.00
Central Plains - Setab 115KV CKT 1 Per GEN-2007-013 Facility Study	Previously Allocated		$4,800,000.00
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	Previously 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	**$850,000.00**	
GEN-2008-029			
GEN-2008-029 Interconnection Costs See Oneline Diagram	Current Study Allocation	$3,807,000.00	$3,807,000.00
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	Previously Allocated		$60,000,000.00

* 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
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
Midpoint(Wheeler) - TUCO Interchange 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$3,807,000.00**	
GEN-2008-038			
GEN-2008-038 Interconnection Costs See Oneline Diagram	Current Study Allocation	$3,500,000.00	$3,500,000.00
GEN-2008-038 Tap - Osage (OKGE) 138KV CKT 1 Construct approximately 40 miles of new 138kV	Current Study Allocation	$32,000,000.00	$32,000,000.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	Current Study Allocation	$29,802,068.04	$32,000,000.00
	Current Study Total	**$65,302,068.04**	
GEN-2008-051			
GEN-2008-051 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,500,000.00	$1,500,000.00
Anadarko - Midpoint(Wheeler) 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$130,000,000.00
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	Previously Allocated		$60,000,000.00
Stevens County - Gray County 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$58,200,000.00
Knoll - Spearville 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
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
Conway EHV (CONWAY) 345/115/13.8KV Transformer CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$10,000,000.00
Midpoint(Wheeler) (WHEEL-MIDPT) 345/230/13.2KV Transformer CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$6,000,000.00
	Current Study Total	**$1,500,000.00**	
GEN-2008-079			
GEN-2008-079 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,500,000.00	$1,500,000.00
GEN-2008-079 Tap - Judson Large 115KV CKT 2 Construct approximately 16 miles of new 115kV for 2nd circuit	Current Study Allocation	$6,258,429.02	$6,400,000.00

* 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
Judson Large - North Judson Large 115KV CKT 2 Construct approximately 1 mile of new 115kV for 2nd circuit	Current Study Allocation	$400,000.00	$400,000.00
North Judson Large - Spearville 115KV CKT 2 Construct approximately 15 miles of new 115kV for 2nd circuit	Current Study Allocation	$6,000,000.00	$6,000,000.00
Spearville (SPEARVL6-2) 230/115/13.8KV Transformer CKT 1 Add new 230/115/13.8kV transformer for 2nd circuit	Current Study 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
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
Comanche - Medicine Lodge 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$60,000,000.00
Medicine Lodge - Wichita 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$90,000,000.00
Axtell - Knoll 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Stevens County - Gray County 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$58,200,000.00
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	**$17,158,429.02**	
GEN-2008-086N02			
GEN-2008-086N02 Interconnection Costs See Oneline Diagram	Current Study Allocation	$3,500,000.00	$3,500,000.00
Belden - Bloomfield 115KV CKT 1 Construct approximately 45 miles of new 115kV	Current Study Allocation	$358,657.67	$18,000,000.00
Comanche - Woodward 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$80,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00
	Current Study Total	**$3,858,657.67**	
GEN-2008-092			
GEN-2008-092 Interconnection Costs See Oneline Diagram	Current Study Allocation	$2,000,000.00	$2,000,000.00
Spearville - Comanche 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$50,000,000.00

* 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
Axtell - Knoll 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
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	Previously 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	**$2,000,000.00**	
GEN-2008-124			
GEN-2008-124 Interconnection Costs See Oneline Diagram	Current Study 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
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	Previously Allocated		$60,000,000.00
Stevens County - Gray County 345KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$58,200,000.00
Axtell - Knoll 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$3,000,000.00**	
GEN-2008-127			
GEN-2008-127 Interconnection Costs See Oneline Diagram	Current Study Allocation	$10,368,000.00	$10,368,000.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	Current Study Allocation	$601,148.29	$32,000,000.00
	Current Study Total	**$10,969,148.29**	
GEN-2008-129			
GEN-2008-129 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1.00	$1.00
KC South - Longview 161KV CKT 1 Replace terminal equipment to increase limit to conductor rating	Current Study Allocation	$150,000.00	$150,000.00
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.

	Current Study Total	**$150,001.00**	
GEN-2009-006			
GEN-2009-006 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,000,000.00	$1,000,000.00
	Current Study Total	**$1,000,000.00**	
GEN-2009-011			
GEN-2009-011 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,500,000.00	$1,500,000.00
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
Axtell - Knoll 345KV CKT 1 Total E & C Cost for Spearville-Knoll-Axtell Project	Previously Allocated		$236,000,000.00
Midpoint(Wheeler) - Woodward 345KV CKT 1 Total E & C Cost for TUCO - Woodward Project	Previously Allocated		$229,000,000.00
	Current Study Total	**$1,500,000.00**	
GEN-2009-016			
GEN-2009-016 Interconnection Costs See Oneline Diagram	Current Study Allocation	$1,200,000.00	$1,200,000.00
Midpoint(Wheeler) (WHEEL-MIDPT) 345/230/13.2KV Transformer CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$6,000,000.00
Clinton Junction - Elk City 138KV CKT 1 Per Cluster I Impact Restudy	Previously Allocated		$150,000.00
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
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	Previously Allocated		$60,000,000.00
	Current Study Total	**$1,200,000.00**	
GEN-2009-025			
GEN-2009-025 Interconnection Costs See Oneline Diagram	Current Study Allocation	$2,500,000.00	$2,500,000.00
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1 Construct approximately 40 miles of new 138kV	Current Study Allocation	$1,547,909.75	$32,000,000.00
	Current Study Total	**$4,047,909.75**	

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

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
Belden - Bloomfield 115KV CKT 1			**$18,000,000.00**
Construct approximately 45 miles of new 115kV			
GEN-2006-044N		$1,115,981.43	
GEN-2007-011N06		$2,041,429.44	
GEN-2007-011N09		$14,483,931.46	
GEN-2008-086N02		$358,657.67	
	Total	**$18,000,000.00**	
GEN-2006-037N Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2006-037N		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2006-037N1 Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2006-037N01		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2006-044N Interconnection Costs			**$1,500,000.00**
See Oneline Diagram			
GEN-2006-044N		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2007-011N06 Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2007-011N06		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2007-011N09 Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2007-011N09		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2007-040 Interconnection Costs			**$6,200,000.00**
See Oneline Diagram			
GEN-2007-040		$6,200,000.00	
	Total	**$6,200,000.00**	
GEN-2008-021 Interconnection Costs			**$1.00**
See Oneline Diagram			
GEN-2008-021		$1.00	
	Total	**$1.00**	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2008-023 Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2008-023		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2008-025 Interconnection Costs			**$850,000.00**
See Oneline Diagram			
GEN-2008-025		$850,000.00	
	Total	**$850,000.00**	
GEN-2008-029 Interconnection Costs			**$3,807,000.00**
See Oneline Diagram			
GEN-2008-029		$3,807,000.00	
	Total	**$3,807,000.00**	
GEN-2008-038 Interconnection Costs			**$3,500,000.00**
See Oneline Diagram			
GEN-2008-038		$3,500,000.00	
	Total	**$3,500,000.00**	
GEN-2008-038 Tap - Barnsdall (AEPW) 138KV CKT 1			**$32,000,000.00**
Construct approximately 40 miles of new 138kV			
GEN-2008-021		$48,873.92	
GEN-2008-038		$29,802,068.04	
GEN-2008-127		$601,148.29	
GEN-2009-025		$1,547,909.75	
	Total	**$32,000,000.00**	
GEN-2008-038 Tap - Osage (OKGE) 138KV CKT 1			**$32,000,000.00**
Construct approximately 40 miles of new 138kV			
GEN-2008-038		$32,000,000.00	
	Total	**$32,000,000.00**	
GEN-2008-051 Interconnection Costs			**$1,500,000.00**
See Oneline Diagram			
GEN-2008-051		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2008-079 Interconnection Costs			**$1,500,000.00**
See Oneline Diagram			
GEN-2008-079		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2008-079 Tap - Judson Large 115KV CKT 2			**$6,400,000.00**
Construct approximately 16 miles of new 115kV for 2nd circuit			
GEN-2007-040		$141,570.98	

Upgrade Facility		Allocated Costs	E + C Costs
GEN-2008-079		$6,258,429.02	
	Total	**$6,400,000.00**	
GEN-2008-086N02 Interconnection Costs			**$3,500,000.00**
See Oneline Diagram			
GEN-2008-086N02		$3,500,000.00	
	Total	**$3,500,000.00**	
GEN-2008-092 Interconnection Costs			**$2,000,000.00**
See Oneline Diagram			
GEN-2008-092		$2,000,000.00	
	Total	**$2,000,000.00**	
GEN-2008-124 Interconnection Costs			**$3,000,000.00**
See Oneline Diagram			
GEN-2008-124		$3,000,000.00	
	Total	**$3,000,000.00**	
GEN-2008-127 Interconnection Costs			**$10,368,000.00**
See Oneline Diagram			
GEN-2008-127		$10,368,000.00	
	Total	**$10,368,000.00**	
GEN-2008-129 Interconnection Costs			**$1.00**
See Oneline Diagram			
GEN-2008-129		$1.00	
	Total	**$1.00**	
GEN-2009-006 Interconnection Costs			**$1,000,000.00**
See Oneline Diagram			
GEN-2009-006		$1,000,000.00	
	Total	**$1,000,000.00**	
GEN-2009-011 Interconnection Costs			**$1,500,000.00**
See Oneline Diagram			
GEN-2009-011		$1,500,000.00	
	Total	**$1,500,000.00**	
GEN-2009-016 Interconnection Costs			**$1,200,000.00**
See Oneline Diagram			
GEN-2009-016		$1,200,000.00	
	Total	**$1,200,000.00**	
GEN-2009-025 Interconnection Costs			**$2,500,000.00**
See Oneline Diagram			
GEN-2009-025		$2,500,000.00	
	Total	**$2,500,000.00**	

Upgrade Facility	Allocated Costs	E + C Costs
Judson Large - North Judson Large 115KV CKT 2		**$400,000.00**
Construct approximately 1 mile of new 115kV for 2nd circuit		
GEN-2008-079	$400,000.00	
Total	**$400,000.00**	
KC South - Longview 161KV CKT 1		**$150,000.00**
Replace terminal equipment to increase limit to conductor rating		
GEN-2008-129	$150,000.00	
Total	**$150,000.00**	
North Judson Large - Spearville 115KV CKT 2		**$6,000,000.00**
Construct approximately 15 miles of new 115kV for 2nd circuit		
GEN-2008-079	$6,000,000.00	
Total	**$6,000,000.00**	
Petersburg - Madison 115KV CKT 1		**$14,000,000.00**
Construct approximately 35 miles of new 115kV		
GEN-2006-044N	$4,489,550.75	
GEN-2007-011N06	$8,212,592.83	
GEN-2007-011N09	$1,297,856.42	
Total	**$14,000,000.00**	
Spearville (SPEARVL6-2) 230/115/13.8KV Transformer CKT 1		**$3,000,000.00**
Add new 230/115/13.8kV transformer for 2nd circuit		
GEN-2008-079	$3,000,000.00	
Total	**$3,000,000.00**	
Stuart - Oneil 115KV CKT 1		**$14,000,000.00**
Construct approximately 35 miles of new 115kV		
GEN-2006-037N	$13,437,807.40	
GEN-2006-037N01	$562,192.60	
Total	**$14,000,000.00**	
Valentine - Stuart 115KV CKT 1		**$40,000,000.00**
Construct approximately 100 miles of new 115kV		
GEN-2006-037N	$39,790,598.95	
GEN-2006-037N01	$209,401.05	
Total	**$40,000,000.00**	
	Current Study Upgrades Total	**$214,875,002.00**

H: ACCC Analysis (No Upgrades)

See Attachment

I: Stability Study for Group 1

SPP DISIS-2009-001 Group 1
Definitive Impact Study

Draft Report for

Southwest Power Pool

Prepared by:
Excel Engineering, Inc.

January 20, 2010

Principal Contributor:

Michael Cronier, P.E.
William Quaintance, P.E.

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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 DISIS-2009-001 Group 1 Definitive 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	MW Sum/Win	Turbine	Point of Interconnection
GEN-2008-029	250	GE 1.5 MW	Woodward 138kV (515376)

The previously-queued requests shown in Table 1-2 were included in this study and dispatched at 100% of rated capacity.

Table 1-2. Nearby Interconnection Requests Already in the Queue

Request	MW	Turbine	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-2006-046	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-2006-024S	18.9	Suzlon 2.1MW	Buffalo Bear 69kV (521120)

The study included a stability analysis for each 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 a 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 DISIS-2009-001 Group 1 Definitive Impact Study evaluated the impacts of interconnecting project GEN-2008-029 to the SPP electric system. No stability problems were found during summer or winter peak conditions due to the addition of this plant.

Power factor requirements were determined, and all study plants 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, DISIS-2009-001 Group 1 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. Each 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 plant is provided in Appendix D.

Power flow one-line diagram of the study project in summer peak conditions are shown in **Error! Reference source not found.**. As the figure show, the plant model includes explicit representation of the radial transmission line, if any; the substation transformer(s) from transmission voltage to 34.5 kV; and the substation reactive power device(s), if any. The remainder of each wind farm is represented by one or more lumped equivalents 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 520, 524, 525, 526, 531, 534, and 536 were monitored.

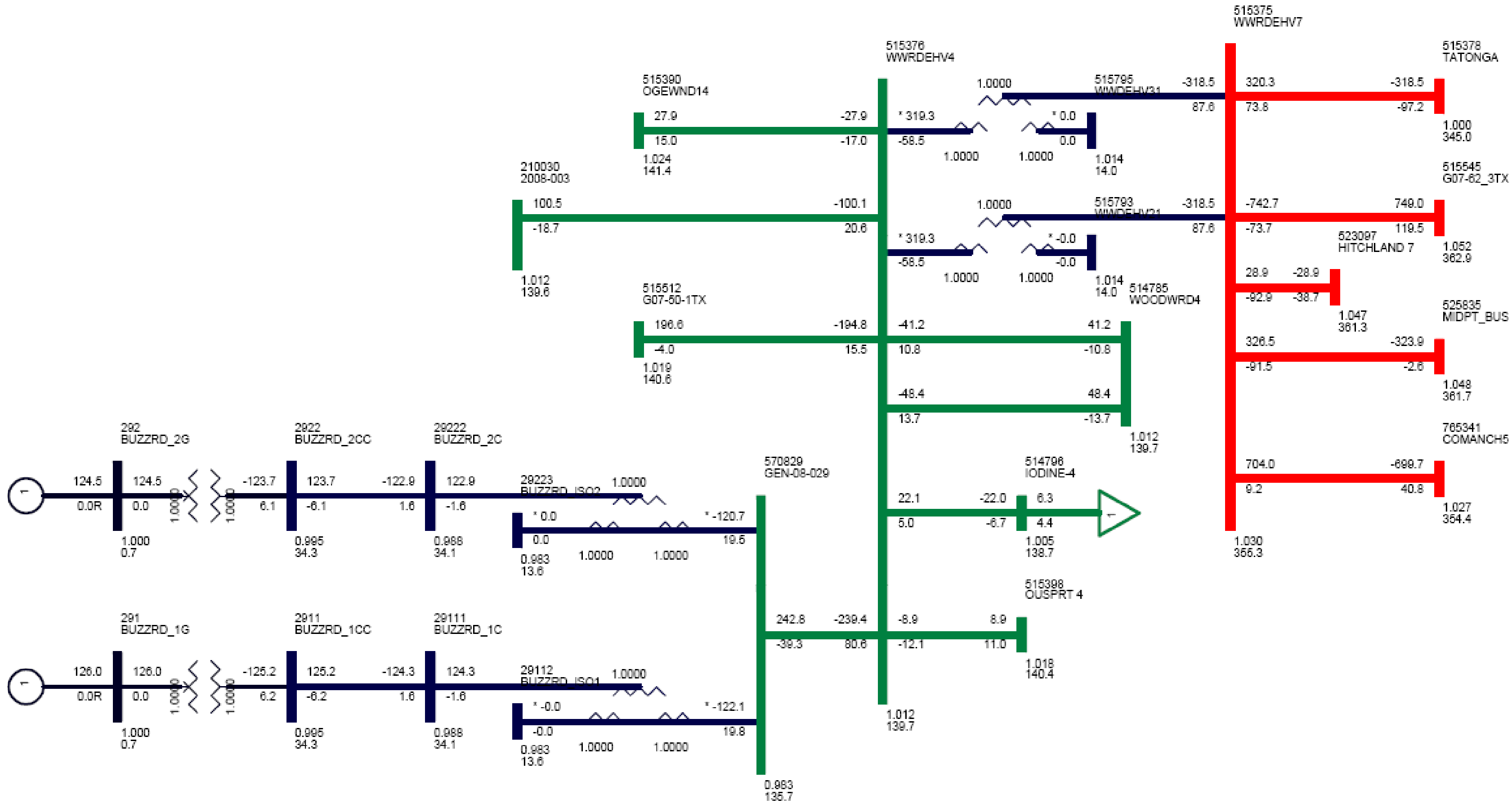

Figure 3-1. Power Flow One-line for GEN-2008-029 and adjacent equipment (SP)

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 for under voltage relay actuation. 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.

ATC studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission facilities may be required based on subsequent ATC analysis.

Stability analysis was performed for the 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 DISIS-2009-001 Group 1

Cont. No.	Contingency 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 Hitchland (523097) 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	FLT11-3PH	3 phase fault on the GEN-2008-013 (210130) to Wichita (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. 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*

Cont. No.	Contingency Name	Description
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 Arcadia (514908) 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.
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*
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*

Cont. No.	Contingency Name	Description
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. 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*

Cont. No.	Contingency Name	Description
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. 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 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. 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 Anadarko (511541) 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*

Cont. No.	Contingency Name	Description
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*

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 a fault at the POI of each of the study project generators. Complete sets of plots for both summer and winter peak seasons for each fault and each wind project 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 one of the Woodward (515375) to Tatonga (515378) 345kV lines, near Woodward.	OK	OK
2	FLT02-1PH	*Single phase fault and sequence like previous*	OK	OK
3	FLT03-3PH	3 phase fault on one of the Woodward (515375) to Hitchland (523097) 345kV lines, near Woodward.	OK	OK
4	FLT04-1PH	*Single phase fault and sequence like previous*	OK	OK
5	FLT05-3PH	3 phase fault on the Woodward (515375) to Comanche (765341) 345kV line, near Woodward.	OK	OK
6	FLT06-1PH	*Single phase fault and sequence like previous*	OK	OK
7	FLT07-3PH	3 phase fault on the Woodward 345kV (515375) to 138kV (515376) transformer, near the 345 kV bus.	OK	OK
8	FLT08-1PH	*Single phase fault and sequence like previous*	OK	OK
9	FLT09-3PH	3 phase fault on one of the Tatonga (515378) to Woodward (515375) 345kV lines, near Tatonga.	OK	OK
10	FLT10-1PH	*Single phase fault and sequence like previous*	OK	OK
11	FLT11-3PH	3 phase fault on the GEN-2008-013 (210130) to Wichita (532781) 345kV line, near GEN-2008-013.	OK	OK
12	FLT12-1PH	*Single phase fault and sequence like previous*	OK	OK
13	FLT13-3PH	3 phase fault on one of the Comanche (765341) to Medicine Lodge (765342) 345kV lines, near Comanche.	OK	OK
14	FLT14-1PH	*Single phase fault and sequence like previous*	OK	OK
15	FLT15-3PH	3 phase fault on the Comanche (765341) to Spearville (531469) 345kV line, near Comanche.	OK	OK
16	FLT16-1PH	*Single phase fault and sequence like previous*	OK	OK

Cont. No.	Contingency Name	Description	Summer Peak Results	Winter Peak Results
17	FLT17-3PH	3 phase fault on the Woodring (514715) to Cimarron (514901) 345kV line, near Woodring.	OK	OK
18	FLT18-1PH	*Single phase fault and sequence like previous*	OK	OK
19	FLT19-3PH	3 phase fault on the Cimarron (514901) to Draper (514934) 345kV line, near Cimarron.	OK	OK
20	FLT20-1PH	*Single phase fault and sequence like previous*	OK	OK
21	FLT21-3PH	3 phase fault on the Northwest (514880) to Arcadia (514908) 345kV line, near Northwest.	OK	OK
22	FLT22-1PH	*Single phase fault and sequence like previous*	OK	OK
23	FLT23-3PH	3 phase fault on the Northwest (514880) to Spring Creek (514881) 345kV line, near Northwest.	OK	OK
24	FLT24-1PH	*Single phase fault and sequence like previous*	OK	OK
25	FLT25-3PH	3 phase fault on the Northwest (514880) to Cimarron (514901) 345kV line, near Northwest.	OK	OK
26	FLT26-1PH	*Single phase fault and sequence like previous*	OK	OK
27	FLT27-3PH	3 phase fault on Northwest 345kV (514880) to 138kV (514879) transformer T2, near the 345 kV bus.	OK	OK
28	FLT28-1PH	*Single phase fault and sequence like previous*	OK	OK
29	FLT29-3PH	3 phase fault on the Hitchland (523097) to GEN-2003-013 (560029) 345kV line, near Hitchland.	OK	OK
30	FLT30-1PH	*Single phase fault and sequence like previous*	OK	OK
31	FLT31-3PH	3 phase fault on the Hitchland (523097) to GEN-2005-017 (51700) 345kV line, near Hitchland.	OK	OK
32	FLT32-1PH	*Single phase fault and sequence like previous*	OK	OK
33	FLT33-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV.	OK	OK
34	FLT34-1PH	*Single phase fault and sequence like previous*	OK	OK
35	FLT35-3PH	3 phase fault on the Woodward (514785) to GEN-2001-037 (515785) 138kV line, near Woodward.	OK	OK
36	FLT36-1PH	*Single phase fault and sequence like previous*	OK	OK
37	FLT37-3PH	3 phase fault on the GEN-2001-037 (515785) to Woodward (514785) 138kV line, near GEN-2001-037.	OK	OK
38	FLT38-1PH	*Single phase fault and sequence like previous*	OK	OK
39	FLT39-3PH	3 phase fault on the GEN-2001-037 (515785) to Mooreland (520999) 138kV line, near GEN-2001-037.	OK	OK
40	FLT40-1PH	*Single phase fault and sequence like previous*	OK	OK
41	FLT41-3PH	3 phase fault on the Mooreland (520999) to GEN-2001-037 (515785) 138kV line, near Mooreland.	OK	OK
42	FLT42-1PH	*Single phase fault and sequence like previous*	OK	OK
43	FLT43-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV.	OK	OK
44	FLT44-1PH	*Single phase fault and sequence like previous*	OK	OK
45	FLT45-3PH	3 phase fault on the Mooreland (520999) to Glass Mountain (514788) 138kV line, near Mooreland.	OK	OK

Cont. No.	Contingency Name	Description	Summer Peak Results	Winter Peak Results
46	FLT46-1PH	*Single phase fault and sequence like previous*	OK	OK
47	FLT47-3PH	3 phase fault on the Mooreland (520999) to Morewood (521001) 138kV line, near Mooreland.	OK	OK
48	FLT48-1PH	*Single phase fault and sequence like previous*	OK	OK
49	FLT49-3PH	3 phase fault on the Taloga (521065) to Dewey (514787) 138kV line, near Taloga.	OK	OK
50	FLT50-1PH	*Single phase fault and sequence like previous*	OK	OK
51	FLT51-3PH	3 phase fault on the Dewey (514787) to Southard (514822) 138kV line, near Dewey.	OK	OK
52	FLT52-1PH	*Single phase fault and sequence like previous*	OK	OK
53	FLT53-3PH	3 phase fault on the Woodward (515375) to Midpoint/Wheeler (525835) 345kV line, near Woodward.	OK	OK
54	FLT54-1PH	*Single phase fault and sequence like previous*	OK	OK
55	FLT55-3PH	3 phase fault on one of the Midpoint/Wheeler (525835) to Anadarko (511541) 345kV lines, near Midpoint/Wheeler.	OK	OK
56	FLT56-1PH	*Single phase fault and sequence like previous*	OK	OK
57	FLT57-3PH	3 phase fault on one of the Midpoint/Wheeler (525835) to Tuco (525832) 345kV lines, near Midpoint/Wheeler.	OK	OK
58	FLT58-1PH	*Single phase fault and sequence like previous*	OK	OK
59	FLT59-3PH	3 phase fault on one of the El Reno (514819) – Roman Nose (514823) 138kV lines, near Roman Nose.	OK	OK
60	FLT60-1PH	*Single phase fault and sequence like previous*	OK	OK

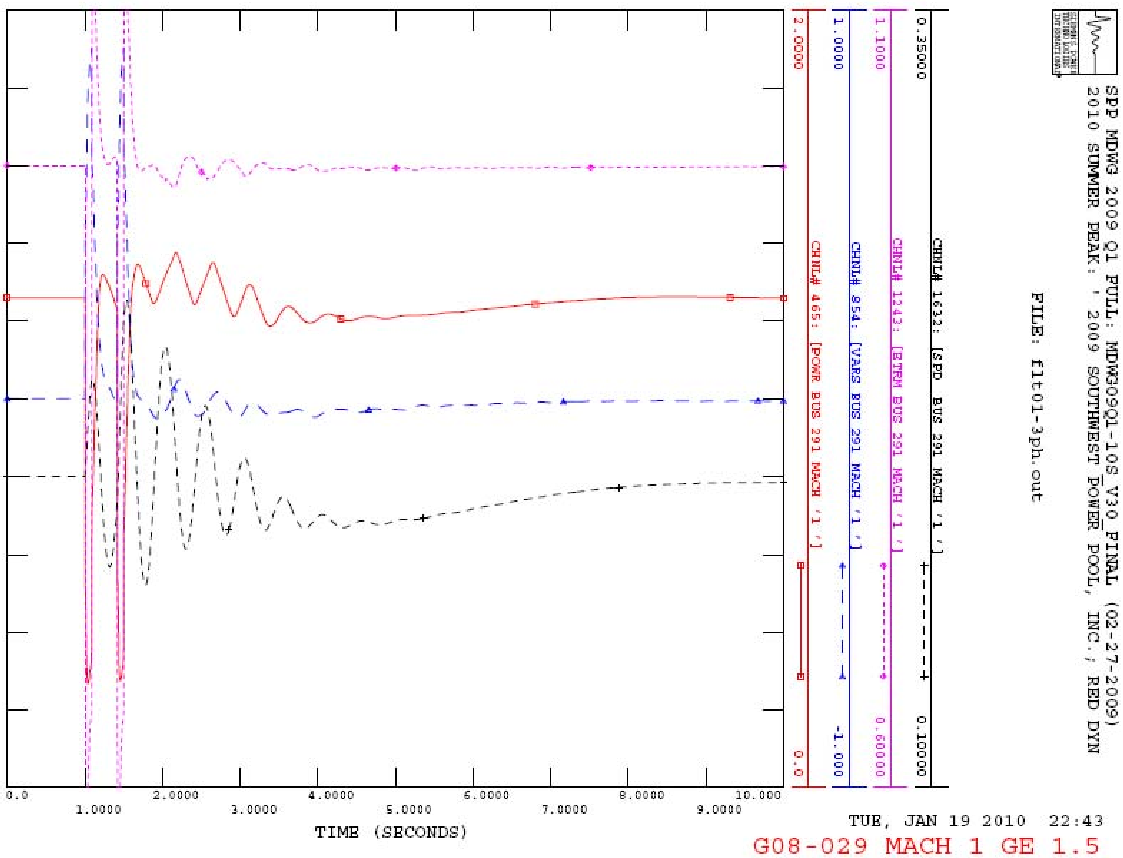

Figure 4-1. **GEN-2008-029 Machine 1 Plot for Fault 01, a 3 phase fault on the Woodward – Tatonga 345 kV line, near Woodward**

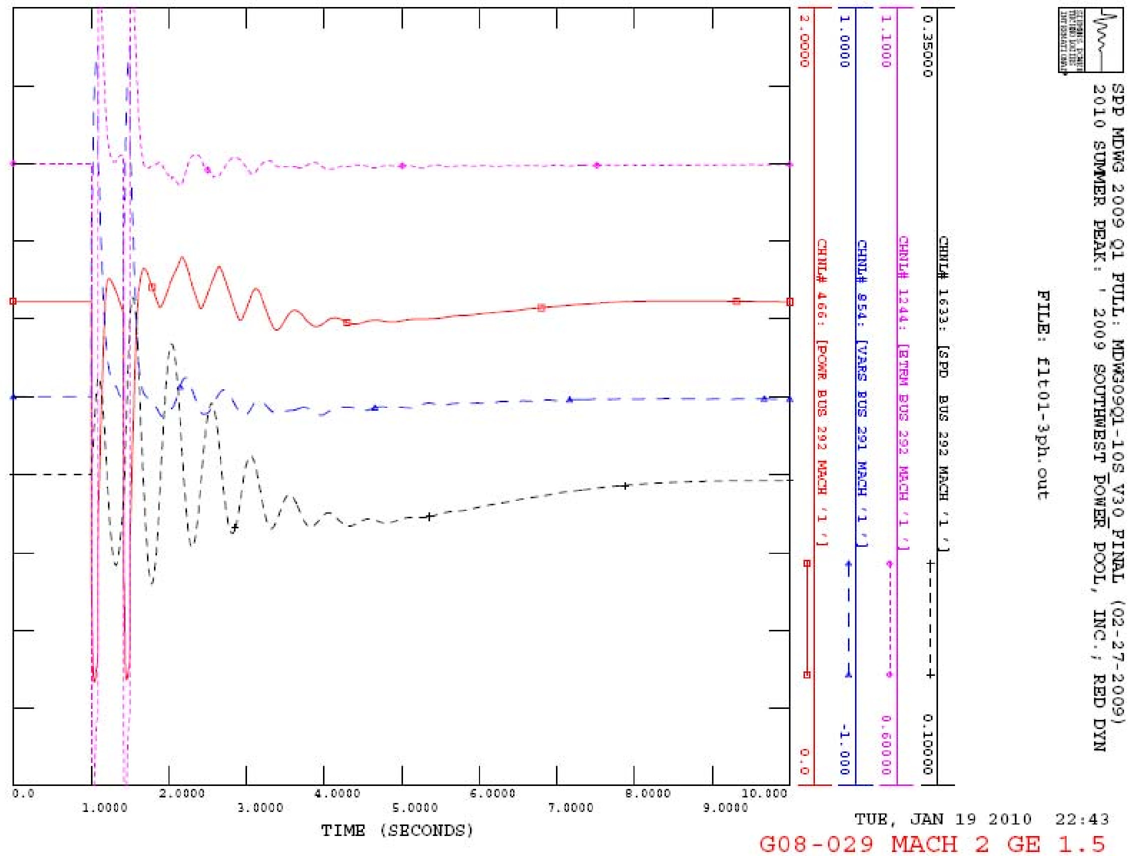

Figure 4-2. GEN-2008-029 Machine 2 Plot for Fault 01, a 3 phase fault on the Woodward – Tatonga 345 kV line, near Woodward

4.2 Generator Performance

All the study projects and prior-queued projects perform well for all faults, with no tripping evident.

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 projects to maintain scheduled voltage at their respective points of interconnection (POI). The voltage schedules are set equal to the voltages at the POIs before the projects are added, with a minimum of 1.0 per unit. Fictitious reactive power sources were added to the study projects to maintain scheduled voltage during all studied contingencies. The MW and Mvar injections from the study projects at the POIs 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 projects 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 is less than 0.95 lagging, then the requirement will be set to 0.95 lagging. The most lagging power factor needed for GEN-2008-029 to maintain voltage schedule is 0.936 but only 0.95 lagging will be required. The limit for leading power factor requirement is also 0.95, and this level was also surpassed. The most leading power factor needed for GEN-2008-029 to maintain voltage schedule is 0.921 but only 0.95 leading will be required.

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-2008-029	250	G.E. 1.5 MW	Woodward 138kV	0.95	0.95

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 DISIS-2009-001 Group 1 Definitive Impact Study evaluated the impacts of interconnecting the project shown below.

Table 5-1. Interconnection Requests Evaluated

Request	MW Sum/Win	Turbine	Point of Interconnection
GEN-2008-029	250	GE 1.5 MW	Woodward 138kV (515376)

No stability problems were found during summer or winter peak conditions due to the addition of these generators.

Power factor requirements were determined, and all study plants 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, DISIS-2009-001 Group 1 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

Contingency numbers correspond to fault numbers in Table 3-1.

C.1 GEN-2008-029
MW, Mvar, and Power Factor at the POI to maintain voltage schedule of 1.0 pu.
Highest and lowest power factors are highlighted.

		Summer Peak				Winter Peak			
		MW	Mvar	PF		MW	Mvar	PF	
Contingency	0	-240.8	-4.3	1.000	lagging	-239.4	80.1	0.948	leading
Contingency	1	-240.8	0.4	1.000	leading	-238.9	**101.3**	**0.921**	**leading**
Contingency	3	-240.9	-14.4	0.998	lagging	-240.5	12.8	0.999	leading
Contingency	5	-240.8	-3.3	1.000	lagging	-240.7	-21.4	0.996	lagging
Contingency	7	-240.8	-61.6	0.969	lagging	-240.6	8.0	0.999	leading
Contingency	9	-240.8	0.4	1.000	leading	-238.9	**101.3**	**0.921**	**leading**
Contingency	11	-240.8	-4.5	1.000	lagging	-239.4	76.8	0.952	leading
Contingency	13	-240.8	2.8	1.000	leading	-239.3	90.2	0.936	leading
Contingency	15	-240.8	-3.6	1.000	lagging	-240.6	27.4	0.994	leading
Contingency	17	-240.8	-4.5	1.000	lagging	-239.5	76.7	0.952	leading
Contingency	19	-240.8	-4.7	1.000	lagging	-239.5	75.8	0.953	leading
Contingency	21	-240.8	-4.7	1.000	lagging	-239.8	65.6	0.965	leading
Contingency	23	-240.8	-5.4	1.000	lagging	-239.7	70.2	0.960	leading
Contingency	25	-240.8	-2.9	1.000	lagging	-239.4	80.0	0.948	leading
Contingency	27	-240.8	-4.3	1.000	lagging	-239.4	84.7	0.943	leading
Contingency	29	-240.8	-4.4	1.000	lagging	-240.0	58.4	0.972	leading
Contingency	31	-240.8	-4.8	1.000	lagging	-239.1	91.2	0.934	leading
Contingency	33	-240.7	2.8	1.000	leading	-239.6	73.0	0.957	leading
Contingency	35	-240.7	7.4	1.000	leading	-239.4	79.3	0.949	leading
Contingency	37	-240.7	7.4	1.000	leading	-239.4	79.3	0.949	leading
Contingency	39	-240.6	-8.6	0.999	lagging	-240.1	52.2	0.977	leading
Contingency	41	-240.6	-8.6	0.999	lagging	-240.1	52.2	0.977	leading
Contingency	43	-240.7	2.8	1.000	leading	-239.6	73.0	0.957	leading
Contingency	45	-241	-43.8	0.984	lagging	-240.4	25.1	0.995	leading
Contingency	47	-241	-44.1	0.984	lagging	-240.4	37.4	0.988	leading
Contingency	49	-240.9	-3.1	1.000	lagging	-239.2	86.4	0.941	leading
Contingency	51	-240.9	-28.1	0.993	lagging	-240.4	37.3	0.988	leading
Contingency	53	-240.9	-20.2	0.997	lagging	-240.7	-12.1	0.999	lagging
Contingency	55	-240.8	-4.9	1.000	lagging	-239.9	59.2	0.971	leading
Contingency	57	-240.8	-4.9	1.000	lagging	-239.5	74.7	0.955	leading
Contingency	59	-240.5	**-90.6**	**0.936**	**lagging**	-240.7	-50.7	0.979	lagging

J: Stability Study for Group 2

No stability analysis for Group 2 for DISIS-2009-001