Preliminary Interconnection System Impact Study for Generation Interconnection Requests

(PISIS-2012-001)

August 2012

Generation Interconnection

SPP Southwest Power Pool

Revision History

Date	Author	Change Description
08/17/2012	SPP	Report Issued (PISIS-2012-001)

Executive Summary

Generation Interconnection customers have requested a Preliminary Interconnection System Impact Study (PISIS) under the Generation Interconnection Procedures (GIP) in the Southwest Power Pool Open Access Transmission Tariff (OATT). The Interconnection Customers' requests have been clustered together for the following System Impact Cluster Study window which closed March 31, 2012. The customer will be referred to in this study as the PISIS-2012-001 Interconnection Customers. This System Impact Study analyzes the interconnecting of a single generation interconnection request associated with new generation totaling approximately 150.4 MW of new generation which would be located within the transmission system of Sunflower Electric Power Corporation / Mid-Kansas Electric Power Company (SUNC/MKEC). The generation interconnection request has a proposed in-service date of December 31, 2014[1]. The generation interconnection request included in this System Impact Cluster Study is listed in Appendix A by their queue number, amount, requested interconnection service, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

Power flow analysis has indicated that for the power flow cases studied, 150.4 MW of nameplate generation may be interconnected with transmission system reinforcements within the SPP transmission system. Dynamic stability analysis has determined that the transmission system will remain stable with the assigned Network Upgrades. Additionally, the wind farm project is found to stay connected during the contingencies that were studied, meeting the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The total estimated minimum cost for interconnecting the PISIS-2012-001 interconnection customer is $24,066,604. These costs are shown in Appendix E and F. Interconnection Service to the PISIS-2012-001 interconnection customer is also contingent upon higher queued customers paying for certain required network upgrades. **The in service date for the PISIS customer will be deferred until the construction of these network upgrades can be completed.**

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

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

The required interconnection costs listed in Appendix E and F 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. Also, 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 identified and shown in Appendix H.

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Introduction

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Preliminary Interconnection System Impact Study (PISIS) for a single generation interconnection request in the SPP Generation Interconnection Queue. This interconnection request has been clustered for the following System Impact Study window which closed March 31, 2012. The customer will be referred to in this study as the PISIS-2012-001 Interconnection Customer. This System Impact Study analyzes the interconnecting of a single generation interconnection request associated with new generation totaling 150.4 MW of new generation which would be located within the transmission system of Sunflower Electric Power Corporation / Mid-Kansas Electric Power Company (SUNC/MKEC). The single generation interconnection request has a proposed in-service date of December 31, 2014[2]. The generation interconnection request included in this System Impact Study is listed in Appendix A by its queue number, amount, requested interconnection service, area, requested interconnection point, proposed interconnection point, and the requested in-service date.

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

[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 competition of the Facility Study.

Model Development

Interconnection Requests Included in the Cluster

SPP has included all interconnection requests that submitted a Preliminary Interconnection System Impact Study Agreement no later than March 31, 2012 and were subsequently accepted by Southwest Power Pool under the terms of the Generator Interconnection Procedures (GIP). The interconnection requests that are included in this study are listed in Appendix A.

Previously Queued Interconnection Requests

The previous queued requests included in this study are listed in Appendix B. In addition to the Base Case Upgrades, the previous queued requests 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. Prior queued projects that requested Network Resource Interconnection Service (NRIS) were dispatched in an additional analysis into the balancing authority of the interconnecting transmission owner.

Development of Base Cases

Power Flow

The 2011 series Transmission Service Request (TSR) Models 2012 spring, 2012 summer and winter peak, and the 2017 summer and winter peak scenario 0 cases were used for this study. After the cases were developed, each of the control areas' resources were then re-dispatched to account for the new generation requests using current dispatch orders.

Dynamic Stability

The 2011 series SPP Model Development Working Group (MDWG) Models 2012 winter and 2012 summer were used as starting points for this study.

Base Case Upgrades

The following facilities are part of the SPP Transmission Expansion Plan or the Balanced Portfolio or recently approved Priority Projects. These facilities, have an approved Notice to Construct (NTC), or are in construction stages and were assumed to be in-service at the time of dispatch and added to the base case models. The PISIS-2012-001 Customers have not been assigned acceleration costs for the below listed projects. The PISIS-2012-001 Customers Generation Facilities in service dates may need to be delayed until the completion of the following upgrades. If for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the PISIS customers.

- Hitchland 230/115kV area projects[3]:

[3] SPP Regional Reliability Projects identified in 2007 STEP. As of the writing of this report, SPP Project Tracking TAGIT shows some of these project's in-service dates have been delayed from the original 2010/2011 in-service dates.

- Hitchland – Ochiltree 230kV Project, scheduled for 2/1/2013 in-service

- Balanced Portfolio Projects[4]:
  - Woodward – Border – TUCO 345kV project, scheduled for 5/19/2014 in-service
    - Woodward 345/138kV circuit #2 autotransformer
    - TUCO 345/138kV circuit #2 autotransformer
    - Reactors at Woodward and Border
  - Iatan– Nashua 345kV, scheduled for 6/1/2015 in-service
    - Nashua 345/161kV autotransformer
  - Muskogee– Seminole 345kV, scheduled for 12/31/2013 in-service
  - Post Rock – Axtell 345kV, scheduled for 6/1/2013 in-service
  - Cleveland – Sooner 345kV, scheduled for 12/31/2012 in-service
  - Tap Stillwell – Swissvale 345kV line at West Gardner, scheduled for 12/31/2012 in-service
- Priority Projects[5]:
  - Hitchland – Woodward double circuit 345kV, scheduled for 6/30/2014 in-service
    - Hitchland 345/230kV circuit #2 autotransformer
  - Woodward – Thistle double circuit 345kV, scheduled for 12/31/2014 in-service
  - Spearville – Clark double circuit 345kV, scheduled for 12/31/2014 in-service
  - Clark – Thistle double circuit 345kV, scheduled for 12/31/2014 in-service
  - Thistle – Wichita double circuit 345kV, scheduled for 12/31/2014 in-service
  - Thistle 345/138kV autotransformer, scheduled for 12/31/2014 in-service
  - Thistle – Flat Ridge 138kV, scheduled for 12/31/2014 in-service
- Various MKEC Transmission System Upgrades[6]
  - Harper – Flat Ridge 138kV rebuild, scheduled for 6/15/2013 in-service
  - Medicine Lodge 138/115kV autotransformer replacement, scheduled for 6/1/2013 in-service
- Northwest 345/138/13.8kV circuit #3 autotransformer, scheduled for 6/1/2017 in-service[7]
- Woodward (OKGE) – Woodward (WFEC) 69kV rebuild, scheduled for 12/1/2013 in-service[8]
- Sheldon – SW7th and Pleasant Hill 115kV circuit #2 rebuild, scheduled for 5/15/2013 in-service[9]
- Moundridge 138/115/13.8kV autotransformer circuit #2, scheduled for 12/1/2014 in-service[10]
- Grassland – Wolfforth 230kV, scheduled for 3/1/2018 in-service[11]

[4] Notice to Construct (NTC) issued June 2009.
[5] Notice to Construct (NTC) issued June 2010.
[6] SPP Transmission Service Projects identified in SPP-2007-AG3-AFS-9.
[7] SPP Transmission Service Project identified in SPP-2009-AG2-AFS6. Per SPP-NTC-20137.
[8] SPP Regional Reliability Project. Per SPP-NTC-20003.
[9] SPP Regional Reliability 2012 ITPNT Project. Per SPP-NTC-200171.
[10] SPP Regional Reliability 2012 ITP10 Project. Per SPP-NTC-200181.
[11] SPP Regional Reliability 2012 ITP10 Project. Per SPP-NTC-200184.

Contingent Upgrades

The following facilities do not yet have approval. These facilities have been assigned to higher queued interconnection customers. These facilities have been included in the models for the PISIS-2012-001 study and are assumed to be in service. This list may not be all inclusive. The PISIS-2012-001 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 GIA or withdraw from the interconnection queue. The PISIS-2012-001 Customer Generation Facilities in service dates may need to be delayed until the completion of the following upgrades.

- Finney – Holcomb 345kV circuit #2, assigned to GEN-2006-049 interconnection customer[12]
- Upgrades assigned to DISIS-2009-001 Interconnection Customers:
  - Fort Dodge – North Fort Dodge – Spearville 115kV circuit #2
  - Albion – Petersburg – Neligh 115kV rerate
  - Fort Randall – Madison County – Kelly 230kV rerate (320MVA)
  - Spearville 345/115kV autotransformer
- Upgrades assigned to DISIS-2010-001 Interconnection Customers:
  - Post Rock 345/230kV circuit #2 autotransformer
  - South Hays – Hays Plant – Vine Street 115kV rebuild
  - Switch 2749 – Wildorado 69kV rebuild
  - Madison County – Kelly 230kV rerate (478MVA)
  - Washita – Gracemont 138kV circuit #2
- Upgrades assigned to DISIS-2010-002 Interconnection Customers:
  - Beaver County 345kV Expansion (Tap & Tie Hitchland – Woodward CKT 2 into Beaver County 345kV)
  - Twin Church – Dixon County 230kV rerate (320MVA)
  - (NRIS only) Spearville – Mullergren 230kV circuit #1 rebuild at 3000 amps
- Upgrades assigned to DISIS-2011-001 interconnection Customers:
  - Beaver County – Gray County 345kV
  - Spearville – Mullergren – Reno double circuit 345kV
  - Tatonga – Matthewson - Cimarron 345kV circuit #2
    - Tatonga terminal equipment upgrade (1792 MVA)
  - Rice County – Circle 230kV conversion
  - Rice County – Lyons 115kV rebuild
  - Rice County 230/115kV autotransformer
  - Lyons – Wheatland 115kV rerate (199 MVA)
  - Hoskins – Dixon County – Twin Church 230kV rerate
  - (NRIS only) Benton – Wichita 345kV rerate (1195 MVA)
  - (NRIS only) Chisolm – Maize – Evans Energy Center 138kV rerate
  - (NRIS only) Deaf Smith County – South Randle County 230kV rerate
  - (NRIS only) EL Reno – Roman Nose 138kV rebuild
  - (NRIS only) Woodward – FPL Switch – Mooreland 138kV rebuild

[12] Impact Study posted February 2012.

- (NRIS only) Hitchland 230/115/13.2kV transformer circuit #2
- (NRIS only) Knoll – North Hays – Vine 115kV rebuild

- Upgrades assigned to DISIS-2011-002 interconnection Customers:
  - Harbine – Crete 115kV Rebuild
  - Jones – Lubbock South 230kV CKT 2 - Replace Wave Traps at 1600 amps
  - Power System Stabilizers - Install Power System Stabilizers at Tolk(Units: 1,2) and Jones (Units: 1,2,3)
  - SUB 967 - SUB 968 69kV CKT 1 - replace terminal equipment
  - (NRIS only) Allen – Lubbock South 115kV rebuild at 1200 amps
  - (NRIS only) Cimarron – Draper 345kV replace Cimarron line trap and Draper CT
  - (NRIS only) Glass Mountain – Mooreland 138kV rebuild
  - (NRIS only) Hydro Carbon Tap - Sub974 69kV rewire CT
  - (NRIS only) Jones – TUCO 230kV CKT 1 - Replace line traps at 1600 amps
  - (NRIS only) Lubbock South - Lubbock East 115kV CKT 1 – Rebuild at 1200 amps
  - (NRIS only) Lubbock South 230/115kV Autotransformer build CKT 2 (250 MVA)
  - (NRIS only) Nebraska City U Syracuse – SUB 970 CKT 1 - replace terminal equipment

Potential Upgrades Not in the Base Case

Any potential upgrades that do not have a Notification to Construct (NTC) and not explicitly listed within this report 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 section.

Regional Groupings

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

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

Power Flow

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 fifteen different scenarios with each group being studied at 80% nameplate rating. These projects were dispatched as Energy Resources with equal distribution across the SPP footprint. Certain projects that requested Network Resource Interconnection Service were dispatched in an additional analysis into the balancing authority of the interconnecting transmission owner. 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. Other sensitivity analyses are also performed with each interconnection request modeled at 100% nameplate.

Peaking units were not dispatched in the 2012 spring model. To study peaking units' impacts, the 2012 summer and winter and 2017 summer and winter seasonal models were chosen and peaking

units were modeled at 100% of the nameplate rating and wind generating facilities were modeled at 10% of the nameplate rating. Each interconnection request was also modeled separately at 100% nameplate for certain analyses.

Dynamic Stability

For each group, all interconnection requests were studied at 100% nameplate output while the other groups were dispatched at 20% output for wind requests and 100% output for thermal requests.

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. Interconnection Requests that have requested Network Resource Interconnection Service (NRIS) were also studied in the NRIS analysis to determine if any constraint had at least a 3% DF. If so, these constraints were considered for mitigation.

Determination of Cost Allocated Network Upgrades

Cost Allocated Network Upgrades of wind generation interconnection requests were determined using the 2012 spring model. Cost Allocated Network Upgrades of peaking units was determined using the 2017 summer peak model. A MUST sensitivity analysis was performed to determine the Distribution Factors (DF), a distribution factor with no contingency 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 Z2 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.

Required Interconnection Facilities

The requirement to interconnect the 150.4 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 F by upgrade. The interconnection requirements for the cluster total $24,066,604. Interconnection Facilities specific to each generation interconnection request are listed in Appendix E. A preliminary one-line drawing for each generation interconnection request are listed in Appendix D.

A list of constraints that were identified and used for mitigation are listed in Appendix G. Listed within Appendix G are the ERIS constraints with greater than or equal to a 20% DF, as well as, the NRIS constraints that have a DF of 3% or greater. Other Network Constraints which are not requiring mitigation 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.

Power Flow Analysis

Power Flow 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 element and special (i.e., breaker-to-breaker, multi-element, etc) contingencies in portions or all of the modeled control areas of SPP, as well as, other control areas external to SPP and the resulting scenarios analyzed. This satisfies the "more probable" contingency testing criteria mandated by NERC and the SPP criteria.

Power Flow Analysis

A power flow analysis was conducted for each Interconnection Customer's facility using modified versions of the 2012 spring peak, 2012 summer and winter peak, and the 2017 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. Certain requests that requested Network Resource Interconnection Service (NRIS) had an additional analysis conducted for displacing resources in the interconnecting Transmission Owner's balancing authority.

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 criteria violations will occur on the SUNC, MKEC, and WERE transmission systems under system intact and contingency conditions in the peak seasons.

Cluster Group 1 (Woodward Area)

In addition to the 5,151.8 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 2 (Hitchland Area)

In addition to the 3,529.4 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 3 (Spearville Area)

In addition to the 5,965.4 MW of previously queued generation in the area, 150.4 MW of new interconnection service was studied. The Harper – Milan Tap – Clearwater 138kV transmission circuit will need to be reconductored or rebuilt in order to mitigate thermal overloading.

Cluster Group 4 (Mingo/NW Kansas Group)

In addition to the 845.2 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 5 (Amarillo Area)

In addition to the 1,572.6 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 6 (South Texas Panhandle/New Mexico)

In addition to the 2,837.3 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 7 (Southwestern Oklahoma)

In addition to the 1,991.0 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 8 (South Central Kansas/North Oklahoma)

In addition to the 1,986.3 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 9/10 (Nebraska)

In addition to the 1,931.1 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 11 (North Central Kansas)

In addition to the 1,445.1 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 12 (Northwest Arkansas)

In addition to the 0 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 13 (Northwest Missouri)

In addition to the 585.6 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 14 (South Central Oklahoma)

In addition to the 462.2 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new ERIS constraints were found in this area.

Cluster Group 15 (reserved)

This group has been retired and all prior Group 15 requests have been re-designated as Group 9/10 requests.

Stability Analysis

A stability analysis was conducted for each Interconnection Customer's facility using modified versions of the 2012 summer and 2012 winter peak models. The stability analysis was conducted with all upgrades in service that were identified in the power flow 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 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)

There was no stability analysis conducted in the Woodward area due to no requests in the area.

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 analysis for this study was performed by Southwest Power Pool (SPP). Stability analysis has determined that Group 3 projects with the addition of previously assigned network upgrades, the 150.4 MW of new generation interconnection requests can be accommodated. Once the previously assigned upgrades are placed in service the transmission system will remain stable and low voltage ride through requirements are satisfied for the contingencies studied.

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

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI	
				Lagging (supplying)	Leading (absorbing)
GEN-2012-006	150.4	G.E. 1.6 MW	Harper 138kV (539668)	0.95	0.95

*As reactive power is required for all projects, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the point of interconnection.

Cluster Group 4 (Mingo Area)

There was no stability analysis conducted in the Mingo area due to no requests in the area.

Cluster Group 5 (Amarillo Area)

There was no stability analysis conducted in the Amarillo area due to no requests in the area.

Cluster Group 6 (South Texas Panhandle/New Mexico)

There was no stability analysis conducted in the South Texas Panhandle / New Mexico area due to no requests in the area.

Cluster Group 7 (Southwest Oklahoma Area)

There was no stability analysis conducted in the Southwest Oklahoma area due to no requests in the area.

Cluster Group 8 (South Central Kansas/North Oklahoma)

There was no stability analysis conducted in the South Central Kansas/North Oklahoma area due to no requests in the area.

Cluster Group 9/10 (Nebraska)

There was no stability analysis conducted in the Nebraska area due to no requests in the area.

Cluster Group 11 (North Central Kansas Area)

There was no stability analysis conducted in the North Central Kansas area due to no requests in the area.

Cluster Group 12 (Northwest Arkansas Area)

There was no stability analysis conducted in the Northwest Arkansas area due to no requests in the area.

Cluster Group 13 (Northwest Missouri Area)

There was no stability analysis conducted in the Northwest Missouri area due to no requests in the area.

Cluster Group 14 (South Central Oklahoma)

There was no stability analysis conducted in the South Central Oklahoma area due to no requests in the area.

Cluster Group 15 (reserved)

This group has been retired and all prior Group 15 requests have been re-designated as Group 9/10 requests.

Conclusion

The minimum cost of interconnecting 150.4 MW of new interconnection requests included in this Preliminary Interconnection System Impact Study is estimated at $24,066,604 for the Allocated Network Upgrades and Transmission Owner Interconnection Facilities are listed in Appendix E and F. 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 will be performed if the Interconnection Customer executes the appropriate Interconnection Facilities Study Agreement and provides the required data along with demonstration of Site Control and the appropriate deposit. At the time of the Interconnection Facilities Study, a better determination of the interconnection facilities may be available.

The required interconnection costs listed in Appendices E, and F, 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

See next page.

A: Generation Interconnection Requests Considered for Impact Study

Request	Amount	Service	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date	In Service Date Delayed Until no earlier than*
GEN-2012-006	150.4	ER	SUNCMKEC	Harper 138kV	Harper 138kV	12/31/2014	TBD
TOTAL	**150.4**						

*request dependent upon Priority Projects or Balanced Portfolio may be delayed until 12/31/2014. Other projects in service date to be determined after Facility Study.

B: Prior Queued Interconnection Requests

See next page.

B: Prior Queued Interconnection Requests

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
ASGI-2010-006	150	AECI	Tap Fairfax Tap - Fairfax (AECI) 138kV	AECI queue Affected Study
ASGI-2010-010	42	SPS	Lovington 115kV	Lea County Affected Study
ASGI-2010-011	48	SPS	TC-Texas County 69kV	Tri-County Affected Study
ASGI-2010-020	30	SPS	Tap LE-Tatum - LE-Crossroads 69kV	Lea County Affected Study
ASGI-2010-021	15	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV	Lea County Affected Study
ASGI-2011-001	28.8	SPS	LE-Lovington 115kV	Lea County Affected Study
ASGI-2011-002	10	SPS	Herring 115kV	AECI queue Affected Study
ASGI-2011-003	10	SPS	Hendricks 115kV	AECI queue Affected Study
ASGI-2011-004	20	SPS	Pleasant Hill 69kV	Under Study (DISIS-2011-002)
GEN-2001-014	96	WFEC	Ft Supply 138kV	On-Line
GEN-2001-026	74	WFEC	Washita 138kV	On-Line
GEN-2001-033	180	SPS	San Juan Tap 230kV	On-Line
GEN-2001-036	80	SPS	Norton 115kV	On-Line
GEN-2001-037	100	OKGE	FPL Moreland Tap 138kV	On-Line
GEN-2001-039A	105	SUNCMKEC	Tap Greensburg - Ft Dodge 115kV	On Schedule for 2012
GEN-2001-039M	100	SUNCMKEC	Central Plains Tap 115kV	On-Line
GEN-2002-004	200	WERE	Latham 345kV	On-Line at 150MW
GEN-2002-005	120	WFEC	Red Hills Tap 138kV	On-Line
GEN-2002-008	240	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2002-009	80	SPS	Hansford 115kV	On-Line
GEN-2002-022	240	SPS	Bushland 230kV	On-Line
GEN-2002-023N	0.8	NPPD	Harmony 115kV	On-Line
GEN-2002-025A	150	SUNCMKEC	Spearville 230kV	On-Line
GEN-2003-004 GEN-2004-023 GEN-2005-003	151.2	WFEC	Washita 138kV	On-Line
GEN-2003-005	100	WFEC	Anadarko - Paradise (Blue Canyon) 138kV	On-Line
GEN-2003-006A	200	SUNCMKEC	Elm Creek 230kV	On-Line
GEN-2003-019	250	MIDW	Smoky Hills Tap 230kV	On-Line
GEN-2003-020	160	SPS	Martin 115kV	On-Line
GEN-2003-021N	75	NPPD	Ainsworth Wind Tap 115kV	On-Line
GEN-2003-022	120	AEPW	Washita 34.5kV	On-Line
GEN-2004-005N	30	NPPD	St Francis 115kV	IA Pending
GEN-2004-014	154.5	SUNCMKEC	Spearville 230kV	On Schedule for 2012
GEN-2004-020	27	AEPW	Washita 34.5kV	On-Line
GEN-2004-023N	75	NPPD	Columbus County 115kV	On Schedule
GEN-2005-005	18	OKGE	FPL Moreland Tap 138kV	IA Pending
GEN-2005-008	120	OKGE	Woodward 138kV	On-Line
GEN-2005-012	250	SUNCMKEC	Spearville 345kV	On Schedule for 2012
GEN-2005-013	201	WERE	Tap Latham - Neosho (Caney River) 345kV	On-Line
GEN-2006-002	101	AEPW	Sweetwater 230kV	On-Line
GEN-2006-006	205.5	SUNCMKEC	Spearville 345kV	IA Pending
GEN-2006-014	300	MIPU	Tap Maryville - Midway 161kV	On Suspension
GEN-2006-018	170	SPS	Antelope 230kV	On-Line
GEN-2006-020N	42	NPPD	Bloomfield 115kV	On-Line
GEN-2006-020S	18.9	SPS	DWS Frisco 115kV	On Schedule for 3/2012

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2006-021	101	SUNCMKEC	Flat Ridge Tap 138kV	On-Line
GEN-2006-022	150	SUNCMKEC	Pratt 115kV	On Suspension
GEN-2006-024S	19.8	WFEC	Buffalo Bear Tap 69kV	On-Line
GEN-2006-026	502	SPS	Hobbs 230kV	On-Line
GEN-2006-031	75	MIDW	Knoll 115kV	On-Line
GEN-2006-032	200	MIDW	South Hays 230kV	On Suspension
GEN-2006-035	225	AEPW	Sweetwater 230kV	On-Line at 132MW
GEN-2006-037N1	75	NPPD	Broken Bow 115kV	On Suspension
GEN-2006-038N005	80	NPPD	Broken Bow 115kV	On Schedule for 2012
GEN-2006-038N019	80	NPPD	Petersburg 115kV	On-Line
GEN-2006-040	108	SUNCMKEC	Mingo 115kV	On Suspension
GEN-2006-043	99	AEPW	Sweetwater 230kV	On-Line
GEN-2006-044	370	SPS	Hitchland 345kV	On Schedule for 2012
GEN-2006-044N	40.5	NPPD	Petersburg 115kV	On-Line
GEN-2006-044N02	100.5	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV	IA Pending
GEN-2006-045	240	SPS	Tap and Tie both Potter - Plant X 230kV and Bushland - Deaf Smith (South Randle County) 230kV	On Suspension
GEN-2006-046	131	OKGE	Dewey 138kV	On-Line
GEN-2006-047	240	SPS	Tap and Tie both Potter - Plant X 230kV and Bushland - Deaf Smith (South Randle County) 230kV	On Suspension
GEN-2006-049	400	SPS	Tap Finney - Hitchland (Stevens County) 345kV	On Schedule for 2014
GEN-2007-011	135	SUNCMKEC	Syracuse 115kV	On Suspension
GEN-2007-011N08	81	NPPD	Bloomfield 115kV	On-Line
GEN-2007-015	135	WERE	Tap Kelly(WERE) - S1399(OPPD) 161kV	On Suspension
GEN-2007-021	201	OKGE	Tatonga 345kV	On Schedule for 2014
GEN-2007-025	300	WERE	Tap Wichita - Woodring (Sumner County) 345kV	On Schedule for 2012
GEN-2007-032	150	WFEC	Tap Clinton Junction - Clinton 138kV	On Schedule for 2013
GEN-2007-038	200	SUNCMKEC	Spearville 345kV	On Schedule for 2015
GEN-2007-040	200	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV	On Schedule for 2012
GEN-2007-043	200	OKGE	Minco 345kV	On-Line
GEN-2007-044	300	OKGE	Tatonga 345kV	On Schedule for 2014
GEN-2007-046	199.5	SPS	Hitchland 115kV	On Schedule for 2014
GEN-2007-048	400	SPS	Tap Amarillo S - Swisher 230kV	On Schedule for 2014
GEN-2007-050	170	OKGE	Woodward EHV 138kV	On-Line at 150MW
GEN-2007-051	200	WFEC	Mooreland 138kV	On Schedule for 2014
GEN-2007-052	150	WFEC	Anadarko 138kV	On-Line
GEN-2007-057	34.5	SPS	Moore County East 115kV	On Schedule for 2014
GEN-2007-062	765	OKGE	Woodward EHV 345kV	On Schedule for 2014
GEN-2008-003	101	OKGE	Woodward EHV 138kV	On-Line
GEN-2008-008	60	SPS	Graham 69kV	On Schedule for 2014
GEN-2008-009	60	SPS	San Juan Tap 230kV	On Schedule for 2014
GEN-2008-013	300	OKGE	Tap Wichita - Woodring (South of GEN-2007-025) 345kV	On Schedule for 2012
GEN-2008-014	150	SPS	Tap Tuco- Oklaunion 345kV	On Schedule for 2014
GEN-2008-016	248	SPS	Grassland 230kV	IA Pending
GEN-2008-017	300	SUNCMKEC	Setab 345kV	On Schedule for 2014
GEN-2008-018	405	SPS	Finney 345kV	On Schedule for 2012
GEN-2008-019	300	OKGE	Tatonga 345kV	On Schedule for 2015
GEN-2008-021	42.0	WERE	Wolf Creek 345kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2008-022	300	SPS	Tap Eddy Co - Tolk (Chaves County) 345kV	On Schedule for 2015
GEN-2008-023	150	AEPW	Hobart Junction 138kV	On Schedule for 2012
GEN-2008-025	101	SUNCMKEC	Ruleton 115kV	On SchedulE for 2015
GEN-2008-029	250	OKGE	Woodward EHV 138kV	On Schedule for 2014
GEN-2008-037	101	WFEC	Tap Washita - Blue Canyon Wind 138kV	On-Line
GEN-2008-044	197.8	OKGE	Tatonga 345kV	On-Line
GEN-2008-046	200	OKGE	Sunnyside 345kV	On Suspension
GEN-2008-047	300	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA Pending
GEN-2008-051	322	SPS	Potter County 345kV	On Schedule for 2012
GEN-2008-071	76.8	OKGE	Newkirk 138kV	On Suspension
GEN-2008-079	100.5	SUNCMKEC	Tap Cudahy - Ft Dodge 115kV	On Schedule for 2012
GEN-2008-086N02	200	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV	On Schedule for 2014
GEN-2008-088	50.6	SPS	Vega 69kV	IA Pending
GEN-2008-092	201	MIDW	Postrock 230kV	IA Pending
GEN-2008-098	100.8	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV	IA Pending
GEN-2008-119O	60	OPPD	S1399 161kV	On-Line
GEN-2008-123N	89.7	NPPD	Tap Guide Rock - Pauline 115kV	On Suspension
GEN-2008-124	200	SUNCMKEC	Spearville 345kV	On Schedule for 2014
GEN-2008-129	80	MIPU	Pleasant Hill 161kV	On-Line
GEN-2009-008	199.5	MIDW	South Hays 230kV	On Suspension
GEN-2009-016	100.8	AEPW	Falcon Road 138kV	On Suspension
GEN-2009-020	48.6	MIDW	Tap Nekoma - Bazine 69kV	On Suspension
GEN-2009-025	60	OKGE	Tap Deer Creek - Sinclair Blackwell 69kV	On Schedule for 2012
GEN-2009-040	73.8	WERE	Tap Smittyville - Knob Hill 115kV	On Suspension
GEN-2009-067S	20	SPS	Seven Rivers 69kV	On Suspension
GEN-2010-001	300	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	ule for 2014 (204 MW) and 2015
GEN-2010-003	100.8	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV	IA Pending
GEN-2010-005	300	WERE	Tap Wichita - Woodring (Sumner County) 345kV	On Schedule for 2012
GEN-2010-006	205	SPS	Jones 230kV	On-Line
GEN-2010-009	165.6	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV	On Schedule for 2012
GEN-2010-011	30	OKGE	Tatonga 345kV	On Line
GEN-2010-012	65	WFEC	Brantley 138kV	On Schedule for 2015
GEN-2010-014	360	SPS	Hitchland 345kV	IA Pending
GEN-2010-015	200.1	SUNCMKEC	Spearville 345kV	On Schedule for 2015
GEN-2010-020	20	SPS	Roswell 69kV	IA Pending
GEN-2010-029	450	SUNCMKEC	Spearville 345kV	IA Pending
GEN-2010-036	4.6	WERE	6th Street 115kV	On Schedule for 2012
GEN-2010-040	300	OKGE	Cimarron 345kV	On Schedule for 2012
GEN-2010-041	10.5	OPPD	S 1399 161kV	Facility Study
GEN-2010-044	99	NPPD	Harbine 115kV	Under Study (DISIS-2011-002)
GEN-2010-045	197.8	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV	IA Pending
GEN-2010-046	56	SPS	Tuco 230kV	On Schedule for 2016
GEN-2010-048	70	MIDW	Tap Beach Station - Redline 115kV	IA Pending
GEN-2010-051	200	NPPD	Tap Twin Church - Hoskins 230kV	On Schedule for 2014
GEN-2010-053	199.8	SUNCMKEC	Clark County 345kV	IA Pending
GEN-2010-055	4.5	AEPW	Wekiwa 138kV	IA Pending
GEN-2010-056	151	MIPU	Tap Saint Joseph - Cooper 345kV	IA Pending

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2010-057	201	WERE	Rice County 230kV	On Schedule for 2012
GEN-2010-058	20	SPS	Chaves County 115kV	IA Pending
GEN-2010-061	180	MIDW	Tap Post Rock - Spearville 345kV	Under Study (DISIS-2011-002)
GEN-2011-007	250	OKGE	Tap Cimarron - Woodring (Matthewson) 345kV	IA Pending
GEN-2011-008	600	SUNCMKEC	Clark County 345kV	Facility Study
GEN-2011-010	100.8	OKGE	Minco 345kV	On Schedule for 2012
GEN-2011-011	50	KACP	Iatan 345kV	IA Pending
GEN-2011-012	104.5	SPS	Tap Moore County - Hitchland 345kV	IA Pending
GEN-2011-014	201	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV	IA Pending
GEN-2011-016	200.1	SUNCMKEC	Spearville 345kV	IA Pending
GEN-2011-017	299	SUNCMKEC	Tap Spearville - PostRock 345kV	Facility Study
GEN-2011-018	73.6	NPPD	Steele City 115kV	Facility Study
GEN-2011-019	299	OKGE	Woodward 345kV	IA Pending
GEN-2011-020	299	OKGE	Woodward 345kV	IA Pending
GEN-2011-021	299	SPS	Tap Hitchland - Beaver 345kV	Facility Study
GEN-2011-022	299	SPS	Hitchland 345kV	IA Pending
GEN-2011-023	299	SUNCMKEC	Clark 345kV	Facility Study
GEN-2011-024	299	OKGE	Tatonga 345kV	IA Pending
GEN-2011-025	82.3	SPS	Tap Floyd County - Crosby County 115kV	IA Pending
GEN-2011-027	120	NPPD	Tap Twin Church - Hoskins 230kV (GEN-2010-51 Tap)	Facility Study
GEN-2011-037	7	WFEC	Blue Canyon 5 138kV	IA Pending
GEN-2011-040	111	OKGE	Tap Ratliff - Pooleville 138kV	Under Study (DISIS-2011-002)
GEN-2011-043	150	SUNCMKEC	Thistle 345kV	Under Study (DISIS-2011-002)
GEN-2011-044	150	SUNCMKEC	Thistle 345kV	Under Study (DISIS-2011-002)
GEN-2011-045	205	SPS	Jones 230kV	Facility Study
GEN-2011-046	27	SPS	Lopez 115kV	Facility Study
GEN-2011-048	165	SPS	Mustang 230kV	Under Study (DISIS-2011-002)
GEN-2011-049	250	OKGE	Border 345kV	Under Study (DISIS-2011-002)
GEN-2011-050	109.8	AEPW	Tap Rush Springs - Marlow 138kV	Under Study (DISIS-2011-002)
GEN-2011-051	104.4	OKGE	Tap Woodward - Tatonga 345kV	Under Study (DISIS-2011-002)
GEN-2011-054	300	OKGE	Cimarron 345kV	Under Study (DISIS-2011-002)
GEN-2011-055	52.8	OPPD	South Sterling 69kV	Under Study (DISIS-2011-002)
GEN-2011-056	3.6	NPPD	Jeffrey 115kV	Under Study (DISIS-2011-002)
GEN-2011-056A	3.6	NPPD	John 1 115kV	Under Study (DISIS-2011-002)
GEN-2011-056B	4.5	NPPD	John 2 115kV	Under Study (DISIS-2011-002)
GEN-2011-057	150.4	WERE	Creswell 138kV	Under Study (DISIS-2011-002)
GEN-2012-001	61.2	SPS	Tap Grassland - Borden County 230kV	Under Study (DISIS-2012-001)
GEN-2012-002	101.2	SUNCMKEC	Tap Pile - Scott City 115kV	Under Study (DISIS-2012-001)
GEN-2012-003	22.5	SUNCMKEC	Tap Hugoton - Rolla 69kV	Under Study (DISIS-2012-001)
GEN-2012-004	41.4	OKGE	Ratliff - Pooleville 138kV	Under Study (DISIS-2012-001)
GEN-2012-007	120	SUNCMKEC	Rubart 115kV	Under Study (DISIS-2012-001)
GEN-2012-008	40	SPS	Mustang 115kV & Mustang 230kV	Under Study (DISIS-2012-001)
GEN-2012-009	15	SPS	Mustang 230kV	Under Study (DISIS-2012-001)
GEN-2012-010	15	SPS	Mustang 230kV	Under Study (DISIS-2012-001)
GEN-2012-011	200	SUNCMKEC	Tap Spearville - Post Rock 345kV (GEN-2011-017T)	Under Study (DISIS-2012-001)
GEN-2012-012	200	SUNCMKEC	Clark County 345kV	Under Study (DISIS-2012-001)
Gray County Wind (Montezuma)	110	SUNCMKEC	Haggard 115kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
Llano Estacado (White Deer)	80	SPS	Llano Wind 115kV	On-Line
NPPD Distributed (Broken Bow)	8.3	NPPD	Broken Bow 115kV	On-Line
NPPD Distributed (Burwell)	3	NPPD	Ord 115kV	On-Line
NPPD Distributed (Columbus Hydro)	45	NPPD	Columbus 115kV	On-Line
NPPD Distributed (Jeffrey)	18.0	NPPD	Jeffrey 115kV	On-Line
NPPD Distributed (John Lake 1)	19.0	NPPD	John Lake 1 115kV	On-Line
NPPD Distributed (John Lake 2)	19.0	NPPD	John Lake 2 115kV	On-Line
NPPD Distributed (Ord)	10.8	NPPD	Ord 115kV	On-Line
NPPD Distributed (Stuart)	2.1	NPPD	Ainsworth 115kV	On-Line
SPS Distributed (Dumas 19th St)	20	SPS	Dumas 19th Street 115kV	On-Line
SPS Distributed (Etter)	20	SPS	Etter 115kV	On-Line
SPS Distributed (Moore E)	25	SPS	Moore East 115kV	On-Line
SPS Distributed (Sherman)	20	SPS	Sherman 115kV	On-Line
SPS Distributed (Spearman)	10	SPS	Spearman 69kV	On-Line
SPS Distributed (TC-Texas County)	20	SPS	Texas County 115kV	On-Line
TOTAL	**28,303.0**			

C: Study Groupings

See next page

C. Study Groups

GROUP 1: WOODWARD AREA			
Request	**Capacity**	**Area**	**Proposed Point of Interconnection**
GEN-2001-014	96.0	WFEC	Ft Supply 138kV
GEN-2001-037	100.0	OKGE	FPL Moreland Tap 138kV
GEN-2005-005	18.0	OKGE	FPL Moreland Tap 138kV
GEN-2005-008	120.0	OKGE	Woodward 138kV
GEN-2006-024S	19.8	WFEC	Buffalo Bear Tap 69kV
GEN-2006-046	131.0	OKGE	Dewey 138kV
GEN-2007-021	201.0	OKGE	Tatonga 345kV
GEN-2007-043	200.0	OKGE	Minco 345kV
GEN-2007-044	300.0	OKGE	Tatonga 345kV
GEN-2007-050	170.0	OKGE	Woodward EHV 138kV
GEN-2007-051	200.0	WFEC	Mooreland 138kV
GEN-2007-062	765.0	OKGE	Woodward EHV 345kV
GEN-2008-003	101.0	OKGE	Woodward EHV 138kV
GEN-2008-019	300.0	OKGE	Tatonga 345kV
GEN-2008-029	250.0	OKGE	Woodward EHV 138kV
GEN-2008-044	197.8	OKGE	Tatonga 345kV
GEN-2010-011	30.0	OKGE	Tatonga 345kV
GEN-2010-040	300.0	OKGE	Cimarron 345kV
GEN-2011-007	250.0	OKGE	Tap Cimarron - Woodring (Matthewson) 345kV
GEN-2011-010	100.8	OKGE	Minco 345kV
GEN-2011-019	299.0	OKGE	Woodward 345kV
GEN-2011-020	299.0	OKGE	Woodward 345kV
GEN-2011-024	299.0	OKGE	Tatonga 345kV
GEN-2011-051	104.4	OKGE	Tap Woodward - Tatonga 345kV
GEN-2011-054	300.0	OKGE	Cimarron 345kV
PRIOR QUEUED SUBTOTAL	**5,151.8**		
AREA TOTAL	**5,151.8**		

GROUP 2: HITCHLAND AREA			
Request	**Capacity**	**Area**	**Proposed Point of Interconnection**
ASGI-2010-011	48.0	SPS	TC-Texas County 69kV
GEN-2002-008	240.0	SPS	Hitchland 345kV
GEN-2002-009	80.0	SPS	Hansford 115kV
GEN-2003-020	160.0	SPS	Martin 115kV
GEN-2006-020S	18.9	SPS	DWS Frisco 115kV
GEN-2006-044	370.0	SPS	Hitchland 345kV
GEN-2006-049	400.0	SPS	Tap Finney - Hitchland (Stevens County) 345kV
GEN-2007-046	199.5	SPS	Hitchland 115kV
GEN-2007-057	34.5	SPS	Moore County East 115kV
GEN-2008-047	300.0	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV
GEN-2010-001	300.0	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV
GEN-2010-014	360.0	SPS	Hitchland 345kV
GEN-2011-012	104.5	SPS	Tap Moore County - Hitchland 345kV
GEN-2011-014	201.0	SPS	Tap Hitchland - Woodward Ckt 1 (Beaver County) 345kV
GEN-2011-021	299.0	SPS	Tap Hitchland - Beaver 345kV
GEN-2011-022	299.0	SPS	Hitchland 345kV
SPS Distributed (Dumas 19th St)	20.0	SPS	Dumas 19th Street 115kV
SPS Distributed (Etter)	20.0	SPS	Etter 115kV
SPS Distributed (Moore E)	25.0	SPS	Moore East 115kV
SPS Distributed (Sherman)	20.0	SPS	Sherman 115kV
SPS Distributed (Spearman)	10.0	SPS	Spearman 69kV
SPS Distributed (TC-Texas County)	20.0	SPS	Texas County 115kV
PRIOR QUEUED SUBTOTAL	**3,529.4**		
AREA TOTAL	**3,529.4**		

GROUP 3: SPEARVILLE AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-039A	105.0	SUNCMKEC	Tap Greensburg - Ft Dodge 115kV
GEN-2002-025A	150.0	SUNCMKEC	Spearville 230kV
GEN-2004-014	154.5	SUNCMKEC	Spearville 230kV
GEN-2005-012	250.0	SUNCMKEC	Spearville 345kV
GEN-2006-006	205.5	SUNCMKEC	Spearville 345kV
GEN-2006-021	101.0	SUNCMKEC	Flat Ridge Tap 138kV
GEN-2006-022	150.0	SUNCMKEC	Pratt 115kV
GEN-2007-038	200.0	SUNCMKEC	Spearville 345kV
GEN-2007-040	200.0	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV
GEN-2008-018	405.0	SPS	Finney 345kV
GEN-2008-079	100.5	SUNCMKEC	Tap Cudahy - Ft Dodge 115kV
GEN-2008-124	200.0	SUNCMKEC	Spearville 345kV
GEN-2010-009	165.6	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV
GEN-2010-015	200.1	SUNCMKEC	Spearville 345kV
GEN-2010-029	450.0	SUNCMKEC	Spearville 345kV
GEN-2010-045	197.8	SUNCMKEC	Tap Holcomb - Spearville (Gray County) 345kV
GEN-2010-053	199.8	SUNCMKEC	Clark County 345kV
GEN-2010-061	180.0	MIDW	Tap Post Rock - Spearville 345kV
GEN-2011-008	600.0	SUNCMKEC	Clark County 345kV
GEN-2011-016	200.1	SUNCMKEC	Spearville 345kV
GEN-2011-017	299.0	SUNCMKEC	Tap Spearville - PostRock 345kV
GEN-2011-023	299.0	SUNCMKEC	Clark 345kV
GEN-2011-043	150.0	SUNCMKEC	Thistle 345kV
GEN-2011-044	150.0	SUNCMKEC	Thistle 345kV
GEN-2012-003	22.5	SUNCMKEC	Tap Hugoton - Rolla 69kV
GEN-2012-007	120.0	SUNCMKEC	Rubart 115kV
GEN-2012-011	200.0	SUNCMKEC	Tap Spearville - Post Rock 345kV (GEN-2011-017T)
GEN-2012-012	200.0	SUNCMKEC	Clark County 345kV
Gray County Wind (Montezuma)	110.0	SUNCMKEC	Haggard 115kV
PRIOR QUEUED SUBTOTAL	**5,965.4**		
GEN-2012-006	150.4	SUNCMKEC	Harper 138kV
CURRENT CLUSTER SUBTOTAL	**150.4**		
AREA TOTAL	**6,115.8**		

GROUP 4: MINGO/NW KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-039M	100.0	SUNCMKEC	Central Plains Tap 115kV
GEN-2006-040	108.0	SUNCMKEC	Mingo 115kV
GEN-2007-011	135.0	SUNCMKEC	Syracuse 115kV
GEN-2008-017	300.0	SUNCMKEC	Setab 345kV
GEN-2008-025	101.0	SUNCMKEC	Ruleton 115kV
GEN-2012-002	101.2	SUNCMKEC	Tap Pile - Scott City 115kV
PRIOR QUEUED SUBTOTAL	**845.2**		
AREA TOTAL	**845.2**		

GROUP 5: AMARILLO AREA			
Request	**Capacity**	**Area**	**Proposed Point of Interconnection**
GEN-2002-022	240.0	SPS	Bushland 230kV
GEN-2006-045	240.0	SPS	Tap and Tie both Potter - Plant X 230kV and Bushland - Deaf Smith (South Randle County) 230kV
GEN-2006-047	240.0	SPS	Tap and Tie both Potter - Plant X 230kV and Bushland - Deaf Smith (South Randle County) 230kV
GEN-2007-048	400.0	SPS	Tap Amarillo S - Swisher 230kV
GEN-2008-051	322.0	SPS	Potter County 345kV
GEN-2008-088	50.6	SPS	Vega 69kV
Llano Estacado (White Deer)	80.0	SPS	Llano Wind 115kV
PRIOR QUEUED SUBTOTAL	**1,572.6**		
AREA TOTAL	**1,572.6**		

GROUP 6: S-TX PANHANDLE/NW AREA			
Request	**Capacity**	**Area**	**Proposed Point of Interconnection**
ASGI-2010-010	42.0	SPS	Lovington 115kV
ASGI-2010-020	30.0	SPS	Tap LE-Tatum - LE-Crossroads 69kV
ASGI-2010-021	15.0	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV
ASGI-2011-001	28.8	SPS	LE-Lovington 115kV
ASGI-2011-002	10.0	SPS	Herring 115kV
ASGI-2011-003	10.0	SPS	Hendricks 115kV
ASGI-2011-004	20.0	SPS	Pleasant Hill 69kV
GEN-2001-033	180.0	SPS	San Juan Tap 230kV
GEN-2001-036	80.0	SPS	Norton 115kV
GEN-2006-018	170.0	SPS	Antelope 230kV
GEN-2006-026	502.0	SPS	Hobbs 230kV
GEN-2008-008	60.0	SPS	Graham 69kV
GEN-2008-009	60.0	SPS	San Juan Tap 230kV
GEN-2008-014	150.0	SPS	Tap Tuco- Oklaunion 345kV
GEN-2008-016	248.0	SPS	Grassland 230kV
GEN-2008-022	300.0	SPS	Tap Eddy Co - Tolk (Chaves County) 345kV
GEN-2009-067S	20.0	SPS	Seven Rivers 69kV
GEN-2010-006	205.0	SPS	Jones 230kV
GEN-2010-020	20.0	SPS	Roswell 69kV
GEN-2010-046	56.0	SPS	Tuco 230kV
GEN-2010-058	20.0	SPS	Chaves County 115kV
GEN-2011-025	82.3	SPS	Tap Floyd County - Crosby County 115kV
GEN-2011-045	205.0	SPS	Jones 230kV
GEN-2011-046	27.0	SPS	Lopez 115kV
GEN-2011-048	165.0	SPS	Mustang 230kV
GEN-2012-001	61.2	SPS	Tap Grassland - Borden County 230kV
GEN-2012-008	40.0	SPS	Mustang 115kV & Mustang 230kV
GEN-2012-009	15.0	SPS	Mustang 230kV
GEN-2012-010	15.0	SPS	Mustang 230kV
PRIOR QUEUED SUBTOTAL	**2,837.3**		
AREA TOTAL	**2,837.3**		

GROUP 7: SW OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-026	74.0	WFEC	Washita 138kV
GEN-2002-005	120.0	WFEC	Red Hills Tap 138kV
GEN-2003-004 GEN-2004-023 GEN-2005-003	151.2	WFEC	Washita 138kV
GEN-2003-005	100.0	WFEC	Anadarko - Paradise (Blue Canyon) 138kV
GEN-2003-022	120.0	AEPW	Washita 34.5kV
GEN-2004-020	27.0	AEPW	Washita 34.5kV
GEN-2006-002	101.0	AEPW	Sweetwater 230kV
GEN-2006-035	225.0	AEPW	Sweetwater 230kV
GEN-2006-043	99.0	AEPW	Sweetwater 230kV
GEN-2007-032	150.0	WFEC	Tap Clinton Junction - Clinton 138kV
GEN-2007-052	150.0	WFEC	Anadarko 138kV
GEN-2008-023	150.0	AEPW	Hobart Junction 138kV
GEN-2008-037	101.0	WFEC	Tap Washita - Blue Canyon Wind 138kV
GEN-2009-016	100.8	AEPW	Falcon Road 138kV
GEN-2010-012	65.0	WFEC	Brantley 138kV
GEN-2011-037	7.0	WFEC	Blue Canyon 5 138kV
GEN-2011-049	250.0	OKGE	Border 345kV
PRIOR QUEUED SUBTOTAL	**1,991.0**		
AREA TOTAL	**1,991.0**		

GROUP 8: N-OK/S-KS AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-006	150.0	AECI	Tap Fairfax Tap - Fairfax (AECI) 138kV
GEN-2002-004	200.0	WERE	Latham 345kV
GEN-2005-013	201.0	WERE	Tap Latham - Neosho (Caney River) 345kV
GEN-2007-025	300.0	WERE	Tap Wichita - Woodring (Sumner County) 345kV
GEN-2008-013	300.0	OKGE	Tap Wichita - Woodring (South of GEN-2007-025) 345kV
GEN-2008-021	42.0	WERE	Wolf Creek 345kV
GEN-2008-071	76.8	OKGE	Newkirk 138kV
GEN-2008-098	100.8	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV
GEN-2009-025	60.0	OKGE	Tap Deer Creek - Sinclair Blackwell 69kV
GEN-2010-003	100.8	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV
GEN-2010-005	300.0	WERE	Tap Wichita - Woodring (Sumner County) 345kV
GEN-2010-055	4.5	AEPW	Wekiwa 138kV
GEN-2011-057	150.4	WERE	Creswell 138kV
PRIOR QUEUED SUBTOTAL	**1,986.3**		
AREA TOTAL	**1,986.3**		

GROUP 9/10: NEBRASKA AREA			
Request	**Capacity**	**Area**	**Proposed Point of Interconnection**
GEN-2002-023N	0.8	NPPD	Harmony 115kV
GEN-2003-021N	75.0	NPPD	Ainsworth Wind Tap 115kV
GEN-2004-005N	30.0	NPPD	St Francis 115kV
GEN-2004-023N	75.0	NPPD	Columbus County 115kV
GEN-2006-020N	42.0	NPPD	Bloomfield 115kV
GEN-2006-037N1	75.0	NPPD	Broken Bow 115kV
GEN-2006-038N005	80.0	NPPD	Broken Bow 115kV
GEN-2006-038N019	80.0	NPPD	Petersburg 115kV
GEN-2006-044N	40.5	NPPD	Petersburg 115kV
GEN-2006-044N02	100.5	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV
GEN-2007-011N08	81.0	NPPD	Bloomfield 115kV
GEN-2007-015	135.0	WERE	Tap Kelly(WERE) - S1399(OPPD) 161kV
GEN-2008-086N02	200.0	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV
GEN-2008-119O	60.0	OPPD	S1399 161kV
GEN-2008-123N	89.7	NPPD	Tap Guide Rock - Pauline 115kV
GEN-2009-040	73.8	WERE	Tap Smittyville - Knob Hill 115kV
GEN-2010-041	10.5	OPPD	S 1399 161kV
GEN-2010-044	99.0	NPPD	Harbine 115kV
GEN-2010-051	200.0	NPPD	Tap Twin Church - Hoskins 230kV
GEN-2011-018	73.6	NPPD	Steele City 115kV
GEN-2011-027	120.0	NPPD	Tap Twin Church - Hoskins 230kV (GEN-2010-51 Tap)
GEN-2011-055	52.8	OPPD	South Sterling 69kV
GEN-2011-056	3.6	NPPD	Jeffrey 115kV
GEN-2011-056A	3.6	NPPD	John 1 115kV
GEN-2011-056B	4.5	NPPD	John 2 115kV
NPPD Distributed (Broken Bow)	8.3	NPPD	Broken Bow 115kV
NPPD Distributed (Burwell)	3.0	NPPD	Ord 115kV
NPPD Distributed (Columbus Hydro)	45.0	NPPD	Columbus 115kV
NPPD Distributed (Jeffrey)	18.0	NPPD	Jeffrey 115kV
NPPD Distributed (John Lake 1)	19.0	NPPD	John Lake 1 115kV
NPPD Distributed (John Lake 2)	19.0	NPPD	John Lake 2 115kV
NPPD Distributed (Ord)	10.8	NPPD	Ord 115kV
NPPD Distributed (Stuart)	2.1	NPPD	Ainsworth 115kV
PRIOR QUEUED SUBTOTAL	**1,931.1**		
AREA TOTAL	**1,931.1**		

GROUP 11: N KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2003-006A	200.0	SUNCMKEC	Elm Creek 230kV
GEN-2003-019	250.0	MIDW	Smoky Hills Tap 230kV
GEN-2006-031	75.0	MIDW	Knoll 115kV
GEN-2006-032	200.0	MIDW	South Hays 230kV
GEN-2008-092	201.0	MIDW	Postrock 230kV
GEN-2009-008	199.5	MIDW	South Hays 230kV
GEN-2009-020	48.6	MIDW	Tap Nekoma - Bazine 69kV
GEN-2010-048	70.0	MIDW	Tap Beach Station - Redline 115kV
GEN-2010-057	201.0	WERE	Rice County 230kV
PRIOR QUEUED SUBTOTAL	**1,445.1**		
AREA TOTAL	**1,445.1**		

GROUP 12: NW AR AREA

Request	Capacity	Area	Proposed Point of Interconnection
AREA TOTAL	**0.0**		

GROUP 13: NW MISSOURI AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2006-014	300.0	MIPU	Tap Maryville - Midway 161kV
GEN-2008-129	80.0	MIPU	Pleasant Hill 161kV
GEN-2010-036	4.6	WERE	6th Street 115kV
GEN-2010-056	151.0	MIPU	Tap Saint Joseph - Cooper 345kV
GEN-2011-011	50.0	KACP	latan 345kV
PRIOR QUEUED SUBTOTAL	**585.6**		
AREA TOTAL	**585.6**		

GROUP 14: S OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2008-046	200.0	OKGE	Sunnyside 345kV
GEN-2011-040	111.0	OKGE	Tap Ratliff - Pooleville 138kV
GEN-2011-050	109.8	AEPW	Tap Rush Springs - Marlow 138kV
GEN-2012-004	41.4	OKGE	Ratliff - Pooleville 138kV
PRIOR QUEUED SUBTOTAL	**462.2**		
AREA TOTAL	**462.2**		

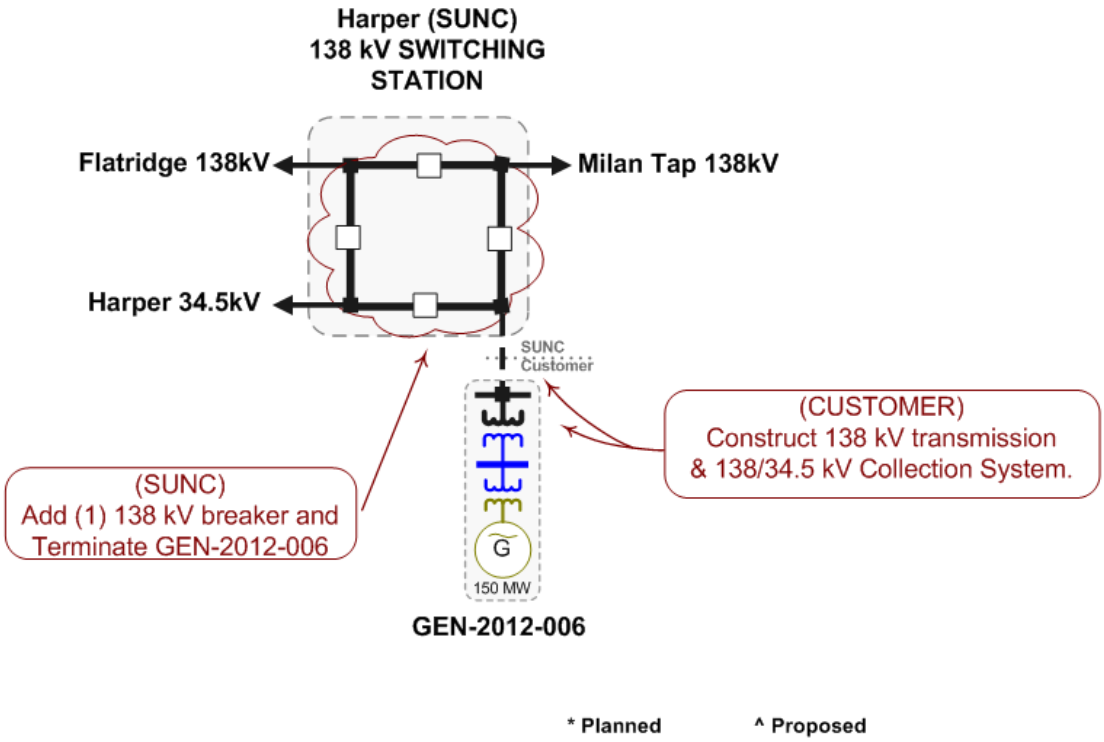
GROUP 15: RESERVED

Request	Capacity	Area	Proposed Point of Interconnection
AREA TOTAL	**0.0**		

CLUSTER TOTAL (CURRENT STUDY)	**150.4**	**MW**
PQ TOTAL (PRIOR QUEUED)	**28,303.0**	**MW**
CLUSTER TOTAL (INCLUDING PRIOR QUEUED)	**28,453.4**	**MW**

D: Proposed Point of Interconnection One line Diagrams

GEN-2012-006



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

Important Note:

****WITHDRAWAL OF HIGHER QUEUED PROJECTS WILL CAUSE A RESTUDY AND MAY RESULT IN HIGHER INTERCONNECTION COSTS****

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

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

In addition should a higher queued request, defined as one this study includes as a prior queued request, withdraw, the Network Upgrades assigned to the withdrawn request may be reallocated to the remaining requests that have an impact on the Network Upgrade under a restudy. Also, should a Interconnection Request choose to go into service prior to the operation date of any necessary Network Upgrades, the costs associated with those upgrades may be reallocated to the impacted Interconnection Request. The actual costs allocated to each Generation Interconnection Request Customer will be determined at the time of a restudy.

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 E. Cost Allocation Per Request

(Including Previously Allocated Network Upgrades*)

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN 2012-006			
GEN-2012-006 Interconnection Costs See Oneline Diagram.	Current Study	$4,000,000.00	$4,000,000.00
Harper - Milan Tap 138kV CKT 1 Rebuild approximately 22 miles of 138kV line	Current Study	$9,613,332.00	$9,613,332.00
Milan Tap - Clearwater 138kV CKT 1 Rebuild approximately 12 miles of 138kV line	Current Study	$10,453,272.00	$10,453,272.00
Axtell - PostRock 345KV CKT 1 Balanced Portfolio: PostRock - Axtell 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$136,000,000.00
Beaver County - Gray County (Buckner) 345kV Build approximately 90 miles of 345kV from Beaver County - Gray County @ 3000 amps	Previously Allocated		$170,209,050.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,932,114.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,932,114.00
Flat Ridge - Harper 138kV CKT 1 Per 2007-AG3-AFS-9	Previously Allocated		$11,048,967.00
Hitchland 345/230kV Autotransformer CKT 2 Priority Project: Hitchland 345/230kV Autotransformer CKT 2 (Total Project E&C Cost Shown).	Previously Allocated		$8,883,760.00
Matthewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Matthewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
Post Rock - GEN-2011-017 Tap 345kV CKT 2 Build second 345kV circuit from Post Rock - GEN-2011-017 Tap	Previously Allocated		$42,003,000.00
Tatonga - Matthewson 345kV CKT 2 Build second 345kV circuit from Tatonga - Matthewson @ 3000 amps	Previously Allocated		$104,260,473.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$166,598,000.00
Thistle 345/138KV Transformer CKT 1 Priority Project: Thistle 345/138kV Transformer CKT 1 & Thistle - Flat Ridge 138kV CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$12,632,149.00

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00
	Current Study Total	$24,066,604.00	
	TOTAL CURRENT STUDY COSTS:	**$24,066,604.00**	

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

F: Cost Allocation per Proposed Study Network Upgrade

Important Note:

****WITHDRAWAL OF HIGHER QUEUED PROJECTS WILL CAUSE A RESTUDY AND MAY RESULT IN HIGHER INTERCONNECTION COSTS****

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 E for more details.

Appendix F. Cost Allocation by Upgrade

GEN-2012-006 Interconnection Costs		**$4,000,000.00**
See Oneline Diagram.		
	GEN 2012-006	$4,000,000.00
	Total Allocated Costs	**$4,000,000.00**
Harper - Milan Tap 138kV CKT 1		**$9,613,332.00**
Rebuild approximately 22 miles of 138kV line		
	GEN 2012-006	$9,613,332.00
	Total Allocated Costs	**$9,613,332.00**
Milan Tap - Clearwater 138kV CKT 1		**$10,453,272.00**
Rebuild approximately 12 miles of 138kV line		
	GEN 2012-006	$10,453,272.00
	Total Allocated Costs	**$10,453,272.00**

* Withdrawal of higher queued projects will cause a restudy and may result in higher costs

G: Power Flow Analysis (Constraints For Mitigation)

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (%MVA)	CONTINGENCY
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5141	156.3379	EVANS ENERGY CENTER SOUTH - LAKERIDGE 138KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5141	171.7949	EVANS ENERGY CENTER SOUTH - LAKERIDGE 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5141	155.6070	HOOVER NORTH - LAKERIDGE 138KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5141	170.9817	HOOVER NORTH - LAKERIDGE 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	148.4275	BASE CASE
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	163.3002	BASE CASE
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5193	156.5959	TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5193	171.8818	TATONGA7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5205	151.7893	THISTLE 7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5205	166.8284	THISTLE 7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5205	151.7893	THISTLE 7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5205	166.8284	THISTLE 7 345.00 - WOODWARD DISTRICT EHV 345KV CKT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5191	155.6336	MATTHEWSON 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5191	170.8785	MATTHEWSON 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5191	155.6336	MATTHEWSON 345.00 - TATONGA7 345.00 345KV CKT 2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5191	170.8785	MATTHEWSON 345.00 - TATONGA7 345.00 345KV CKT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5189	153.1813	G11-17T 345.00 - POST ROCK 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5189	168.3006	G11-17T 345.00 - POST ROCK 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5189	151.7705	AXTELL - POST ROCK 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5189	166.8138	AXTELL - POST ROCK 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5178	152.7581	RENO COUNTY - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5178	167.8377	RENO COUNTY - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	151.7617	MULGREN7 345.00 - RENO COUNTY 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	166.7882	MULGREN7 345.00 - RENO COUNTY 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	151.7617	MULGREN7 345.00 - RENO COUNTY 345KV CKT 2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	166.7882	MULGREN7 345.00 - RENO COUNTY 345KV CKT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5176	145.0194	CANEYRV7 345.00 - NEOSHO 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5176	159.7191	CANEYRV7 345.00 - NEOSHO 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5176	160.0992	CANEYRV7 345.00 - LATHAMS7 345.00 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5195	159.5133	BENTON - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5195	175.0341	BENTON - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5205	166.6405	THISTLE 7 345.00 - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5205	182.3781	THISTLE 7 345.00 - WICHITA 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5205	166.6405	THISTLE 7 345.00 - WICHITA 345KV CKT 2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5205	182.3781	THISTLE 7 345.00 - WICHITA 345KV CKT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5178	144.0428	ANDERSONCO 345.00 - WOLF CREEK 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5178	158.7043	ANDERSONCO 345.00 - WOLF CREEK 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5058	145.7761	59TH ST - EL PASO 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5058	145.3114	59TH ST - GILL ENERGY CENTER SOUTH 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	154.1790	CENTENNIAL - COWSKIN 138KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5117	169.4818	CENTENNIAL - COWSKIN 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	153.4949	CENTENNIAL - WACO 138KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5117	168.7232	CENTENNIAL - WACO 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	156.8384	COWSKIN - EVANS ENERGY CENTER SOUTH 138KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5117	172.3820	COWSKIN - EVANS ENERGY CENTER SOUTH 138KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (%MVA)	CONTINGENCY
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	151.1899	GILL ENERGY CENTER WEST - WACO 138KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.7412	196.1196	THISTLE 7 345.00 345/138KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.7412	213.2724	THISTLE 7 345.00 345/138KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5192	141.5089	CLARKCO 7 345.00 - THISTLE 7 345.00 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5192	156.0380	CLARKCO 7 345.00 - THISTLE 7 345.00 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5192	141.5089	CLARKCO 7 345.00 - THISTLE 7 345.00 345KV CKT 2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5192	156.0380	CLARKCO 7 345.00 - THISTLE 7 345.00 345KV CKT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5178	143.7096	ANDERSONCO 345.00 - LACYGNE 345KV CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5178	158.3619	ANDERSONCO 345.00 - LACYGNE 345KV CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5166	153.1203	WICHITA (WICHT11X) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5166	168.2118	WICHITA (WICHT11X) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5161	154.2704	WICHITA (WICHT12X) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5161	169.4160	WICHITA (WICHT12X) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5213	144.5735	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5213	159.2600	MEDICINE LODGE (MED-LDG4) 138/115/2.72KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	151.8545	GEN335831 1-RIVERBEND UNIT#1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	166.9010	GEN335831 1-RIVERBEND UNIT#1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	152.4687	GEN336153 1-WATERFORD UNIT#3
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	167.5270	GEN336153 1-WATERFORD UNIT#3
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	152.8985	GEN336821 1-GRAND GULF UNIT
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	167.9884	GEN336821 1-GRAND GULF UNIT
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	151.9413	GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	166.9987	GEN337911 1-ARKANSAS NUCLEAR ONE UNIT #2
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	167.2050	GEN532722 1-EVANS ENERGY CENTER UNIT 2
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	158.8694	GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	174.2805	GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5185	143.5316	GEN539945 1-FLATRWDWG1 0.6900
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5185	158.1639	GEN539945 1-FLATRWDWG1 0.6900

H: Power Flow Analysis (Other Constraints Not Requiring Mitigation)

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (%MVA)	CONTINGENCY
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	1.0000	115.8661	SPP-MKEC-08
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	1.0000	103.2091	SPP-MKEC-08
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5141	170.6538	SPP-WERE-32
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5141	155.2927	SPP-WERE-32
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5117	168.7060	SPP-WERE-30
FDNS	3	0	12G	G12_006	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	95.6	0.5117	168.4976	SPP-WERE-28
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	153.4363	SPP-WERE-30
FDNS	3	0	12G	G12_006	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	100	0.5117	153.2791	SPP-WERE-28
FDNS	3	0	12G	G12_006	TO->FROM	NINNESC3 115.00 - PRATT 115KV CKT 1	87.6	0.1412	112.5972	THISTLE 7 345.00 345/138KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	NINNESC3 115.00 - ST JOHN 115KV CKT 1	87.6	0.1412	106.4803	THISTLE 7 345.00 345/138KV TRANSFORMER CKT 1
FDNS	0	0	12SP	G12_006	FROM->TO	GILL ENERGY CENTER EAST (GEC3 GSU) 138/69/14.4KV TRANSFORMER CKT 1	137.5	0.0635	108.3352	GILL ENERGY CENTER SOUTH (GILL 5X) 138/69/13.2KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	FROM->TO	ST JOHN - ST_JOHN 115KV CKT 1	86	0.0521	119.3913	THISTLE 7 345.00 345/138KV TRANSFORMER CKT 1
FDNS	3	0	12G	G12_006	TO->FROM	BENTON - WICHITA 345KV CKT 1	956	0.0490	105.9045	GEN532751 1-WOLF CREEK GENERATING STATION UNIT 1
FDNS	0	0	17SP	G12_006	FROM->TO	GILL ENERGY CENTER EAST (GEC3 GSU) 138/69/14.4KV TRANSFORMER CKT 1	137.5	0.0408	100.3572	GILL ENERGY CENTER SOUTH (GILL 5X) 138/69/13.2KV TRANSFORMER CKT 1

I: Group 3 Dynamic Stability Analysis Report

See next page.

SPP Southwest Power Pool

Preliminary Interconnection System Impact Study

PISIS-2012-001 (Group 3)

SPP Generation Interconnection Studies

(PISIS-2012-001)

August 2012

Executive Summary

A transient stability study has been performed by Southwest Power Pool (SPP) to evaluate a interconnection request in the Sunflower Electric Power Corporation/Mid-Kansas Electric Power Company (SUNC/MKEC) area, to evaluate the dynamic stability of the system affects of adding GEN-2012-006 (150.4 MW/Wind).

GEN-2012-006 consists ninety-four (94) G.E. 1.6 MW wind turbines interconnecting at Harper 138kV substation in Sunflower Electric Power Corporation/Mid-Kansas Electric Power Company (SUNC/MKEC) area. As of the posting of this study, there are currently twenty-nine (29) prior queued interconnection requests in the Southwest Kansas Grouping (Group 3) and GEN-2012-006 is the only request in the current study in this area.

The results of a stability analysis determined that for the addition of the PISIS-2012-001 interconnection request, the transmission system was found to remain stable for both summer and winter peak conditions with the reconductor of Flat Ridge – Harper – Milan Tap – Clearwater 138kV CKT 1, which are needed for mitigating thermal overloads in the power flow part of the PISIS-2012-001 study. Balanced portfolio and priority projects are included in the models. Additionally, the wind farm project is found to stay connected during the contingencies that were studied, meeting the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The results of the power factor analysis show that the interconnection request is to maintain a power factor of 95% lagging (supplying vars) and 95% leading (providing vars) at the point of interconnection.

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

Table of Contents

1.0 Introduction

A transient stability study has been performed by Southwest Power Pool (SPP) to evaluate a interconnection request in the Sunflower Electric Power Corporation/Mid-Kansas Electric Power Company (SUNC/MKEC) area, to evaluate the dynamic stability of the system affects of adding GEN-2012-006 (150.4 MW/Wind).

GEN-2012-006 consists ninety-four (94) G.E. 1.6 MW wind turbines interconnecting at Harper 138kV substation in Sunflower Electric Power Corporation/Mid-Kansas Electric Power Company (SUNC/MKEC) area. As of the posting of this study, there are currently twenty-nine (29) prior queued interconnection requests in the Southwest Kansas Grouping (Group 3) and GEN-2012-006 is the only request in the current study in this area.

The results of a stability analysis determined that for the addition of the PISIS-2012-001 interconnection request the transmission system was found to remain stable for both summer and winter peak conditions with the reconductor of Flat Ridge – Harper – Milan Tap – Clearwater 138kV CKT 1, which are needed for mitigating thermal overloads in the power flow part of the PISIS-2012-001 study. Balanced portfolio and priority projects are included in the models. Additionally, the wind farm project is found to stay connected during the contingencies that were studied, meeting the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

Two seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. A 2012 summer peak case and a 2012 winter peak case which were both modified to include the prior queued projects shown in Table 1.

2.0 Purpose

The purpose of this Impact Study is to evaluate the impact of the proposed interconnection on the reliability of the Transmission System. Table 1 below lists the requests that were analyzed in this study.

Table 1: PISIS-2012-001 Impact Study Request

Request	Amount (MW)
GEN-2012-006	150.4

Table 2: PISIS-2012-001 Prior Queued Interconnection Requests

Request	Amount (MW)
GEN-2001-039A	104
GEN-2002-025A	150
GEN-2004-014	154.5
GEN-2005-012	250.7
GEN-2006-006	205.5
GEN-2006-021	100
GEN-2006-022	150
GEN-2007-038	200
GEN-2007-025	300
GEN-2007-040	200.1
GEN-2008-079	98.9
GEN-2008-124	200.1
GEN-2010-005	300
GEN-2010-009	165.6

Request	Amount (MW)
GEN-2010-015	200.1
GEN-2010-029	450
GEN-2010-045	197.8
GEN-2010-053	199.8
GEN-2010-061	179.4
GEN-2011-008	600
GEN-2011-016	200.1
GEN-2011-017	299
GEN-2011-023	299
GEN-2011-043	149.5
GEN-2011-044	149.5
GEN-2012-003	20.74/21.21
GEN-2012-007	96/120
GEN-2012-011	200
GEN-2012-012	200

Should any previously queued projects that were included in this study withdraw, then this PISIS-2012-001 Impact Study may require a re-study of this request at the expense of the customer.

3.0 Facilities

3.1 Interconnection Facility

GEN-2012-006 generating facility is studied with the assumption that it would be using ninety-four (94) G.E. 1.6 MW wind turbines. The nameplate rating of each turbine is 1.6MW (1,600kW) with a machine base of 1.78MVA (1,780kVA). Each wind turbine has a 34.5kV/0.69kV 1.85MVA (1,8500kVA) transformer. Customer's Interconnection Facilities will include one (1) 138/34.5kV 100/133/167MVA transformers. The Point of Interconnection (POI) will be at Harper 138kV substation. Figure 1 below shows a Point of Interconnection (POI) one-line diagram of the Customer's facility. Figure 2 shows a detailed one-line diagram of the GEN-2012-006 facility.

Figure 1: GEN-2012-006 POI One-line Diagram

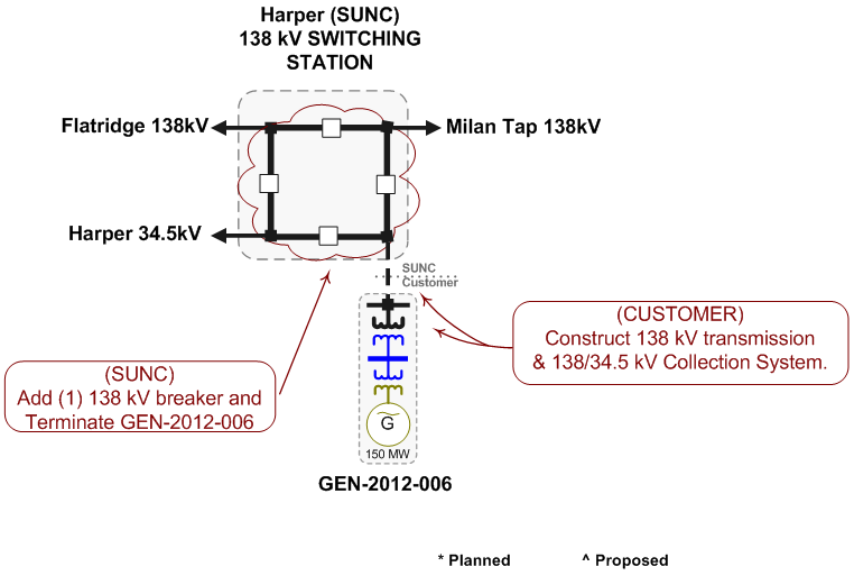
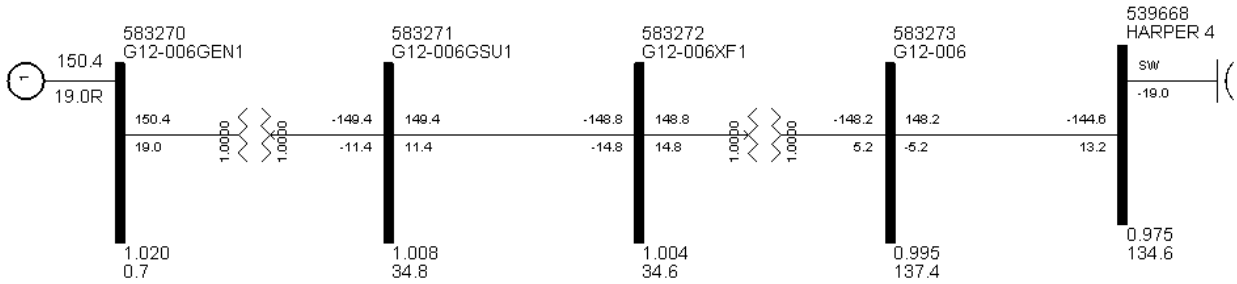


Figure 2: GEN-2012-006 Facility POI One-line Diagram



3.2 Generating Facility

Table 2 lists the point of interconnection and machines used in this impact study to simulate the contingencies.

Table 2: Point of Interconnection and Machine Type

Request	Generator Model	Point of Interconnection
GEN-2001-039A	G.E. 1.6MW	Tap on Fort Dodge – Greensburg 115kV line (579025)
GEN-2002-025A	G.E. 1.5 MW	Spearville 230kV (539695)
GEN-2004-014	G.E. 1.6 MW	Spearville 230kV (539695)
GEN-2005-012	Siemens 2.3MW	Spearville 345kV (531469)
GEN-2006-006	G.E. 1.5 MW	Spearville 345kV (531469)
GEN-2006-021	Clipper 2.5MW	Flat Ridge 138kV (539638)
GEN-2006-022	Clipper 2.5MW	Pratt 115kV (539687)
GEN-2007-038	Clipper 2.5MW	Spearville 345kV (531469)
GEN-2007-025	G.E. 1.6MW	Viola 345kV
GEN-2007-040	Siemens 2.3MW	Gray County 345kV (579284)
GEN-2008-079	Siemens 2.3MW	Tap on Cudahy – Fort Dodge 115kV line (573029)
GEN-2008-124	Siemens 2.3MW	Spearville 345kV (531469)
GEN-2010-005	G.E. 1.6MW	Viola 345kV
GEN-2010-009	Siemens SWT 2.3MW	Gray County 345kV (579284)
GEN-2010-015	Siemens SWT 2.3MW	Spearville 345kV (531469)
GEN-2010-029	Vestas V90 1.8MW	Spearville 345kV (531469)
GEN-2010-045	Siemens 2.3MW	Gray County 345kV (579284)
GEN-2010-053	Vestas V90 1.8MW	Clark County 345kV (539800)
GEN-2010-061	Siemens 2.3MW	Tap on Spearville – Post Rock 345kV line (G11-017 POI, 576704)
GEN-2011-008	G.E. 1.6MW	Clark County 345kV (539800)
GEN-2011-016	Siemens 2.3MW	Spearville 345kV (531469)
GEN-2011-017	Siemens 2.3MW	Tap on Spearville – Post Rock 345kV line (G11-017 POI, 576704)
GEN-2011-023	Siemens 2.3MW	Clark County 345kV (539800)
GEN-2011-043	Siemens 2.3MW	Thistle 345kV (539801)
GEN-2011-044	Siemens 2.3MW	Thistle 345kV (539801)
GEN-2012-003	GENSAL	Tap on Rolla – Hugoton 69kV (562114)
GEN-2012-007	GENSAL	Tap on Kickok – Satanta 115kV (562116)
GEN-2012-011	G.E. 1.6MW	Tap on Spearville – Post Rock 345kV line (G11-017 POI, 576704)
GEN-2012-012	Clipper 2.5MW	Clark County 345kV (539800)

4.0 Stability Study Criteria

4.1 Contingencies Simulated

Thirty-seven (37) contingencies were considered for the transient stability simulations. The faults that were defined and simulated are listed in Table 3. These contingencies included three phase faults and single phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying a fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

Table 3: Contingencies Evaluated

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Harper (539668) to Flat Ridge (539638) 138kV line, near Harper. a. Apply fault at the Harper 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the Harper (539668) to Milan Tap (539675) 138kV line, near Harper. a. Apply fault at the Harper 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on Milan Tap (539675) to Clearwater (533036) 138kV line, near Milan Tap. a. Apply fault at the Milan Tap 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on Clearwater (533036) to Gill W (533045) 138kV line, near Clearwater. a. Apply fault at the Harper 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on Gill W (533045) to Gill E (533044) 138kV line, near Gill W. a. Apply fault at the Gill W 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT11-3PH	3 phase fault on Gill W (533045) to Gill S (533046) 138kV line, near Gill W. a. Apply fault at the Gill W 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on Gill W (533045) to Waco (533072) 138kV line, near Gill W. a. Apply fault at the Gill W 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	*Single phase fault and sequence like previous*
15	FLT15-3PH	3 phase fault on Flat Ridge (538638) to Medicine Lodge (539674)138kV line, near Flatridge. a. Apply fault at the Flat Ridge 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*

Cont. No.	Cont. Name	Description
17	FLT17-3H	3 phase fault on Medicine Lodge (539673) to Sawyer (539649) 115kV line, near Medicine Lodge. a. Apply fault at the Medicine Lodge 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on Medicine Lodge (539673) to Sun City (539697) 115kV line, near Medicine Lodge. a. Apply fault at the Medicine Lodge 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on G01-039A-POI (579025) to Fort Dodge (539671) 115kV line, near G01-039A-POI. a. Apply fault at the G01-039A-POI 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	*Single phase fault and sequence like previous*
23	FLT23-3PH	3 phase fault on Ninnesc (539648) to St. John (539696) 115kV line, near Ninnesc. a. Apply fault at the Ninnesc 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	*Single phase fault and sequence like previous*
25	FLT25-3PH	3 phase fault on the Thistle (539801) 345kV to Flatridge (539368) 138kV transformer near the 345kV bus. a. Apply fault at the Thistle 345kVbus. b. Clear fault after 5 cycles and trip the faulted transformer.
26	FLT26-3PH	3 phase fault on the Medicine Lodge (539674) 138kV to Medicine Lodge (539673) 115kV transformer near the 138kV bus. a. Apply fault at the Medicine Lodge 138kVbus. b. Clear fault after 5 cycles and trip the faulted transformer.
27	FLT27-3PH	3 phase fault on the Gill S (533046) 138kV to Gill E (533795) 69kV transformer near the 138kV bus. a. Apply fault at the Gill S 138kVbus. b. Clear fault after 5 cycles and trip the faulted transformer.
28	FLT28-3PH	3 phase fault on Thistle (539801) to Clark County (539800) 345kV line, ckt1, near Thistle. a. Apply fault at the Thistle 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.
29	FLT29-1PH	*Single phase fault and sequence like previous*
30	FLT30-3PH	3 phase fault on Thistle (539801) to Woodward (515375) 345kV line, ckt1, near Thistle. a. Apply fault at the Thistle 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
31	FLT31-1PH	*Single phase fault and sequence like previous*
32	FLT32-3PH	3 phase fault on Thistle (539801) to Wichita (532796) 345kV line, ckt1, near Thistle. a. Apply fault at the Thistle 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.
33	FLT33-1PH	*Single phase fault and sequence like previous*
34	FLT34-3PH	3 phase fault on G07-025 POI (579267) to Wichita (532796) 345kV line, near G07-025 POI. a. Apply fault at the G07-025 POI 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.
35	FLT35-1PH	*Single phase fault and sequence like previous*
36	FLT36-3PH	3 phase fault on Hunter (579406) to Woodring (514715) 345kV line, near Hunter. a. Apply fault at the Hunter 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.
37	FLT37-1PH	*Single phase fault and sequence like previous*

4.2 Further Model Preparation

The base cases contain prior queued projects as shown in Table 1. All prior queued projects are dispatched at 100% nameplate.

The wind generation from the study customer and the previously queued customers were dispatched into the SPP footprint.

Initial simulations were carried out on both base cases and cases with the added generation for a no-disturbance run of 20 seconds to verify the numerical stability of the model. All cases were confirmed to be stable.

5.0 Results

5.1 Stability Fault Analysis

Results of the stability analysis are summarized in Table 4. The results indicate that the transmission system is stable for all contingencies tested summer and winter cases.

Table 4: Results of Simulated Contingencies

Cont. No.	Cont. Name	Description	Summer	Winter
1	FLT01-3PH	3 phase fault on the Harper (539668) to Flat Ridge (539638) 138kV line, near Harper.	STABLE	STABLE
2	FLT02-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
3	FLT03-3PH	3 phase fault on the Harper (539668) to Milan Tap (539675) 138kV line, near Harper.	STABLE	STABLE
4	FLT04-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
5	FLT05-3PH	3 phase fault on Milan Tap (539675) to Clearwater (533036) 138kV line, near Milan Tap.	STABLE	STABLE
6	FLT06-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
7	FLT07-3PH	3 phase fault on Clearwater (533036) to Gill W (533045) 138kV line, near Clearwater.	STABLE	STABLE
8	FLT08-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
9	FLT09-3PH	3 phase fault on Gill W (533045) to Gill E (533044) 138kV line, near Gill W.	STABLE	STABLE
10	FLT10-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
11	FLT11-3PH	3 phase fault on Gill W (533045) to Gill S (533046) 138kV line, near Gill W.	STABLE	STABLE
12	FLT12-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
13	FLT13-3PH	3 phase fault on Gill W (533045) to Waco (533072) 138kV line, near Gill W.	STABLE	STABLE
14	FLT14-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
15	FLT15-3PH	3 phase fault on Flat Ridge (538638) to Medicine Lodge (539674)138kV line, near Flatridge.	STABLE	STABLE
16	FLT16-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
17	FLT17-3H	3 phase fault on Medicine Lodge (539673) to Sawyer (539649) 115kV line, near Medicine Lodge.	STABLE	STABLE
18	FLT18-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
19	FLT19-3PH	3 phase fault on Medicine Lodge (539673) to Sun City (539697) 115kV line, near Medicine Lodge	STABLE	STABLE
20	FLT20-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
21	FLT21-3PH	3 phase fault on G01-039A-POI (579025) to Fort Dodge (539671) 115kV line, near G01-039A-POI.	STABLE	STABLE
22	FLT22-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
23	FLT23-3PH	3 phase fault on Ninnesc (539648) to St. John (539696) 115kV line, near Ninnesc.	STABLE	STABLE
24	FLT24-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
25	FLT25-3PH	3 phase fault on the Thistle (539801) 345kV to Flatridge (539368) 138kV transformer near the 345kV bus	STABLE	STABLE
26	FLT26-3PH	3 phase fault on the Medicine Lodge (539674) 138kV to Medicine Lodge (539673) 115kV transformer near the 138kV bus.	STABLE	STABLE

Cont. No.	Cont. Name	Description	Summer	Winter
27	FLT27-3PH	3 phase fault on the Gill S (533046) 138kV to Gill E (533795) 69kV transformer near the 138kV bus.	STABLE	STABLE
28	FLT28-3PH	3 phase fault on Thistle (539801) to Clark County (539800) 345kV line, ckt1, near Thistle.	STABLE	STABLE
29	FLT29-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
30	FLT30-3PH	3 phase fault on Thistle (539801) to Woodward (515375) 345kV line, ckt1, near Thistle.	STABLE	STABLE
31	FLT31-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
32	FLT32-3PH	3 phase fault on Thistle (539801) to Wichita (532796) 345kV line, ckt1, near Thistle.	STABLE	STABLE
33	FLT33-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
34	FLT34-3PH	3 phase fault on G07-025 POI (579267) to Wichita (532796) 345kV line, near G07-025 POI.	STABLE	STABLE
35	FLT35-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE
36	FLT36-3PH	3 phase fault on Hunter (579406) to Woodring (514715) 345kV line, near Hunter.	STABLE	STABLE
37	FLT37-1PH	*Single phase fault and sequence like previous*	STABLE	STABLE

5.2 Power Factor Analysis

A power factor analysis was performed for GEN-2012-006 by modeling a VAR generator at the Point of Interconnection (POI) bus. The VAR generator was set to hold a voltage schedule of 1.00 per unit at the Point of Interconnection (POI) for GEN-2012-006. The analysis was done for both the summer and winter cases. The contingencies and results are shown in Tables 5.

The results show that the wind generator is required to maintain a power factor of 95% lagging (supplying vars) and 95% leading (providing vars) at the point of interconnection.

Table 5: GEN-2012-006 Power Factor Table

Bus 539668 (POI) voltage: 1.000 PU (SP) / 1.000 PU (WP)	GEN-2012-006							
CONTINGENCY	MW (SP)	MVAR (SP)	PF (SP)		MW (WP)	MVAR (WP)	PF (WP)	
No Contingency	150.4	21.6	0.99	LAG	150.4	38.9	0.968	LEAD
Harper (539668) to Flat Ridge (539638) 138kV CKT 1	150.4	-43.2	0.961	LEAD	150.4	-23.9	0.988	LEAD
Harper (539668) to Milan Tap (539675) 138kV CKT 1	150.4	7.4	0.999	LAG	150.4	7.2	0.999	LAG
Milan Tap (539675) to Clearwater (533036) 138kV CKT 1	150.4	1.6	1	LAG	150.4	-0.8	1.000	LAG
Clearwater (533036) to Gill W (533045) 138kV CKT 1	150.4	-13.8	0.996	LEAD	150.4	-16.9	0.994	LEAD
Gill W (533045) to Gill E (533044) 138kV CKT 1	150.4	23.9	0.988	LAG	150.4	36.9	0.971	LAG
Gill W (533045) to Gill S (533046) 138kV CKT 1	150.4	17.1	0.994	LAG	150.4	43.2	0.961	LAG
Gill W (533045) to Waco (533072) 138kV CKT 1	150.4	18.3	0.993	LAG	150.4	35.1	0.974	LAG
Flat Ridge (538638) to Medicine Lodge (539674)138kV CKT 1	150.4	16.6	0.994	LAG	150.4	35.2	0.974	LAG
Medicine Lodge (539673) to Sawyer (539649) 115kV CKT 1	150.4	23.4	0.988	LAG	150.4	41.8	0.963	LAG
Medicine Lodge (539673) to Sun City (539697) 115kV CKT 1	150.4	17	0.994	LAG	150.4	34.3	0.975	LAG
G01-039A-POI (579025) to Fort Dodge (539671) 115kV CKT 1	150.4	25.1	0.986	LAG	150.4	43.1	0.961	LAG
Ninnesc (539648) to St. John (539696) 115kV CKT 1	150.4	34.4	0.975	LAG	150.4	52.8	0.944	LAG
Thistle (539801) 345kV to Flatridge (539368) 138kV transformer CKT 1	150.4	13.8	0.996	LAG	150.4	30.1	0.981	LAG
Medicine Lodge (539674) 138kV to Medicine Lodge (539673) 115kV transformer CKT 1	150.4	16.6	0.994	LAG	150.4	35.2	0.974	LAG
Gill S (533046) 138kV to Gill E (533795) 69kV transformer CKT 1	150.4	21	0.99	LAG	150.4	38.3	0.969	LAG
Thistle (539801) to Clark County (539800) 345kV CKT 1	150.4	23.4	0.988	LAG	150.4	44.9	0.958	LAG
Thistle (539801) to Woodward (515375) 345kV CKT 1	150.4	35.7	0.973	LAG	150.4	57.2	0.935	LAG
Thistle (539801) to Wichita (532796) 345kV CKT 1	150.4	51.4	0.946	LAG	150.4	71.9	0.902	LAG
G07-025 POI (579267) to Wichita (532796) 345kV CKT 1	150.4	22.3	0.989	LAG	150.4	45.8	0.957	LAG
Hunter (579406) to Woodring (514715) 345kV CKT 1	150.4	27.8	0.983	LAG	150.4	47.8	0.953	LAG

(SP) - Summer Case
(WP) - Winter Case

Lowest leading power factor
Lowest lagging power factor

5.3 FERC LVRT Compliance

FERC Order 661A Low Voltage Ride-Through Provisions (LVRT), which went into effect January 1, 2006, requires that wind generating plants remain in-service during 3-phase faults at the point of interconnection that draw the voltage down at the POI to 0.0 pu.

6.0 Conclusion

A transient stability study has been performed by Southwest Power Pool (SPP) to evaluate a interconnection request in the Sunflower Electric Power Corporation (SUNC) area, to evaluate the dynamic stability of the system affects of adding GEN-2012-006 (150.4 MW/Wind).

The PISIS-2012-001 study has twenty-nine (29) prior queued interconnection requests and GEN-2012-006 is the only request in the current study in the SUNC area.

The results of a stability analysis determined that for the addition of the PISIS-2012-001 interconnection requests the transmission system was found to remain stable for both summer and winter peak conditions with the reconductor of Flat Ridge – Harper – Milan Tap – Clearwater 138kV CKT 1, which are needed for mitigating thermal overloads in the power flow part of the PISIS-2012-001 study. Balanced portfolio and priority projects are included in the models. Additionally, the wind farm project is found to stay connected during the contingencies that were studied, meeting the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The results of the power factor analysis show that the interconnection request is to maintain a power factor of 95% lagging (supplying vars) and 95% leading (providing vars) at the point of interconnection.

The estimates do not include any costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer requests transmission service through Southwest Power Pool's OASIS. It should be noted that the models used for simulation do not contain all SPP transmission service.

All plots are available upon request.