Preliminary Interconnection System Impact Study for Generator Interconnection Requests

(PISIS-2015-001)

August 2015

Generator Interconnection

Southwest Power Pool

Revision History

Date	Author	Change Description
8/28/2015	SPP	Report Issued (PISIS-2015-001)

Executive Summary

Generator Interconnection customers have requested a Preliminary Interconnection System Impact Study (PISIS) under the Generator 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, 2015. The customers will be referred to in this study as the PISIS-2015-001 Interconnection Customers. This System Impact Study analyzes the interconnecting new generation totaling approximately 300.13 MW of new generation which would be located within the transmission system of Sunflower Electric Power Corporation (SUNC). The generator interconnection requests have a requested in service dates of as listed in Appendix A[1]. The generator interconnection requests included in this System Impact Cluster Study are 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, 300.13 MW of nameplate generation may be interconnected with transmission system reinforcements within the SPP transmission system. Dynamic stability and power factor analysis has determined the need for reactive compensation in accordance with FERC Order #661A for wind farm interconnection requests and those requirements are listed for each interconnection request within the contents of this report. Dynamic stability analysis has determined that the transmission system will remain stable with the assigned Network Upgrades and necessary reactive compensation requirements. A short circuit analysis has been performed with available short circuit values given in the stability study for each group in the appendices of this report.

In no way does this study guarantee operation for all periods of time. This interconnection study identifies and assigns transmission reinforcements for Energy Resource (ER) interconnection injection constraints (defined as a 20% distribution factor impact for outage based constraints and 3% distribution factor for system intact constraints) and Network Resource (NR) constraints (defined as 3% distribution factor impact), if requested by the Customer. These constraints are listed in Appendix G. This interconnection study does not assign transmission reinforcements for all potential transmission constraints. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

[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 Customers 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 total estimated minimum cost for interconnecting the PISIS-2015-001 Interconnection Customers is estimated at $8,000,000. These costs are shown in Appendix E and F. Interconnection Service to PISIS-2015-001 Interconnection Customers is also contingent upon higher queued customers paying for certain required network upgrades. **The in-service date for the PISIS customers will be deferred until the construction of these network upgrades can be completed.**

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

Constraints listed in Appendix H do not require transmission reinforcement for Interconnection Service, but could require Interconnection Customer to reduce generation in operational conditions. These transmission constraints occur when this study's generation is dispatched into the SPP footprint for Energy Resource Interconnection Service (ERIS) or when this study's generation is dispatched into the interconnecting Transmission Owner's (T.O.) area for Network Resource Interconnection Service (NRIS).

It should be noted that the additional network constraints identified in Appendix H may also be identified by a Transmission Service Request (TSR) and may need to be verified by associated studies. With a defined source and sink in a TSR, the list of network constraints will be refined and expanded to account for all Network Upgrade requirements. The required interconnection costs listed in Appendix E and F do not include costs associated with the deliverability of the energy to load or other customers. These costs are determined by separate studies should the Customer decide to submit a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT. Furthermore, this DISIS neither guarantees transmission service or deliverability of the requested resource.

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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 certain generator interconnection requests in the SPP Generator Interconnection Queue. These interconnection requests have been clustered together for the following System Impact Study window which closed March 31, 2015. The customers will be referred to in this study as the PISIS-2015-001 Interconnection Customers. This PISIS analyzes interconnecting a generator interconnection request associated with new generation totaling 300.13 MW which would be located within the transmission system of Sunflower Electric Power Corporation (SUNC). The interconnection requests have a requested in service date as listed in Appendix A[2]. The generator interconnection requests included in this System Impact Study are 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.

The primary objective of this PISIS is to identify the system constraints associated with connecting the generation to the area transmission system. The Impact Study and other subsequent Interconnection Studies are designed to identify required interconnection 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 Customers that proceed to the Facility Study will be provided a new in-service date based on the completion of the Facility Study.

Model Development

Interconnection Requests Included in the Cluster

SPP included all interconnection requests that submitted a Preliminary Interconnection System Impact Study Agreement no later than March 31, 2015 and were subsequently accepted by Southwest Power Pool under the terms of the Generator Interconnection Procedures (GIP) that were in effect at the time this study commenced on April 1, 2015. 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 2014 series Integrated Transmission Planning models (used in the 2015 ITPNT) including the 2015 (spring and summer peak seasons), the 2020 (summer and winter peak seasons), and the 2025 (summer peak season) scenario 0 cases are used for this study. After the cases are developed, each of the control areas' resources are then re-dispatched to account for the new generation requests using current dispatch merit-orders. Planned High Priority Incremental Loads (HPILs) are also accounted for in these models.

Dynamic Stability

The 2014 series SPP Model Development Working Group (MDWG) Models 2015 (summer and winter peak seasons), and the 2025 (summer peak season) cases were used as starting points for this study.

Short Circuit

The 2025 summer peak stability case was used for this analysis.

Base Case Upgrades

The following facilities are part of the SPP Transmission Expansion Plan, the Balanced Portfolio or recently approved Priority Projects. These facilities have an approved Notification 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-2015-001 Interconnection Customers have not been assigned acceleration costs for the below listed projects. <u>The PISIS-2015-001 Interconnection Customers' Generation Facilities in service dates may need to be delayed until the completion of the following upgrades. If the Interconnection Request proceeds into the DISIS Queue, it may be determined that the Interconnection Request may only go into service with Limited Operation.</u> If for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the DISIS Interconnection Customers.

- 2012 Integrated Transmission Plan (2012 ITP10) Projects
  - Woodward-Tatonga-Mathewson-Cimarron 345kV transmission line, scheduled for 2021 in-service[3]
  - Chisholm – Gracemont 345kV transmission line, and Chisholm 345/230kV transformer circuit #1, scheduled for 3/1/2018 in-service[4]
- 2015 Integrated Transmission Plan Near Term (2015 ITPNT) Projects
  - China Draw 115kV Reactive Power Support
    - 200Mvar Capacitive and 50Mvar Inductive Static Var Compensator (SVC)
  - Road Runner 115kV Reactive Power Support
    - 200Mvar Capacitive and 50Mvar Inductive Static Var Compensator (SVC)
  - Agave Hill 115kV reactive Power Support
    - 28.8Mvar Capacitor Bank(s)
  - Potash Junction – Intrepid – IMC #1 – Livingston Ridge 115kV rebuild
  - National Enrichment Plant – Targa – Cardinal 115kV circuit #1 rebuild
- Nebraska City – Mullin Creek – Sibley 345kV circuit #1 build, scheduled for 12/31/2016 in-service[5]
- Hoskins – Neligh East 345/115 kV Project[6]
  - Neligh East 345/115 kV substation and transformer
  - Neligh East Area 115 kV upgrades to support new station
  - Hoskins – Neligh East 345 kV circuit #1
- High Priority Incremental Loads (HPILs) Projects[7]:
  - TUCO Interchange – Yoakum – Hobbs Interchange 345/230 kV Project
    - TUCO Interchange – Yoakum – Hobbs Interchange 345 kV circuit #1 and associated terminal equipment upgrades
    - Hobbs 345/230/13 kV transformer circuit #1
    - Yoakum 345/230/13 kV transformer circuit #1
  - Battle Axe – Road Runner 115 kV circuit #1
  - Chaves County – Price – CV Pines – Capitan 115 kV circuit #1
  - China Draw – Yeso Hills 115 kV circuit #1
  - Dollarhide – Toboso Flats 115 kV circuit #1
  - Hobbs Interchange – Kiowa 345 kV circuit #1
  - Kiowa – North Loving – China Draw 345/115 kV Projects
    - Kiowa – North Loving – China Draw circuit #1 and associated terminal equipment upgrades

[3] SPP Notification to Construct (NTC) 200223
[4] SPP Notification to Construct (NTC) 200240 and 200255
[5] SPP Notification to Construct (NTC) 20097 and 20098
[6] SPP Regional Reliability 2012 ITP 10 Project Per SPP-NTC-200220
[7] Per Network Upgrades assigned in High Priority Incremental Loads (HPILs) study, Including Direct Assigned Upgrades, Projects in SPP-NTC-200256 and SPP-NTC-200283.

        - China Draw 345/115/13 kV transformer circuit #1
        - North Loving 345/115/13 kV transformer circuit #1
    - Kiowa – Road Runner 345/230/115 kV Projects
        - Kiowa 345/230 kV transformer circuit #1
        - Road Runner 345/115/13 kV transformer circuit #1
    - Livingston Ridge – Sage Brush – Lagarto – Cardinal 115 kV circuit #1
    - North Loving – South Loving 115 kV circuit #1
    - Ponderosa – Ponderosa Tap 115 kV circuit #1
    - Potash 230/115/13kV Transformer circuit #1 replacement

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-2015-001 study and are assumed to be in service. This list may not be all inclusive. <u>The PISIS-2015-001 Interconnection Customer, at this time, does not have responsibility for these facilities but may later be assigned the cost of these facilities if higher queued customers terminate their Generator Interconnection Agreement or withdraw from the interconnection queue. The PISIS-2015-001 Interconnection Customer Generation Facilities in-service dates may need to be delayed until the completion of the following upgrades.</u>

- Upgrades assigned to DISIS-2010-001 Interconnection Customers:
    - None at this time
- Upgrades assigned to DISIS-2010-002 Interconnection Customers:
    - Twin Church – Dixon County 230 kV circuit #1 rerate (320 MVA)
    - Buckner – Spearville 345 kV terminal equipment
- Upgrades assigned to DISIS-2011-001 Interconnection Customers:
    - Hoskins – Dixon County – Twin Church 230 kV circuit #1 conductor clearance increase
    - (NRIS only) Woodward – FPL Switch – Mooreland 138 kV circuit #1 rebuild
- Upgrades assigned to DISIS-2011-002 Interconnection Customers:
    - None at this time
- Upgrades assigned to DISIS-2012-001 Interconnection Customers:
    - None at this time
- Upgrades assigned to DISIS-2012-002 Interconnection Customers:
    - Associated Electric Cooperatives Inc. (AECI) Fairfax 138/69 kV transformer replacement
    - Lake Creek – Lone Wolf 69 kV circuit #1 reset CT
    - Remington – Fairfax 138 kV circuit #1 conductor clearance increase
    - (NRIS only) Arkansas City – Paris –Creswell – Oak – Rainbow – City of Winfield 69kV circuit #1 rebuild
    - (NRIS only) Creswell 138/69/13kV Transformer circuit #1 and #2, replacements
- Upgrades assigned to DISIS-2013-001 Interconnection Customers:
    - None at this time
- Upgrades assigned to DISIS-2013-002 Interconnection Customers:
    - Battle Creek – County Line – Neligh East 115kV circuit #1 rebuild
- Upgrades assigned to DISIS-2014-001 Interconnection Customers:

    - None at this time
- Upgrades assigned to DISIS-2014-002 Interconnection Customers:
    - Arnold – Ransom 115kV circuit #1, terminal equipment replacement
    - Beaver County 345kV Reactive Power Support, build approximately 75Mvars of capacitive reactive power support
    - Carlisle 230/115/13kV Transformer circuit #1 replacement
    - Harper Milan Tap – Clearwater 138kV rebuild
    - Knoll – Post Rock 230kV circuit #1 rebuild
    - Norton – Pleasant Hill 230kV circuit #1 rebuild for voltage conversion
    - Oklaunion 345kV Reactive Power Support, build approximately 110Mvars of Capacitor Bank(s) and +/- 50Mvar Static Var Compensator (SVC)
    - Pleasant Hill 345/230/13kV transformer circuit #1 build
    - Potter County Interchange 345/230/13kV transformer circuit #2 build
    - Tolk – Plant X 230kV circuit #3 build
    - TUCO 2 Substation 345/230kV
        - Build new 345/230kV substation along TUCO – Border 345kV and TUCO – Swisher 230kV. Tie in and Terminate TUCO 345kV, Border 345kV, TUCO 230kV, and Swisher 230kV at TUCO 2.
        - Build 345/230/13kV transformer
    - TUCO 2 – TUCO Interchange 230kV circuit #1 replace terminal equipment
- Upgrades assigned to DISIS 2015-001 Interconnection Customers
    - Albion – Petersburg – North Petersburg 115kV circuit #1 rebuild
    - Battle Creek – Norfolk 115kV circuit #1 rebuild
    - Beaver County – Grapevine – Chisholm 345kV circuit #1 build
    - Benton – Wichita 345kV circuit #1 terminal equipment upgrade
    - Bloomfield – Gavins Point 115kV rebuild
    - Border 345kV Reactive Power Support
        - 200Mvar Capacitive Static VAR Compensator (SVC)
        - 200Mvar Capacitor Bank(s)
    - Chisholm Substation Expansion
        - Rerouting and terminate Border – Woodward 345kV into Chisholm 345kV
    - Chisholm – Elk City 230kV circuit #2 rebuild
    - Crooked Creek – Cudahy – Kismet 115kV circuit #1 rebuild
    - Elk City 230/138/13kV transformer circuit #1 substation upgrades
    - GEN-2014-059 Tap – Ogallala 230kV circuit #1 terminal equipment upgrade
    - GEN-2014-074 Tap 345kV Reactive Power Support
        - 30Mvar Inductive Static VAR Compensator (SVC)
    - Gerald Gentleman Station (GGS) Flowgate Mitigation
    - Greenburg – Shooting Star 115kV circuit #1 rebuild
    - Kress Interchange – Swisher 115kV circuit #1 terminal equipment upgrade
    - Lawton East Side (LES) – GEN-2014-057 Tap – Sunnyside 345kV circuit #1 terminal equipment upgrade
    - Meadow Grove – North Petersburg 115kV circuit #1 build
    - Meadow Grove 230/115/13kV transformer circuit #1 build
    - Ochoa – Ponderosa Tap 115kV circuit #1 build
    - Oklaunion 345kV Reactive Power Support Incremental Upgrade

        - Add 100Mvars of capacitance to the DISIS-2014-002 Oklaunion SVC
    - Tolk – Pleasant Hill – Potter – Grapevine 345kV circuit #1 build
    - TUCO 2 – Border – Chisholm 345kV circuit #1 build
    - TUCO 2 – Yoakum 345kV re-termination
        - Incremental upgrade for SPP-NTC-200283 upgrade Hobbs – Yoakum – TUCO 345kV to re-terminate from TUCO to TUCO 2
    - Viola 345/138/13kV transformer circuit #2 build
    - (NRIS only) Bushland Interchange 230/115/13.2kV transformer circuit #1 replacement
    - (NRIS only) Carlsbad Interchange – Pecos Interchange 115kV circuit #1 terminal equipment upgrade
    - (NRIS only) Cunningham – Maddox 115kV circuit #1 rebuild

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 are grouped together into one (1) active regional groups based on geographical and electrical impacts. These groupings are shown in Appendix C.

To determine interconnection impacts, one (1) different generation dispatch scenarios of the spring, summer, and winter base case models are developed to accommodate the regional groupings.

Power Flow

For Variable Energy Resources (VER) (solar/wind) in each power flow case, Energy Resource Interconnection Service (ERIS), is evaluated for the generating plants within a geographical area of the interconnection request(s) for the VERs dispatched at 100% nameplate of maximum generation. The VERs in the remote areas are dispatched at 20% nameplate of maximum generation. These projects are dispatched across the SPP footprint using load factor ratios.

Peaking units are not dispatched in the 2015 spring, or in the “High VER” summer and winter peaks. To study peaking units’ impacts, the 2015 summer and winter peaks, 2020 summer and winter peaks, and 2025 summer peak models are developed with peaking units dispatched at 100% of the nameplate rating and VERs dispatched at 20% of the nameplate rating. Each interconnection request is also modeled separately at 100% nameplate for certain analyses.

All generators (VER and peaking) that requested Network Resource Interconnection Service (NRIS) are dispatched in an additional analysis into the interconnecting Transmission Owner’s (T.O.) area at 100% nameplate with Energy Resource Interconnection Service (ERIS) only requests at 80% nameplate. This method allows for identification of network constraints that are common between regional groupings to have affecting requests share the mitigating upgrade costs throughout the cluster.

Dynamic Stability

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

Short Circuit

The dynamic stability models (2025 SP) are used for this analysis.

Identification of Network Constraints

Network constraints are found by using PSS/E AC Contingency Calculation (ACCC) analysis with PSS/E MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels previously mentioned. The ERIS constraints are then screened to determine which of the generation interconnection requests have at least a 20% Distribution Factor (DF) upon outage based constraints (n-1) and 3% DF upon system intact constraints (n-0) or on non-convergences case solutions during outage based constraints (n-1). In addition, stability issues are also considered for transmission reinforcement under ERIS. Interconnection Requests that requested Network Resource Interconnection Service (NRIS) are also studied in the NRIS analysis to determine if any constraint measured greater than or equal to a 3% DF. If so, these constraints are also considered for mitigation under NRIS.

Constraints that are identified and require transmission reinforcement are listed in Appendix G. These constraints met the criteria for analysis for Energy Resource Interconnection Service and Network Resource Interconnection Service (if requested).

Other network constraints not requiring transmission reinforcements are shown in Appendix H. With a defined source and sink in a Transmission Service Request, this list of network constraints can be refined and expanded to account for all Network Upgrade requirements for firm transmission service. Additional constraints identified by multi-element contingencies are listed in Appendix I.

In no way does the list of constraints in Appendix G identify all potential constraints that guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Determination of Cost Allocated Network Upgrades

Cost Allocated Network Upgrades of Variable Energy Resources (VER) (solar/wind) generation interconnection requests are determined using the 2015 spring model. Cost Allocated Network Upgrades of peaking units is determined using the 2020 summer peak model. A PSS/E and MUST sensitivity analysis is performed to determine the Distribution Factors (DF), a distribution factor with no contingency that each generation interconnection request has on each new upgrade. The impact each generation interconnection request has on each upgrade project is weighted by the size of each request. Finally the costs due by each request for a particular project are 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 Generator 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 Generator 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/Compensation for Amounts Advanced for Network Upgrades

Interconnection Customer shall be entitled to either credits or potentially Long Term Congestion Rights (LTCR)[8] in accordance with Attachment Z2 of the SPP Tariff for any Network Upgrades

[8] FERC compliance filing pending

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 300.13 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 an estimated $8,000,000. Interconnection Facilities specific to each generator interconnection request are listed in Appendix E. A preliminary one-line drawing for each generator interconnection request are listed in Appendix D.

For an explanation of how required Network Upgrades and Interconnection Facilities were determined, refer to the section on “Identification of Network Constraints” above.

Power Flow Analysis

Power Flow Analysis Methodology

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. Single element and multi-element contingencies were evaluated.

Power Flow Analysis

A power flow analysis is conducted for each Interconnection Customer’s facility using modified versions of the 2015 spring, 2015 summer and winter peaks, the 2020 summer and winter peaks, and the 2025 summer peak models. The output of the Interconnection Customer’s facility is 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 Interconnection Service request (ERIS). Certain requests that are also pursuing Network Resource Interconnection Service (NRIS) have an additional analysis conducted for displacing resources in the interconnecting Transmission Owner’s balancing area.

Power Flow Results

Cluster Group 1 (Woodward Area)

In addition to the 4,377.54 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 3,662.7 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 3,743.17 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 4 (Northwest Kansas Area)

In addition to the 1,706.97 MW of previously queued generation in the area, 300.13 MW of new interconnection service was studied.

Cluster ERIS Constraints			
MONITORED ELEMENT	Limiting Rate A/B (MVA)	TC%LOADING (% MVA)	CONTINGENCY

Cluster Group 5 (Amarillo Area)

In addition to the 1,176.5 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) Area

In addition to the 5,575.03 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 Area)

In addition to the 1,923.90 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 (North Oklahoma/South Central Kansas Area)

In addition to the 5,642.26 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 (Nebraska Area)

In addition to the 3,069.3 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 10 (Southeast Oklahoma/Northeast Texas Area)

In addition to the 0.0 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 12 (Northwest Arkansas Area)

In addition to the 90.0 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 (Northeast Kansas/Northwest Missouri Area)

In addition to the 808.7 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 Area)

In addition to the 612.5 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.

Curtailment and System Reliability

In no way does this study guarantee operation for all periods of time. It should be noted that although this study analyzed many of the most probable contingencies, it is not an all-inclusive list and cannot account for every operational situation. Because of this, it is likely that the Customer(s) may be required to reduce their generation output to 0 MW, also known as curtailment, under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Stability & Short Circuit Analysis

A stability and short circuit analysis was conducted for each Interconnection Customer using modified versions of the 2014 series SPP Model Development Working Group (MDWG) Models 2015 summer, 2015 winter, and 2025 summer peak dynamic cases[9]. The stability analysis was conducted with all upgrades in service that were identified in the power flow analysis unless otherwise noted in the individual group stability study. For each group, the interconnection requests were studied at 100% nameplate output while the other groups were dispatched at 20% output for non-dispatchable requests and 100% output for other requests. The output of the Interconnection Customer's facility was offset in each model by a reduction in output of existing online SPP generation. Each Interconnection Request was studied in a Stand Alone scenario in addition to the cluster scenario. 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 were no customers requesting interconnection service in the Woodward area.

Cluster Group 2 (Hitchland Area)

There were no customers requesting interconnection service in the Hitchland area.

Cluster Group 3 (Spearville Area)

There were no customers requesting interconnection service in the Spearville area.

Cluster Group 4 (Northwest Kansas Area)

The Group 4 stability analysis for the Northwest Kansas area was performed by SPP staff. Stability analysis has determined that with all previously assigned and currently assigned Network Upgrades placed in service the transmission system will remain stable and low voltage ride through requirements are satisfied for the probable contingencies studied. Power Factor requirements are listed in the table below. In addition, the GEN-2015-012 Interconnection Request may have requirements for reactors under low wind conditions as identified in the stability report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN 2015-012**	300.125	GE 1.715MW WTG	Mingo 345kV	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.
** Requirement for reactors for low wind conditions

[9] Short Circuit analysis performed only on the 2025 Summer Peak seasonal model.

Cluster Group 5 (Amarillo Area)

There were no customers requesting interconnection service in the Amarillo Area.

Cluster Group 6 (South Texas Panhandle/New Mexico Area)

There were no customers requesting interconnection service in the Texas Panhandle/New Mexico area.

Cluster Group 7 (Southwest Oklahoma Area)

There were no customers requesting interconnection service in the Southwest Oklahoma area.

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

There were no customers requesting interconnection service in the South Central Kansas/North Oklahoma area.

Cluster Group 9 (Nebraska Area)

There were no customers requesting interconnection service in the Nebraska area.

Cluster Group 10 (Southeast Oklahoma/Northeast Texas)

There were no customers requesting interconnection service in the Southeast Oklahoma/Northeast Texas area.

Cluster Group 12 (Northwest Arkansas Area)

There were no customers requesting interconnection service in the Northwest Arkansas area.

Cluster Group 13 (Northeast Kansas/Northwest Missouri Area)

There were no customers requesting interconnection service in the Northwest Missouri area.

Cluster Group 14 (South Central Oklahoma Area)

There were no customers requesting interconnection service in the Northwest Missouri area.

Conclusion

The minimum cost of interconnecting 300.13 MW of new interconnection requests included in this Preliminary Interconnection System Impact Study is estimated at $8,000,000 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).

Appendices

A: Generator Interconnection Requests Considered for Impact Study

See next page.

A: Generation Interconnection Requests Considered for 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-2015-012	300.13	ER/NR	SUNCMKEC	Mingo 345kV	Mingo 345kV	1/1/2017	TBD
Total:	300.13						

*In-Service Date for each request is to be determined after the Interconnection Facility Study is completed.

B: Prior Queued Generator 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	150.00	AECI	Tap Fairfax (AECI) - Shilder (AEPW) 138kV	AECI queue Affected Study
ASGI-2010-010	42.20	SPS	Lovington 115kV	Lea County Affected Study
ASGI-2010-020	30.00	SPS	Tap LE-Tatum - LE-Crossroads 69kV	Lea County Affected Study
ASGI-2010-021	15.00	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV	Lea County Affected Study
ASGI-2011-001	27.30	SPS	Lovington 115kV	On-Line
ASGI-2011-002	20.00	SPS	Herring 115kV	On-Line
ASGI-2011-003	10.00	SPS	Hendricks 115kV	On-Line
ASGI-2011-004	20.00	SPS	Pleasant Hill 69kV	Under Study (DISIS-2011-002)
ASGI-2012-002	18.15	SPS	FE-Clovis Interchange 115kV	Under Study (DISIS-2012-002)
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV	Under Study (DISIS-2012-001)
ASGI-2013-001	11.50	SPS	PanTex South 115kV	Under Study (DISIS-2013-001)
ASGI-2013-002	18.40	SPS	FE Tucumcari 115kV	Under Study (DISIS-2013-001)
ASGI-2013-003	18.40	SPS	FE Clovis 115kV	Under Study (DISIS-2013-001)
ASGI-2013-004	36.60	SUNCMKEC	Morris 115kV	Under Study (DISIS-2013-002)
ASGI-2013-005	1.65	SPS	FE Clovis 115kV	Under Study (DISIS-2013-002)
ASGI-2013-006	2.00	SPS	SP-Erskine 115kV	
ASGI-2014-001	2.50	SPS	SP-Erskine 115kV	Under Study (DISIS-2014-001)
ASGI-2014-002	49.60	SPS	Tap Tucumcari - Santa Rosa 115kV	Under Study (DISIS-2014-001)
ASGI-2014-005	10.00	SPS	Strata 69kV	Under Study (DISIS-2014-002)
ASGI-2014-008	10.00	SPS	South Loving 69kV	Under Study (DISIS-2014-002)
ASGI-2014-009	10.00	SPS	Wood Draw 115kV	Under Study (DISIS-2014-002)
ASGI-2014-010	10.00	SPS	Ochoa 115kV	Under Study (DISIS-2014-002)
ASGI-2014-012	10.00	SPS	Cooper Ranch 115kV	Under Study (DISIS-2014-002)
ASGI-2014-014	56.40	GRDA	Ferguson 69kV	Under Study (DISIS-2014-002)
ASGI-2015-001	6.13	SUNCMKEC	Ninnescah 115kV	DISIS Stage
ASGI-2015-002	2.00	SPS	SP-Yuma 69kV	DISIS Stage
ASGI-2015-003	30.00	SPS	Tap San Jon Tap - Wheatland 115/69kV	DISIS Stage
ASGI-2015-004	56.36	GRDA	Coffeyville City 69kV	DISIS Stage
GEN-2001-014	96.00	WFEC	Ft Supply 138kV	On-Line
GEN-2001-026	74.30	WFEC	Washita 138kV	On-Line
GEN-2001-033	180.00	SPS	San Juan Tap 230kV	On-Line at 120MW
GEN-2001-036	80.00	SPS	Norton 115kV	On-Line
GEN-2001-037	100.00	OKGE	FPL Moreland Tap 138kV	On-Line
GEN-2001-039A	105.00	SUNCMKEC	Shooting Star Tap 115kV	On-Line
GEN-2001-039M	100.00	SUNCMKEC	Central Plains Tap 115kV	On-Line
GEN-2002-004	200.00	WERE	Latham 345kV	On-Line at 150MW
GEN-2002-005	120.00	WFEC	Red Hills Tap 138kV	On-Line
GEN-2002-008	240.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2002-009	80.00	SPS	Hansford 115kV	On-Line
GEN-2002-022	240.00	SPS	Bushland 230kV	On-Line
GEN-2002-023N	0.80	NPPD	Harmony 115kV	On-Line
GEN-2002-025A	150.00	SUNCMKEC	Spearville 230kV	On-Line
GEN-2003-004	100.00	WFEC	Washita 138kV	On-Line
GEN-2003-005	100.00	WFEC	Anadarko - Paradise (Blue Canyon) 138kV	On-Line
GEN-2003-006A	200.00	SUNCMKEC	Elm Creek 230kV	On-Line
GEN-2003-019	250.00	MIDW	Smoky Hills Tap 230kV	On-Line
GEN-2003-020	160.00	SPS	Martin 115kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV	On-Line
GEN-2003-022	120.00	AEPW	Washita 138kV	On-Line
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV	On-Line at 100MW
GEN-2004-020	27.00	AEPW	Washita 138kV	On-Line
GEN-2004-023	20.60	WFEC	Washita 138kV	On-Line
GEN-2004-023N	75.00	NPPD	Columbus Co 115kV	On-Line
GEN-2005-003	30.60	WFEC	Washita 138kV	On-Line
GEN-2005-008	120.00	OKGE	Woodward 138kV	On-Line
GEN-2005-012	250.00	SUNCMKEC	Ironwood 345kV	On-Line at 160MW
GEN-2005-013	201.00	WERE	Caney River 345kV	On-Line
GEN-2006-002	101.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV	On-Line
GEN-2006-020N	42.00	NPPD	Bloomfield 115kV	On-Line
GEN-2006-020S	18.90	SPS	DWS Frisco 115kV	On-Line
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV	On-Line
GEN-2006-024S	19.80	WFEC	Buffalo Bear Tap 69kV	On-Line
GEN-2006-026	502.00	SPS	Hobbs 230kV & Hobbs 115kV	On-Line
GEN-2006-031	75.00	MIDW	Knoll 115kV	On-Line
GEN-2006-035	225.00	AEPW	Sweetwater 230kV	On-Line at 132MW
GEN-2006-037N1	75.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV	On-Line
GEN-2006-043	99.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-044	370.00	SPS	Hitchland 345kV	On-Line at 120MW
GEN-2006-044N	40.50	NPPD	North Petersburg 115kV	On-Line
GEN-2006-046	131.00	OKGE	Dewey 138kV	On-Line
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV	On-Line
GEN-2007-021	201.00	OKGE	Tatonga 345kV	On-Line
GEN-2007-025	300.00	WERE	Viola 345kV	On-Line
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV	On-Line at 132MW
GEN-2007-043	200.00	OKGE	Minco 345kV	On-Line
GEN-2007-044	300.00	OKGE	Tatonga 345kV	On-Line at 199MW
GEN-2007-046	200.00	SPS	Hitchland 115kV	On Schedule for 2015
GEN-2007-050	170.00	OKGE	Woodward EHV 138kV	On-Line at 150MW
GEN-2007-052	150.00	WFEC	Anadarko 138kV	On-Line
GEN-2007-062	765.00	OKGE	Woodward EHV 345kV	On Schedule for 2016 and 2017
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV	On-Line
GEN-2008-013	300.00	OKGE	Hunter 345kV	On-Line at 235MW
GEN-2008-018	250.00	SPS	Finney 345kV	On-Line
GEN-2008-021	42.00	WERE	Wolf Creek 345kV	On-Line
GEN-2008-022	300.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV	On Schedule for 2015
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV	On-Line
GEN-2008-037	101.00	WFEC	Tap Washita - Blue Canyon Wind 138kV	On-Line
GEN-2008-044	197.80	OKGE	Tatonga 345kV	On-Line
GEN-2008-047	300.00	OKGE	Beaver County 345kV	On-Line
GEN-2008-051	322.00	SPS	Potter County 345kV	On-Line at 161MW
GEN-2008-079	99.20	SUNCMKEC	Crooked Creek 115kV	On-Line
GEN-2008-086N02	201.00	NPPD	Meadow Grove 230kV	On-Line
GEN-2008-092	201.00	MIDW	Post Rock 230kV	On Schedule for 2015
GEN-2008-098	100.80	WERE	Waverly 345kV	On Schedule for 2015

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2008-119O	60.00	OPPD	S1399 161kV	On-Line
GEN-2008-123N	89.70	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV	On Schedule for 2015
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV	On Schedule for 2016
GEN-2008-129	80.00	GMO	Pleasant Hill 161kV	On-Line
GEN-2009-008	199.50	MIDW	South Hays 230kV	On Schedule for 2015
GEN-2009-020	48.30	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV	On Schedule for 2015
GEN-2009-025	59.80	OKGE	Nardins 69kV	On-Line
GEN-2009-040	73.80	WERE	Marshall 115kV	On Schedule for 2016
GEN-2010-001	300.00	OKGE	Beaver County 345kV	On-Line at 204 MW, On Schedule for 2015 (96 MW)
GEN-2010-003	100.80	WERE	Waverly 345kV	On Schedule for 2015
GEN-2010-005	299.20	WERE	Viola 345kV	On-Line at 170MW
GEN-2010-006	205.00	SPS	Jones 230kV	On-Line
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV	On-Line
GEN-2010-011	29.70	OKGE	Tatonga 345kV	On-Line
GEN-2010-014	358.80	SPS	Hitchland 345kV	On Suspension
GEN-2010-036	4.60	WERE	6th Street 115kV	On-Line
GEN-2010-040	300.00	OKGE	Cimarron 345kV	On-Line
GEN-2010-041	10.50	OPPD	S1399 161kV	On Schedule for 2015
GEN-2010-045	197.80	SUNCMKEC	Buckner 345kV	On Schedule for 2017
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV	On Schedule for 2016
GEN-2010-048	70.00	MIDW	Tap Beach Station - Redline 115kV	DISIS Stage
GEN-2010-051	200.00	NPPD	Tap Twin Church - Hoskins 230kV	On Suspension
GEN-2010-055	4.50	AEPW	Wekiwa 138kV	On-Line
GEN-2010-057	201.00	MIDW	Rice County 230kV	On-Line
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV	On Schedule for 2016
GEN-2011-010	100.80	OKGE	Minco 345kV	On-Line
GEN-2011-011	50.00	KCPL	Iatan 345kV	On-Line
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV	On Schedule for 2016
GEN-2011-016	200.10	SUNCMKEC	Spearville 345kV	Facility Study Stage
GEN-2011-017	299.00	SUNCMKEC	Tap Spearville - Post Rock (GEN-2011-017T) 345kV	On Schedule for 2018
GEN-2011-018	73.60	NPPD	Steele City 115kV	On-Line
GEN-2011-019	299.00	OKGE	Woodward 345kV	On Suspension
GEN-2011-020	299.00	OKGE	Woodward 345kV	On Suspension
GEN-2011-022	299.00	SPS	Hitchland 345kV	On Suspension
GEN-2011-025	80.00	SPS	Tap Floyd County - Crosby County 115kV	On Schedule for 2016
GEN-2011-027	120.00	NPPD	Tap Hoskins - Twin Church 230kV	On Suspension
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV	On-Line
GEN-2011-040	111.00	OKGE	Carter County 138kV	On-Line
GEN-2011-045	205.00	SPS	Jones 230kV	On-Line
GEN-2011-046	27.00	SPS	Lopez 115kV	On-Line
GEN-2011-048	175.00	SPS	Mustang 230kV	On-Line
GEN-2011-049	250.70	OKGE	Border 345kV	On Schedule for 2016
GEN-2011-050	109.80	AEPW	Santa Fe Tap 138kV	On Schedule for 2016
GEN-2011-051	104.40	OKGE	Tap Woodward - Tatonga 345kV (GEN-2011-051 Tap)	On Suspension
GEN-2011-054	300.00	OKGE	Cimarron 345kV	On Schedule for 2015
GEN-2011-056	3.60	NPPD	Jeffrey 115kV	On-Line
GEN-2011-056A	3.60	NPPD	John 1 115kV	On-Line
GEN-2011-056B	4.50	NPPD	John 2 115kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2011-057	150.40	WERE	Creswell 138kV	On Schedule for 2015
GEN-2012-001	61.20	SPS	Cirrus Tap 230kV	On-Line
GEN-2012-004	41.40	OKGE	Carter County 138kV	On-Line
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV	On-Line
GEN-2012-009	15.00	SPS	Mustang 230kV	On-Line
GEN-2012-010	15.00	SPS	Mustang 230kV	On-Line
GEN-2012-020	478.00	SPS	TUCO 230kV	On Schedule for 2016
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV	On-Line
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV	On Schedule for 2016
GEN-2012-027	136.00	AEPW	Shidler 138kV	On Suspension
GEN-2012-028	74.80	WFEC	Gotebo 69kV	On Schedule for 2015
GEN-2012-032	300.00	OKGE	Open Sky 345kV	On Schedule for 2015
GEN-2012-033	98.80	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV	On Schedule for 2015
GEN-2012-034	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-035	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-036	7.00	SPS	Mustang 230kV	On-Line
GEN-2012-037	203.00	SPS	TUCO 345kV	On-Line
GEN-2012-040	76.50	WFEC	Chilocco 138kV	On Suspension
GEN-2012-041	121.50	OKGE	Ranch Road 345kV	On-Line
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Schedule for 2016
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV	On Schedule for 2015
GEN-2013-008	1.20	NPPD	Steele City 115kV	On-Line
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV	Facility Study
GEN-2013-011	30.00	AEPW	Turk 138kV	On-Line
GEN-2013-012	147.00	OKGE	Redbud 345kV	On-Line
GEN-2013-014	25.50	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV	On Suspension
GEN-2013-016	203.00	SPS	TUCO 345kV	IA Pending
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	On Schedule for 2016
GEN-2013-022	25.00	SPS	Norton 115kV	On Schedule for 2016
GEN-2013-027	150.00	SPS	Tap Tolk - Yoakum 230kV	Facility Study
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV	On Schedule for 2017
GEN-2013-029	300.00	OKGE	Renfrow 345kV	On Schedule for 2016 (150MW) and 2016 (150MW)
GEN-2013-030	300.00	OKGE	Beaver County 345kV	On Schedule for 2016 (200MW) and 2017 (100MW)
GEN-2013-032	204.00	NPPD	Antelope 115kV	On Schedule for 2017
GEN-2013-033	28.00	MIDW	Goodman Energy Center 115kV	On Schedule for 2016
GEN-2014-001	200.60	WERE	Tap Wichita - Emporia Energy Center 345kV	IA Pending
GEN-2014-002	10.50	OKGE	Tatonga 345kV (GEN-2007-021 POI)	Facility Study Stage
GEN-2014-003	15.84	OKGE	Tatonga 345kV (GEN-2007-044 POI)	Facility Study Stage
GEN-2014-004	4.00	NPPD	Steele City 115kV (GEN-2011-018 POI)	Facility Study Stage
GEN-2014-005	5.70	OKGE	Minco 345kV (GEN-2011-010 POI)	On-Line
GEN-2014-012	225.00	SPS	Tap Hobbs Interchange - Andrews 230kV	IA Pending
GEN-2014-013	73.50	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV	On Schedule for 2015
GEN-2014-020	100.00	AEPW	Tuttle 138kV	Facility Study
GEN-2014-021	300.00	GMO	Tap Nebraska City - Mullin Creek 345kV	Facility Study
GEN-2014-023	79.90	NPPD	Tap Fort Randall - Meadow Grove 230kV	DISIS Stage
GEN-2014-025	2.40	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV	Facility Study

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2014-026	150.00	OKGE	Beaver County 345kV	Facility Study
GEN-2014-028	35.00	EMDE	Riverton 161kV	Facility Study
GEN-2014-031	35.80	NPPD	Meadow Grove 230kV	Facility Study
GEN-2014-032	10.20	NPPD	Meadow Grove 230kV	Facility Study
GEN-2014-033	70.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-034	70.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-035	30.00	SPS	Chaves County 115kV	Facility Study
GEN-2014-037	200.00	SPS	Tap Hitchland - Beaver County Dbl Ckt (Optima) 345kV	DISIS Stage
GEN-2014-038	200.00	SPS	Tap Hitchland - Potter County 345kV	DISIS Stage
GEN-2014-039	73.40	NPPD	Friend 115kV	Facility Study
GEN-2014-040	320.00	SPS	Castro 115kV	IA Pending
GEN-2014-041	123.17	SUNCMKEC	Arnold 115kV	Facility Study
GEN-2014-046	125.40	SPS	Chaves County 115kV	DISIS Stage
GEN-2014-047	40.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV	Facility Study
GEN-2014-049	200.00	SUNCMKEC	Thistle 345kV	Facility Study
GEN-2014-051	174.00	WERE	Jeffrey Energy Center 345kV	Facility Study
GEN-2014-053	80.00	SPS	Carlisle 230kV	Facility Study
GEN-2014-054	120.00	SPS	Carlisle 230kV	Facility Study
GEN-2014-056	250.00	OKGE	Minco 345kV	Facility Study
GEN-2014-057	250.00	AEPW	Tap Lawton - Sunnyside 345kV	IA Pending
GEN-2014-059	160.00	NPPD	Tap Sidney - Ogallala 230kV	DISIS Stage
GEN-2014-060	125.80	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV	DISIS Stage
GEN-2014-064	248.40	OKGE	Otter 138kV	IA Pending
GEN-2014-065	99.00	SPS	Whitten 115kV	DISIS Stage
GEN-2014-066	30.00	SPS	Norton 115kV	Facility Study
GEN-2014-068	203.00	SPS	Tap Deaf Smith - Plant X 230kV	DISIS Stage
GEN-2014-074	152.00	SPS	Tap TUCO Interchange - Oklaunion 345kV	DISIS Stage
GEN-2015-001	200.00	OKGE	Ranch Road 345kV	DISIS Stage
GEN-2015-003	200.00	OKGE	Renfrow 345kV	DISIS Stage
GEN-2015-004	52.90	OKGE	Border 345kV	DISIS Stage
GEN-2015-005	200.10	GMO	Tap Nebraska City - Sibley 345kV	DISIS Stage
GEN-2015-006	150.00	OKGE	Beaver County 345kV	DISIS Stage
GEN-2015-007	160.00	NPPD	Hoskins 345kV	DISIS Stage
GEN-2015-008	150.40	NPPD	Antelope 115kV	DISIS Stage
GEN-2015-009	300.00	SPS	Hobbs 230kV	DISIS Stage
GEN-2015-010	250.70	SPS	Tap South Roosvelt - Tolk 230kV	DISIS Stage
GEN-2015-013	120.00	WFEC	Synder 138kV	DISIS Stage
GEN-2015-014	150.00	SPS	Tap Cochran - Lehman 115kV	DISIS Stage
GEN-2015-015	154.60	OKGE	Tap Medford Tap - Coyote 138kV	DISIS Stage
GEN-2015-016	200.00	KCPL	Tap Marmaton - Centerville 161kV	DISIS Stage
GEN-2015-017	172.00	SUNCMKEC	Mingo 115kV	DISIS Stage
GEN-2015-018	80.00	SPS	Tap Curry County - Bailey 115kV	DISIS Stage
GEN-2015-019	60.00	AEPW	Fitzhugh 161kV	DISIS Stage
GEN-2015-020	99.96	SPS	Oasis 115kV	DISIS Stage
GEN-2015-021	20.00	SUNCMKEC	Johnson Corner 115kV	DISIS Stage
GEN-2015-022	112.00	SPS	Swisher 115kV	DISIS Stage
GEN-2015-023	300.70	NPPD	Holt County 345kV	DISIS Stage
GEN-2015-024	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT	DISIS Stage
GEN-2015-025	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT	DISIS Stage
GEN-2015-026	8.30	SUNCMKEC	Buckner 345kV	DISIS Stage

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2015-027	4.94	SUNCMKEC	Crooked Creek 115kV	DISIS Stage
GEN-2015-028	3.00	OKGE	Nardins 69kV	DISIS Stage
GEN-2015-029	161.00	OKGE	Tatonga 345kV	DISIS Stage
GEN-2015-030	200.10	OKGE	Sooner 345kV	DISIS Stage
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV	On-Line
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV	On-Line
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV	On-Line
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast	On-Line
NPPD Distributed (Burt County Wind)	12.00	NPPD	Tekamah & Oakland 115kV	On-Line
NPPD Distributed (Burwell)	3.00	NPPD	Ord 115kV	On-Line
NPPD Distributed (Columbus Hydro)	45.00	NPPD	Columbus 115kV	On-Line
NPPD Distributed (North Platte - Lexington)	54.00	NPPD	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV	On-Line
NPPD Distributed (Ord)	11.90	NPPD	Ord 115kV	On-Line
NPPD Distributed (Stuart)	2.10	NPPD	Ainsworth 115kV	On-Line
SPS Distributed (Dumas 19th St)	20.00	SPS	Dumas 19th Street 115kV	On-Line
SPS Distributed (Etter)	20.00	SPS	Etter 115kV	On-Line
SPS Distributed (Hopi)	10.00	SPS	Hopi 115kV	On-Line
SPS Distributed (Jal)	10.00	SPS	S Jal 115kV	On-Line
SPS Distributed (Lea Road)	10.00	SPS	Lea Road 115kV	On-Line
SPS Distributed (Monument)	10.00	SPS	Monument 115kV	On-Line
SPS Distributed (Moore E)	25.00	SPS	Moore East 115kV	On-Line
SPS Distributed (Ocotillo)	10.00	SPS	S_Jal 115kV	On-Line
SPS Distributed (Sherman)	20.00	SPS	Sherman 115kV	On-Line
SPS Distributed (Spearman)	10.00	SPS	Spearman 69kV	On-Line
SPS Distributed (TC-Texas County)	20.00	SPS	Texas County 115kV	On-Line
SPS Distributed (Yuma)	2.57	SPS	SP-Yuma 69kV	On-Line
Total:	**32,388.6**			

C: Study Groupings

See next page

C. Study Groups

GROUP 1: WOODWARD AREA Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-014	96.00	WFEC	Ft Supply 138kV
GEN-2001-037	100.00	OKGE	FPL Moreland Tap 138kV
GEN-2005-008	120.00	OKGE	Woodward 138kV
GEN-2006-024S	19.80	WFEC	Buffalo Bear Tap 69kV
GEN-2006-046	131.00	OKGE	Dewey 138kV
GEN-2007-021	201.00	OKGE	Tatonga 345kV
GEN-2007-043	200.00	OKGE	Minco 345kV
GEN-2007-044	300.00	OKGE	Tatonga 345kV
GEN-2007-050	170.00	OKGE	Woodward EHV 138kV
GEN-2007-062	765.00	OKGE	Woodward EHV 345kV
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV
GEN-2008-044	197.80	OKGE	Tatonga 345kV
GEN-2010-011	29.70	OKGE	Tatonga 345kV
GEN-2010-040	300.00	OKGE	Cimarron 345kV
GEN-2011-010	100.80	OKGE	Minco 345kV
GEN-2011-019	299.00	OKGE	Woodward 345kV
GEN-2011-020	299.00	OKGE	Woodward 345kV
GEN-2011-051	104.40	OKGE	Tap Woodward - Tatonga 345kV (GEN-2011-051 Tap)
GEN-2011-054	300.00	OKGE	Cimarron 345kV
GEN-2014-002	10.50	OKGE	Tatonga 345kV (GEN-2007-021 POI)
GEN-2014-003	15.84	OKGE	Tatonga 345kV (GEN-2007-044 POI)
GEN-2014-005	5.70	OKGE	Minco 345kV (GEN-2011-010 POI)
GEN-2014-020	100.00	AEPW	Tuttle 138kV
GEN-2014-056	250.00	OKGE	Minco 345kV
GEN-2015-029	161.00	OKGE	Tatonga 345kV
PRIOR QUEUED SUBTOTAL	**4,377.54**		
AREA TOTAL	**4,377.54**		

GROUP 2: HITCHLAND AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2011-002	20.00	SPS	Herring 115kV
GEN-2002-008	240.00	SPS	Hitchland 345kV
GEN-2002-009	80.00	SPS	Hansford 115kV
GEN-2003-020	160.00	SPS	Martin 115kV
GEN-2006-020S	18.90	SPS	DWS Frisco 115kV
GEN-2006-044	370.00	SPS	Hitchland 345kV
GEN-2007-046	200.00	SPS	Hitchland 115kV
GEN-2008-047	300.00	OKGE	Beaver County 345kV
GEN-2010-001	300.00	OKGE	Beaver County 345kV
GEN-2010-014	358.80	SPS	Hitchland 345kV
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2011-014 Tap) 345kV
GEN-2011-022	299.00	SPS	Hitchland 345kV
GEN-2013-030	300.00	OKGE	Beaver County 345kV
GEN-2014-026	150.00	OKGE	Beaver County 345kV
GEN-2014-037	200.00	SPS	Tap Hitchland - Beaver County Dbl Ckt (Optima) 345kV
GEN-2014-038	200.00	SPS	Tap Hitchland - Potter County 345kV
GEN-2015-006	150.00	OKGE	Beaver County 345kV
SPS Distributed (Dumas 19th St)	20.00	SPS	Dumas 19th Street 115kV
SPS Distributed (Etter)	20.00	SPS	Etter 115kV
SPS Distributed (Moore E)	25.00	SPS	Moore East 115kV
SPS Distributed (Sherman)	20.00	SPS	Sherman 115kV
SPS Distributed (Spearman)	10.00	SPS	Spearman 69kV
SPS Distributed (TC-Texas County)	20.00	SPS	Texas County 115kV
PRIOR QUEUED SUBTOTAL	**3,662.70**		
AREA TOTAL	**3,662.70**		

GROUP 3: SPEARVILLE AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV
ASGI-2015-001	6.13	SUNCMKEC	Ninnescah 115kV
GEN-2001-039A	105.00	SUNCMKEC	Shooting Star Tap 115kV
GEN-2002-025A	150.00	SUNCMKEC	Spearville 230kV
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV
GEN-2005-012	250.00	SUNCMKEC	Ironwood 345kV
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV
GEN-2008-018	250.00	SPS	Finney 345kV
GEN-2008-079	99.20	SUNCMKEC	Crooked Creek 115kV
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV
GEN-2010-045	197.80	SUNCMKEC	Buckner 345kV
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV
GEN-2011-016	200.10	SUNCMKEC	Spearville 345kV
GEN-2011-017	299.00	SUNCMKEC	Tap Spearville - Post Rock (GEN-2011-017T) 345kV
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock (North of GEN-2011-017 Tap) 345kV
GEN-2014-049	200.00	SUNCMKEC	Thistle 345kV
GEN-2015-021	20.00	SUNCMKEC	Johnson Corner 115kV
GEN-2015-026	8.30	SUNCMKEC	Buckner 345kV
GEN-2015-027	4.94	SUNCMKEC	Crooked Creek 115kV
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV
PRIOR QUEUED SUBTOTAL	**3,743.17**		
AREA TOTAL	**3,743.17**		

GROUP 4: NORTHWEST KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2013-004	36.60	SUNCMKEC	Morris 115kV
GEN-2001-039M	100.00	SUNCMKEC	Central Plains Tap 115kV
GEN-2003-006A	200.00	SUNCMKEC	Elm Creek 230kV
GEN-2003-019	250.00	MIDW	Smoky Hills Tap 230kV
GEN-2006-031	75.00	MIDW	Knoll 115kV
GEN-2008-092	201.00	MIDW	Post Rock 230kV
GEN-2009-008	199.50	MIDW	South Hays 230kV
GEN-2009-020	48.30	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV
GEN-2010-048	70.00	MIDW	Tap Beach Station - Redline 115kV
GEN-2010-057	201.00	MIDW	Rice County 230kV
GEN-2013-033	28.00	MIDW	Goodman Energy Center 115kV
GEN-2014-025	2.40	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV
GEN-2014-041	123.17	SUNCMKEC	Arnold 115kV
GEN-2015-017	172.00	SUNCMKEC	Mingo 115kV
PRIOR QUEUED SUBTOTAL	**1,706.97**		
GEN-2015-012	300.13	SUNCMKEC	Mingo 345kV
CURRENT CLUSTER SUBTOTAL	**300.13**		
AREA TOTAL	**2,007.10**		

GROUP 5: AMARILLO AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2013-001	11.50	SPS	PanTex South 115kV
GEN-2002-022	240.00	SPS	Bushland 230kV
GEN-2008-051	322.00	SPS	Potter County 345kV
GEN-2014-040	320.00	SPS	Castro 115kV
GEN-2014-068	203.00	SPS	Tap Deaf Smith - Plant X 230kV
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV
PRIOR QUEUED SUBTOTAL	**1,176.50**		
AREA TOTAL	**1,176.50**		

GROUP 6: SOUTH TEXAS PANHANDLE/NEW MEXICO AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-010	42.20	SPS	Lovington 115kV
ASGI-2010-020	30.00	SPS	Tap LE-Tatum - LE-Crossroads 69kV
ASGI-2010-021	15.00	SPS	Tap LE-Saunders Tap - LE-Anderson 69kV
ASGI-2011-001	27.30	SPS	Lovington 115kV
ASGI-2011-003	10.00	SPS	Hendricks 115kV
ASGI-2011-004	20.00	SPS	Pleasant Hill 69kV
ASGI-2012-002	18.15	SPS	FE-Clovis Interchange 115kV
ASGI-2013-002	18.40	SPS	FE Tucumcari 115kV
ASGI-2013-003	18.40	SPS	FE Clovis 115kV
ASGI-2013-005	1.65	SPS	FE Clovis 115kV
ASGI-2013-006	2.00	SPS	SP-Erskine 115kV
ASGI-2014-001	2.50	SPS	SP-Erskine 115kV
ASGI-2014-002	49.60	SPS	Tap Tucumcari - Santa Rosa 115kV
ASGI-2014-005	10.00	SPS	Strata 69kV
ASGI-2014-008	10.00	SPS	South Loving 69kV
ASGI-2014-009	10.00	SPS	Wood Draw 115kV
ASGI-2014-010	10.00	SPS	Ochoa 115kV
ASGI-2014-012	10.00	SPS	Cooper Ranch 115kV
ASGI-2015-002	2.00	SPS	SP-Yuma 69kV
ASGI-2015-003	30.00	SPS	Tap San Jon Tap - Wheatland 115/69kV
GEN-2001-033	180.00	SPS	San Juan Tap 230kV
GEN-2001-036	80.00	SPS	Norton 115kV
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV
GEN-2006-026	502.00	SPS	Hobbs 230kV & Hobbs 115kV
GEN-2008-022	300.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV
GEN-2010-006	205.00	SPS	Jones 230kV
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV
GEN-2011-025	80.00	SPS	Tap Floyd County - Crosby County 115kV
GEN-2011-045	205.00	SPS	Jones 230kV
GEN-2011-046	27.00	SPS	Lopez 115kV
GEN-2011-048	175.00	SPS	Mustang 230kV
GEN-2012-001	61.20	SPS	Cirrus Tap 230kV
GEN-2012-009	15.00	SPS	Mustang 230kV
GEN-2012-010	15.00	SPS	Mustang 230kV
GEN-2012-020	478.00	SPS	TUCO 230kV
GEN-2012-034	7.00	SPS	Mustang 230kV
GEN-2012-035	7.00	SPS	Mustang 230kV
GEN-2012-036	7.00	SPS	Mustang 230kV
GEN-2012-037	203.00	SPS	TUCO 345kV
GEN-2013-016	203.00	SPS	TUCO 345kV
GEN-2013-022	25.00	SPS	Norton 115kV
GEN-2013-027	150.00	SPS	Tap Tolk - Yoakum 230kV
GEN-2014-012	225.00	SPS	Tap Hobbs Interchange - Andrews 230kV
GEN-2014-033	70.00	SPS	Chaves County 115kV
GEN-2014-034	70.00	SPS	Chaves County 115kV
GEN-2014-035	30.00	SPS	Chaves County 115kV
GEN-2014-046	125.40	SPS	Chaves County 115kV
GEN-2014-047	40.00	SPS	Tap Tolk - Eddy County (Crossroads) 345kV
GEN-2014-053	80.00	SPS	Carlisle 230kV
GEN-2014-054	120.00	SPS	Carlisle 230kV

GEN-2014-065	99.00	SPS	Whitten 115kV
GEN-2014-066	30.00	SPS	Norton 115kV
GEN-2014-074	152.00	SPS	Tap TUCO Interchange - Oklaunion 345kV
GEN-2015-009	300.00	SPS	Hobbs 230kV
GEN-2015-010	250.70	SPS	Tap South Roosvelt - Tolk 230kV
GEN-2015-014	150.00	SPS	Tap Cochran - Lehman 115kV
GEN-2015-018	80.00	SPS	Tap Curry County - Bailey 115kV
GEN-2015-020	99.96	SPS	Oasis 115kV
GEN-2015-022	112.00	SPS	Swisher 115kV
SPS Distributed (Hopi)	10.00	SPS	Hopi 115kV
SPS Distributed (Jal)	10.00	SPS	S Jal 115kV
SPS Distributed (Lea Road)	10.00	SPS	Lea Road 115kV
SPS Distributed (Monument)	10.00	SPS	Monument 115kV
SPS Distributed (Ocotillo)	10.00	SPS	S_Jal 115kV
SPS Distributed (Yuma)	2.57	SPS	SP-Yuma 69kV
PRIOR QUEUED SUBTOTAL	**5,575.03**		
AREA TOTAL	**5,575.03**		

GROUP 7: SOUTHWEST OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-026	74.30	WFEC	Washita 138kV
GEN-2002-005	120.00	WFEC	Red Hills Tap 138kV
GEN-2003-004	100.00	WFEC	Washita 138kV
GEN-2003-005	100.00	WFEC	Anadarko - Paradise (Blue Canyon) 138kV
GEN-2003-022	120.00	AEPW	Washita 138kV
GEN-2004-020	27.00	AEPW	Washita 138kV
GEN-2004-023	20.60	WFEC	Washita 138kV
GEN-2005-003	30.60	WFEC	Washita 138kV
GEN-2006-002	101.00	AEPW	Sweetwater 230kV
GEN-2006-035	225.00	AEPW	Sweetwater 230kV
GEN-2006-043	99.00	AEPW	Sweetwater 230kV
GEN-2007-052	150.00	WFEC	Anadarko 138kV
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV
GEN-2008-037	101.00	WFEC	Tap Washita - Blue Canyon Wind 138kV
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV
GEN-2011-049	250.70	OKGE	Border 345kV
GEN-2012-028	74.80	WFEC	Gotebo 69kV
GEN-2015-004	52.90	OKGE	Border 345kV
GEN-2015-013	120.00	WFEC	Synder 138kV
PRIOR QUEUED SUBTOTAL	**1,923.90**		
AREA TOTAL	**1,923.90**		

GROUP 8: NORTH OKLAHOMA/SOUTH CENTRAL KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-006	150.00	AECI	Tap Fairfax (AECI) - Shilder (AEPW) 138kV
ASGI-2014-014	56.40	GRDA	Ferguson 69kV
ASGI-2015-004	56.36	GRDA	Coffeyville City 69kV
GEN-2002-004	200.00	WERE	Latham 345kV
GEN-2005-013	201.00	WERE	Caney River 345kV
GEN-2007-025	300.00	WERE	Viola 345kV
GEN-2008-013	300.00	OKGE	Hunter 345kV
GEN-2008-021	42.00	WERE	Wolf Creek 345kV
GEN-2008-098	100.80	WERE	Waverly 345kV
GEN-2009-025	59.80	OKGE	Nardins 69kV
GEN-2010-003	100.80	WERE	Waverly 345kV
GEN-2010-005	299.20	WERE	Viola 345kV
GEN-2010-055	4.50	AEPW	Wekiwa 138kV
GEN-2011-057	150.40	WERE	Creswell 138kV
GEN-2012-027	136.00	AEPW	Shidler 138kV
GEN-2012-032	300.00	OKGE	Open Sky 345kV
GEN-2012-033	98.80	OKGE	Tap and Tie South 4th - Bunch Creek & Enid Tap - Fairmont (GEN-2012-033T) 138kV
GEN-2012-040	76.50	WFEC	Chilocco 138kV
GEN-2012-041	121.50	OKGE	Ranch Road 345kV
GEN-2013-012	147.00	OKGE	Redbud 345kV
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV
GEN-2013-029	300.00	OKGE	Renfrow 345kV
GEN-2014-001	200.60	WERE	Tap Wichita - Emporia Energy Center 345kV
GEN-2014-028	35.00	EMDE	Riverton 161kV
GEN-2014-064	248.40	OKGE	Otter 138kV
GEN-2015-001	200.00	OKGE	Ranch Road 345kV

GEN-2015-003	200.00	OKGE	Renfrow 345kV
GEN-2015-015	154.60	OKGE	Tap Medford Tap - Coyote 138kV
GEN-2015-016	200.00	KCPL	Tap Marmaton - Centerville 161kV
GEN-2015-024	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT
GEN-2015-025	220.00	WERE	Tap Thistle - Wichita 345kV Dbl CKT
GEN-2015-028	3.00	OKGE	Nardins 69kV
GEN-2015-030	200.10	OKGE	Sooner 345kV
PRIOR QUEUED SUBTOTAL	**5,642.26**		
AREA TOTAL	**5,642.26**		

GROUP 9: NEBRASKA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2002-023N	0.80	NPPD	Harmony 115kV
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV
GEN-2004-023N	75.00	NPPD	Columbus Co 115kV
GEN-2006-020N	42.00	NPPD	Bloomfield 115kV
GEN-2006-037N1	75.00	NPPD	Broken Bow 115kV
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV
GEN-2006-044N	40.50	NPPD	North Petersburg 115kV
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV
GEN-2008-086N02	201.00	NPPD	Meadow Grove 230kV
GEN-2008-119O	60.00	OPPD	S1399 161kV
GEN-2008-123N	89.70	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV
GEN-2009-040	73.80	WERE	Marshall 115kV
GEN-2010-041	10.50	OPPD	S1399 161kV
GEN-2010-051	200.00	NPPD	Tap Twin Church - Hoskins 230kV
GEN-2011-018	73.60	NPPD	Steele City 115kV
GEN-2011-027	120.00	NPPD	Tap Hoskins - Twin Church 230kV
GEN-2011-056	3.60	NPPD	Jeffrey 115kV
GEN-2011-056A	3.60	NPPD	John 1 115kV
GEN-2011-056B	4.50	NPPD	John 2 115kV
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2
GEN-2013-008	1.20	NPPD	Steele City 115kV
GEN-2013-014	25.50	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2
GEN-2013-032	204.00	NPPD	Antelope 115kV
GEN-2014-004	4.00	NPPD	Steele City 115kV (GEN-2011-018 POI)
GEN-2014-013	73.50	NPPD	Meadow Grove (GEN-2008-086N2 Sub) 230kV
GEN-2014-023	79.90	NPPD	Tap Fort Randall - Meadow Grove 230kV
GEN-2014-031	35.80	NPPD	Meadow Grove 230kV
GEN-2014-032	10.20	NPPD	Meadow Grove 230kV
GEN-2014-039	73.40	NPPD	Friend 115kV
GEN-2014-059	160.00	NPPD	Tap Sidney - Ogallala 230kV
GEN-2014-060	125.80	NPPD	Tap Pauline - Hildreth (Rosemont) 115kV
GEN-2015-007	160.00	NPPD	Hoskins 345kV
GEN-2015-008	150.40	NPPD	Antelope 115kV
GEN-2015-023	300.70	NPPD	Holt County 345kV
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV
NPPD Distributed (Buffalo County Solar)	10.00	NPPD	Kearney Northeast
NPPD Distributed (Burt County Wind)	12.00	NPPD	Tekamah & Oakland 115kV

NPPD Distributed (Burwell)	3.00	NPPD	Ord 115kV
NPPD Distributed (Columbus Hydro)	45.00	NPPD	Columbus 115kV
NPPD Distributed (North Platte - Lexington)	54.00	NPPD	Multiple: Jeffrey 115kV, John_1 115kV, John_2 115kV
NPPD Distributed (Ord)	11.90	NPPD	Ord 115kV
NPPD Distributed (Stuart)	2.10	NPPD	Ainsworth 115kV
PRIOR QUEUED SUBTOTAL	**3,069.30**		
AREA TOTAL	**3,069.30**		

GROUP 10: SOUTHEAST OKLAHOMA/NORTHEAST TEXAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
AREA TOTAL	**0.00**		

GROUP 12: NORTHWEST ARKANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2013-011	30.00	AEPW	Turk 138kV
GEN-2015-019	60.00	AEPW	Fitzhugh 161kV
PRIOR QUEUED SUBTOTAL	**90.00**		
AREA TOTAL	**90.00**		

GROUP 13: NORTHWEST MISSOURI AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2008-129	80.00	GMO	Pleasant Hill 161kV
GEN-2010-036	4.60	WERE	6th Street 115kV
GEN-2011-011	50.00	KCPL	Iatan 345kV
GEN-2014-021	300.00	GMO	Tap Nebraska City - Mullin Creek 345kV
GEN-2014-051	174.00	WERE	Jeffrey Energy Center 345kV
GEN-2015-005	200.10	GMO	Tap Nebraska City - Sibley 345kV
PRIOR QUEUED SUBTOTAL	**808.70**		
AREA TOTAL	**808.70**		

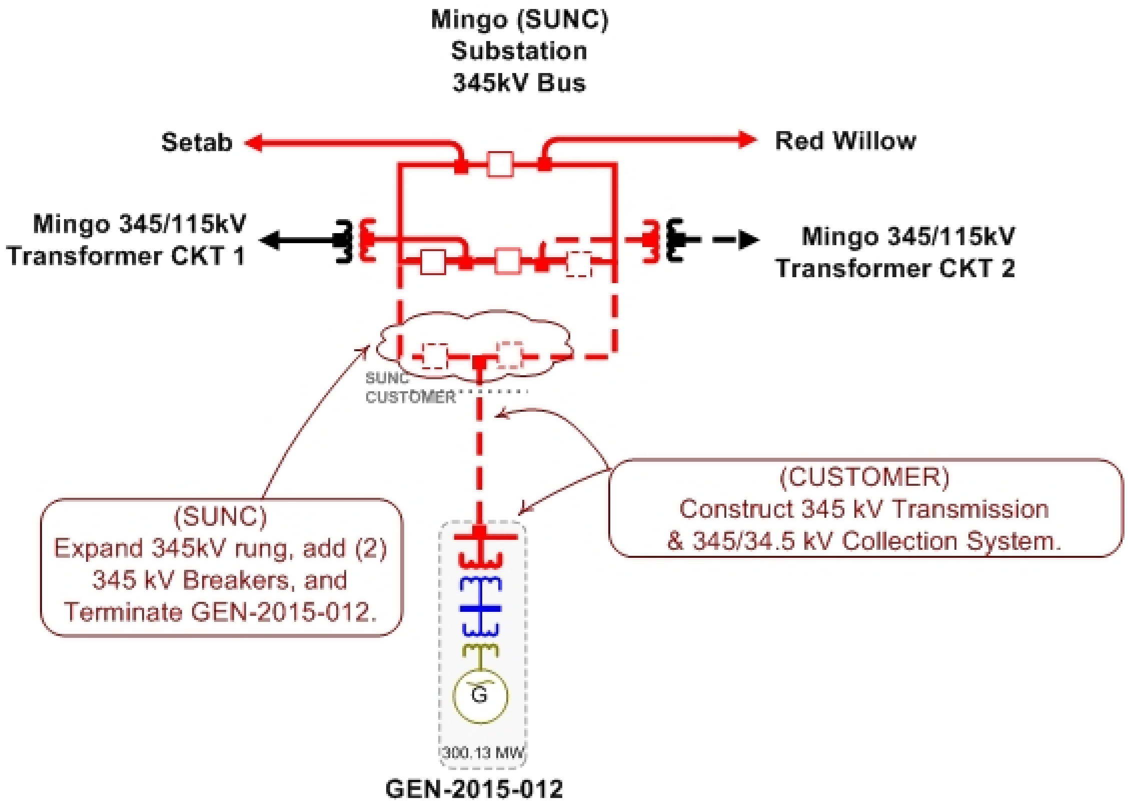
GROUP 14: SOUTH CENTRAL OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2011-040	111.00	OKGE	Carter County 138kV
GEN-2011-050	109.80	AEPW	Santa Fe Tap 138kV
GEN-2012-004	41.40	OKGE	Carter County 138kV
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV
GEN-2014-057	250.00	AEPW	Tap Lawton - Sunnyside 345kV
PRIOR QUEUED SUBTOTAL	**612.50**		
AREA TOTAL	**612.50**		

CLUSTER TOTAL (CURRENT STUDY)	**300.1**	MW
PQ TOTAL (PRIOR QUEUED)	**32,388.6**	MW
CLUSTER TOTAL (INCLUDING PRIOR QUEUED)	**32,688.7**	MW

D: Proposed Point of Interconnection One Line Diagrams

GEN-2015-012



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 Generator 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 Generator 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.

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

Appendix E. Cost Allocation Per Request

(Including Previously Allocated Network Upgrades*)

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2015-012			
GEN-2015-012 Interconnection Costs See One-Line Diagram.	Current Study	$8,000,000	$8,000,000
Arnold - Ransom 115kV CKT 1 Replace terminal equipment to achieve at least a 600 amp rating.	Previously Allocated		$3,000,000
	Current Study Total	$8,000,000	
TOTAL CURRENT STUDY COSTS:		**$8,000,000**	

* 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 Generator 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-2015-012 Interconnection Costs		**$8,000,000**
See One-Line Diagram.		
GEN-2015-012	$8,000,000	
Total Allocated Costs	**$8,000,000**	

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

G: Power Flow Analysis (Constraints Requiring Transmission Reinforcement)

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.103	116.3644	MINGO - SETAB 345KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04595	100.5495	MINGO - RED WILLOW 345KV CKT 1

H: Power Flow Analysis (Constraints Not Requiring Transmission Reinforcement)

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08427	115.1292	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08347	113.8629	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08278	113.1564	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08315	112.3277	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08382	105.6424	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.08316	105.4925	MINGO - SETAB 345KV CKT 1
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.0316	104.6631	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.0316	104.6602	MIDW-CATB01B
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03155	104.2649	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03145	104.2636	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03145	104.2527	MIDW-CATB01B
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03155	104.2518	MIDW-CATB01B
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.0316	103.8446	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04579	103.8002	MINGO - RED WILLOW 345KV CKT 1
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04258	103.6978	HOLCOMB - SETAB 345KV CKT 1
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04561	103.6548	MINGO - RED WILLOW 345KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04583	103.5049	MINGO - RED WILLOW 345KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03155	103.451	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03145	103.445	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04229	103.1068	HOLCOMB - SETAB 345KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03312	103.0254	MANNING TAP - SCOTT CITY 115KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03131	103.0233	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03131	103.0176	MIDW-CATB01B
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03332	102.6622	MANNING TAP - SCOTT CITY 115KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03142	102.3398	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03142	102.3324	MIDW-CATB01B
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03131	102.2039	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03372	102.1653	SCOTT CITY - SETAB 115KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.042	101.9511	HOLCOMB - SETAB 345KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03142	101.5239	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03445	101.4101	HOXIE - SEGNTP 3 115.00 115KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04581	101.1054	MINGO - RED WILLOW 345KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04582	101.0542	MINGO - RED WILLOW 345KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.0316	100.9533	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03313	100.4983	MANNING TAP - SCOTT CITY 115KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03143	100.3604	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03143	100.3498	MIDW-CATB01B
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03445	100.1849	MIDW-CATB01
FDNS	04ALL	0	15SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04245	100	HOLCOMB - SETAB 345KV CKT 1
FDNS	04ALL	0	20WP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03419	99.9	HOXIE - SEGNTP 3 115.00 115KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03431	99.7	HOXIE - SEGNTP 3 115.00 115KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03143	99.5	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04218	99.4	HOLCOMB - SETAB 345KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.05039	98.9	HOLCOMB - SETAB 345KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04216	98.8	HOLCOMB - SETAB 345KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03649	98.8	MIDW-CATB01B
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03649	98.8	PHEASANT RUN - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03142	98.6	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1
FDNS	04ALL	0	20SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03431	98.3	MIDW-CATB01
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03649	98	SEGNTP 3 115.00 - SEGUIN 3 115.00 115KV CKT 1
FDNS	04ALL	0	25SP	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03432	97.8	HOXIE - SEGNTP 3 115.00 115KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03946	97.5	HOXIE - SEGNTP 3 115.00 115KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.0366	97.2	MULLERGREN - SOUTH HAYS 230KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.04558	97.1	SCOTT CITY - SETAB 115KV CKT 1
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03457	96.9	GEN560309 1-G09201425 0.6900
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03946	96.7	MIDW-CATB01
FDNS	04NR	0	15G	G15_012	FROM->TO	ARNOLD - RANSOM 115KV CKT 1	79.7	79.7	0.03946	95.5	BEACH STATION - HOXIE 115KV CKT 1
FDNS	00NR	0	25SP	G15_012	TO->FROM	ATWOOD - COLBY 115KV CKT 1	66	77	0.03531	96.3	BREWSTER - MINGO 115KV CKT 1
FDNS	00NR	0	20SP	G15_012	TO->FROM	ATWOOD - COLBY 115KV CKT 1	66	77	0.03531	95	BREWSTER - MINGO 115KV CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07194	105.1943	DBL-CLRK-THI
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07521	105.1038	DBL-CLRK-THI
FDNS	04ALL	0	20WP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.06991	100.8528	DBL-CLRK-THI
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.04259	100	POST ROCK (POSTROCK T1) 345/230/13.8KV TRANSFORMER CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEA (MVA)	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.04039	99.8	POST ROCK (POSTROCK T1) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.05776	99.7	DBL-G1524-WI
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.06067	99.1	DBL-G1524-WI
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07194	99.1	DBL-IRON-CLR
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07521	99	DBL-IRON-CLR
FDNS	04ALL	0	20SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07004	98	DBL-CLRK-THI
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.05776	97.8	DBL-THIS-G15
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.06067	97	DBL-THIS-G15
FDNS	04ALL	0	20WP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.03979	96.8	POST ROCK (POSTROCK T1) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.04522	96.4	AXTELL - POST ROCK 345KV CKT 1
FDNS	04ALL	0	15WP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.0722	96.3	DBL-CLRK-THI
FDNS	04ALL	0	15SP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07194	96	DBL-SPRVL-CL
FDNS	04ALL	0	15G	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.07521	95.7	DBL-SPRVL-CL
FDNS	04ALL	0	20WP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.05576	95.5	DBL-G1524-WI
FDNS	04ALL	0	20WP	G15_012	FROM->TO	SMOKYHL6 230.00 - SUMMIT 230KV CKT 1	330	330	0.06991	95.3	DBL-IRON-CLR

I: Power Flow Analysis (Constraints from Multi-Contingencies)

To be performed; results will be available upon request. Contact SPP Generator Interconnection Studies for details.

J: Group 4 Dynamic Stability Analysis Report

See report on next page.

Group 4 Stability Impact Study

PISIS-2015-001

August 2015
Generator Interconnection

Revision History

Date	Author	Change Description
08/28/2015	SPP	PISIS-2015-001 Group 4 Stability Report Issued

Southwest Power Pool

Executive Summary

PISIS-2015-001 Interconnection Customers have requested a Preliminary Interconnection System Impact Study detailing the impacts of interconnecting the generation projects shown below.

- GEN-2015-012 – 300.125 MW wind farm generation facility using one hundred seventy-five (175) G.E. 1.715MW WTG generators interconnecting to the Sunflower Electric Power Corporation (SUNC) transmission system at the Mingo 345kV substation.

A stability cluster impact analysis was performed for the generation project from the PISIS-2015-001 Group 4 study. The analysis was performed on three (3) seasonal models including 2015 summer peak (15SP), the 2015 winter peak (15WP), and the 2025 summer peak (25SP) cases. These cases are modified versions of the 2014 model series of Model Development Working Group (MDWG) dynamic study models. A total of twenty-seven (27) contingencies were evaluated for the three (3) seasonal cases.

Stability analysis has determined with all previously assigned Network Upgrades in service, all generators in the monitored areas remained stable and within the pre-contingency, voltage recovery, and post fault voltage recovery criterion of 0.7pu to 1.2pu for the entire modeled disturbances.

In addition to the cluster impact stability analysis, power factor analysis for each generation project was performed on the current study upgrade 2015 summer peak, the 2015 winter peak, and the 2025 summer peak cases. Short Circuit analysis was conducted using the current study upgrade 2025 summer peak case.

A reduced generation analysis was conducted for wind farms to determine reactor inductive amounts to compensate the capacitive effects on the transmission system during low or reduced wind conditions cause by the interconnecting project’s generator lead transmission line and collector systems.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool’s OASIS by the Customer.

Table of Contents

1. Introduction

PISIS-2015-001 Interconnection Customers have requested a Preliminary Interconnection System Impact Study detailing the impacts of interconnecting the generation projects shown **Table 1-1** below.

Table 1-1: Group 4 Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2015-012	300.125	GE 1.715MW WTG	Mingo 345kV

The previously queued generation projects in the Group 4 area are listed in **Table 1-2** below.

Table 1-2: Group 4 Prior Queued Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2001-039M	99.0	Vestas V90VCRS 3.0MW	Central Plains 115kV (531485)
GEN-2003-006A	201.0	Vestes V90VCRS	Elm Creek 230kV (539639)
GEN-2003-019	249.3	GE 1.5MW & Vestas 3.0MW	Smoky Hills 230kV (530592)
GEN-2006-031	76.0	GENROU (530674, Machine ID 01; 530675, Machine ID 07)	Knoll 115kV (530561)
GEN-2008-092	201.0	GE 1.5MW	Knoll 230kV (530558)
GEN-2009-008	198.9	GE 1.7MW	South Hays 230kV (530582)
GEN-2009-020/GEN-2014-025	50.75	Siemens SWT-2.415MW-108	Tap on the Balzine to Nekoma 69kV line (560306)
GEN-2010-057	201.0	GE 1.5MW	Rice County 230kV (530686)
ASGI-2013-004	27.6 Summer 36.6 Winter	GENSAL (583693)	Morris 115kV (531430)
GEN-2013-033	28.0 (uprate of GEN-2006-031)	GENSAL (Bus 530675, Machine ID 10)	Knoll 115kV (530561)
GEN-2014-041	123..165	Siemens SWT-2.415MW-108	Arnold 115kV (531409)
GEN-2010-048	70	Nordex 2.5MW	Tap on the Ross Beach to Redline 115kV line (560336)
GEN-2015-017	155 Summer 172 Winter	GENROU	Mingo 115kV (531429)

A stability analysis was performed for the addition of the generation projects in Group 4. The analysis was performed on three (3) seasonal models including 2015 summer peak (15SP), the 2015 winter peak (15WP), and the 2025 summer peak (25SP) cases. These cases are modified versions of the 2014 model series of Model Development Working Group (MDWG) dynamic study models.

The stability analysis determines the impacts of the new interconnecting project on the stability and voltage recovery of the nearby systems and the ability of the interconnecting project to meet FERC Order 661A. If problems with stability or voltage recovery are identified, the need for reactive compensation or system upgrades is investigated. The contingencies listed in **Table 3-1** were used in the stability analysis.

The power factor analysis determines the power factor at the point of interconnection (POI) for the wind interconnection projects for pre-contingency and post-contingency conditions. The contingencies used in the power factor analysis are a subset of the stability analysis contingencies shown in **Table D-1**.

A reduced generation analysis was conducted for wind farms to determine reactor inductive amounts to compensate the capacitive effects on the transmission system during low or reduced wind conditions cause by the interconnecting project's generator lead transmission line and collector systems. **Table 5-1** displays the minimum reactor inductive amount requirement to compensate capacitive effects from GEN-2015-012 facilities.

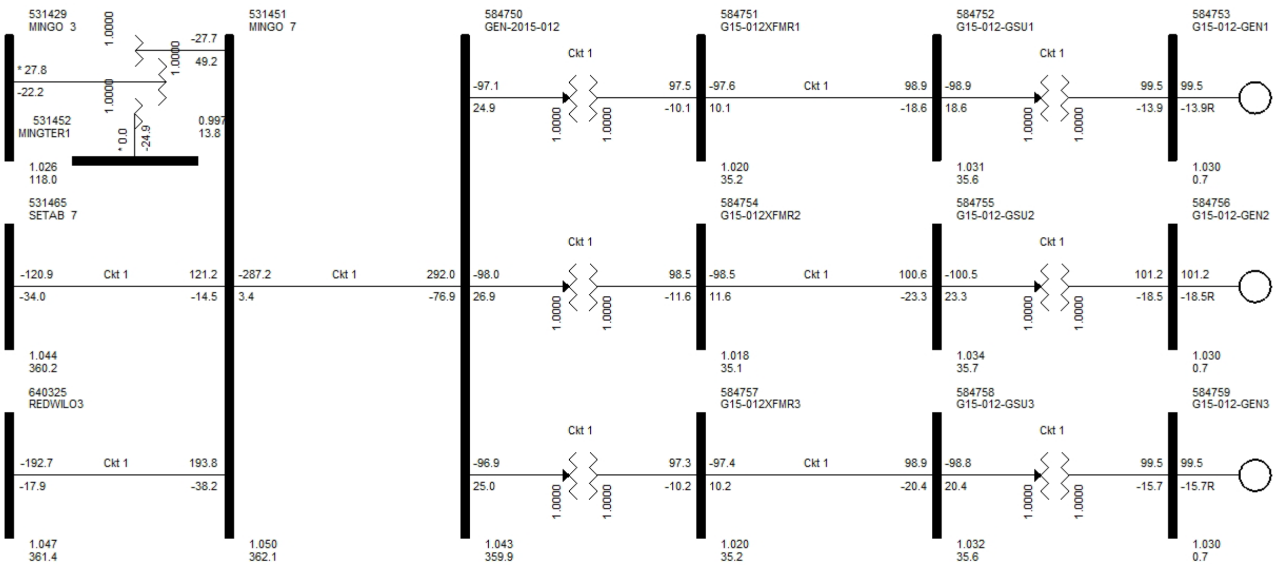
Short Circuit analysis was conducted using the current study upgrade 2025 summer peak case. The results from the Short circuit analysis are show in Appendix F.

Nothing in this System Impact Study constitutes a request for transmission service or grants the Interconnection Customer any rights to transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

2. Facilities

A one-line PSS/E slider drawings for each of the generation interconnection requests in this study is shown in **Figure 2-1**.

Figure 2-1*:* GEN-2015-012 One-line Diagram



3. Stability Analysis

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bus voltages stay within planning criteria bandwidth during and after a disturbance while considering the addition of a generator interconnection request.

Model Preparation

Transient stability analysis was performed using modified versions of the 2014 series of Model Development Working Group (MDWG) dynamic study models including the 2015 summer peak, 2015 winter peak, and the 2025 summer peak seasonal models. The cases are then loaded with prior queued interconnection requests and network upgrades assigned to those interconnection requests. Finally the prior queued and study generation are dispatched into the SPP footprint. Initial simulations are then carried out for a no-disturbance run of twenty (20) seconds to verify the numerical stability of the model.

Disturbances

Twenty-seven (27) contingencies were identified for use in this study and are listed in **Table 3-1**. These contingencies are faults at locations defined by SPP Generation Interconnection Staff. These contingencies include three-phase N-1, single-phase stuck breaker, and three-phase prior outage faults. Single-phase line faults were simulated by applying 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.

Except for transformer faults, the typical sequence of events for a three-phase fault is as follows:

1. apply fault at particular location
2. continue fault for five (5) cycles, clear the fault by tripping the faulted facility
3. after an additional twenty (20) cycles, re-close the previous facility back into the fault
4. continue fault for five (5) additional cycles
5. trip the faulted facility and remove the fault

Transformer faults are typically modeled as three-phase faults, unless otherwise noted. The sequence of events for a transformer fault is as follows:

1. apply fault for five (5) cycles
2. clear the fault by tripping the affected transformer facility (unless otherwise noted there will be no re-closing into a transformer fault)

The SPP areas monitored during the stability analysis were:

- 520: American Electric Power West (AEPW)
- 524: Oklahoma Gas and Electric Company (OKGE)
- 525: Western Farmers Electric Cooperative (WFEC)
- 526: Southwestern Public Service Company (SPS)
- 531: Midwest Energy, Inc. (MIDW)
- 534: Sunflower Electric Power Corp. (SUNC)
- 536: Westar Energy, Inc. (WERE)
- 640: Nebraska Public Power District (NPPD)

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
0	FLT_00_NoFault	No Fault Conditions
1	FLT_01_NESSCTY3_RANSOM3_115kV_3PH	3 phase fault on the Ness City 115kV (531456) to Ransom 115kV (531414) CKT 1, near Ness City. a. Apply fault at the Ness City 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.
2	FLT_02_NESSCTY3_BEELER3_115kV_3PH	3 phase fault on the Ness City 115kV (531456) to Beeler 115kV (531359) CKT 1, near Ness City. a. Apply fault at the Ness City 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.
3	FLT_03_BEACH3_HOXIE3_115kV_3PH	3 phase fault on the Beach 115kV (530557) to Hoxie 115kV (530556) CKT 1, near Beach. a. Apply fault at the Beach 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.
4	FLT_04_COLBY3_ATWOOD3_115kV_3PH	3 phase fault on the Colby 115kV (530555) to Atwood 115kV (530554) CKT 1, near Colby. a. Apply fault at the Colby 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.
5	FLT_05_COLBY3_SEGNTP3_115kV_3PH	3 phase fault on the Colby 115kV (530555) to Seguin Tap 115kV (530682) CKT 1, near Colby. a. Apply fault at the Colby 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.
6	FLT_06_COLBY3_MINGO3_115kV_3PH	3 phase fault on the Colby 115kV (530555) to Mingo 115kV (531429) CKT 1, near Colby. a. Apply fault at the Colby 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.
7	FLT_07_MINGO3_PHRUN3_115kV_3PH	3 phase fault on the Mingo 115kV (531429) to Pheasant Run 115kV (530559) CKT 1, near Mingo. a. Apply fault at the Mingo 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.
8	FLT_08_MINGO3_BREWSTR3_115kV_3PH	3 phase fault on the Mingo 115kV (531429) to Brewster 115kV (531351) CKT 1, near Mingo. a. Apply fault at the Mingo 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.
9	FLT_09_MINGO7_REDWILO3_345kV_3PH	3 phase fault on the Mingo 345kV (531451) to Red Willow 345kV (640325) CKT 1, near Mingo. a. Apply fault at the Mingo 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT_10_MINGO7_SETAB7_345kV_3PH	3 phase fault on the Mingo 345kV (531451) to Setab 345kV (531465) CKT 1, near Mingo. a. Apply fault at the Mingo 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.
11	FLT_11_SETAB7_HOLCOMB7_345kV_3PH	3 phase fault on the Setab 345kV (531465) to Holcomb 345kV (531449) CKT 1, near Setab. a. Apply fault at the Setab 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT_12_NESCTY3_ALXNDR3_115kV_3PH	3 phase fault on the Ness City 115kV (530607) to Alexander 115kV (530606) CKT 1, near Ness City. a. Apply fault at the Ness City 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.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
13	FLT_13_PHRUN3_SEGUIN3_115kV_3PH	3 phase fault on the Pheasant Run 115kV (530559) to Seguin 115kV (530683) CKT 1, near Pheasant Run. a. Apply fault at the Pheasant Run 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.
14	FLT_14_PHRUN3_GRINNEL3_115kV_3PH	3 phase fault on the Pheasant Run 115kV (530559) to Grinnel 115kV (530683) CKT 1, near Pheasant Run. a. Apply fault at the Pheasant Run 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.
15	FLT_15_RULETON3_NSITAP3_115kV_3PH	3 phase fault on the Ruleton 115kV (531357) to NSI Tap 115kV (531356) CKT 1, near Ruleton. a. Apply fault at the Ruleton 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.
16	FLT_16_RULETON3_LAWNRID3_115kV_3PH	3 phase fault on the Ruleton 115kV (531357) to Lawn Ridge 115kV (531368) CKT 1, near Ruleton. a. Apply fault at the Ruleton 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.
17	FLT_17_ATWOOD3_ATWODSW3_115kV_3PH	3 phase fault on the Atwood 115kV (530554) to Atwood SW 115kV (531364) CKT 1, near Atwood. a. Apply fault at the Atwood 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT_18_ATWOOD3_BVERVLLY_115kV_3PH	3 phase fault on the Atwood 115kV (530554) to Beaver Valley 115kV (531488) CKT 1, near Atwood. a. Apply fault at the Atwood 115kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
19	FLT_19_HOLCOMB7_FINNEY7_345kV_3PH	3 phase fault on the Holcomb 345kV (531449) to Finney 345kV (523853) CKT 1, near Holcomb. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT_20_HOLCOMB7_BUCKNER7_345kV_3PH	3 phase fault on the Holcomb 345kV (531449) to Buckner 345kV (531501) CKT 1, near Holcomb. a. Apply fault at the Holcomb 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.
21	FLT_21_REDWILO3_GENTLMN3_345kV_3PH	3 phase fault on the Red Willow 345kV (640325) to Gentleman 345kV (640183) CKT 1, near Red Willow. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT_22_GENTLMN3_KEYSTON3_345kV_3PH	3 phase fault on the Gentleman 345kV (640183) to Keystone 345kV (640252) CKT 1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
23	FLT_23_GENTLMN3_SWEETW3_345kV_3PH	3 phase fault on the Gentleman 345kV (640183) to Sweetwater 345kV (640374) CKT 1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT_24_MINGO3_MINGO7_115_345kV_3PH	3 phase fault on the Mingo 115kV (531429) to Mingo 345kV (531451) to Mingo 13.8kV (531452) XFMR CKT 1, near Mingo 115kV. a. Apply fault at the Mingo 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
25	FLT_25_SETAB7_SETAB3_345_115kV_3PH	3 phase fault on the Setab 345kV (531465) to Setab 115kV (531464) to Setab 13.8kV (531259) XFMR CKT 1, near Setab 345kV. a. Apply fault at the Setab 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Table 3-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
26	FLT_26_HOLCOMB7_HOLCOMB3_345_115kV_3PH	3 phase fault on the Holcomb 345kV (531449) to Holcomb 115kV (531448) to Holcomb 13.8kV (531450) XFMR CKT 1, near Holcomb 345kV. a. Apply fault at the Holcomb 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
27	FLT_27_REDWILO3_REDWILO7_345_115kV_3PH	3 phase fault on the Red Willow 345kV (640325) to Red Willow 115kV (640326) to Red Willow 13.8kV (640327) XFMR CKT 1, near Red Willow 345kV. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

Results

The stability analysis was performed and the results are summarized in **Table 3-2**. The stability plots will be available upon customer request.

Table 3-2: Stability Analysis Results

Contingency Number and Name		2015SP	2015WP	2025SP
0	FLT_00_NoFault	STABLE	STABLE	STABLE
1	FLT_01_NESSCTY3_RANSOM3_115kV_3PH	STABLE	STABLE	STABLE
2	FLT_02_NESSCTY3_BEELER3_115kV_3PH	STABLE	STABLE	STABLE
3	FLT_03_BEACH3_HOXIE3_115kV_3PH	STABLE	STABLE	STABLE
4	FLT_04_COLBY3_ATWOOD3_115kV_3PH	STABLE	STABLE	STABLE
5	FLT_05_COLBY3_SEGNTP3_115kV_3PH	STABLE	STABLE	STABLE
6	FLT_06_COLBY3_MINGO3_115kV_3PH	STABLE	STABLE	STABLE
7	FLT_07_MINGO3_PHRUN3_115kV_3PH	STABLE	STABLE	STABLE
8	FLT_08_MINGO3_BREWSTR3_115kV_3PH	STABLE	STABLE	STABLE
9	FLT_09_MINGO7_REDWILO3_345kV_3PH	STABLE	STABLE	STABLE
10	FLT_10_MINGO7_SETAB7_345kV_3PH	STABLE	STABLE	STABLE
11	FLT_11_SETAB7_HOLCOMB7_345kV_3PH	STABLE	STABLE	STABLE
12	FLT_12_NESCTY3_ALXNDR3_115kV_3PH	STABLE	STABLE	STABLE
13	FLT_13_PHRUN3_SEGUIN3_115kV_3PH	STABLE	STABLE	STABLE
14	FLT_14_PHRUN3_GRINNEL3_115kV_3PH	STABLE	STABLE	STABLE
15	FLT_15_RULETON3_NSITAP3_115kV_3PH	STABLE	STABLE	STABLE
16	FLT_16_RULETON3_LAWNRID3_115kV_3PH	STABLE	STABLE	STABLE
17	FLT_17_ATWOOD3_ATWODSW3_115kV_3PH	STABLE	STABLE	STABLE
18	FLT_18_ATWOOD3_BVERVLLY_115kV_3PH	STABLE	STABLE	STABLE
19	FLT_19_HOLCOMB7_FINNEY7_345kV_3PH	STABLE	STABLE	STABLE
20	FLT_20_HOLCOMB7_BUCKNER7_345kV_3PH	STABLE	STABLE	STABLE
21	FLT_21_REDWILO3_GENTLMN3_345kV_3PH	STABLE	STABLE	STABLE
22	FLT_22_GENTLMN3_KEYSTON3_345kV_3PH	STABLE	STABLE	STABLE
23	FLT_23_GENTLMN3_SWEETW3_345kV_3PH	STABLE	STABLE	STABLE
24	FLT_24_MINGO3_MINGO7_115_345kV_3PH	STABLE	STABLE	STABLE
25	FLT_25_SETAB7_SETAB3_345_115kV_3PH	STABLE	STABLE	STABLE
26	FLT_26_HOLCOMB7_HOLCOMB3_345_115kV_3PH	STABLE	STABLE	STABLE
27	FLT_27_REDWILO3_REDWILO7_345_115kV_3PH	STABLE	STABLE	STABLE

FERC LVRT Compliance

FERC Order #661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI that draw the voltage down at the POI to 0.0 pu. The faults listed below in Table 3-3 were tested to meet Order 661A LVRT provisions. The results are listed in Table 3-2.

Table 3-3 LVRT Contingencies

Contingency Number and Name	Description
FLT_09_MINGO7_REDWILO3_345kV_3PH	3 phase fault on the Mingo 345kV (531451) to Red Willow 345kV (640325) CKT 1, near Mingo. a. Apply fault at the Mingo 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.
FLT_10_MINGO7_SETAB7_345kV_3PH	3 phase fault on the Mingo 345kV (531451) to Setab 345kV (531465) CKT 1, near Mingo. a. Apply fault at the Mingo 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.
FLT_24_MINGO3_MINGO7_115_345kV_3PH	3 phase fault on the Mingo 115kV (531429) to Mingo 345kV (531451) to Mingo 13.8kV (531452) XFMR CKT 1, near Mingo 115kV. a. Apply fault at the Mingo 115kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.

4. Power Factor Analysis

The power factor analysis was performed for each project included in this study and is designed to demonstrate the reactive power requirements at the point of interconnection (POI) using the current study upgrade cases. For all projects that require reactive power, the final requirement in the GIA will be the pro-forma 95% lagging to 95% leading at the POI.

Model Preparation

For each project included in this study, as well as previous queued projects modeled at the same POI, the projects were turned off for the power factor analysis. The projects were replaced by an equivalent generator located at the POI producing the total MW of the project at that POI and 0.0 Mvar capability.

A Mvar generator without limits was modeled at the interconnection project POI to hold a voltage schedule at the POI consistent with the greater of the voltage schedule in the base case or unity (1.0 pu) voltage.

Disturbances

Each contingency evaluated in the Stability Analysis found in ***Table 3-1*** was also included in the determination of the power factor requirements.

Results

The power factor ranges are summarized in **Table 4-1** and the resultant ranges are shown **Table D-1** for GEN-2015-012. The analysis showed that reactive power is required for the study project, the final requirement in the Generation Interconnection Agreement (GIA) for each project will be the pro-forma 95% lagging to 95% leading at the POI.

For analyzing power factor results a positive Q (Mvar) output indicts that the equivalent generator is supplying reactive power to the system, implying a lagging power factor. A negative Q (Mvar) output indicts that the equivalent generator is absorbing reactive power from the system, implying a leading power factor.

Table 4-1*: Summary of Power Factor Analysis at the POI*

Request	Capacity (MW)	Point of Interconnection (POI)	Fuel	Generator	Lagging (providing Mvars)	Leading (absorbing Mvars)
GEN-2015-012	300.125	Mingo 345kV	Wind	GE 1.715MW WTG	0.979	0.986

NOTE: 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.

5. Reduced Wind Generation Analysis

Interconnection requests for wind/solar generation projects that interconnect to the SPP transmission system are analyzed for the capacitive charging effects during reduced generation conditions (unsuitable wind speeds, curtailment, etc.) at the generation site.

Model Preparation

The project generators and capacitors (if any), and all other wind projects that share the same POI, were turned off in the base case. The resulting reactive power injection into the transmission network comes from the capacitance of the project's transmission lines and collector cables. This reactive power injection is measured at the POI. Shunt reactors were added at the study project substation low voltage bus to bring the Mvar flow into the POI down to approximately zero.

Results

A final shunt reactor requirement for each of the studied interconnection requests is shown in **Table 5-1**. One line PSS/e slider diagrams used in the analysis are show in **Appendix E – Reduced Wind Generation Analysis Results**

Table 5-1*: Summary of Shunt Reactor Requirements*

Request	Capacity	Point of Interconnection (POI)	Fuel	Generator	Approximate Shunt Reactor Required (Mvar)
GEN-2015-012	300.125	Mingo 345kV	Wind	GE 1.715MW WTG	154.6

6. Short Circuit Analysis

The short circuit analysis was performed on the current study upgrade 2025 Summer Peak power flow case using the PSS/E ASCC program. Since the power flow model does not contain negative and zero sequence data, only three-phase symmetrical fault current levels were calculated at the point of interconnection up to and including five levels away. The following pages list the results of the analysis.

Results

The results of the short circuit analysis are shown in **Appendix F.**

Short Circuit Analysis was conducting using flat conditions with the following PSS/E ASCCC program settings:

- BUS VOLTAGES SET TO 1 PU AT 0 PHASE ANGLE
- GENERATOR P=0, Q=0
- TRANSFORMER TAP RATIOS=1.0 PU and PHASE ANGLES=0.0
- LINE CHARGING=0.0 IN +/-/0 SEQUENCE
- LOAD=0.0 IN +/- SEQUENCE, CONSIDERED IN ZERO SEQUENCE
- LINE/FIXED/SWITCHED SHUNTS=0.0 AND MAGNETIZING ADMITTANCE=0.0 IN +/-/0 SEQUENCE
- DC LINES AND FACTS DEVICES BLOCKED
- TRANSFORMER ZERO SEQUENCE IMPEDANCE CORRECTIONS IGNORED

7. Conclusion

PISIS-2015-001 Interconnection Customer(s) have requested an Impact Study to determine the impacts of interconnecting generation to the SPP Transmission System.

A stability cluster impact analysis was performed for the generation projects from the PISIS-2015-001 Group 4 study. The analysis was performed on three (3) seasonal models including 2015 summer peak (15SP), the 2015 winter peak (15WP), and the 2025 summer peak (25SP) cases. These cases are modified versions of the 2014 model series of Model Development Working Group (MDWG) dynamic study models. A total of twenty-seven (27) contingencies were evaluated for the three (3) seasonal cases.

The stability analysis has determine with all BASE Case network upgrades and previously assigned network upgrades, all generators in the monitored areas remained stable and within the pre-contingency, voltage recovery, and post fault voltage recovery criterion of 0.7pu to 1.2pu for the entire modeled disturbances.

In additional to the cluster impact stability analysis, power factor analysis for each generation project was performed on the current study upgrade 2015 summer peak, the 2015 winter peak, and the 2025 summer peak cases. Short Circuit analysis was conducted using the current study upgrade 2025 summer peak case.

A reduced generation analysis was conducted for wind farms to determine reactor inductive amounts to compensate the capacitive effects on the transmission system during low or reduced wind conditions cause by the interconnecting project's generator lead transmission line and collector systems.

Nothing in this study should be construed as a guarantee of delivery or transmission service. If the customer wishes to sell power from the facility, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the Customer.

Appendix A – 2015 Summer Peak Stability Plots

(Available on request)

Appendix B – 2015 Winter Peak Stability Plots

(Available on request)

Appendix C – 2025 Summer Peak Stability Plots

(Available on request)

Appendix D – Power Factor Analysis Results

Table D-1: GEN-2015-012 Power Factor Analysis Results

PISIS-2015-001 Group 04 GEN-2015-012										
	POI: Mingo 345kV MW at POI = 300.125	2015 Summer Voltage = 1.04933 pu			2015 Winter Voltage = 1.04211 pu			2025 Summer Voltage = 1.04799 pu		
	Contingency Name	Mvars at POI	Power Factor		Mvars at POI	Power Factor		Mvars at POI	Power Factor	
0	FLT_00_NoFault	-3.892	1.000	LEAD	0.034	1.000	LAG	-5.059	1.000	LEAD
1	FLT_01_NESSCTY3_RANSOM3_115kV	15.581	0.999	LAG	17.012	0.998	LAG	9.780	0.999	LAG
2	FLT_02_NESSCTY3_BEELER3_115kV	-4.325	1.000	LEAD	-0.346	1.000	LEAD	-4.745	1.000	LEAD
3	FLT_03_BEACH3_HOXIE3_115kV	1.109	1.000	LAG	4.352	1.000	LAG	-2.890	1.000	LEAD
4	FLT_04_COLBY3_ATWOOD3_115kV	0.575	1.000	LAG	3.865	1.000	LAG	-0.618	1.000	LEAD
5	FLT_05_COLBY3_SEGNTP3_115kV	-3.081	1.000	LEAD	1.052	1.000	LAG	-3.451	1.000	LEAD
6	FLT_06_COLBY3_MINGO3_115kV	-1.732	1.000	LEAD	-1.511	1.000	LEAD	-5.789	1.000	LEAD
7	FLT_07_MINGO3_PHRUN3_115kV	-4.889	1.000	LEAD	0.279	1.000	LAG	-9.278	1.000	LEAD
8	FLT_08_MINGO3_BREWSTR3_115kV	-5.449	1.000	LEAD	2.532	1.000	LAG	-3.267	1.000	LEAD
9	FLT_09_MINGO7_REDWILO3_345kV	43.967	0.989	LAG	63.233	0.979	LAG	40.037	0.991	LAG
10	FLT_10_MINGO7_SETAB7_345kV	16.963	0.998	LAG	-2.439	1.000	LEAD	5.418	1.000	LAG
11	FLT_11_SETAB7_HOLCOMB7_345kV	-2.725	1.000	LEAD	22.500	0.997	LAG	-10.211	0.999	LEAD
12	FLT_12_NESCTY3_ALXNDR3_115kV	7.974	1.000	LAG	13.377	0.999	LAG	2.315	1.000	LAG
13	FLT_13_PHRUN3_SEGUIN3_115kV	-1.565	1.000	LEAD	2.095	1.000	LAG	-4.758	1.000	LEAD
14	FLT_14_PHRUN3_GRINNEL3_115kV	-3.673	1.000	LEAD	-0.009	1.000	LEAD	-5.313	1.000	LEAD
15	FLT_15_RULETON3_NSITAP3_115kV	-3.413	1.000	LEAD	0.767	1.000	LAG	-4.859	1.000	LEAD
16	FLT_16_RULETON3_LAWNRID3_115kV	-3.448	1.000	LEAD	0.090	1.000	LAG	-6.808	1.000	LEAD
17	FLT_17_ATWOOD3_ATWODSW3_115kV	-2.735	1.000	LEAD	2.007	1.000	LAG	-3.953	1.000	LEAD
18	FLT_18_ATWOOD3_BVERVLLY_115kV	-3.540	1.000	LEAD	-0.500	1.000	LEAD	-6.373	1.000	LEAD
19	FLT_19_HOLCOMB7_FINNEY7_345kV	25.522	0.996	LAG	38.072	0.992	LAG	18.862	0.998	LAG
20	FLT_20_HOLCOMB7_BUCKNER7_345kV	-0.659	1.000	LEAD	9.696	0.999	LAG	7.256	1.000	LAG
21	FLT_21_REDWILO3_GENTLMN3_345kV	-37.079	0.992	LEAD	-23.234	0.997	LEAD	-37.796	0.992	LEAD
22	FLT_22_GENTLMN3_KEYSTON3_345kV	-6.988	1.000	LEAD	-0.399	1.000	LEAD	-6.615	1.000	LEAD
23	FLT_23_GENTLMN3_SWEETW3_345kV	3.764	1.000	LAG	9.501	0.999	LAG	-1.448	1.000	LEAD
24	FLT_24_MINGO3_MINGO7_115_345kV	-51.486	0.986	LEAD	-33.978	0.994	LEAD	-41.865	0.990	LEAD
25	FLT_25_SETAB7_SETAB3_345_115kV	-18.649	0.998	LEAD	-4.214	1.000	LEAD	-21.701	0.997	LEAD
26	FLT_26_HOLCOMB7_HOLCOMB3_345_115kV	-7.049	1.000	LEAD	-17.553	0.998	LEAD	-6.103	1.000	LEAD
27	FLT_27_REDWILO3_REDWILO7_345_115kV	2.305	1.000	LAG	8.077	1.000	LAG	-2.434	1.000	LEAD

Appendix E – Reduced Wind Generation Analysis Results

Figure E-1: GEN-2015-012 with generators off and no shunt reactors

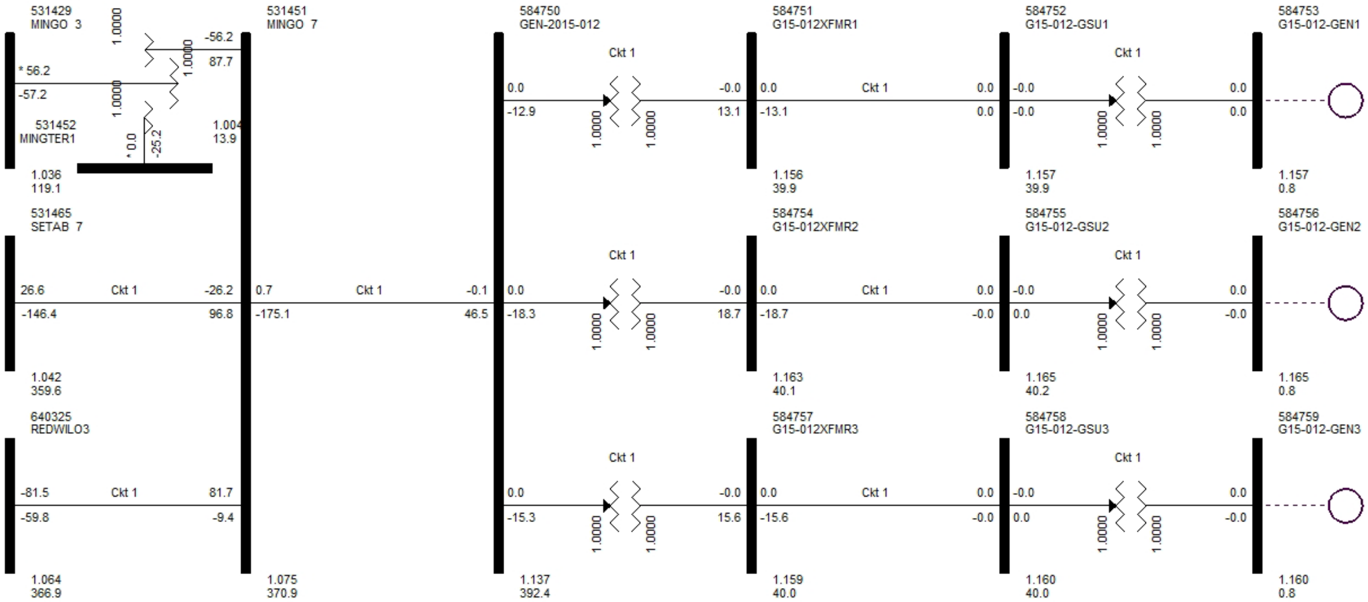
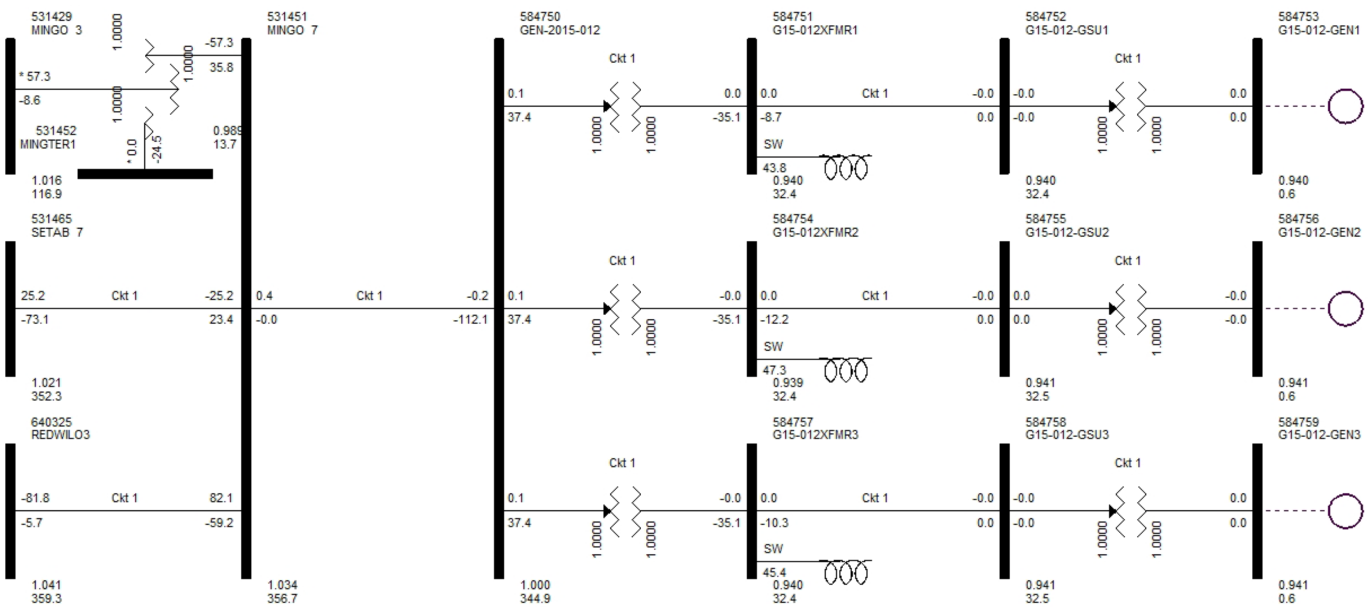


Figure E-2: GEN-2015-012 with generators off and shunt reactors added to the low side of the substation 345/34.5kV



Appendix F – Short Circuit Analysis Results

Table F-1: GEN-2015-012 25SP Short Circuit Analysis Results

POI: Mingo 345kV (531451) 5 Bus Level Short Circuit Analysis			3 Phase Short Circuit Current (Amps)	
Bus Number	Bus Name	Bus Voltage (kV)	Magnitude	Angle
531451	MINGO 7	345	6564.7	-85.6
531429	MINGO 3	115	12228.3	-85.93
531452	MINGTER1	13.8	28460.4	-88.69
531465	SETAB 7	345	7644.5	-85.56
584750	GEN-2015-012	345	2426.8	-85.35
640325	REDWILO3	345	6368.7	-85.11
530555	COLBY 3	115	6111.5	-80.66
530559	PH RUN 3	115	4691.4	-78.2
531259	SETAB 1	13.8	27422.2	-88.29
531351	BREWSTR3	115	3105	-76.81
531449	HOLCOMB7	345	11953.1	-86.46
531464	SETAB 3	115	11050.8	-85.22
584590	GEN-2015-017	115	11985.4	-85.95
584751	G15-012XFMR1	34.5	9201.2	-87.58
584754	G15-012XFMR2	34.5	9209.8	-87.47
584757	G15-012XFMR3	34.5	9195.5	-87.56
640183	GENTLMN3	345	15369.3	-87.25
640326	REDWILO7	115	11413.5	-84.44
640327	REDWILO9	13.8	14869.4	-87.58
523853	FINNEY 7	345	11809.8	-86.42
530554	ATWOOD 3	115	3033.9	-72.56
530644	COLBY 2	69	3962.5	-85
530645	CLBYT1 1	13.8	7036.5	-88.73
530682	SEGNTP 3	115	4408	-75.52
530683	SEGUIN 3	115	4187.4	-76.78
531353	GOODLND3	115	2662.6	-75.65
531412	GRINNEL3	115	3886.9	-77.85
531416	CTYSERT3	115	10368	-84.44
531433	SCOTCTY3	115	9290.8	-83.57
531448	HOLCOMB3	115	22632.1	-87.61
531450	HOLCTER1	13.8	17649.2	-89.59
531501	BUCKNER7	345	10559.8	-86.08
531998	HOLCOMB_2-ST	22	59590.6	-88.52
531999	HOLCOMB_1-CT	18	42579.8	-88.78
584593	G15-017-GEN1	18	66129.5	-88.04
584752	G15-012-GSU1	34.5	8682.6	-85.59
584755	G15-012-GSU2	34.5	8462.4	-84.69
584758	G15-012-GSU3	34.5	8619.3	-85.37
640011	GENTLM2G	24	179636.8	-88.78
640082	BEVERLY7	115	4730.1	-81.73
640184	GENTLMN4	230	18915.5	-87.22
640185	G.GENT19	13.8	27800.1	-87.03
640252	KEYSTON3	345	8378.6	-86.22
640269	MCCOOK 7	115	8770.9	-82.17
640365	STOCKVL7	115	4616.8	-75.6
640374	SWEET W3	345	9805.2	-85.31
640500	CHERRYC3	345	5082.8	-85.68
643066	GENTLEMANT29	13.8	27052	-87.12
523097	HITCHLAND 7	345	16915.8	-85.95
523118	BUFF_DUNES 7	345	6614	-85.69
530556	HOXIE 3	115	3636.3	-73.05
530646	CLBY34 1	34.5	3848.8	-86.55
531256	SCOTCTY1	13.8	4159.9	-89.66
531362	MANNGT 3	115	5187.5	-81.11

POI: Mingo 345kV (531451) 5 Bus Level Short Circuit Analysis			3 Phase Short Circuit Current (Amps)	
Bus Number	Bus Name	Bus Voltage (kV)	Magnitude	Angle
531364	ATWODSW3	115	2694.9	-73.44
531379	JONES3	115	11183.1	-81.41
531393	PLYMELL3	115	7662.4	-84.37
531411	GOVE 3	115	3038.4	-78.4
531418	CTYSERV3	115	10112.4	-84.23
531420	FLETCHR3	115	6742.6	-82.47
531427	SCOTCTY2	69	3360.8	-88.61
531432	PILE 3	115	6629.5	-82.34
531443	GODLNDT3	115	2648.9	-75.58
531445	GRDNCTY3	115	14612.9	-85.16
531447	HOLCGEN1	22	94555.2	-88.87
531469	SPERVIL7	345	14031.4	-85.73
531485	CNTRLPL3	115	6284	-80.05
531488	BVERVLLY	115	2417.8	-73.53
531502	CIMRRN 7	345	8263.3	-85.95
531504	CPV_CIMRRN 7	345	10559.8	-86.08
580049	GEN-2010-045	345	7264.6	-85.32
599950	LAMAR7	345	2484.3	-84.87
640010	GENTLM1G	23	169450	-87.96
640017	MCCOOK G	13.8	35909.8	-88.59
640065	AXTELL 3	345	8832.1	-84.79
640083	BEVERLY8	69	4010.3	-83.97
640100	CAMBRIG7	115	4146.7	-77.59
640167	ENDERS 7	115	3709.7	-78.03
640253	KEYSTON7	115	14137.6	-86.31
640254	KEYSTON9	13.8	15311.8	-87.84
640270	MCCOOK 8	69	4440.6	-85.43
640286	N.PLATT4	230	12868.3	-84.76
640287	N.PLATT7	115	18000.3	-84.64
640302	OGALALA4	230	7703.6	-85.09
640366	STOCKVL8	69	3473.8	-82.93
640510	HOLT.CO3	345	7157	-85.87
643017	BEVERLY T1 9	13.8	5961.4	-84.47
643018	BEVERLY T2 9	13.8	3833.2	-86.66
643099	MCCOOK T1 9	13.8	4023.4	-87.99
643100	MCCOOK T3 9	13.8	2994.6	-85.72
643146	STOCKVLLET19	13.8	4014.6	-88.65
652571	GR ISLD3	345	11916.3	-85.08
659133	SIDNEY 3	345	5628.4	-85.91
523091	HITCHLD_TR01	13.2	33247.6	-88.59
523094	HITCHLD_TR21	13.2	33247.6	-88.59
523095	HITCHLAND 6	230	15076.5	-86.41
523101	NOBLE_WND 7	345	16837.5	-85.95
523112	NOVUS1 7	345	16588.9	-85.9
523114	BUFF_DN_TR11	13.8	71325.8	-88.12
523115	BUFF_DN_TR21	13.8	71325.8	-88.12
523119	BUFF_DUNES31	34.5	24312.2	-88.02
530557	BEACH 3	115	4053.3	-73.67
530583	POSTROCK7	345	7990.5	-84.87
530647	CLBY-DSL	13	9540.6	-86.1
531220	HERNTAP3	115	2602.8	-73.7
531254	GC-CITY	13.8	6694.6	-89.73
531258	GRDNCYT1	13.8	4038.5	-89.87
531263	CNTRLPL3-WP	115	6284	-80.05
531357	RULETON3	115	2612.8	-74.3
531360	DIGHTNT3	115	3688.6	-78.73
531363	MANNING3	115	4109.9	-78.07
531369	NATWOOD3	115	2569.9	-73.56
531392	PIONTAP3	115	6481.3	-82.43
531399	LAKIN3	34.5	3660.1	-88.78

POI: Mingo 345kV (531451) 5 Bus Level Short Circuit Analysis			3 Phase Short Circuit Current (Amps)	
Bus Number	Bus Name	Bus Voltage (kV)	Magnitude	Angle
531400	PK_GOAB3	115	4674.8	-81.56
531408	PIERCVL3	115	3862	-79.71
531409	ARNOLD3	115	3374.2	-78.49
531417	CTYSERV2	69	956.7	-69.45
531421	GC-C 1	34.5	5558.9	-89.45
531423	GARDNCY2	69	4118.2	-89.33
531426	JAMESON3	115	10652.5	-81.24
531428	LEOTI 3	115	4371.2	-77.7
531440	WILLIAM3	115	3739.3	-74.1
531444	GOODCTY3	115	2121.7	-73.66
531459	S2 GEN 1	13.8	52514.4	-89.22
531461	S4 GEN 1	13.2	39980.3	-89.44
531462	S5 GEN 1	13.2	37782.4	-89.52
531468	SPERTER1	13.8	12832.2	-89.73
531476	SWNDTAP3	115	7764.3	-81.67
531480	KSAVWTP3	115	14044.8	-84.89
531487	MCDONLD3	115	2323.4	-73.66
531489	ONEOK 3	115	1950.2	-74.79
531493	GANO 3	115	6944.1	-82.28
531500	FLETCHER-T	13.2	5604.8	-89.28
531503	CIMRRN 1	34.5	23472.1	-87.58
531505	CPV_CIMRRN 1	34.5	20688.9	-87.65
539695	SPEARVL6	230	12660.9	-86.73
539759	SPRVL 3	115	11653.2	-87.62
539800	CLARKCOUNTY7	345	12376	-85.58
539803	IRONWOOD7	345	13581.8	-85.69
539960	SPRVL-T	13.8	27378.9	-89.18
560010	G14-037-TAP	345	16642.9	-86.03
560011	G14-038T	345	10434.6	-85.5
560014	G14-059-TAP	230	5686.8	-84.61
560242	G11-017-TAP	345	10009.5	-85.26