Definitive Interconnection System Impact Study for Generation Interconnection Requests

(DISIS-2013-002)

January 2014

Generator Interconnection

SPP Southwest Power Pool

Revision History

Date	Author	Change Description
01/31/2014	SPP	Report Issued (DISIS-2013-002)

Executive Summary

Generation Interconnection customers have requested a Definitive Interconnection System Impact Study (DISIS) under the Generation Interconnection Procedures (GIP) in the Southwest Power Pool Open Access Transmission Tariff (OATT). The Interconnection Customers' requests have been clustered together for the following System Impact Cluster Study window which closed September 30, 2013. The customers will be referred to in this study as the DISIS-2013-002 Interconnection Customers. This System Impact Study analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling approximately 2,244.6 MW of new generation which would be located within the transmission systems of Grand River Dam Authority (GRDA), Lincoln Electric System (LES), Midwest Energy (MIDW), Nebraska Public Power District (NPPD), Oklahoma Gas and Electric (OKGE), Southwestern Public Service (SPS), and Sunflower Electric Power Corporation/Mid-Kansas Electric Power LLC (SUNC)/(MKEC). The various generation interconnection requests have differing proposed in-service dates[1]. The generation 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, 2,244.6 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. Certain measures for mitigation of the Gentleman Stability interface have yet to be determined as of the posting of this DISIS. These measures will be further analyzed in the Facility Study phase.

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) and Network Resource (NR) constraints, if requested by the Customer. 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.

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[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 DISIS-2013-002 Interconnection Customers is estimated at $132,835,938 plus the costs associated with mitigating the stability flowgate limit of Gerald Gentleman Station which are yet to be determined. These costs are shown in Appendix E and F. Interconnection Service to DISIS-2013-002 Interconnection Customers is also contingent upon higher queued customers paying for certain required network upgrades. **The in-service date for the DISIS customers will be deferred until the construction of these network upgrades can be completed.**

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

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

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

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Introduction

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Definitive Interconnection System Impact Study (DISIS) for certain generation interconnection requests in the SPP Generation Interconnection Queue. These interconnection requests have been clustered together for the following System Impact Study window which closed September 30, 2013. The customers will be referred to in this study as the DISIS-2013-002 Interconnection Customers. This DISIS analyzes the interconnecting of multiple generation interconnection requests associated with new generation totaling 2,244.6 MW which would be located within the transmission systems of Grand River Dam Authority (GRDA), Lincoln Electric System (LES), Midwest Energy (MIDW), Nebraska Public Power District (NPPD), Oklahoma Gas and Electric (OKGE), Southwestern Public Service (SPS), and Sunflower Electric Power Corporation/Mid-Kansas Electric Power LLC (SUNC)/(MKEC). The various generation interconnection requests have differing proposed in-service dates[2]. The generation 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 DISIS 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.

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[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 Definitive Interconnection System Impact Study Agreement no later than September 30, 2013 and were subsequently accepted by Southwest Power Pool under the terms of the Generator Interconnection Procedures (GIP). The interconnection requests that are included in this study are listed in Appendix A.

Affected System Interconnection Request

Also included in this Definitive Interconnection System Impact Study are two Affected System Studies. The Affected System Study Requests have been given the designations: ASGI-2013-004, a 28MW/36MW combustion gas turbine interconnecting to the Garden City municipal 34.5kV distribution system (with a point of interconnection on Sunflower Electric Power Corporation at Morris 115kV) and ASGI-2013-005, a 1.8MW increase of the previously studied ASGI-2012-002 request on the Farmers Electric Cooperative Transmission System at Clovis 115kV (on the Southwestern Public Service system).

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 2013 series Transmission Service Request (TSR) Models including the 2014 (spring, summer and winter peak seasons), the 2019 (summer and winter peak seasons), and the 2024 (summer peak season) scenario 0 cases were used for this study. After the cases were developed, each of the control areas' resources were then re-dispatched to account for the new generation requests using current dispatch orders.

Dynamic Stability

The 2013 series SPP Model Development Working Group (MDWG) Models 2014 winter, 2015 summer, and 2024 summer peak cases were used as starting points for this study.

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 DISIS-2013-002 Interconnection Customers have not been assigned acceleration costs for the below listed projects. <u>The DISIS-2013-002 Interconnection Customers Generation Facilities in service dates may need to be delayed until the completion of</u>

the following upgrades. If for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the DISIS Interconnection Customers.

- Balanced Portfolio Projects[3]:
    - Woodward – Border – TUCO 345kV project, scheduled for 5/19/2014 in-service
        - Woodward 345/138kV circuit #2 autotransformer
        - TUCO 345/138kV circuit #2 autotransformer
        - Reactors at Woodward and Border
    - Iatan – Nashua 345kV, scheduled for 6/1/2015 in-service
        - Nashua 345/161kV autotransformer
- Priority Projects[4]:
    - Hitchland – Woodward double circuit 345kV, scheduled for 6/30/2014 in-service
        - Hitchland 345/230kV circuit #2 autotransformer
    - Woodward – Thistle double circuit 345kV, scheduled for 12/31/2014 in-service
    - Spearville – Clark County double circuit 345kV, scheduled for 12/31/2014 in-service
    - Clark County – Thistle double circuit 345kV, scheduled for 12/31/2014 in-service
    - Thistle – Wichita double circuit 345kV, scheduled for 12/31/2014 in-service
    - Thistle 345/138kV autotransformer, scheduled for 12/31/2014 in-service
    - Thistle – Flat Ridge 138kV, scheduled for 12/31/2014 in-service
- St. John – Barber 115kV rebuild, scheduled for 6/20/2014 in service
- Hays – South Hays 115kV line rebuild, scheduled for 6/1/2015 in-service[5]
- Northwest 345/138/13.8kV circuit #3 autotransformer, scheduled for 6/1/2017 in-service[6]
- Ogallala 230/115/13kV Transformer circuit #1 replacement[7]
- Hoskins – Neligh East Projects[8]
    - Neligh East 345/115kV substation and transformer
    - Neligh East Area 115kV upgrades to support new station
    - Hoskins – Neligh East 345kV circuit #1
- Maxwell – North Platte 115kV terminal equipment upgrade[9]

Contingent Upgrades

The following facilities do not yet have approval. These facilities have been assigned to higher queued interconnection customers. These facilities have been included in the models for the DISIS-2013-002 study and are assumed to be in service. This list may not be all inclusive. The DISIS-2013-002 Interconnection Customers, at this time, do not have responsibility for these facilities but may later be assigned the cost of these facilities if higher queued customers terminate their Generation

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[3] Notification to Construct (NTC) issued June 2009
[4] Notification to Construct (NTC) issued June 2010
[5] SPP Regional Reliability 2013 ITPNT Project Per SPP-NTC-200210
[6] SPP Transmission Service Project identified in SPP 2009-AG2-AFS6. Per SPP NTC 20137
[7] Notification to Construct (NTC) SPP-2009-AGP1-AFS-5 Per SPP-NTC-20117
[8] SPP Regional Reliability 2012 ITP 10 Project Per SPP-NTC-200220
[9] SPP Regional Reliability 2014 ITPNT Per SPP-NTC-200253

Interconnection Agreement or withdraw from the interconnection queue. The DISIS-2013-002 Interconnection Customer Generation Facilities in-service dates may need to be delayed until the completion of the following upgrades.

- Upgrades assigned to DISIS-2009-001 Interconnection Customers:
    - Lancer Project
        - Spearville – Lancer 345kV addition
        - Lancer 345/115kV transformer circuit #1 addition
        - Lancer – North Ft. Dodge 115kV addition
        - Ft Dodge – North Ft. Dodge circuit #2 addition
        - Move Fort Dodge terminal of Shooting Star 115kV at North Ft Dodge
    - Fort Randall – Meadow Grove – Kelly 230kV circuit #1 rerate (320MVA)
- Upgrades assigned to DISIS-2010-001 Interconnection Customers:
    - Switch 2749 – Wildorado 69kV circuit # 1 rebuild
- Upgrades assigned to DISIS-2010-002 Interconnection Customers:
    - Twin Church – Dixon County 230kV circuit #1 rerate (320MVA)
    - Buckner – Spearville 345kV terminal equipment
- Upgrades assigned to DISIS-2011-001 Interconnection Customers:
    - Beaver County – Buckner 345kV circuit #1 build
    - Tatonga – Mathewson - Cimarron 345kV circuit #2 build and Tatonga terminal equipment upgrade (1792 MVA)
    - Hoskins – Dixon County – Twin Church 230kV circuit #1 conductor clearance increase
    - (NRIS only) Hitchland 230/115/13.2kV transformer circuit #2
    - (NRIS only) New Deal – TUCO 345kV/115kV Project
    - (NRIS only) Spearville – Mullergren 230kV circuit #1 rebuild
    - (NRIS only) Woodward – FPL Switch – Mooreland 138kV circuit #1 rebuild
- Upgrades assigned to DISIS-2011-002 interconnection Customers:
    - Power System Stabilizers - Install Power System Stabilizers @ Tolk(Units: 1,2) and Jones (Units: 1,2,3,4)
    - Mullergen 345kV Expansion Project
        - Mullergren 345/230kV substation and transformer
        - GEN-2011-017 Tap – Mullergren 345kV circuit #1
        - Extend Mullergren 230kV circuit to new 345/230kV Mullergren substation
    - Jones – Lubbock South 230kV circuit #2 replace line traps
    - West Brock – SUB 967 – SUB 968 – SUB 969 – SUB 974 69kV circuit #1 replace terminal equipment
    - (NRIS only) Hydro Carbon Tap - Sub974 69kV circuit #1 rewire CT
    - (NRIS only) Lubbock South 230/115kV Autotransformer circuit #2 addition
    - (NRIS only) Mullergren – Reno 345kV circuit #1
    - (NRIS only) Nebraska City U Syracuse – SUB 970 circuit #1 replace terminal equipment
    - (NRIS only) Yoakum 230/115kV transformer circuit #1 and #2 replacements
- Upgrades assigned to DISIS-2012-001 interconnection Customers:
    - Dobson – Gano 115kV replace terminal equipment
    - Garden City – Kansas Ave Water Treatment Plant 115kV replace terminal equipment
    - Mustang – Yoakum 230kV circuit #1 replace line traps

- Upgrades assigned to DISIS-2012-002 interconnection Customers:
  - Amoco Wasson – Oxy Tap – Yoakum 230kV circuit #1 replace line traps
  - Fairfax 138/69kV transformer replacement
  - Lake Creek – Lone Wolf 69kV circuit #1 reset CT
  - Remington – Fairfax 138kV circuit #1 conductor clearance increase
  - (NRIS only) Arkansas City – Paris – Creswell – Oak – Rainbow – City of Winfield 69kV rebuild
  - (NRIS only) Creswell 138/69/13.2kV Transformers circuit #1 and #2 replacements
- Upgrades assigned to DISIS-2013-001 interconnection Customers:
  - Deaf Smith – Plant X 230kV circuit #1 line trap replacements
  - 60 Mvar Capacitor Bank(s) at Oklaunion
  - Meadow Grove & S Norfolk Projects
    - Meadow Grove 115kV substation bay and transformer
    - Meadow Grove – N Petersburg 115kV
    - Meadow Grove – S Norfolk 230kV
    - S Norfolk 345/230kV substation and transformer
  - Tolk – Plant X 230kV circuit #3 addition
  - Vinita – Vinita Junction 69kV rebuild
  - Vinita Junction 138/69/13.2kV transformer circuit #1 replacement
  - (NRIS only) Catoosa – Terra Nitrogen Tap – Verdigras 138kV rebuild
  - (NRIS only) Knoll – N Hays – Vine – Hays Plant 115kV rebuild
  - (NRIS only) Plant X 230/115/13kV transformer circuit #2 addition
  - (NRIS only) Vinita – Eastern State Hospital Tap – Vinita Neo Tap – J6 – Explorer Tap – Afton 69kV 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 were grouped together into twelve active regional groups based on geographical and electrical impacts. These groupings are shown in Appendix C.

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

Power Flow

For Energy Resource Interconnection Service (ERIS), the wind generating plants were modeled at 100% nameplate of maximum generation. The other wind generating plants in the area were modeled at 80% nameplate while the wind generating plants in the remote areas were modeled at 20% nameplate of maximum generation. These projects were dispatched as Energy Resources with a load factor by area distribution across the SPP footprint. All wind generators that requested Network Resource Interconnection Service (NRIS) were dispatched in an additional analysis into the balancing authority of the interconnecting transmission owner at 100% nameplate. This method allowed for the identification of network constraints that were common to the regional groupings that could then in turn have the mitigating upgrade cost allocated throughout the entire cluster. Other sensitivity analyses are also performed with all interconnection requests in each group being dispatched at 100% nameplate.

Peaking units were not dispatched in the 2014 spring model. To study peaking units' impacts, the 2014 summer and winter and 2019 summer and winter, and 2024 summer seasonal models were chosen and peaking units were modeled at 100% of the nameplate rating and wind generating facilities were modeled at 10% of the nameplate rating. Each interconnection request was also modeled separately at 100% nameplate for certain analyses.

Dynamic Stability

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

Identification of Network Constraints

The initial set of network constraints were found by using PSS®MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels mentioned above. These constraints were then screened to determine which of the generation interconnection requests had at least a 20% Distribution Factor (DF) upon the constraint. Constraints that measured at least a 20% DF from at least one interconnection request were considered for transmission reinforcement. In addition, stability issues are also considered for transmission reinforcement. Interconnection Requests that have requested Network Resource Interconnection Service (NRIS) were also studied in the NRIS analysis to determine if any constraint had at least a 3% DF. If so, these constraints were also considered for mitigation.

Determination of Cost Allocated Network Upgrades

Cost Allocated Network Upgrades of wind generation interconnection requests were determined using the 2014 spring model. Cost Allocated Network Upgrades of peaking units was determined using the 2019 summer peak model. A PSS®MUST sensitivity analysis was performed to determine the Distribution Factors (DF), a distribution factor with no contingency that each generation interconnection request had on each new upgrade. The impact each generation interconnection request had on each upgrade project was weighted by the size of each request. Finally the costs due by each request for a particular project were then determined by allocating the portion of each request's impact over the impact of all affecting requests.

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

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

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

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

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

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

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

- Repeat previous for each responsible GI request for each Project

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

Credits for Amounts Advanced for Network Upgrades

Interconnection Customer shall be entitled to credits in accordance with Attachment Z2 of the SPP Tariff for any Network Upgrades including any tax gross-up or any other tax-related payments associated with the Network Upgrades, and not refunded to the Interconnection Customer.

Required Interconnection Facilities

The requirement to interconnect the 2,244.6 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 $132,835,938 plus the costs associated with mitigating the stability flowgate limit of Gerald Gentleman Station which are yet to be determined. Interconnection Facilities specific to each generation interconnection request are listed in Appendix E. A preliminary one-line drawing for each generation interconnection request are listed in Appendix D.

A list of constraints that were identified and used for mitigation are listed in Appendix G. Listed within Appendix G are the ERIS constraints with greater than or equal to a 20% DF, as well as, the NRIS constraints that have a DF of 3% or greater. Other Network Constraints which are not requiring mitigation are shown in Appendix H. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. Additional constraints identified by NERC category “C” contingencies are listed in Appendix I.

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. NERC Category “B” and “C” contingencies were evaluated.

Power Flow Analysis

A power flow analysis was conducted for each Interconnection Customer’s facility using modified versions of the 2014 spring peak, 2014 summer and winter peak, and the 2019 summer and winter peak, 2024 summer peak models. The output of the Interconnection Customer’s facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource Interconnection Service request (ERIS). Certain requests that are pursuing Network Resource Interconnection Service (NRIS) had an additional analysis conducted for displacing resources in the interconnecting Transmission Owner’s balancing authority.

This analysis was conducted assuming that previous queued requests in the immediate area of these interconnect requests were in-service. The analysis of each Customer’s project indicates that criteria violations will occur on the AECI, GRDA, NPPD, OKGE, SUNC/MKEC, WERE, and WAPA transmission systems under system intact and contingency conditions in the peak seasons.

Cluster Group 1 (Woodward Area)

In addition to the 5,195.1 MW of previously queued generation in the area, 123.6 MW of new interconnection service was studied. No new ERIS constraints for mitigation were found in this area. For Interconnection Requests with NRIS, a number of additional upgrades were identified in Appendices E and F for mitigation of overloads.

NRIS Constraints

MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
EVANS ENERGY CENTER NORTH - MAIZEW 4 138.00 138KV CKT 1	346	101.1896	BENTON - WICHITA 345KV CKT 1
FPL SWITCH - WOODWARD 138KV CKT 1	153	112.088	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	123.4206	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1 NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1	153	106.4677	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	115.2058	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1

Cluster Group 2 (Hitchland Area)

In addition to the 2,961.2 MW of previously queued generation in the area, 300.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 3 (Spearville Area)

In addition to the 4,489.4 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 4/11 (NW Kansas Group)

In addition to the 1,988.1 MW of previously queued generation in the area, 57.6 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 5 (Amarillo Area)

In addition to the 944.1 MW of previously queued generation in the area, 370.0 MW of new interconnection service was studied. ERIS constraints were identified on the Bushland 230/115/13kV Transformer and Bushland Interchange – Hillside – Coulter Interchange 115kV circuit #1. A new 230kV transmission line from Bushland to a new substation (Bushland South) on Potter County – Plant X 230kV transmission line will relieve these constraints. For Interconnection Requests with NRIS, a number of additional upgrades were identified in Appendices E and F for mitigation of overloads.

ERIS Constraints

MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	137.9637	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	137.9027	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	113.7402	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1

NRIS Constraints

MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	105.9726	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 1	168	104.0473	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	142.8307	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	162.822	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	161.115	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	165.8101	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.6	139.0869	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1

Cluster Group 6 (South Texas Panhandle/New Mexico)

In addition to the 3,681.85 MW of previously queued generation in the area, 26.8 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 7 (Southwestern Oklahoma)

In addition to the 1,900.0 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 8 (South Central Kansas/North Oklahoma)

In addition to the 3,004.6 MW of previously queued generation in the area, 859.5 MW of new interconnection service was studied. 559.0 MW (GEN-2013-028) of this amount has requested interconnection service given retirement of an existing 490.0 MW of generation located nearby, effectively making the net increase in generation and change in location the subject of study for this request. ERIS constraint on Viola – Wichita 345kV circuit #1 is identified for the loss of Hunter – Woodring 345kV circuit #1. Upgrading terminal equipment on Viola – Wichita 345kV circuit #1 will mitigate the overload. For Interconnection Request with NRIS, a number of additional upgrades were identified in Appendices E and F for mitigation of overloads. Further analysis will be needed in an affect system study from AECI on the overloads seen on Sub 184 – Neosho South Junction 161/69kV transformer.

ERIS Constraints

MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
VIOLA 7 345.00 - WICHITA 345KV CKT 1	1035	100.9917	HUNTERS7 345.00 - WOODRING 345KV CKT 1

NRIS Constraints

MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	129.438	SUB 404 - HOCKERVILLE - VINITA JUNCTION 138KV CKT 1
EASTERN STATE HOSPITAL TAP - VINITA NEO TAP 69KV CKT 1	48	101.5241	SUB 404 - HOCKERVILLE - VINITA JUNCTION 138KV CKT 1
SUB 184 - NEOSHO SOUTH JCT. 161/69KV TRANSFORMER CKT 1	84	106.3695	5WASHBRN 161.00 161/69KV TRANSFORMER CKT 1

Cluster Group 9/10 (Nebraska)

In addition to the 2,006.9 MW of previously queued generation in the area, 507.1 MW of new interconnection service was studied. ERIS constraints on the Ogallala 230/115/13kV transformer, GGS flowgate, and overloads in the Battle Creek area are identified. ERIS mitigations at this time will include the need for Ogallala 230/115/13kV transformer replacement per SPP-NTC-20117, the Neligh – Hoskins 345kV Project per SPP-NTC-200220. The transmission owner will further review the GGS flowgate violation during the Facility Study. In addition to the ERIS mitigations, for Interconnection Requests with NRIS, a number of additional upgrades were identified in Appendices E and F for mitigation of overloads. Further analysis will be needed from WAPA for the constraints seen on the WAPA transmission system during an Affected Impact System Study.

ERIS Constraints			
MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	122.6091	BLOOMFIELD - GAVINS POINT 115KV CKT 1
BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	117.0857	BLOOMFIELD - GAVINS POINT 115KV CKT 1
GGS	1635	100.1063	BASE CASE
OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	103.8513	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1

NRIS Constraints			
MONITORED ELEMENT	RATE B (MVA)	TC%LOADING (% MVA)	CONTINGENCY
BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	121.6553	BLOOMFIELD - GAVINS POINT 115KV CKT 1
BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	116.12	BLOOMFIELD - GAVINS POINT 115KV CKT 1
GAVINS POINT - HARTINGTON 115KV CKT 1	120	106.7198	GAVINS POINT - YANKON JCT 115KV CKT 1
GAVINS POINT - YANKON JCT 115KV CKT 1	128	119.9259	MANNING - SPIRIT MOUND 115KV CKT 1
MAXWELL - NORTH PLATTE 115KV CKT 1	160	114.5944	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	103.8513	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
UTICA - YANKON JCT 115KV CKT 1	120	101.8035	MANNING - SPIRIT MOUND 115KV CKT 1

Cluster Group 12 (Northwest Arkansas)

In addition to the 30.0 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 13 (Northwest Missouri)

In addition to the 375.8 MW of previously queued generation in the area, 0.0 MW of new interconnection service was studied. No new constraints were found in this area.

Cluster Group 14 (South Central Oklahoma)

In addition to the 362.5 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 Analysis

A stability analysis was conducted for each Interconnection Customer using modified versions of the 2013 series SPP Model Development Working Group (MDWG) Models 2014 winter, 2015 summer, and 2024 summer peak dynamic cases. The stability analysis was conducted with all upgrades in service that were identified in the power flow analysis. For each group, the interconnection requests were studied at 100% nameplate output while the other groups were dispatched at 20% output for wind requests and 100% output for 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. The following synopsis is included for each group. The entire stability study for each group can be found in the Appendices section.

Cluster Group 1 (Woodward Area)

The Group 1 stability analysis for this area was performed by POWER-Tek Global, Inc. (POWER-tek). 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 contingencies studied. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the POWER-Tek report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN-2013-025**	50.0	Vestas V100 VCSS 2.0MW	Tap Cimarron – Woodring (Mathewson) 345kV	0.95	0.95
GEN-2013-034	73.6	Siemens 2.3MW	Tap Hitchland – Woodward DBL CKT (GEN-2013-034 Tap) 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

Cluster Group 2 (Hitchland Area)

The Group 2 stability analysis for this area was performed by Excel Engineering (Excel). 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 contingencies studied. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the Excel report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN-2013-030**	300.0	Vestas V100 VCSS 2.0MW	Tap Hitchland – Woodward DBL CKT (Beaver County) 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

Cluster Group 3 (Spearville Area)

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

Cluster Group 4/11 (Northwest Kansas)

The Group 4 stability analysis for this area was performed by Quanta Technology (Quanta). 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 contingencies studied. For certain prior outage conditions, the study generators will need to curtail their output as discussed in the Quanta report. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the Quanta report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
ASGI-2013-004	29.6	GENSAL	Morris 115kV	0.95	0.95
GEN-2013-033	28.0	GENSAL	Goodman Energy Center 115kV	0.95	0.95

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

Cluster Group 5 (Amarillo Area)

The Group 5 stability analysis for this area was performed by Excel Engineering (Excel). 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 contingencies studied. For certain prior outage conditions, the study generators will need to curtail their output as discussed in the Excel report. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the Excel report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN-2013-031	370.0	GENROU	Bushland 230kV	0.95	0.95

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

Cluster Group 6 (South Texas Panhandle/New Mexico)

The Group 6 stability analysis for this area was performed by S&C Electric Company (S&C). 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 contingencies studied. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the S&C report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
ASGI-2013-005	1.8	Vestas V82 1.65MW	FE-Clovis 115kV	0.95	0.95
GEN-2013-022	25.0	Solaron 0.5MW Inverter	Caprock Wind 34.5kV	0.95	0.95

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

Cluster Group 7 (Southwest Oklahoma)

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

Cluster Group 8 (South Central Kansas/North Oklahoma)

The Group 8 stability analysis for this area was performed by Mitsubishi Electric Power Products Inc. (MEPPI). 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 contingencies studied. For certain prior outage conditions, the study generators will need to curtail their output as discussed in the MEPPI report. Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the MEPPI report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN-2013-028	559.5	GENROU	Tap North Tulsa – GRDA1 345kV	0.95	0.95
GEN-2013-029**	300.0	Vestas V100 VCSS 2.0MW	Renfrow 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

Cluster Group 9/10 (Nebraska)

The Group 9/10 stability analysis for this area was performed by Mitsubishi Electric Power Products Inc. (MEPPI). For GEN-2013-019 and GEN-2013-032 Interconnection Requests, 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 contingencies studied. **However, additional analysis is required to further evaluate the effects of GEN-2013-021 on the Gerald Gentleman stability interface. This analysis will take place during the Facility Study.** Power Factor requirements are listed in the table below. In addition, some Interconnection Requests may have additional requirements for reactors under low wind conditions as identified in the MEPPI report.

Power Factor Requirements:

Request	Size (MW)	Generator Model	Point of Interconnection	Power Factor Requirement at POI*	
				Lagging (supplying)	Leading (absorbing)
GEN-2013-019	73.6	Siemens 2.3MW	Tap Sheldon – Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	0.95	0.95
GEN-2013-021**	229.5	GE 1.70MW	Ogallala 230kV	0.95	0.95
GEN-2013-032	204.0	GE 1.70MW	Neligh 115kV	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

Cluster Group 12 (Northwest Arkansas Area)

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

Cluster Group 13 (Northwest Missouri Area)

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

Cluster Group 14 (South Central Oklahoma)

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

Conclusion

The minimum cost of interconnecting 2,244.6 MW of new interconnection requests included in this Definitive Interconnection System Impact Study is estimated at $132,835,938 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: Generation Interconnection Requests Considered for Impact Study

See next page.

A: Generation Interconnection Requests Considered for Impact Study

Request	Amount	Service	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date	In Service Date Delayed Until no earlier than*
ASGI-2013-004	29.60	ER	SUNCMKEC	Morris 115kV	Morris 115kV		
ASGI-2013-005	1.80	ER	SPS	FE Clovis 115kV	FE Clovis 115kV		
GEN-2013-019	73.60	ER/NR	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2	6/30/2014	TBD
GEN-2013-021	229.50	ER/NR	NPPD	Ogallala 230kV	Ogallala 230kV	12/1/2016	TBD
GEN-2013-022	25.00	ER/NR	SPS	Norton 115kV	Norton 115kV	5/1/2015	TBD
GEN-2013-025	50.00	ER	OKGE	Tap Cimarron - Woodring (Mathewson) 345kV	Tap Cimarron - Woodring (Mathewson) 345kV	9/30/2015	TBD
GEN-2013-028	559.50	ER/NR	GRDA	Tap N Tulsa - GRDA 1 345kV	Tap N Tulsa - GRDA 1 345kV	4/16/2016	TBD
GEN-2013-029	300.00	ER	OKGE	Renfrow 345kV	Renfrow 345kV	12/15/2015	TBD
GEN-2013-030	300.00	ER	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	12/15/2015	TBD
GEN-2013-031	370.00	ER/NR	SPS	Bushland 230kV	Bushland 230kV	6/1/2016	TBD
GEN-2013-032	204.00	ER/NR	NPPD	Neligh 115kV	Neligh 115kV	12/31/2016	TBD
GEN-2013-033	28.00	ER/NR	MIDW	Goodman Energy Center 115kV	Goodman Energy Center 115kV	12/31/2015	TBD
GEN-2013-034	73.60	ER/NR	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2013-034 Tap) 345kV	Tap Hitchland - Woodward Dbl Ckt (GEN-2013-034 Tap) 345kV	12/31/2014	TBD
Total:	**2,244.60**						

*Requests that are dependent upon Priority Projects or Balanced Portfolio may be delayed until 12/31/2014. Other requests in-service date to be determined after Facility Study.

B: Prior Queued Interconnection Requests

See next page.

B: Prior Queued Interconnection Requests

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
ASGI-2010-006	150.00	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	28.80	SPS	Lovington 115kV	On-Line
ASGI-2011-002	20.00	SPS	Herring 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-2013-006	2.00	SPS	SP-Erskine 115kV	
ASGI-2013-007	90.00	AECI	Tap Hickory Creek - Locust Creek 161kV	AECI System Impact Study
GEN-2001-014	96.00	WFEC	Ft Supply 138kV	On-Line
GEN-2001-026	74.00	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	Tap Greensburg - Ft Dodge (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
GEN-2003-021N	75.00	NPPD	Ainsworth Wind Tap 115kV	On-Line
GEN-2003-022	120.00	AEPW	Washita 138kV	On-Line
GEN-2004-005N	30.00	NPPD	St Francis 115kV	On Suspension
GEN-2004-014	154.50	SUNCMKEC	Spearville 230kV	On-Line at 100MW
GEN-2004-020	27.00	AEPW	Washita 34.5kV	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	Tap Latham - Neosho (Caney River) 345kV	On-Line
GEN-2006-002	101.00	AEPW	Sweetwater 230kV	On-Line
GEN-2006-006	205.50	SUNCMKEC	Spearville 345kV	On Schedule for 2015
GEN-2006-018	170.00	SPS	TUCO Interchange 230kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
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	604.00	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 Schedule for 2014
GEN-2006-038N005	80.00	NPPD	Broken Bow 115kV	On-Line
GEN-2006-038N019	80.00	NPPD	Petersburg North 115kV	On-Line
GEN-2006-040	108.00	SUNCMKEC	Mingo 115kV	On Suspension
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-2006-047	240.00	SPS	Tap Bushland - Deaf Smith (Buffalo) 230kV	On Suspension
GEN-2007-011	135.00	SUNCMKEC	Syracuse 115kV	On Suspension
GEN-2007-011N08	81.00	NPPD	Bloomfield 115kV	On-Line
GEN-2007-021	201.00	OKGE	Tatonga 345kV	On Schedule for 2014
GEN-2007-025	300.00	WERE	Viola 345kV	On-Line
GEN-2007-032	150.00	WFEC	Tap Clinton Junction - Clinton 138kV	On Suspension
GEN-2007-038	200.00	SUNCMKEC	Spearville 345kV	On Schedule for 2015
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 Schedule for 2014
GEN-2007-046	199.50	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 2014
GEN-2008-003	101.00	OKGE	Woodward EHV 138kV	On-Line
GEN-2008-008	60.00	SPS	Graham 69kV	On Suspension
GEN-2008-013	300.00	OKGE	Tap Wichita - Woodring (Hunter) 345kV	On-Line at 235MW
GEN-2008-017	300.00	SUNCMKEC	Setab 345kV	On Schedule for 2015
GEN-2008-018	250.00	SPS	Finney 345kV	On-Line
GEN-2008-019	300.00	OKGE	Tatonga 345kV	On Schedule for 2015
GEN-2008-021	42.00	WERE	Wolf Creek 345kV	On-Line
GEN-2008-022	300.00	SPS	Tap Eddy Co - Tolk (Chaves County) 345kV	On Schedule for 2015
GEN-2008-023	150.00	AEPW	Hobart Junction 138kV	On-Line
GEN-2008-029	250.50	OKGE	Woodward EHV 138kV	On Schedule for 2014
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	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	On Schedule for 2014
GEN-2008-051	322.00	SPS	Potter County 345kV	On-Line at 161MW
GEN-2008-079	99.20	SUNCMKEC	Tap Cudahy - Ft Dodge 115kV	On-Line
GEN-2008-086N02	200.00	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV	On Schedule for 2014
GEN-2008-088	50.60	SPS	Vega 69kV	On Suspension
GEN-2008-092	201.00	MIDW	Post Rock 230kV	On Schedule for 2014
GEN-2008-098	100.80	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV	On Schedule for 2015
GEN-2008-119O	60.00	OPPD	S1399 161kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2008-123N	89.70	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV	On Schedule for 2014
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV	On Schedule for 2016
GEN-2008-129	80.00	MIPU	Pleasant Hill 161kV	On-Line
GEN-2009-008	199.50	MIDW	South Hays 230kV	On Suspension
GEN-2009-020	48.60	MIDW	Tap Nekoma - Bazine (Walnut Creek) 69kV	On Suspension
GEN-2009-025	60.00	OKGE	Nardins 69kV	On-Line
GEN-2009-040	108.00	WERE	Marshall 115kV	On Schedule for 2015
GEN-2010-001	300.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	On Schedule for 2014 (204 MW) and 2015 (96 MW)
GEN-2010-003	100.80	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV	On Schedule for 2015
GEN-2010-005	300.00	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 Schedule for 2016
GEN-2010-015	200.10	SUNCMKEC	Spearville 345kV	On Schedule for 2015
GEN-2010-020	20.00	SPS	Roswell 69kV	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	S 1399 161kV	IA Pending
GEN-2010-045	197.80	SUNCMKEC	Buckner 345kV	IA Pending
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV	On Schedule for 2016
GEN-2010-048	70.00	MIDW	Tap Beach Station - Redline 115kV	IA Pending
GEN-2010-051	200.00	NPPD	Tap Twin Church - Hoskins 230kV	On Schedule for 2014
GEN-2010-055	4.50	AEPW	Wekiwa 138kV	On-Line
GEN-2010-056	151.20	MIPU	Tap Saint Joseph - Cooper 345kV	On Schedule for 2015
GEN-2010-057	201.00	MIDW	Rice County 230kV	On-Line
GEN-2010-058	20.00	SPS	Chaves County 115kV	On Suspension
GEN-2010-061	180.00	SUNCMKEC	Tap Post Rock - Spearville (GEN-2011-017T) 345kV	Facility Study
GEN-2011-007	250.10	OKGE	Tap Cimarron - Woodring (Mathewson) 345kV	On Schedule for 2014
GEN-2011-008	600.00	SUNCMKEC	Clark County 345kV	IA Pending
GEN-2011-010	100.80	OKGE	Minco 345kV	On-Line
GEN-2011-011	50.00	KACP	Iatan 345kV	On-Line
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	IA Pending
GEN-2011-016	200.10	SUNCMKEC	Spearville 345kV	IA Pending
GEN-2011-017	299.00	SUNCMKEC	Tap Spearville - PostRock (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 Schedule for 2017
GEN-2011-020	299.00	OKGE	Woodward 345kV	On Schedule for 2017
GEN-2011-021	299.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV	IA Pending
GEN-2011-022	299.00	SPS	Hitchland 345kV	On Schedule for 2017
GEN-2011-025	82.30	SPS	Tap Floyd County - Crosby County 115kV	On Suspension
GEN-2011-027	120.00	NPPD	Tap Twin Church - Hoskins 230kV (GEN-2010-51 Tap)	IA Pending
GEN-2011-037	7.00	WFEC	Blue Canyon 5 138kV	On-Line
GEN-2011-040	111.00	OKGE	Tap Ratliff - Pooleville 138kV	On Schedule for 2014
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	250.00	OKGE	Border 345kV	IA Pending

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
GEN-2011-050	109.80	AEPW	Rush Springs Natural Gas Tap 138kV	On Suspension
GEN-2011-051	104.40	OKGE	Tap Woodward - Tatonga 345kV	IA Pending
GEN-2011-054	300.00	OKGE	Cimarron 345kV	On Schedule for 2013 (200 MW) and 2014 (99 MW)
GEN-2011-055	52.80	OPPD	South Sterling 69kV	Facility Study
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
GEN-2011-057	150.40	WERE	Creswell 138kV	On Schedule for 2014
GEN-2012-001	61.20	SPS	Tap Grassland - Borden County 230kV	On-Line
GEN-2012-004	41.40	OKGE	Tap Ratliff - Pooleville (Carter County) 138kV	On Schedule for 2014
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV	On Schedule for 2014
GEN-2012-009	15.00	SPS	Mustang 230kV	Facility Study
GEN-2012-010	15.00	SPS	Mustang 230kV	Facility Study
GEN-2012-011	200.00	SUNCMKEC	Tap Spearville - Post Rock 345kV (North of GEN-2011-017 Tap)	Facility Study
GEN-2012-016	312.00	OKGE	Tap Woodward - Thistle 345kV Ckt 1	IA Pending
GEN-2012-020	478.00	SPS	TUCO 230kV	IA Pending
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV	On-Line
GEN-2012-023	115.00	WERE	Viola 345kV	IA Pending
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV	Facility Study
GEN-2012-026	100.00	MIDW	Colby 115kV	IA Pending
GEN-2012-027	136.00	AEPW	Shidler 138kV	On Schedule for 2015
GEN-2012-028	74.80	WFEC	Gotebo 69kV	On Schedule for 2015
GEN-2012-031	200.00	OKGE	Cimarron 345kV (GEN-2010-040 Sub)	IA Pending
GEN-2012-032	300.00	OKGE	Tap Rose Hill - Sooner (Ranch) 345kV	IA Pending
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	IA Pending
GEN-2012-035	7.00	SPS	Mustang 230kV	IA Pending
GEN-2012-036	7.00	SPS	Mustang 230kV	IA Pending
GEN-2012-037	203.00	SPS	TUCO 345kV	Facility Study
GEN-2012-040	76.50	WFEC	Chilocco 138kV	On Schedule for 2015
GEN-2012-041	121.50	OKGE	Tap Rose Hill - Sooner 345kV	On Schedule for 2015
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill 115kV CKT 2	Facility Study
GEN-2013-003	48.00	OKGE	Tap Woodwad - Thistle 345kV Dbl CKT (GEN-2012-016 Tap)	Facility Study
GEN-2013-004	6.00	NPPD	Tap Fort Randall - Columbus (Madison County)	Facility Study
GEN-2013-005	73.50	NPPD	Madison County (GEN-2008-086N2 Sub)	Facility Study
GEN-2013-006	50.60	NPPD	Tap Fort Randall - Columbus (Madison County)	Facility Study
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV	Facility Study
GEN-2013-008	1.20	NPPD	Steele City 115kV	IA Pending
GEN-2013-009	100.30	AEPW	Tap Alluwe Tap - Vinita Junction 138kV	Facility Study
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock 345kV (GEN-2012-011 Tap)	Facility Study
GEN-2013-011	30.00	AEPW	Turk 138kV	Facility Study
GEN-2013-012	147.00	OKGE	Redbud 345kV	Facility Study
GEN-2013-013	248.40	SPS	Tap Eddy County - Tolk 345kV	Facility Study
GEN-2013-014	25.50	NPPD	Tap Guide Rock - Pauline (GEN-2008-123N Tap) 115kV	Facility Study
GEN-2013-015	125.80	NPPD	Tap Pauline - Hildreth 115kV	Facility Study
GEN-2013-016	203.00	SPS	TUCO 345kV	Facility Study
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV	On-Line

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
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 (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 (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
Total:	**26,848.6**			

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-2008-019	300.00	OKGE	Tatonga 345kV
GEN-2008-029	250.50	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-2011-007	250.10	OKGE	Tap Cimarron - Woodring (Mathewson) 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-2011-054	300.00	OKGE	Cimarron 345kV
GEN-2012-016	312.00	OKGE	Tap Woodward - Thistle 345kV Ckt 1
GEN-2012-031	200.00	OKGE	Cimarron 345kV (GEN-2010-040 Sub)
GEN-2013-003	48.00	OKGE	Tap Woodwad - Thistle 345kV Dbl CKT (GEN-2012-016 Tap)
PRIOR QUEUED SUBTOTAL	**5,195.10**		
GEN-2013-025	50.00	OKGE	Tap Cimarron - Woodring (Mathewson) 345kV
GEN-2013-034	73.60	OKGE	Tap Hitchland - Woodward Dbl Ckt (GEN-2013-034 Tap) 345kV
CURRENT CLUSTER SUBTOTAL	**123.60**		
AREA TOTAL	**5,318.70**		

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	199.50	SPS	Hitchland 115kV
GEN-2008-047	300.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV
GEN-2010-001	300.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV
GEN-2010-014	358.80	SPS	Hitchland 345kV
GEN-2011-014	201.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV
GEN-2011-021	299.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV
GEN-2011-022	299.00	SPS	Hitchland 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	**2,961.20**		
GEN-2013-030	300.00	OKGE	Tap Hitchland - Woodward Dbl Ckt (Beaver County) 345kV
CURRENT CLUSTER SUBTOTAL	**300.00**		
AREA TOTAL	**3,261.20**		

GROUP 3: SPEARVILLE AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2012-006	22.50	SUNCMKEC	Tap Hugoton - Rolla 69kV
GEN-2001-039A	105.00	SUNCMKEC	Tap Greensburg - Ft Dodge (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-2006-006	205.50	SUNCMKEC	Spearville 345kV
GEN-2006-021	101.00	SUNCMKEC	Flat Ridge Tap 138kV
GEN-2007-038	200.00	SUNCMKEC	Spearville 345kV
GEN-2007-040	200.00	SUNCMKEC	Buckner 345kV
GEN-2008-018	250.00	SPS	Finney 345kV
GEN-2008-079	99.20	SUNCMKEC	Tap Cudahy - Ft Dodge 115kV
GEN-2008-124	200.10	SUNCMKEC	Ironwood 345kV
GEN-2010-009	165.60	SUNCMKEC	Buckner 345kV
GEN-2010-015	200.10	SUNCMKEC	Spearville 345kV
GEN-2010-045	197.80	SUNCMKEC	Buckner 345kV
GEN-2010-061	180.00	SUNCMKEC	Tap Post Rock - Spearville (GEN-2011-017T) 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 - PostRock (GEN-2011-017T) 345kV
GEN-2012-007	120.00	SUNCMKEC	Rubart 115kV
GEN-2012-011	200.00	SUNCMKEC	Tap Spearville - Post Rock 345kV (North of GEN-2011-017 Tap)
GEN-2012-024	180.00	SUNCMKEC	Clark County 345kV
GEN-2013-010	99.00	SUNCMKEC	Tap Spearville - Post Rock 345kV (GEN-2012-011 Tap)
Gray County Wind (Montezuma)	110.00	SUNCMKEC	Gray County Tap 115kV
PRIOR QUEUED SUBTOTAL	**4,489.40**		
AREA TOTAL	**4,489.40**		

GROUP 4/11: NW KANSAS AREA

Request	Capacity	Area	Proposed Point of Interconnection
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-2006-040	108.00	SUNCMKEC	Mingo 115kV
GEN-2007-011	135.00	SUNCMKEC	Syracuse 115kV
GEN-2008-017	300.00	SUNCMKEC	Setab 345kV
GEN-2008-092	201.00	MIDW	Post Rock 230kV
GEN-2009-008	199.50	MIDW	South Hays 230kV
GEN-2009-020	48.60	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-2012-026	100.00	MIDW	Colby 115kV
PRIOR QUEUED SUBTOTAL	**1,988.10**		
ASGI-2013-004	29.60	SUNCMKEC	Morris 115kV
GEN-2013-033	28.00	MIDW	Goodman Energy Center 115kV
CURRENT CLUSTER SUBTOTAL	**57.60**		
AREA TOTAL	**2,045.70**		

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-2006-047	240.00	SPS	Tap Bushland - Deaf Smith (Buffalo) 230kV
GEN-2008-051	322.00	SPS	Potter County 345kV
GEN-2008-088	50.60	SPS	Vega 69kV
Llano Estacado (White Deer)	80.00	SPS	Llano Wind 115kV
PRIOR QUEUED SUBTOTAL	**944.10**		
GEN-2013-031	370.00	SPS	Bushland 230kV
CURRENT CLUSTER SUBTOTAL	**370.00**		
AREA TOTAL	**1,314.10**		

GROUP 6: S-TX PANHANDLE/W-TX 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	28.80	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-2013-006	2.00	SPS	SP-Erskine 115kV
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	604.00	SPS	Hobbs 230kV & Hobbs 115kV
GEN-2008-008	60.00	SPS	Graham 69kV
GEN-2008-022	300.00	SPS	Tap Eddy Co - Tolk (Chaves County) 345kV
GEN-2010-006	205.00	SPS	Jones 230kV
GEN-2010-020	20.00	SPS	Roswell 69kV
GEN-2010-046	56.00	SPS	TUCO Interchange 230kV
GEN-2010-058	20.00	SPS	Chaves County 115kV
GEN-2011-025	82.30	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	Tap Grassland - Borden County 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-2013-013	248.40	SPS	Tap Eddy County - Tolk 345kV
GEN-2013-016	203.00	SPS	TUCO 345kV
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
PRIOR QUEUED SUBTOTAL	**3,681.85**		
ASGI-2013-005	1.80	SPS	FE Clovis 115kV
GEN-2013-022	25.00	SPS	Caprock 34.5kV
CURRENT CLUSTER SUBTOTAL	**26.80**		
AREA TOTAL	**3,708.65**		

GROUP 7: SW-OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2001-026	74.00	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 34.5kV
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-2007-032	150.00	WFEC	Tap Clinton Junction - Clinton 138kV
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	250.00	OKGE	Border 345kV
GEN-2012-028	74.80	WFEC	Gotebo 69kV
PRIOR QUEUED SUBTOTAL	**1,900.00**		
AREA TOTAL	**1,900.00**		

GROUP 8: N-OK/S-KS AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2010-006	150.00	AECI	Tap Fairfax (AECI) - Shilder (AEPW) 138kV
GEN-2002-004	200.00	WERE	Latham 345kV
GEN-2005-013	201.00	WERE	Tap Latham - Neosho (Caney River) 345kV
GEN-2007-025	300.00	WERE	Viola 345kV
GEN-2008-013	300.00	OKGE	Tap Wichita - Woodring (Hunter) 345kV
GEN-2008-021	42.00	WERE	Wolf Creek 345kV
GEN-2008-098	100.80	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV
GEN-2009-025	60.00	OKGE	Nardins 69kV
GEN-2010-003	100.80	WERE	Tap Lacygne - Wolf Creek (Anderson County) 345kV
GEN-2010-005	300.00	WERE	Viola 345kV
GEN-2010-055	4.50	AEPW	Wekiwa 138kV
GEN-2011-057	150.40	WERE	Creswell 138kV
GEN-2012-023	115.00	WERE	Viola 345kV
GEN-2012-027	136.00	AEPW	Shidler 138kV
GEN-2012-032	300.00	OKGE	Tap Rose Hill - Sooner (Ranch) 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	Tap Rose Hill - Sooner 345kV
GEN-2013-009	100.30	AEPW	Tap Alluwe Tap - Vinita Junction 138kV
GEN-2013-012	147.00	OKGE	Redbud 345kV
PRIOR QUEUED SUBTOTAL	**3,004.60**		
GEN-2013-028	559.50	GRDA	Tap N Tulsa - GRDA 1 345kV
GEN-2013-029	300.00	OKGE	Renfrow 345kV
CURRENT CLUSTER SUBTOTAL	**859.50**		
AREA TOTAL	**3,864.10**		

GROUP 9/10: 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-2004-005N	30.00	NPPD	St Francis 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	200.00	NPPD	Tap Ft Randle - Columbus (Madison County) 230kV
GEN-2008-119O	60.00	OPPD	S1399 161kV
GEN-2008-123N	89.70	NPPD	Tap Guide Rock - Pauline (Rosemont) 115kV
GEN-2009-040	108.00	WERE	Marshall 115kV
GEN-2010-041	10.50	OPPD	S 1399 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 Twin Church - Hoskins 230kV (GEN-2010-51 Tap)
GEN-2011-055	52.80	OPPD	South Sterling 69kV
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-2012-005	81.00	NPPD	Tap Fort Randall - Columbus (North of Madison Co) 230kV
GEN-2012-021	4.80	LES	Terry Bundy Generating Station 115kV
GEN-2013-002	50.60	LES	Tap Sheldon - Folsom & Pleasant Hill 115kV CKT 2
GEN-2013-004	6.00	NPPD	Tap Fort Randall - Columbus (Madison County)
GEN-2013-005	73.50	NPPD	Madison County (GEN-2008-086N2 Sub)
GEN-2013-006	50.60	NPPD	Tap Fort Randall - Columbus (Madison County)
GEN-2013-008	1.20	NPPD	Steele City 115kV
GEN-2013-014	25.50	NPPD	Tap Guide Rock - Pauline (GEN-2008-123N Tap) 115kV
GEN-2013-015	125.80	NPPD	Tap Pauline - Hildreth 115kV
NPPD Distributed (Broken Bow)	8.30	NPPD	Broken Bow 115kV
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 (Ord)	11.90	NPPD	Ord 115kV
NPPD Distributed (Stuart)	2.10	NPPD	Ainsworth 115kV
PRIOR QUEUED SUBTOTAL	**2,006.90**		
GEN-2013-019	73.60	LES	Tap Sheldon - Folsom & Pleasant Hill (GEN-2013-002 Tap) 115kV CKT 2
GEN-2013-021	229.50	NPPD	Ogallala 230kV
GEN-2013-032	204.00	NPPD	Neligh 115kV
CURRENT CLUSTER SUBTOTAL	**507.10**		
AREA TOTAL	**2,514.00**		

GROUP 12: NW-AR AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2013-011	30.00	AEPW	Turk 138kV
PRIOR QUEUED SUBTOTAL	**30.00**		
AREA TOTAL	**30.00**		

GROUP 13: NW MISSOURI AREA

Request	Capacity	Area	Proposed Point of Interconnection
ASGI-2013-007	90.00	AECI	Tap Hickory Creek - Locust Creek 161kV
GEN-2008-129	80.00	MIPU	Pleasant Hill 161kV
GEN-2010-036	4.60	WERE	6th Street 115kV
GEN-2010-056	151.20	MIPU	Tap Saint Joseph - Cooper 345kV
GEN-2011-011	50.00	KACP	Iatan 345kV
PRIOR QUEUED SUBTOTAL	**375.80**		
AREA TOTAL	**375.80**		

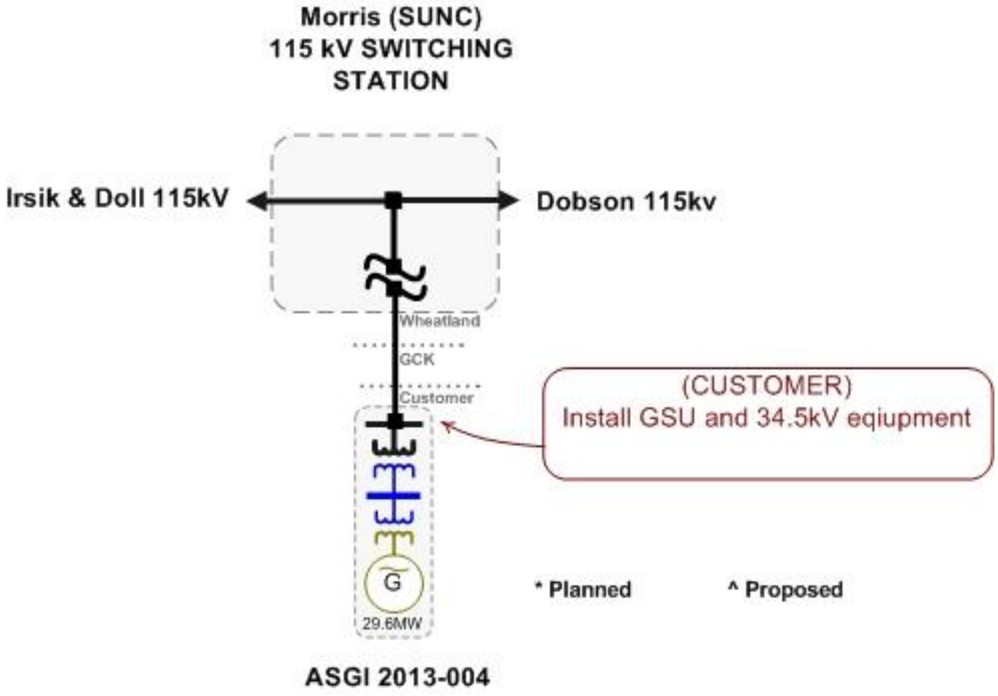
GROUP 14: S-OKLAHOMA AREA

Request	Capacity	Area	Proposed Point of Interconnection
GEN-2011-040	111.00	OKGE	Tap Ratliff - Pooleville 138kV
GEN-2011-050	109.80	AEPW	Rush Springs Natural Gas Tap 138kV
GEN-2012-004	41.40	OKGE	Tap Ratliff - Pooleville (Carter County) 138kV
GEN-2013-007	100.30	OKGE	Tap Prices Falls - Carter 138kV
PRIOR QUEUED SUBTOTAL	**362.50**		
AREA TOTAL	**362.50**		

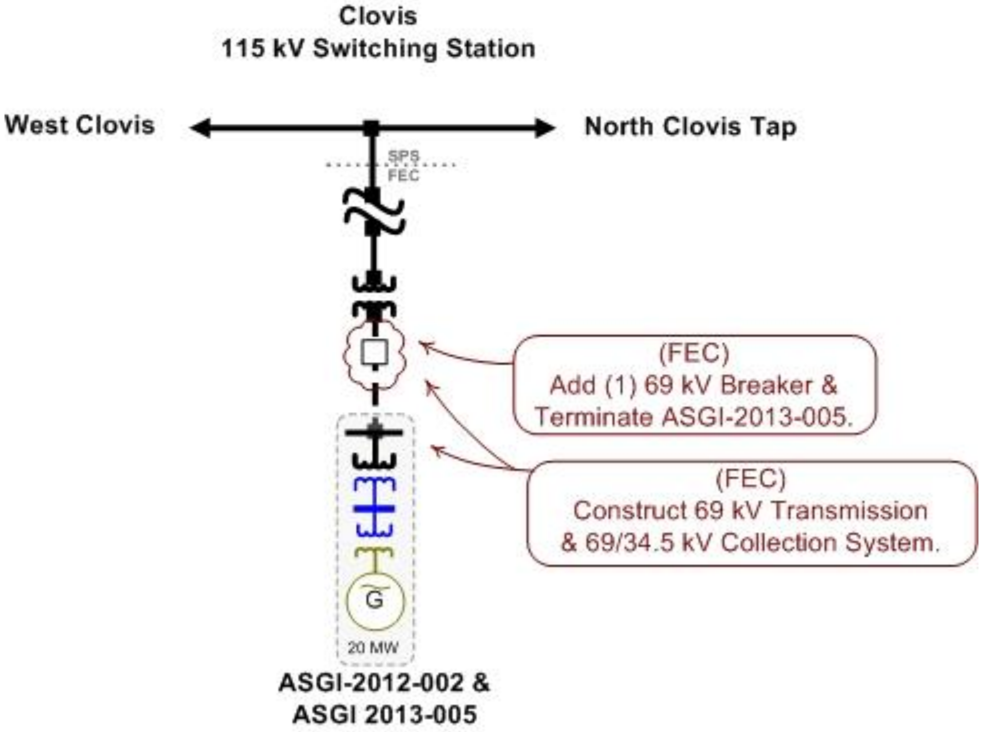
CLUSTER TOTAL (CURRENT STUDY)	**2,244.6**	MW
PQ TOTAL (PRIOR QUEUED)	**26,939.6**	MW
CLUSTER TOTAL (INCLUDING PRIOR QUEUED)	**29,184.2**	MW

D: Proposed Point of Interconnection One Line Diagrams

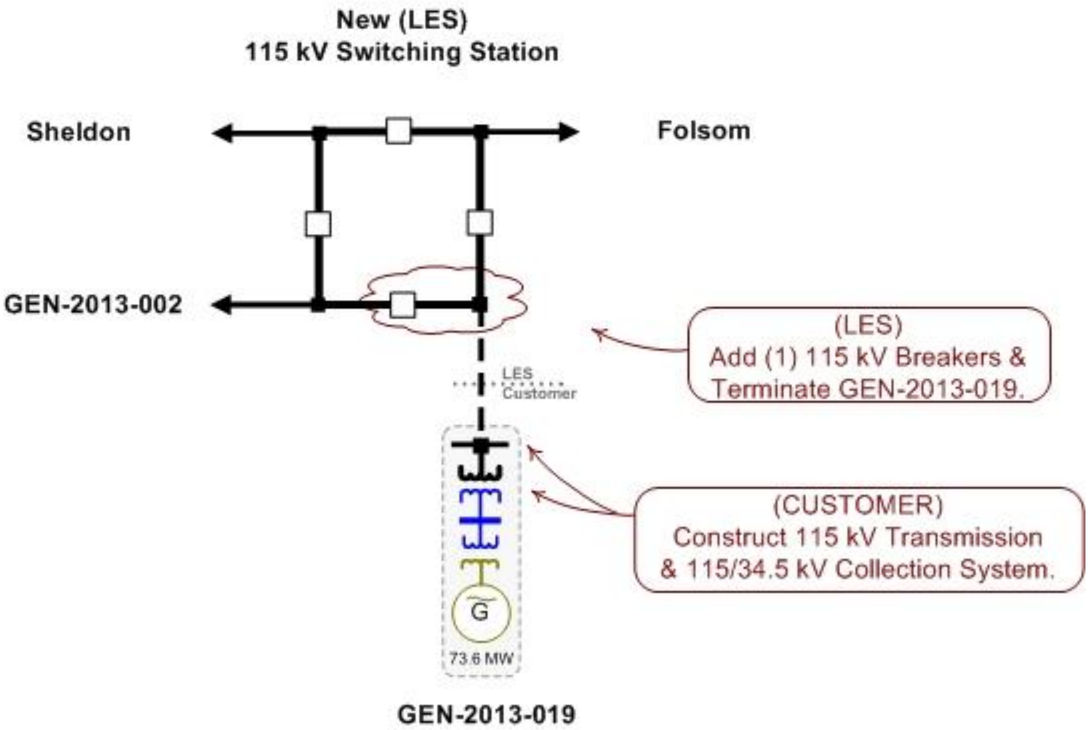
ASGI-2013-004



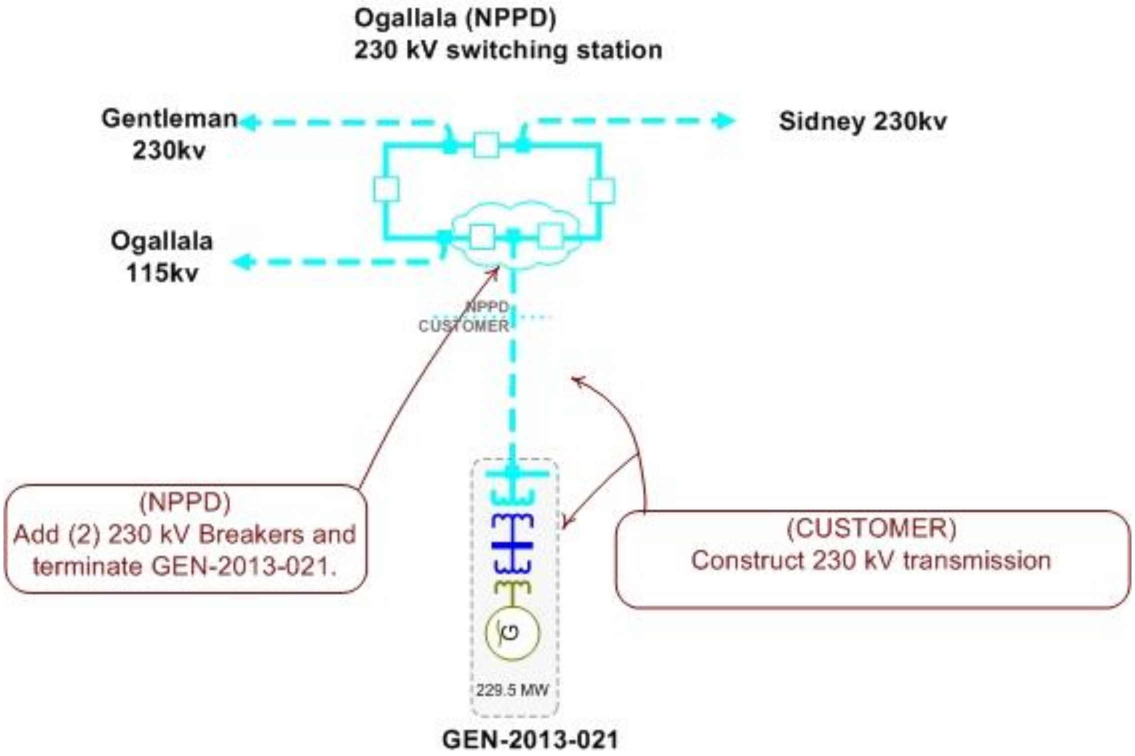
ASGI-2013-005



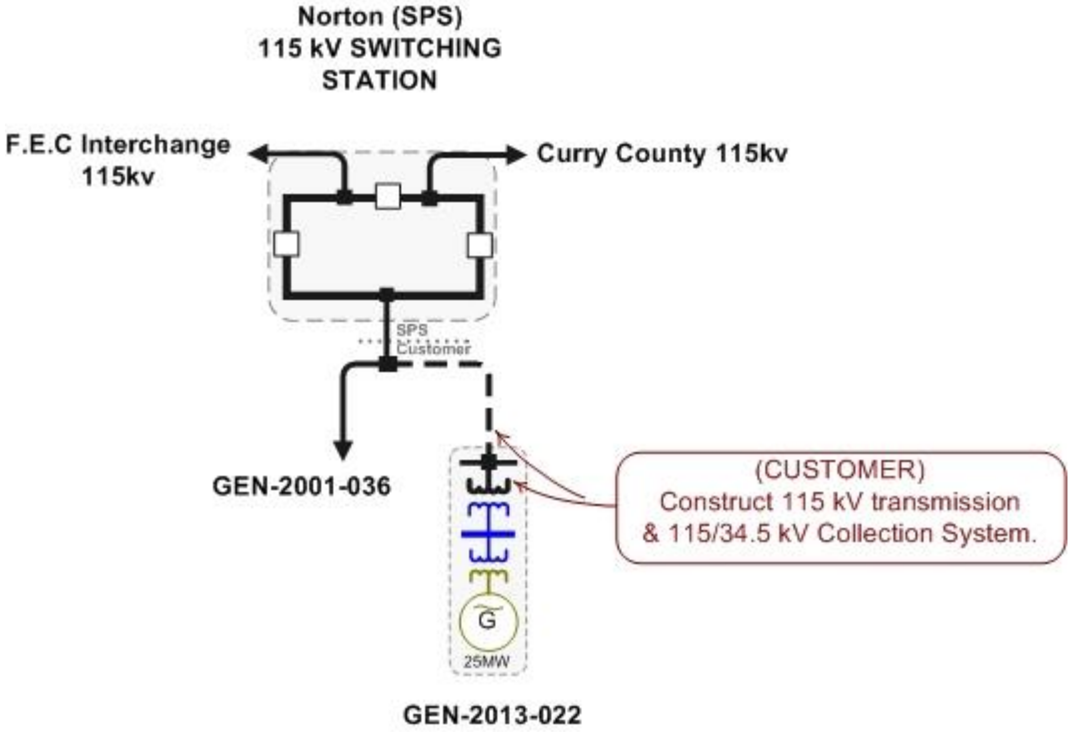
GEN-2013-019



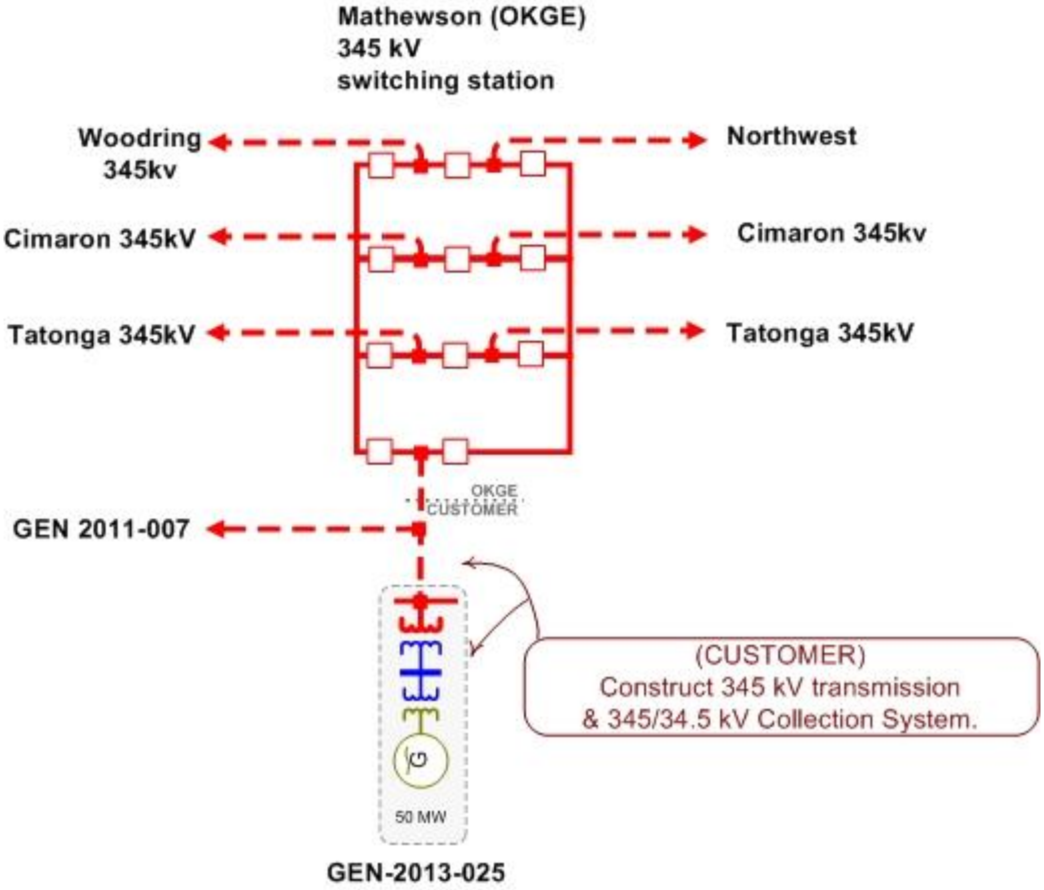
GEN-2013-021



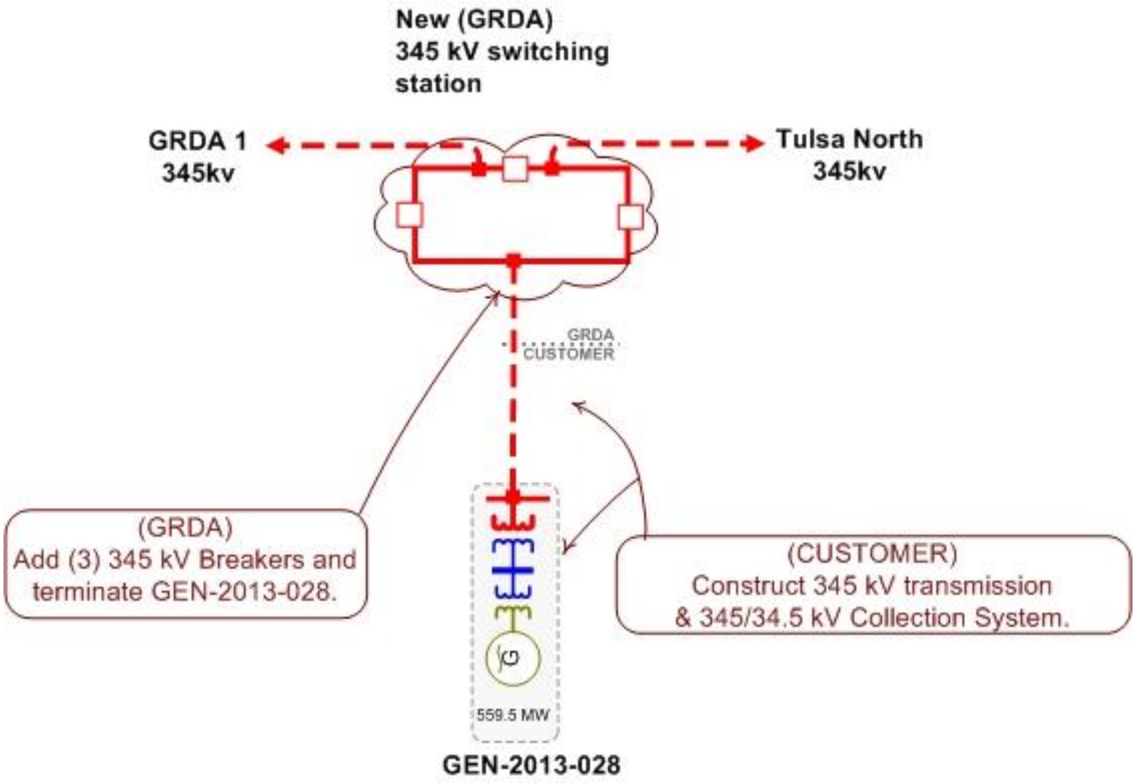
GEN-2013-022



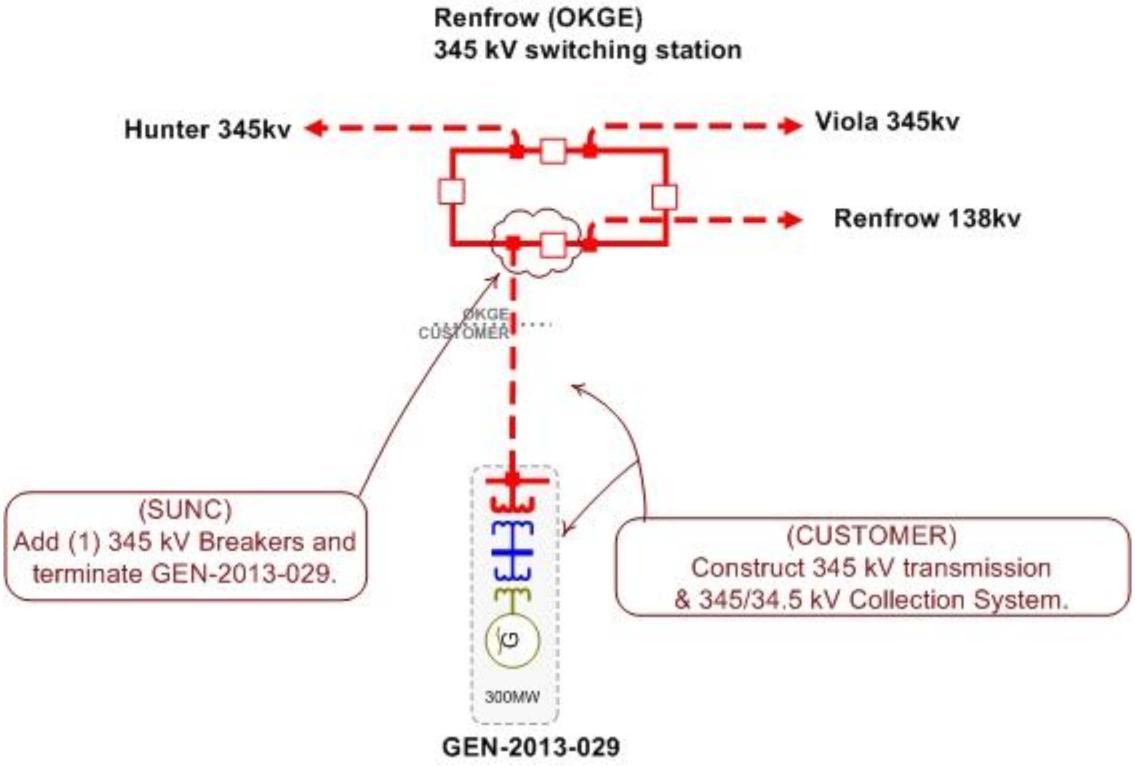
GEN-2013-025



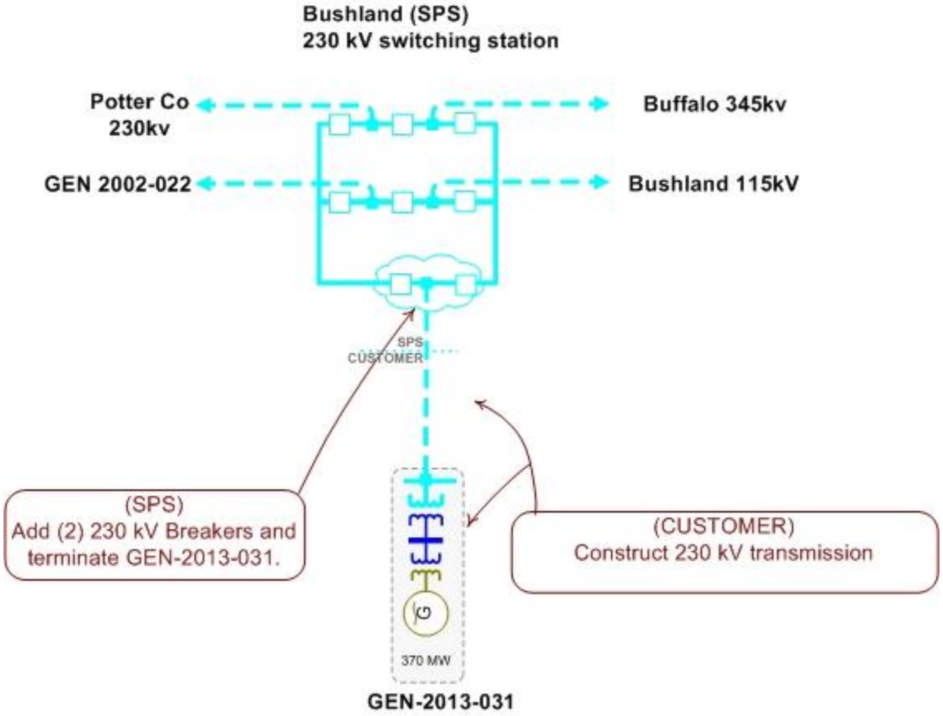
GEN-2013-028



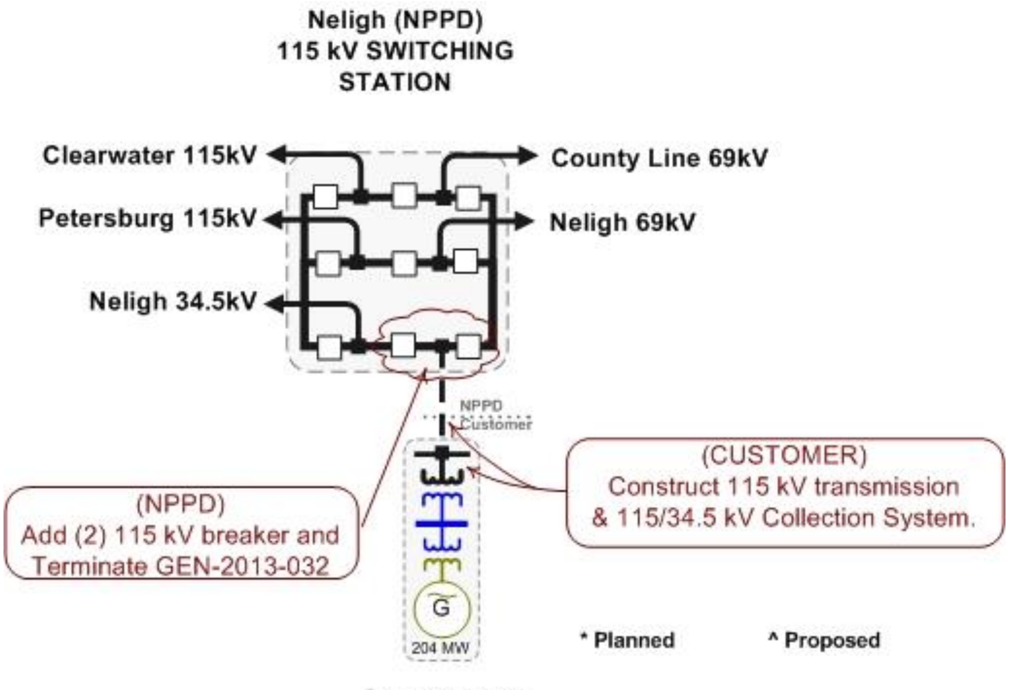
GEN-2013-029



GEN-2013-030

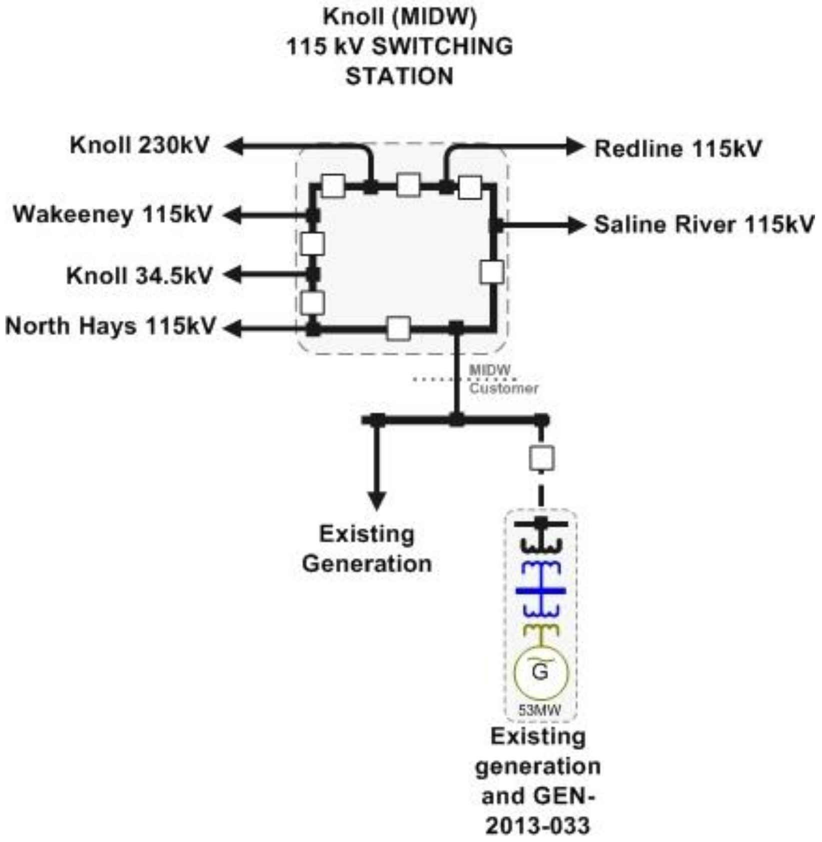

Bushland (SPS)
230 kV switching station
Potter Co
230kv
Buffalo 345kv
GEN 2002-022
Bushland 115kV
SPS
CUSTOMER
(SPS)
Add (2) 230 kV Breakers and terminate GEN-2013-031.
(CUSTOMER)
Construct 230 kV transmission
370 MW
GEN-2013-031

GEN-2013-032

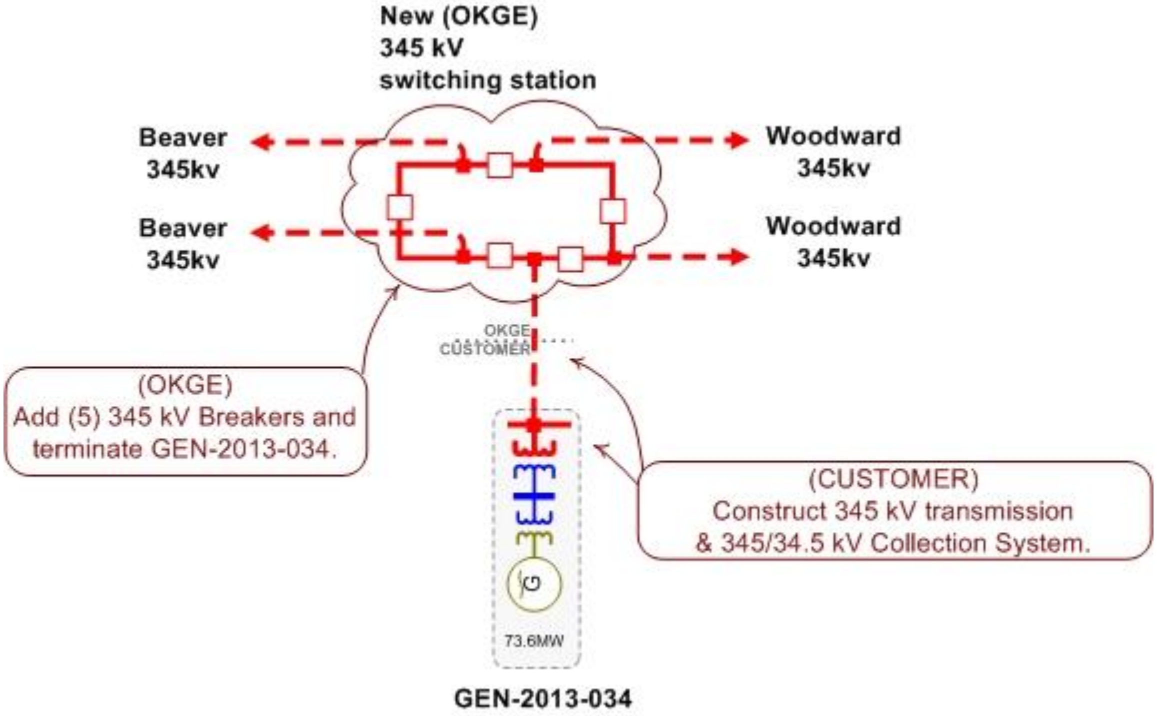


GEN-2013-032

GEN-2013-033



GEN-2013-034


New (OKGE)
345 kV
switching station
Beaver
345kv
Beaver
345kv
Woodward
345kv
Woodward
345kv
OKGE
CUSTOMER
(OKGE)
Add (5) 345 kV Breakers and terminate GEN-2013-034.
(CUSTOMER)
Construct 345 kV transmission & 345/34.5 kV Collection System.
73.6MW
GEN-2013-034

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

Important Note:

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

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

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

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

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

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*)

ASGI-2013-004

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
ASGI-2013-004 Interconnection Costs See One-line diagram	Current Study	$0.00	$0.00
Buckner - Spearville 345V CKT 1 Replace Terminal equipment	Previously Allocated		$771,000.00
Clark - Thistle 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Dobson - Gano 115kV CKT 1 Replace Terminal Equipment	Previously Allocated		$82,481.09
Garden City - Kansas Ave Water Treatment Plant 115KV CKT 1 Replace Terminal Equipment	Previously Allocated		$112,772.18
GEN-2011-017 Tap - Mullergren 345kV CKT 1 Build approximately 55 miles of new 345kV and add new terminal at GEN-2011-017 Tap 345kV	Previously Allocated		$67,000,000.00
Hitchland - Beaver County 345kV Dbl CKT Priority Project: Hitchland - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$226,040,727.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
Mullergren 345/230kV Substation Build new 345/230kV substation for terminating GEN-2011-017 Tap - Mullergren 345kV line, Mullergren 345/230/13kV transformer, and Mullergren - Great Bend 230kV	Previously Allocated		$25,000,000.00
Power System Stabilizers (PSS) Install Power System Stabilizers @ Tolk(Units: 1,2) and Jones (Units: 1,2,3,4)	Previously Allocated		$300,000.00
Spearville - Clark 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Tatonga - Mathewson 345kV CKT 2 Build second 345kV circuit from Tatonga - Mathewson @ 3000 amps	Previously Allocated		$104,260,473.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
	Current Study Total	$0.00	

ASGI-2013-005

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

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
ASGI-2013-005 Interconnection Costs See One-line diagram	Current Study	$0.00	$0.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Deaf Smith - Plant X 230kV CKT 1 Replace line traps at both ends	Previously Allocated		$1,000,000.00
Hitchland - Beaver County 345kV Dbl CKT Priority Project: Hitchland - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$226,040,727.00
Power System Stabilizers (PSS) Install Power System Stabilizers @ Tolk(Units: 1,2) and Jones (Units: 1,2,3,4)	Previously Allocated		$300,000.00
Thistle - Flat Ridge 138kV CKT 1 Priority Project: Thistle - Flat Ridge 138kV CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$5,776,280.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Thistle 345/138KV Transformer CKT 1 Priority Project: Thistle 345/138kV Transformer CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$6,585,986.00
Tolk - Plant X 230kV CKT 3 Build a 3rd circuit betweek Tolk - Plant X 230kV	Previously Allocated		$20,000,000.00
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00
Woodward XFMR 345/138/13.8kV CKT 2 Balanced Portfolio: Woodward 345/138kV Transformer CKT 2 & 50 MVAR Reactor (Total Project E&C Cost Shown).	Previously Allocated		$249,247,072.00
	Current Study Total	$0.00	
GEN-2013-019			
GEN-2013-019 Interconnection Costs See One-line diagram	Current Study	$1,500,000.00	$1,500,000.00
Hydro Carbon Tap - Sub974 69kV CKT 1 NRIS only required upgrade: Rewire CT on Sub 974	Previously Allocated		$10,000.00
Hydrocarbon Tap - Sub 970 CKT 1 Mitigated by replacing terminal equipment at Hydrocarbon Tap	Previously Allocated		$0.00

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

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Nebraska City U Syracuse - SUB 970 CKT 1 NRIS only required upgrade: Replace Terminal Equipment	Previously Allocated		$16,000.00
SUB 967 - SUB 968 69kV CKT 1 Replace terminal equipment	Previously Allocated		$16,000.00
SUB 968 - SUB 969 69kV CKT 1 Mitigated by replacing terminal equipment at Sub 969	Previously Allocated		$0.00
	Current Study Total	$1,500,000.00	
GEN-2013-021			
GEN-2013-021 Interconnection Costs See One-line diagram	Current Study	$7,000,000.00	$7,000,000.00
Gerald Gentleman Station Flowgate Stability Limit Mitigation Mitigation for GGS Flowgate Stability Limit. TBD in the Facilities Study with NPPD.	Current Study	TBD in NPPD Facility Study	
Cherry County - Holt County 345kV CKT 1 Build approximately 146 Miles of 345kV from Cherry County to Holt County. (Total Project E&C Cost Shown).	Previously Allocated		$313,376,623.00
Gentleman - Cherry County 345kV CKT 1 Build approximately 76 Miles of 345kV from Gentleman to Cherry County. (Total Project E&C Cost Shown).	Previously Allocated		$313,376,623.00
Maxwell - North Platte 115kV Regional Reliability 2014 ITP Near Turn. Replace Terminal equipment.	Previously Allocated		$30,000.00
Ogallala 230/115/13.8kV Transformer CKT 1 Per SPP-2009-AGP1-AFS-5. Replace Ogallala 230/115/13.8kV transformer for 6/1/2014 in-service.	Previously Allocated		$5,645,881.00
	Current Study Total	$7,000,000.00*	* Does not include cost to mitigate GGS Stability Flowgate Limit
GEN-2013-022			
GEN-2013-022 Interconnection Costs See One-line diagram	Current Study	$0.00	$0.00
Deaf Smith - Plant X 230kV CKT 1 Replace line traps at both ends	Previously Allocated		$1,000,000.00
Power System Stabilizers (PSS) Install Power System Stabilizers @ Tolk(Units: 1,2) and Jones (Units: 1,2,3,4)	Previously Allocated		$300,000.00
Tolk - Plant X 230kV CKT 3 Build a 3rd circuit betweek Tolk - Plant X 230kV	Previously Allocated		$20,000,000.00
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00

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

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$0.00	
GEN-2013-025			
GEN-2013-025 Interconnection Costs See One-line diagram	Current Study	$0.00	$0.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00
	Current Study Total	$0.00	
GEN-2013-028			
GEN-2013-028 Interconnection Costs See One-line diagram	Current Study	$10,000,000.00	$10,000,000.00
Sub 184 – Neosho 161/69kV Transformer CKT 1 NRIS only required upgrade: Replace existing 161/69kV transformer	Current Study	$2,000,000.00	$2,000,000.00
Afton - Explorer Tap 69kV CKT 1 NRIS only required upgrade: Rebuild approximately 2.1mi 69kV	Previously Allocated		$1,680,000.00
Eastern State Hospital Tap - Neo Tap 69kV CKT 1 NRIS only required upgrade: Rebuild approximately 2 miles of 69kV	Previously Allocated		$1,600,000.00
J6 - Explorer Tap 69kV CKT 1 NRIS only required upgrade: Rebuild approximately 5 miles of 69kV	Previously Allocated		$4,000,000.00
Vinita - Eastern State Hospital Tap 69kV CKT 1 NRIS only required upgrade: Rebuild approximately 2 miles of 69kV	Previously Allocated		$1,600,000.00
Vinita - Vinita Junction 69kV CKT 1 Rebuild approximately 3 miles of 69kV	Previously Allocated		$2,100,000.00
Vinita Junction 138/69/13.2kV Transformer CKT 1 Replace existing Vinita Junction transformer	Previously Allocated		$2,000,000.00
Vinita Neo Tap - J6 69kV CKT 1 NRIS only required upgrade: Rebuild approximately 2 miles of 69kV	Previously Allocated		$1,600,000.00

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
	Current Study Total	$12,000,000.00	

GEN-2013-029

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2013-029 Interconnection Costs See One-line diagram	Current Study	$3,000,000.00	$3,000,000.00
Viola - Wichita 345kV CKT 1 Replace Terminal Equipment	Current Study	$100,000.00	$100,000.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
	Current Study Total	$3,100,000.00	

GEN-2013-030

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2013-030 Interconnection Costs See One-line diagram	Current Study	$7,000,000.00	$7,000,000.00
Beaver County - Buckner 345kV Build approximately 90 miles of 345kV from Beaver County - Buckner @ 3000 amps	Previously Allocated		$170,209,050.00
Beaver County - Woodward 345kV Dbl CKT Priority Project: Hitchland - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$226,040,727.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Clark - Thistle 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Hitchland - Beaver County 345kV Dbl CKT Priority Project: Hitchland - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$226,040,727.00
Hitchland 345/230kV Autotransformer CKT 2 Priority Project: Hitchland 345/230kV Autotransformer CKT 2 (Total Project E&C Cost Shown).	Previously Allocated		$8,883,760.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
Spearville - Clark 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Tatonga - Mathewson 345kV CKT 2 Build second 345kV circuit from Tatonga - Mathewson @ 3000 amps	Previously Allocated		$104,260,473.00

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Thistle - Flat Ridge 138kV CKT 1 Priority Project: Thistle - Flat Ridge 138kV CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$5,776,280.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Thistle - Woodward 345KV Dbl CKT Priority Project: Thistle - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$207,782,000.00
Thistle 345/138KV Transformer CKT 1 Priority Project: Thistle 345/138kV Transformer CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$6,585,986.00
Woodward XFMR 345/138/13.8kV CKT 2 Balanced Portfolio: Woodward 345/138kV Transformer CKT 2 & 50 MVAR Reactor (Total Project E&C Cost Shown).	Previously Allocated		$249,247,072.00
	Current Study Total	$7,000,000.00	
GEN-2013-031			
Bushland - Bushland South 230kV CKT 1 Build 15 miles of 345kV operating at 230kV from Bushland to New Bushland South Substation. Also includes terminal equipment at each end. Includes substation work. Per SPP-2011-AG3-AFS-	Current Study	$30,000,000.00	$30,000,000.00
GEN-2013-031 Interconnection Costs See One-line diagram	Current Study	$6,000,000.00	$6,000,000.00
Beaver County - Buckner 345kV Build approximately 90 miles of 345kV from Beaver County - Buckner @ 3000 amps	Previously Allocated		$170,209,050.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Buckner - Spearville 345V CKT 1 Replace Terminal equipment	Previously Allocated		$771,000.00
Buckner - Spearville 345V CKT 1 Replace Terminal equipment	Previously Allocated		$771,000.00
Buckner - Spearville 345V CKT 1 Replace Terminal equipment	Previously Allocated		$771,000.00
Buckner - Spearville 345V CKT 1 Replace Terminal equipment	Previously Allocated		$771,000.00
Bushland - Buffalo - Deaf Smith 230kV CKT 1 NRIS only required upgrade: Replace line traps	Previously Allocated		$193,279.00

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

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Hitchland - Beaver County 345kV Dbl CKT Priority Project: Hitchland - Woodward Dbl 345kV CKT (Total Project E&C Cost Shown)	Previously Allocated		$226,040,727.00
Power System Stabilizers (PSS) Install Power System Stabilizers @ Tolk(Units: 1,2) and Jones (Units: 1,2,3,4)	Previously Allocated		$300,000.00
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00
	Current Study Total	$36,000,000.00	

GEN-2013-032

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Gavins Point - Yankton Junction 115kV CKT 1 NRIS only required upgrade: Will be studied further under WAPA affected system study.	Current Study	$10,000,000.00	$10,000,000.00
GEN-2013-032 Interconnection Costs See One-line diagram	Current Study	$4,000,000.00	$4,000,000.00
Hoskins - Neligh 345/115kV Project Per SPP 2014 ITP NT and NTC 200253 for 6/1/2016 in-service.	Previously Allocated		$98,697,720.00
Meadow Grove - North Petersburg 115kV CKT 1 Build approximately 25 miles of new 115kV circuit from Meadow Grove - North Petersburg	Previously Allocated		$18,000,000.00
Meadow Grove - South Norfolk 230kV CKT 1 Build approximately 25 miles of new 230kV circuit from Meadow Grove - South Norfolk	Previously Allocated		$25,000,000.00
Meadow Grove 230/115/13.8kV Transformer CKT 1 Build Meadow Grove 230/115/13.8kV Transformer	Previously Allocated		$6,000,000.00
Twin Church - Dixon County 230kV Increase conductor clearances to accommodate 320MVA facility rating	Previously Allocated		$100,000.00
	Current Study Total	$14,000,000.00	

GEN-2013-033

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
GEN-2013-033 Interconnection Costs See One-line diagram	Current Study	$4,000,000.00	$4,000,000.00
Clark - Thistle 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
Mullergren - Reno 345kV CKT 1 Build approximately 92 miles of new 345kV Transmission line from Mullergren - Reno @ 3000 amps	Previously Allocated		$107,408,253.00

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Spearville - Clark 345KV Dbl CKT Priority Project: Spearville - Clark - Thistle Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
Tatonga - Mathewson 345kV CKT 2 Build second 345kV circuit from Tatonga - Mathewson @ 3000 amps	Previously Allocated		$104,260,473.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00
	Current Study Total	$4,000,000.00	
GEN-2013-034			
Cleo Corner - Glass Mountain 138kV CKT 1 NRIS only required upgrade: Rebuild approximately 26 miles of 138kV line	Current Study	$15,163,471.00	$15,163,471.00
GEN-2013-034 Interconnection Costs See One-line diagram	Current Study	$18,000,000.00	$18,000,000.00
Glass Mountain - Mooreland 138kV NRIS only required upgrade: Rebuild approximatley 24 miles of 138kV line	Current Study	$15,072,467.00	$15,072,467.00
Border - Tuco Interchange 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Border - Woodward 345KV CKT 1 Balanced Portfolio: Tuco - Woodward 345kV CKT 1 (Total Project E&C Cost Shown)	Previously Allocated		$249,247,072.00
Evans Energy Center - Maize West 138kV CKT 1 NRIS only required upgrade: Replace terminal equipment per SPP-2011-AG3-AFS-9 for 6/1/2015 in-service.	Previously Allocated		$827,424.00
FPL Switch - Woodward 138kV CKT 1 NRIS only required upgrade: Rebuild approximately 12 miles of 138kV line	Previously Allocated		$6,509,948.00
Mathewson - Cimarron 345kV CKT 2 Build second 345kV circuit from Mathewson - Cimarron @ 3000 amps	Previously Allocated		$42,903,753.00
Northwest 345/138k/13.8kVAutotransformer CKT 3 NRIS only required upgrade: Per 2009-AG2-AFS6	Previously Allocated		$15,000,000.00
Tatonga - Mathewson 345kV CKT 2 Build second 345kV circuit from Tatonga - Mathewson @ 3000 amps	Previously Allocated		$104,260,473.00
Thistle - Flat Ridge 138kV CKT 1 Priority Project: Thistle - Flat Ridge 138kV CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$5,776,280.00
Thistle - Wichita 345KV Dbl CKT Priority Project: Thistle - Wichita Dbl 345kV CKT (Total Project E&C Cost Shown.)	Previously Allocated		$426,504,292.00

Interconnection Request and Upgrades	Upgrade Type	Allocated Cost	Upgrade Cost
Thistle 345/138KV Transformer CKT 1 Priority Project: Thistle 345/138kV Transformer CKT 1 (Total Project E&C Cost Shown.)	Previously Allocated		$6,585,986.00
TUCO Interchange 345/230/13.2KV Autotransformer CKT 2 Balanced Portfolio: TUCO 345/230 kV Transformer CKT 2 (Total Project E&C Cost Shown)	Previously Allocated		$14,900,907.00
	Current Study Total	$48,235,938.00	

TOTAL CURRENT STUDY COSTS: **$132,835,938.00***

* Does not include cost to mitigate GGS Stability Flowgate Limit for GEN-2013-021

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

F: Cost Allocation per Proposed Study Network Upgrade

Important Note:

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

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

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

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

Appendix F. Cost Allocation by Upgrade

ASGI-2013-004 Interconnection Costs **$0.00**

See One-line diagram

ASGI-2013-004	$0.00
Total Allocated Costs	**$0.00**

ASGI-2013-005 Interconnection Costs **$0.00**

See One-line diagram

ASGI-2013-005	$0.00
Total Allocated Costs	**$0.00**

Bushland - Bushland South 230kV CKT 1 **$30,000,000.00**

Build 15 miles of 345kV operating at 230kV from Bushland to New Bushland South Substation. Include all work associated with project.

GEN-2013-031	$30,000,000.00
Total Allocated Costs	**$30,000,000.00**

Cleo Corner - Glass Mountain 138kV CKT 1 **$15,163,471.00**

NRIS only required upgrade: Rebuild approximately 26 miles of 138kV line

GEN-2013-034	$15,163,471.00
Total Allocated Costs	**$15,163,471.00**

Gavins Point - Yankton Junction 115kV CKT 1 **$10,000,000.00**

NRIS only required upgrade: Will be studied further under WAPA affected system study.

GEN-2013-032	$10,000,000.00
Total Allocated Costs	**$10,000,000.00**

GEN-2013-019 Interconnection Costs **$1,500,000.00**

See One-line diagram

GEN-2013-019	$1,500,000.00
Total Allocated Costs	**$1,500,000.00**

GEN-2013-021 Interconnection Costs **$7,000,000.00**

See One-line diagram

GEN-2013-021	$7,000,000.00
Total Allocated Costs	**$7,000,000.00**

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

GEN-2013-022 Interconnection Costs **$0.00**

See One-line diagram

GEN-2013-022	$0.00
Total Allocated Costs	**$0.00**

GEN-2013-025 Interconnection Costs **$0.00**

See One-line diagram

GEN-2013-025	$0.00
Total Allocated Costs	**$0.00**

GEN-2013-028 Interconnection Costs **$10,000,000.00**

See One-line diagram

GEN-2013-028	$10,000,000.00
Total Allocated Costs	**$10,000,000.00**

GEN-2013-029 Interconnection Costs **$3,000,000.00**

See One-line diagram

GEN-2013-029	$3,000,000.00
Total Allocated Costs	**$3,000,000.00**

GEN-2013-030 Interconnection Costs **$7,000,000.00**

See One-line diagram

GEN-2013-030	$7,000,000.00
Total Allocated Costs	**$7,000,000.00**

GEN-2013-031 Interconnection Costs **$6,000,000.00**

See One-line diagram

GEN-2013-031	$6,000,000.00
Total Allocated Costs	**$6,000,000.00**

GEN-2013-032 Interconnection Costs **$4,000,000.00**

See One-line diagram

GEN-2013-032	$4,000,000.00
Total Allocated Costs	**$4,000,000.00**

GEN-2013-033 Interconnection Costs **$4,000,000.00**

See One-line diagram

GEN-2013-033	$4,000,000.00
Total Allocated Costs	**$4,000,000.00**

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

GEN-2013-034 Interconnection Costs **$18,000,000.00**

See One-line diagram

GEN-2013-034	$18,000,000.00
Total Allocated Costs	**$18,000,000.00**

Gerald Gentleman Station Flowgate Stability Limit Mitigation **TBD in Facility Study**

Mitigation for GGS Flowgate Stability Limit. TBD in the Facilities Study with NPPD.

GEN-2013-021	TBD
Total Allocated Costs	**TBD**

Glass Mountain - Mooreland 138kV **$15,072,467.00**

NRIS only required upgrade: Rebuild approximatley 24 miles of 138kV line

GEN-2013-034	$15,072,467.00
Total Allocated Costs	**$15,072,467.00**

Sub 184 – Neosho 161/69kV Transformer CKT 1 **$2,000,000.00**

NRIS only required upgrade: Replace existing 161/69kV transformer

GEN-2013-028	$2,000,000.00
Total Allocated Costs	**$2,000,000.00**

Viola - Wichita 345kV CKT 1 **$100,000.00**

Replace Terminal Equipment

GEN-2013-029	$100,000.00
Total Allocated Costs	**$100,000.00**

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

G: Power Flow Analysis (Constraints Used For Mitigation)

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00G13_021	0	14SP	G13_021	FROM->TO	GGS	1635	0.78349	100.0616	BASE CASE
FDNS	00NR	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03201	114.5944	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00NR	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03484	101.4294	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	09NR	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.58904	103.8513	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	09NR	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.58904	103.2477	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	09G13_021	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.5891	102.9216	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	09G13_021	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.5891	102.5809	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	00G13_021	2	14SP	G13_021	FROM->TO	GGS	1635	0.78336	100.1063	BASE CASE
FDNS	00NR	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03502	101.9014	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	3	14SP	G13_021	FROM->TO	GGS	1635	0.78336	100.0892	BASE CASE
FDNS	00NR	3	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03502	101.9777	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00NR	4	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03202	114.7466	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00NR	4	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03502	102.0931	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00NR	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.05288	130.7257	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.0574	111.4792	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.07383	110.8047	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.06938	109.0361	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.06718	103.6261	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.05288	131.3915	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.05288	125.7209	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.07383	119.7957	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.07383	117.156	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.0574	112.8599	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06718	112.0495	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06718	109.8637	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06938	109.3152	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.0574	108.1862	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06938	105.3087	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.05288	105.2438	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	CURRY COUNTY INTERCHANGE - DEAF SMITH REC-#20 115KV CKT 1	96	0.16401	101.9123	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	119.9216	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	119.9061	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	118.1063	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	118.0911	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	103.9601	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	103.9352	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03478	101.916	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	101.1645	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	101.1641	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03478	100	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04118	99.9	PLANT X STATION - SUNDOWN INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05423	129.438	SUB 404 - HOCKERVILLE - VINITA JUNCTION 138KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05423	129.3258	SUB 404 - HOCKERVILLE (HOCK 138) 161/138/12.5KV TRANSFORMER CKT 1
FDNS	00NR	0	19SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05275	116.9305	PENSACOLA (PENAUTO1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	19WP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05256	110.115	PENSACOLA (PENAUTO1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.10767	110.0607	PENSACOLA (PENAUTO1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05265	109.7731	PENSACOLA (PENAUTO1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.0497	107.9661	KETCHUM5 161.00 - PENSACOLA 161KV CKT 1
FDNS	00NR	0	19SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.0316	107.3485	MAID - PENSACOLA 161KV CKT 1
FDNS	00NR	0	19SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.0316	106.6149	PENSACOLA - PENSACOLA 161KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.0497	106.0267	AFTON - KETCHUM5 161.00 161KV CKT 1
FDNS	00NR	0	19WP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03148	104.9365	MAID - PENSACOLA 161KV CKT 1
FDNS	00NR	0	19WP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03148	104.3417	PENSACOLA - PENSACOLA 161KV CKT 1
FDNS	00NR	0	19SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03115	103.7215	MIAMI - SUB 404 - HOCKERVILLE 161KV CKT 1
FDNS	00NR	0	19SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03038	103.1689	KERR - PENSACOLA 161KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.06121	103.0674	AFTON (AFTAUTO1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.06543	101.5598	MAID - PENSACOLA 161KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.06741	101.5037	MIAMI - SUB 404 - HOCKERVILLE 161KV CKT 1
FDNS	00NR	0	14SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03157	101.4675	MAID - PENSACOLA 161KV CKT 1
FDNS	00NR	0	14SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.03157	100.7905	PENSACOLA - PENSACOLA 161KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.06543	100.75	PENSACOLA - PENSACOLA 161KV CKT 1
FDNS	00NR	0	24SP	G13_028	TO->FROM	EASTERN STATE HOSPITAL TAP - VINITA 69KV CKT 1	39	0.05915	100.6336	SUB 377 - QUAPAW (EAGLE PICHER) - SUB 404 - HOCKERVILLE 69KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	EASTERN STATE HOSPITAL TAP - VINITA NEO TAP 69KV CKT 1	48	0.05423	101.5241	SUB 404 - HOCKERVILLE - VINITA JUNCTION 138KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	EASTERN STATE HOSPITAL TAP - VINITA NEO TAP 69KV CKT 1	48	0.05423	101.4201	SUB 404 - HOCKERVILLE (HOCK 138) 161/138/12.5KV TRANSFORMER CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	SUB 184 - NEOSHO SOUTH JCT. 161/69KV TRANSFORMER CKT 1	84	0.03182	106.2857	5WASHBRN 161.00 161/69KV TRANSFORMER CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	SUB 184 - NEOSHO SOUTH JCT. 161/69KV TRANSFORMER CKT 1	84	0.03182	106.3695	5WASHBRN 161.00 161/69KV TRANSFORMER CKT 1
FDNS	08G13_029	0	14G	G13_029	FROM->TO	VIOLA 7 345.00 - WICHITA 345KV CKT 1	1035	0.83039	100.9917	HUNTERS7 345.00 - WOODRING 345KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.63555	139.0869	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	115.392	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	115.1235	GEN525561 1-TOLK GEN #1 24 KV
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	100.638	GEN527903 1-HOBBS PLANT #3 (ST)
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.36445	165.8101	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.41017	137.9637	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00NR	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.35106	130.7257	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.39723	130.7245	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.39856	118.9675	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.41175	118.2111	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.35558	111.4792	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.37484	110.8047	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.17699	110.2556	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.36569	109.0361	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.39765	107.2359	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.36536	103.6261	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.82301	161.1115	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.64367	116.8196	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.64367	116.8065	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.82301	116.3663	BUFFALO 230.00 - BUSHLAND INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.64367	113.6406	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.67416	104.7892	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36445	162.822	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36445	158.2685	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.41017	137.9027	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.41017	132.6146	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.35106	131.3915	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39723	131.3824	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39856	128.5177	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.41175	127.7552	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39856	125.8292	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.35106	125.7209	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39723	125.6887	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.41175	124.8776	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.37484	119.7957	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.37484	117.156	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.35558	112.8599	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36536	112.0495	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19WP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36536	109.8637	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36569	109.3152	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39765	108.6126	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.17699	108.4015	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.35558	108.1862	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.17699	106.0506	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.36569	105.3087	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.39765	104.1266	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	24SP	G13_031	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.1766	99.9	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1
FDNS	05NR	0	14G	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.36445	142.8307	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.41017	113.7402	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	19SP	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.35106	105.2438	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.39723	105.2356	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.41175	101.4318	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_031	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.39856	101.0234	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.0666	126.6933	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.0666	118.2086	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.06623	105.9726	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.06623	102.7195	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06536	124.4824	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	00NR	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06536	115.5386	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	05NR	0	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06499	104.0473	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	05NR	0	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.06499	100.5206	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	05NR	2	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.25978	103.75	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	2	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.25978	103.315	GEN525561 1-TOLK GEN #1 24 KV
FDNS	00NR	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.05013	125.414	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.05013	116.9702	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	05NR	2	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.04972	101.4989	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00NR	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.04919	123.2139	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	00NR	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.04919	114.3164	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	05NR	4	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.26146	105.821	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	4	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.26146	105.3697	GEN525561 1-TOLK GEN #1 24 KV
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38384	122.6091	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38387	121.6553	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.49738	113.1227	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.49486	112.7024	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35577	112.1929	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35577	112.0349	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	111.8204	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	111.6622	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38384	110.5011	BLOOMFIELD - GAVINS POINT 115KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38448	109.4751	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31495	106.2091	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32409	106.0922	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32409	106.0732	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36889	105.8864	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36889	105.8849	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32465	105.7436	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32465	105.6737	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	105.2543	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36948	104.9034	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36948	104.9023	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32506	104.7409	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33605	104.1459	ALBION - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33754	104.0714	ALBION - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31331	103.514	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	102.8253	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33605	102.8127	COLUMBUS - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33754	102.7747	COLUMBUS - GENOA 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32607	102.7154	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32687	102.2997	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	102.1539	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32506	102.1535	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37872	101.9814	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	101.5937	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37872	101.4173	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32437	100.8683	UTICA - YANKON JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32226	100.6273	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.3234	100.5951	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	100.4866	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32516	100.403	UTICA - YANKON JCT 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35461	100.3867	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	100.3331	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32074	100.3271	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35461	100.233	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38384	100.1368	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32138	100	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38384	117.0857	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38387	116.12	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.49738	107.5844	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.49486	107.1765	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35577	106.6383	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35577	106.4802	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35411	106.2817	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35411	106.1235	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38384	104.9955	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38448	103.9706	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.31495	100.6837	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32409	100.5506	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32409	100.5332	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36889	100.3549	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36889	100.3535	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32465	100.1864	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32465	100.1191	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38384	123.3005	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38387	122.3458	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.49738	113.8159	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.49486	113.3982	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35577	112.8847	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35577	112.7267	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	112.5138	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	112.3558	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38384	111.1987	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38448	110.1731	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31495	106.8865	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32409	106.7867	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32409	106.7677	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36889	106.5816	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36889	106.5802	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32465	106.4365	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32465	106.367	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	105.946	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36948	105.5974	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36948	105.5972	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32506	105.4393	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33605	104.8387	ALBION - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33754	104.7662	ALBION - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31331	104.2121	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	103.5237	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33605	103.506	COLUMBUS - GENOA 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33754	103.4725	COLUMBUS - GENOA 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32607	103.4088	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32687	102.9915	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32506	102.8501	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	102.8473	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37872	102.6773	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	102.2857	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37872	102.1133	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32437	101.5639	UTICA - YANKON JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32226	101.3227	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.3234	101.2894	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	101.1813	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32516	101.0966	UTICA - YANKON JCT 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35461	101.0812	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	101.0281	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	101.0228	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35461	100.9276	ALBION - PETERSBURG 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38384	100.8286	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32138	100.6665	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	100.4597	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.3179	100.235	G10-51T 230.00 - HOSKINS 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32138	100.1043	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38387	100	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	99.9	ONEILL - SPENCER 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - HARTINGTON 115KV CKT 1	120	0.08245	106.7198	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11184	119.9259	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11884	119.3511	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11184	114.8528	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11884	109.0208	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11184	105.7922	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	120	0.09323	101.8035	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	120	0.09827	100.9413	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0579	105.6898	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09NR	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05461	102.351	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0579	101.0332	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0579	105.6787	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09NR	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05461	102.3486	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0579	101.0285	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	4	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0599	108.3882	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09NR	4	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05569	104.7685	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	4	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.0599	103.7216	BERSFORD - MANNING 115KV CKT 1
FDNS	00NR	0	24SP	G13_034	FROM->TO	EVANS ENERGY CENTER NORTH - MAIZEW 4 138.00 138KV CKT 1	346	0.03776	101.1602	BENTON - WICHITA 345KV CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07235	112.088	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07235	112.0259	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07013	106.0912	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	00NR	0	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07013	106.0244	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	123.4607	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	0	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04796	122.7456	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	0	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	121.8069	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	119.2707	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	0	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04796	118.429	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	0	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	117.4519	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	0	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	114.9133	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	0	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	110.7866	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03154	102.8573	KNOBHILL - MOORELAND 138KV CKT 1
FDNS	00NR	0	14SP	G13_034	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.03584	115.2058	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_034	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.03584	113.1832	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_034	FROM->TO	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1	493	0.03459	105.1277	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	14SP	G13_034	FROM->TO	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1	493	0.03459	103.3069	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	4	24SP	G13_034	FROM->TO	EVANS ENERGY CENTER NORTH - MAIZEW 4 138.00 138KV CKT 1	346	0.03776	101.1896	BENTON - WICHITA 345KV CKT 1
FDNS	00NR	4	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07236	112.0171	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	00NR	4	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07236	111.9552	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	4	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07014	105.9915	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	00NR	4	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07014	105.9242	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	123.4206	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	4	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04796	122.7682	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	4	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	121.7156	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	119.2019	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	4	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04796	118.4483	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	4	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	117.3564	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	4	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	114.9925	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	4	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	110.8446	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03154	102.8413	KNOBHILL - MOORELAND 138KV CKT 1
FDNS	00NR	5	19SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0449	106.4677	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	5	19SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0449	106.2707	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	5	14SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0468	105.807	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	5	14SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0468	105.546	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1

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

See next page.

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00ASGI_13_005	0	14SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.11203	140.8223	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09872	129.2364	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.09983	121.8544	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.11016	120.6545	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	24SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09912	106.6905	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11203	140.7015	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11203	135.2732	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09983	131.5919	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11016	130.3605	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09872	129.9142	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09983	128.7936	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14WP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11016	127.3856	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09872	124.3135	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	24SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09912	108.0671	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	24SP	ASGI_13_005	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09912	103.6169	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14SP	ASGI_13_005	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.11203	116.3512	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19SP	ASGI_13_005	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.09872	103.8822	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	19WP	ASGI_13_005	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.09983	103.7062	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00ASGI_13_005	0	14WP	ASGI_13_005	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.11016	103.7018	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	CURRY COUNTY INTERCHANGE - DEAF SMITH REC-#20 115KV CKT 1	96	0.17608	108.8534	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	DEAF SMITH REC-#20 - PARMER COUNTY SUB 115KV CKT 1	96	0.17608	100.148	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05567	122.5894	DBL-WWRD-G12
FDNS	06ASGI_13_005	0	14G	ASGI_13_005	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05611	105.8229	DBL-WWRD-G12
FDNS	6	0	14G	ASGI_13_005	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05612	105.5062	DBL-WWRD-G12
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	106.2218	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	106.2218	SPP-SWPS-K37
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	106.2066	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.08147	105.806	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.08147	103.5395	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	103.3633	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	103.353	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07198	103.353	SPP-SWPS-K37
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.09371	100	TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	SPSSPPTIESB	620	0.42277	119.2722	BASE CASE
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	SPSSPPTIESB1	620	0.32529	102.1466	BASE CASE
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	SPSSPPTIESC	620	0.32529	102.1466	BASE CASE
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	SPSSPPTIESC1	620	0.42277	119.2722	BASE CASE
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1	560	0.36131	118.051	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1	560	0.36131	116.0769	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2	560	0.3567	116.6048	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	ASGI_13_005	FROM->TO	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2	560	0.3567	114.4675	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1
FNSL-Blown up	01ALL	0	14G	G13_019		Non-Converged Contingency	0	0.03879	-	DBL-TGA-MATT
FDNS	00G13_019	0	24SP	G13_019	FROM->TO	STERLING 115/69KV TRANSFORMER CKT 1	56	0.03063	99.9	SUB 1263 BROCK (S1263 T1) 161/69/13.8KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	G13_019	FROM->TO	TUCXFR345230	300	0.03656	120.7	BASE CASE
FNSL-Blown up	01ALL	0	14G	G13_021		Non-Converged Contingency	0	0.07236	-	DBL-TGA-MATT
FDNS	00NR	0	19SP	G13_021	FROM->TO	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1	611.9	0.03021	113.7152	DBL-G1216-TH
FDNS	00NR	0	14SP	G13_021	FROM->TO	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1	611.9	0.03596	105.6068	DBL-G1216-TH
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03923	115.6999	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03923	115.6567	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	0	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03922	110.7542	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	0	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03922	110.7199	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	00G13_021	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03917	110.4361	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FNSL	00G13_021	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03917	110.3327	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04892	108.2909	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04879	107.6823	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04258	106.1785	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	00G13_021	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04258	106.0832	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.05423	105.8878	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	0	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03918	105.3191	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	0	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03918	105.2594	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	104.7351	MISSION - ST FRANCIS 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	103.8461	HARMONY - ST FRANCIS 115KV CKT 1
FDNS	0	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04893	101.7957	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	101.7363	HARMONY - VALENTINE 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	101.7313	LN-1091
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03719	101.4553	FT RANDAL - SPENCER 115KV CKT 1
FDNS	00G13_021	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.0365	101.1955	MISSION - ST FRANCIS 115KV CKT 1
FDNS	0	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.0488	101.1893	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03719	100.8609	ONEILL - SPENCER 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03719	100.8288	LN-WAPA6
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03719	100.8288	NEB001NPPB2
FDNS	00G13_021	0	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.0365	100.503	HARMONY - ST FRANCIS 115KV CKT 1
FDNS	0	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04259	100.4764	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	0	0	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04259	100.4	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04315	100.2431	GERALD GENTLEMAN STATION - SWEETWATER 345KV CKT 1
FDNS	0	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	100.0669	MISSION - ST FRANCIS 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04177	99.9	GRAND ISLAND - SWEETWATER 345KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03627	99.5	LOUP CITY - ST LIBORY 115KV CKT 1
FDNS	00G13_021	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03535	99.5	ALBION - SPALDING 115KV CKT 1
FDNS	0	0	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	99.2	HARMONY - ST FRANCIS 115KV CKT 1
FDNS	09ALL	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.5891	103.241	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	09ALL	0	14G	G13_021	FROM->TO	OGALLALA (OGALLALA T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.5891	102.942	GERALD GENTLEMAN STATION - OGALLALA 230KV CKT 1
FDNS	06ALL	0	14G	G13_021	FROM->TO	TUCXFR345230	300	0.0308	120.7	BASE CASE
FDNS	00G13_021	0	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03582	109.3105	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	0	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03582	108.809	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	0	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03572	104.4502	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	0	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03586	104.0636	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	0	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03572	103.4401	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	0	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03586	103.3704	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	0	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03573	100.4094	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	0	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03573	99.3	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	2	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03923	110.4807	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	0	2	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03923	110.467	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	0	2	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03918	105.0698	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	0	2	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03918	105.0104	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.05455	104.3933	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04297	104.2052	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	00G13_021	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04297	104.1721	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	0	2	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04893	101.5974	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	0	2	19SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04879	101.0853	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	0	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04259	100.3015	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	0	2	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04259	100.2167	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	0	2	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	99.8	MISSION - ST FRANCIS 115KV CKT 1
FDNS	0	2	24SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.03658	99	HARMONY - ST FRANCIS 115KV CKT 1
FDNS	00G13_021	2	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.0359	108.2507	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	2	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.0359	107.7188	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	2	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03575	104.27	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	2	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03585	103.9951	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	2	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03585	103.2978	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	2	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03575	103.2464	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	2	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03572	100.3551	STEGALL - WAYSIDE 230KV CKT 1
FDNS	0	2	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03572	99.3	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	3	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.05455	104.4592	CROOKED CREEK - NORTH PLATTE 230KV CKT 1
FDNS	00G13_021	3	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04297	104.3221	CROOKED CREEK (CR.CREEK T1) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	00G13_021	3	14SP	G13_021	TO->FROM	MAXWELL - NORTH PLATTE 115KV CKT 1	160	0.04297	104.2486	BROKEN BOW - CROOKED CREEK 115KV CKT 1
FDNS	00G13_021	3	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.0359	108.4265	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	3	14WP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.0359	107.8652	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	3	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03575	104.3261	STEGALL - WAYSIDE 230KV CKT 1
FDNS	00G13_021	3	14SP	G13_021	FROM->TO	VICTORY HILL (VICTORYHL T1) 230/115/13.8KV TRANSFORMER CKT 1	187	0.03575	103.311	STEGALL - WAYSIDE 230KV CKT 1
FNSL-Blown up	01ALL	0	14G	G13_022		Non-Converged Contingency	0	0.14175	-	DBL-TGA-MATT
FDNS	00G13_022	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.11376	143.9279	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.11385	137.9637	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09916	131.756	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09906	130.7245	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.10024	124.9248	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.11063	124.2123	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.10038	118.9675	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	177	0.11075	118.2111	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09956	109.1035	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE - HILLSIDE 115KV CKT 1	160	0.09947	107.2359	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11376	143.6887	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11376	138.1203	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11385	137.9027	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.10024	134.8356	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11063	134.1512	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11385	132.6146	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09916	132.3861	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.10024	131.9221	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09906	131.3824	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11063	131.0312	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.10038	128.5177	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11075	127.7552	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09916	126.6616	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.10038	125.8292	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09906	125.6887	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.11075	124.8776	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00G13_022	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09956	110.4776	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09947	108.6126	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09956	105.9272	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	24SP	G13_022	FROM->TO	BUSHLAND INTERCHANGE (WH 7001795) 230/115/13.2KV TRANSFORMER CKT 1	168	0.09947	104.1266	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14SP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.11376	119.1876	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.11385	113.7402	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	14WP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.11063	107.007	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19WP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.10024	106.5595	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	00G13_022	0	19SP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.09916	106.1816	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19SP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	176	0.09906	105.2356	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.11075	101.4318	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	0	0	19WP	G13_022	TO->FROM	COULTER INTERCHANGE - HILLSIDE 115KV CKT 1	191	0.10038	101.0234	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	CURRY COUNTY INTERCHANGE - DEAF SMITH REC-#20 115KV CKT 1	96	0.19174	108.8534	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	DEAF SMITH REC-#20 - PARMER COUNTY SUB 115KV CKT 1	96	0.19174	100.148	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	01ALL	0	14G	G13_022	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.05374	179.9163	DBL-WWRD-G12
FDNS	1	0	14G	G13_022	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.05616	135.2862	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_022	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.05411	117.2183	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05374	282.2734	DBL-WWRD-G12
FDNS	1	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05616	211.9348	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05411	210.9338	DBL-WWRD-G12
FDNS	2	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05573	159.2865	DBL-WWRD-G12
FDNS	06ALL	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05564	122.5894	DBL-WWRD-G12
FDNS	06G13_022	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05604	106.5256	DBL-WWRD-G12
FDNS	6	0	14G	G13_022	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05608	105.5062	DBL-WWRD-G12
FDNS	0	0	14SP	G13_022	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03	120.1111	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_022	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03	115.0443	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	02ALL	0	14G	G13_022	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03665	99.8	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1
FDNS	02ALL	0	14G	G13_022	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	318.7	0.03978	106.6214	G11-17T 345.00 - SPEARVILLE 345KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	119.9061	SPP-SWPS-K37
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04088	118.0911	SPP-SWPS-K37
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	112.996	DEAF SMITH COUNTY INTERCHANGE - DEAF SMITH REC-#21 115KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	110.852	DEAF SMITH COUNTY INTERCHANGE - DEAF SMITH REC-#21 115KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	108.1113	CASTRO COUNTY INTERCHANGE - DEAF SMITH REC-#21 115KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	108.0287	SPP-SWPS-T04
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	106.2779	CASTRO COUNTY INTERCHANGE - DEAF SMITH REC-#21 115KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	106.2218	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	106.2218	SPP-SWPS-K37
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	106.2066	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03852	106.174	SPP-SWPS-T04
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07754	105.806	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	103.9601	SPP-SWPS-K37
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.07754	103.5395	DEAF SMITH COUNTY INTERCHANGE - PLANT X STATION 230KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	103.3633	LAMB COUNTY INTERCHANGE - TOLK STATION WEST 230KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	103.353	LAMB COUNTY INTERCHANGE (WH ALM20172) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.06945	103.353	SPP-SWPS-K37
FDNS	06NR	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.03424	101.1641	SPP-SWPS-K37
FDNS	06ALL	0	14G	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.0912	100	TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14SP	G13_022	FROM->TO	PLANT X STATION (WH ALM20171) 230/115/13.2KV TRANSFORMER CKT 1	252	0.04675	99.6	TOLK STATION EAST - TUCO INTERCHANGE 230KV CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESB	620	0.42274	119.2722	BASE CASE
FDNS	02ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESB1	620	0.32821	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESB1	620	0.32476	102.1466	BASE CASE
FDNS	02ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESC	620	0.32821	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESC	620	0.32476	102.1466	BASE CASE
FDNS	06ALL	0	14G	G13_022	FROM->TO	SPSSPPTIESC1	620	0.42274	119.2722	BASE CASE
FDNS	06ALL	0	14G	G13_022	FROM->TO	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1	560	0.35966	118.051	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2
FDNS	06ALL	0	14G	G13_022	FROM->TO	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1	560	0.35966	116.0769	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2
FDNS	06ALL	0	14G	G13_022	FROM->TO	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2	560	0.35507	116.6048	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	G13_022	FROM->TO	TUCO INTERCHANGE (SIEM 8743066) 345/230/13.2KV TRANSFORMER CKT 2	560	0.35507	114.4675	TUCO INTERCHANGE (GE M1022338) 345/230/13.2KV TRANSFORMER CKT 1
FDNS	01ALL	0	14G	G13_022	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.04454	104.3204	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_022	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.04479	99.4	DBL-WWRD-G12
FDNS	0	2	14SP	G13_022	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03	120.0667	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	2	14SP	G13_022	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03	115.0053	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	06ALL	0	14G	G13_025	FROM->TO	LAWEASOKLUNI	425	0.05538	151.8	BASE CASE
FDNS	6	0	14G	G13_025	FROM->TO	LAWEASOKLUNI	425	0.05391	130.8	BASE CASE
FDNS	0	0	14WP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.0459	125.9	BASE CASE
FDNS	00G13_025	0	14WP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04596	123.6	BASE CASE
FDNS	0	0	19WP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04154	115.6	BASE CASE
FDNS	0	0	19SP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04641	111.6	BASE CASE
FDNS	0	0	14SP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04751	110.1	BASE CASE
FDNS	00G13_025	0	14SP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04761	108	BASE CASE
FDNS	02ALL	0	14G	G13_025	FROM->TO	LAWEASOKLUNI	425	0.05192	104.2	BASE CASE
FDNS	2	0	14G	G13_025	FROM->TO	LAWEASOKLUNI	425	0.05418	99.9	BASE CASE
FDNS	00G13_025	0	14SP	G13_025	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.04521	102.2293	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00G13_025	0	14SP	G13_025	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.04521	100.2042	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	0	0	14SP	G13_025	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.04519	99.8	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	06ALL	0	14G	G13_025	FROM->TO	TUCXFR345230	300	0.04859	120.7	BASE CASE
FDNS	0	2	14WP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.0459	125.9	BASE CASE
FDNS	0	2	19WP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04152	115.7	BASE CASE
FDNS	0	2	19SP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.04641	111.7	BASE CASE
FDNS	0	2	14SP	G13_025	FROM->TO	LAWEASOKLUNI	425	0.0475	110	BASE CASE
FDNS	0	2	14SP	G13_025	FROM->TO	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	0.04519	99.9	NORTHWEST (NORTWST3) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	0	0	14WP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04023	125.9	BASE CASE
FDNS	0	0	19WP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.03675	115.6	BASE CASE
FDNS	0	0	19SP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04163	111.6	BASE CASE
FDNS	0	0	14SP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04167	110.1	BASE CASE
FDNS	00NR	0	24SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.03704	151.8608	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.07028	139.7106	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12795	135.6704	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	24SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12857	132.7132	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.06864	115.6481	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	14SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12534	112.8061	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.07027	111.59	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.13089	110.8606	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.06864	103.4112	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08742	129.3893	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08566	122.1714	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09869	117.4807	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.10049	113.2982	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08558	113.0195	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09906	112.6478	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08467	106.6011	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08463	106.0732	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	14SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09728	102.3406	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08742	112.2314	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08742	111.8737	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08566	106.1152	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08566	106.065	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09869	102.4706	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09869	102.4334	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09906	99.73529	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09906	99.67523	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	24SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08742	129.3748	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08566	122.1542	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09869	117.4637	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	19WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.10049	113.2803	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	19WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08558	113.0017	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	24SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09906	112.629	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08467	106.5818	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	0	14SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08463	106.0554	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	0	14SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09728	102.3227	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	14WP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04022	125.9	BASE CASE
FDNS	0	2	19WP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.03673	115.7	BASE CASE
FDNS	0	2	19SP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04163	111.7	BASE CASE
FDNS	0	2	14SP	G13_028	FROM->TO	LAWEASOKLUNI	425	0.04166	110	BASE CASE
FDNS	0	2	19SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12796	135.611	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	24SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12855	132.9598	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	14SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.12534	112.7662	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.13089	112.1409	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09869	117.4434	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.10049	113.7064	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09905	112.8112	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	14SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.09728	102.3173	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09869	102.4417	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09869	102.4046	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09905	99.8622	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.09905	99.8026	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09869	117.4265	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	19WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.10049	113.6885	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	24SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09905	112.7924	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	0	2	14SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.09728	102.2994	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.03704	151.877	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.07028	139.7776	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14SP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	317	0.06864	115.7342	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.07027	110.3634	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14WP	G13_028	FROM->TO	SILOAM CITY - SILOAM SPRINGS 161KV CKT 1	375	0.06864	102.1395	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08742	129.3846	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00NR	4	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08566	122.2048	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08557	112.6342	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14WP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08466	106.1839	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14SP	G13_028	FROM->TO	SILOAM SPRINGS TAP - TONECESTR5 161.00 161KV CKT 1	277	0.08463	106.1211	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08742	112.2477	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08742	111.8885	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08566	106.1414	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19SP	G13_028	FROM->TO	SILOAM SPRINGS TAP (TONNEC345) 345/161/13.8KV TRANSFORMER CKT 1	350	0.08566	106.0922	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	24SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08742	129.3701	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08566	122.1877	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	19WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08557	112.6164	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14WP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08466	106.1646	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	00NR	4	14SP	G13_028	FROM->TO	TONECESTR5 161.00 - TONNECETP5 161.00 161KV CKT 1	277	0.08463	106.1032	FLINT CREEK - SILOAM SPRINGS TAP 345KV CKT 1
FDNS	06ALL	0	14G	G13_029	FROM->TO	LAWEASOKLUNI	425	0.0367	151.8	BASE CASE
FDNS	6	0	14G	G13_029	FROM->TO	LAWEASOKLUNI	425	0.03523	130.8	BASE CASE
FDNS	02ALL	0	14G	G13_029	FROM->TO	LAWEASOKLUNI	425	0.03324	104.2	BASE CASE
FDNS	2	0	14G	G13_029	FROM->TO	LAWEASOKLUNI	425	0.0355	99.9	BASE CASE
FDNS	06ALL	0	14G	G13_029	FROM->TO	TUCXFR345230	300	0.04263	120.7	BASE CASE
FDNS	08ALL	0	14G	G13_029	FROM->TO	VIOLA 7 345.00 - WICHITA 345KV CKT 1	1035	0.83045	101.2743	HUNTERS7 345.00 - WOODRING 345KV CKT 1
FDNS	00G13_029	0	14WP	G13_029	FROM->TO	WICHITA (WICHT12X) 345/138/13.8KV TRANSFORMER CKT 1	430	0.02999	100	WICHITA (WICHT11X) 345/138/13.8KV TRANSFORMER CKT 1
FNSL-Blown up	01ALL	0	14G	G13_030		Non-Converged Contingency	0	0.21586	-	DBL-TGA-MATT
FDNS	02ALL	0	14G	G13_030	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.0393	103.1906	GEN525562 1-TOLK GEN #2 24 KV
FDNS	02ALL	0	14G	G13_030	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.0393	99.3	GEN525561 1-TOLK GEN #1 24 KV
FDNS	02ALL	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03133	171.4984	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03181	161.7936	DBL-WICH-THI
FDNS	02G13_030	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03137	158.4021	DBL-WICH-THI
FDNS	2	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03141	149.6901	DBL-WICH-THI
FDNS	1	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03163	146.337	DBL-WICH-THI
FNSL	00G13_030	0	14WP	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03101	136.1366	DBL-WICH-THI
FDNS	06ALL	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03137	123.8574	DBL-WICH-THI
FNSL	00G13_030	0	19WP	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03183	115.1694	DBL-WICH-THI
FDNS	6	0	14G	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03157	114.0921	DBL-WICH-THI
FDNS	00G13_030	0	14SP	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03252	109.8079	DBL-WICH-THI
FNSL	0	0	14WP	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03122	99.1	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_030	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.07076	179.9163	DBL-WWRD-G12
FDNS	1	0	14G	G13_030	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.07317	135.2862	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_030	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.07113	117.2183	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07076	282.2734	DBL-WWRD-G12
FDNS	1	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07317	211.9348	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07113	210.9338	DBL-WWRD-G12
FDNS	02G13_030	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07266	174.416	DBL-WWRD-G12
FDNS	2	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07275	159.2865	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04398	146.2036	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04398	146.0849	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04425	133.4406	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04425	133.3491	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	1	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03976	129.4104	DBL-TGA-MATT
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03847	125.3521	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.038	122.7628	DBL-TGA-MATT
FDNS	06ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.07266	122.5894	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03847	121.0513	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	01ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03168	118.7815	DBL-HTCH-BVR
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.038	114.1667	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	02ALL	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.038	113.4512	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	6	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0731	105.5062	DBL-WWRD-G12
FDNS	02G13_030	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04679	105.4772	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	02G13_030	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04679	105.3934	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	02G13_030	0	14G	G13_030	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03924	100.4519	DBL-TGA-MATT
FDNS	02ALL	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03133	181.9824	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03181	172.153	DBL-WICH-THI
FDNS	02G13_030	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03137	168.7789	DBL-WICH-THI
FDNS	2	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03141	160.1161	DBL-WICH-THI
FDNS	1	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03163	156.8036	DBL-WICH-THI
FNSL	00G13_030	0	14WP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03101	146.3465	DBL-WICH-THI
FDNS	06ALL	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03137	134.3674	DBL-WICH-THI
FNSL	00G13_030	0	19WP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03183	126.5663	DBL-WICH-THI
FDNS	6	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03157	124.6143	DBL-WICH-THI
FDNS	00G13_030	0	14SP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03252	124.4184	DBL-WICH-THI
FNSL	0	0	14WP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03122	109.3533	DBL-WICH-THI
FDNS	09ALL	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03174	103.178	DBL-WICH-THI
FDNS	9	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03179	101.9029	DBL-WICH-THI
FDNS	9	0	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03181	101.8359	DBL-WICH-THI
FDNS	00G13_030	0	19SP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03255	100.7676	DBL-WICH-THI

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00G13_030	0	24SP	G13_030	FROM->TO	HITCHLAND INTERCHANGE (H TP80148301) 230/115/13.2KV TRANSFORMER CKT 1	288	0.03875	102.3228	OCHILTREE (H TP80219401) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00G13_030	0	24SP	G13_030	FROM->TO	HITCHLAND INTERCHANGE (H TP80148301) 230/115/13.2KV TRANSFORMER CKT 1	288	0.03875	102.1281	HITCHLAND INTERCHANGE - OCHILTREE 230KV CKT 1
FDNS	00G13_030	0	24SP	G13_030	FROM->TO	HITCHLAND INTERCHANGE (H TP80148301) 230/115/13.2KV TRANSFORMER CKT 1	288	0.03875	99.9	OCHILTREE (H TP80219401) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	00G13_030	0	24SP	G13_030	FROM->TO	HITCHLAND INTERCHANGE (H TP80148301) 230/115/13.2KV TRANSFORMER CKT 1	288	0.03875	99.8	HITCHLAND INTERCHANGE - OCHILTREE 230KV CKT 1
FDNS	02ALL	0	14G	G13_030	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	318.7	0.05838	106.6214	G11-17T 345.00 - SPEARVILLE 345KV CKT 1
FDNS	02G13_030	0	14G	G13_030	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	318.7	0.05765	101.1353	G11-17T 345.00 - SPEARVILLE 345KV CKT 1
FDNS	02ALL	0	14G	G13_030	FROM->TO	SPSSPPTIESB1	620	0.15669	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_030	FROM->TO	SPSSPPTIESB1	620	0.15324	102.1466	BASE CASE
FDNS	00G13_030	0	14WP	G13_030	FROM->TO	SPSSPPTIESB1	620	0.16777	101.6474	BASE CASE
FDNS	02ALL	0	14G	G13_030	FROM->TO	SPSSPPTIESC	620	0.15669	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_030	FROM->TO	SPSSPPTIESC	620	0.15324	102.1466	BASE CASE
FDNS	00G13_030	0	14WP	G13_030	FROM->TO	SPSSPPTIESC	620	0.16777	101.6474	BASE CASE
FDNS	01ALL	0	14G	G13_030	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.05901	104.3204	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_030	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.05926	99.4	DBL-WWRD-G12
FNSL	0	2	14WP	G13_030	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03122	99	DBL-WICH-THI
FNSL	0	2	14WP	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03122	109.2156	DBL-WICH-THI
FDNS	09ALL	2	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03171	103.2464	DBL-WICH-THI
FDNS	9	2	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03179	101.7748	DBL-WICH-THI
FDNS	09ALL	3	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03171	103.2516	DBL-WICH-THI
FDNS	9	3	14G	G13_030	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03179	101.7786	DBL-WICH-THI
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	115.392	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	115.1235	GEN525561 1-TOLK GEN #1 24 KV
FDNS	05NR	0	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.33122	100.638	GEN527903 1-HOBBS PLANT #3 (ST)
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.54477	107.174	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	05NR	0	14G	G13_031	FROM->TO	BUSHLAND INTERCHANGE - POTTER COUNTY INTERCHANGE 230KV CKT 1	351	0.54556	103.3891	SPP-SWPS-04
FDNS	0	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.05899	117.7094	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.05899	109.8315	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.05789	115.674	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	0	0	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.05789	107.3755	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	0	0	14SP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03971	120.1111	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03909	118.9102	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	0	14SP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03971	115.0443	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	0	14WP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03909	114.4852	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	00NR	0	14WP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.04283	139.2	BASE CASE
FDNS	00NR	0	19SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.06476	136	BASE CASE
FDNS	00NR	0	14SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.05836	129.4	BASE CASE
FDNS	00NR	0	19WP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.04583	127.7	BASE CASE
FDNS	00NR	0	24SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.06077	115.5	BASE CASE
FDNS	05NR	0	14G	G13_031	FROM->TO	LAWEASOKLUNI	425	0.0589	99.7	BASE CASE
FDNS	05NR	2	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.25978	103.75	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	2	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.25978	103.315	GEN525561 1-TOLK GEN #1 24 KV
FDNS	0	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.04303	116.6	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	0	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2	168	0.04303	108.7721	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	0	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.04222	114.5727	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	0	2	14SP	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.04222	106.3288	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	05NR	2	14G	G13_031	FROM->TO	DEAF SMITH COUNTY INTERCHANGE (GE M101353) 230/115/13.2KV TRANSFORMER CKT 1	168	0.04879	99.7	DEAF SMITH COUNTY INTERCHANGE (ELCO 13458-1) 230/115/13.8KV TRANSFORMER CKT 2
FDNS	0	2	14SP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03959	120.0667	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	2	14WP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03897	118.8289	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	2	14SP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03959	115.0053	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	0	2	14WP	G13_031	FROM->TO	GRAPEVINE INTERCHANGE (PENN 0257751) 230/115/13.2KV TRANSFORMER CKT 1	112	0.03897	114.4192	GRAPEVINE INTERCHANGE - STATELINE INTERCHANGE 230KV CKT 1
FDNS	00NR	2	14WP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.04142	139.3	BASE CASE
FDNS	00NR	2	19SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.06116	136.2	BASE CASE
FDNS	00NR	2	14SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.05692	129.5	BASE CASE
FDNS	00NR	2	19WP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.04227	128	BASE CASE
FDNS	00NR	2	24SP	G13_031	FROM->TO	LAWEASOKLUNI	425	0.05718	115.7	BASE CASE
FDNS	05NR	2	14G	G13_031	FROM->TO	LAWEASOKLUNI	425	0.05745	99.9	BASE CASE
FDNS	05NR	4	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.26146	105.821	GEN525562 1-TOLK GEN #2 24 KV
FDNS	05NR	4	14G	G13_031	FROM->TO	BUFFALO 230.00 - DEAF SMITH COUNTY INTERCHANGE 230KV CKT 1	350.57	0.26146	105.3697	GEN525561 1-TOLK GEN #1 24 KV
FDNS	05NR	4	14G	G13_031	FROM->TO	LAWEASOKLUNI	425	0.05743	99.9	BASE CASE
FNSL-Blown up	01ALL	0	14G	G13_032		Non-Converged Contingency	0	0.03697	-	DBL-TGA-MATT
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38384	135.6507	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	120.9861	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.35411	120.8329	ALBION - PETERSBURG 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.49486	117.4434	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32409	115.1257	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32409	115.1078	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34696	114.647	WAPA-OG-2
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36889	114.2984	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.36889	114.2959	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31494	114.0454	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	112.9547	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33605	112.8966	ALBION - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	112.1171	NEB02WAPAB2

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33678	111.9048	WAPA-OG-1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33605	111.6055	COLUMBUS - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32607	110.7951	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	110.5245	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	109.8043	LN-1164
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	109.7816	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32308	109.6689	DAK02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	109.2196	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32226	108.7915	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32437	108.627	UTICA - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	107.9291	LN-WAPA6
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	107.9291	NEB001NPPB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	107.8936	ONEILL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32074	107.8357	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	107.3512	FT RANDAL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32074	107.2792	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31881	106.8595	GEN560350 1-G10-51 0.6900
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31986	106.6772	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31722	106.3946	G10-51T 230.00 - HOSKINS 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38384	106.3304	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32074	106.2192	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32007	105.6816	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32189	105.3584	UTICA JCT (UJ KV3A) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34697	105.3316	WAPA-OG-2
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34847	104.9783	WAPA-OG-2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32414	104.4151	NEB02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32506	103.7329	NEB02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33819	103.0616	WAPA-OG-1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31881	103.0167	BASE CASE
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.33678	102.9964	WAPA-OG-1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37844	102.1745	LN-1164
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.37872	102.0002	LN-1164
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32308	101.94	DAK02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32386	100.9882	DAK02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31217	100.5132	NORFOLK - NORTH NORFOLK 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31881	100.1039	GEN560228 1-G08-86N2 0.6900
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32725	99.9	EMMET - ONEILL 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32725	99.9	LN-1267
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32725	99.8	ATKINSON - EMMET 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32074	99.8	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31881	99.7	GEN659118 1-LARAMIE RIVER UNIT1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32725	99.6	ATKINSON - STUART 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32725	99.5	AINSWORTH - STUART 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.3179	99.5	G10-51T 230.00 - HOSKINS 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31881	99.4	GEN640026 1-AINSWORTH WIND
FDNS	09ALL	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31641	99.4	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.32138	99.4	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.38387	99.3	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	99.2	LN-WAPA6
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	99.2	NEB001NPPB2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.34786	99.2	ONEILL - SPENCER 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31986	99	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38384	130.1753	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35411	115.4456	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.35411	115.2924	ALBION - PETERSBURG 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.49486	111.9225	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32409	109.5843	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32409	109.5696	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34696	109.1242	WAPA-OG-2
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36889	108.7691	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36889	108.7669	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.31494	108.5383	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32414	107.3893	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.33605	107.3736	ALBION - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32414	106.5642	NEB02WAPAB2
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.33678	106.3839	WAPA-OG-1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.33605	106.0861	COLUMBUS - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32607	105.2734	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32414	104.9733	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.37844	104.2745	LN-1164
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.37844	104.252	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32308	104.1165	DAK02WAPAB2
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.37844	103.69	CLEARWATER - ONEILL 115KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32226	103.2343	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32437	103.0773	UTICA - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34786	102.4092	LN-WAPA6
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34786	102.4092	NEB001NPPB2
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34786	102.374	ONEILL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32074	102.2859	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34786	101.8303	FT RANDAL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32074	101.7311	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.31881	101.3167	GEN560350 1-G10-51 0.6900
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.31986	101.1404	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.31722	100.8652	G10-51T 230.00 - HOSKINS 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.38384	100.7557	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32074	100.6809	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32007	100.148	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32189	99.8	UTICA JCT (UJ KV3A) 230/115/13.2KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32007	99.8	RASMUSN - SIOUX CITY 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34697	99.8	WAPA-OG-2
FDNS	09G13_032	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32414	99.7	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36948	99.4	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.36948	99.4	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.34847	99.4	WAPA-OG-2
FDNS	09NR	0	14G	G13_032	FROM->TO	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1	120	0.32506	99.2	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	0.24802	113.3549	COUNTY LINE - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	0.24802	113.3037	LN-1163
FDNS	09ALL	0	14G	G13_032	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	0.24802	113.2117	BATTLE CREEK - COUNTY LINE 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	BLOOMFIELD - GAVINS POINT 115KV CKT 1	120	0.24802	111.6818	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38384	136.3439	BLOOMFIELD - GAVINS POINT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	121.6768	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.35411	121.5243	ALBION - PETERSBURG 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.49486	118.1382	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32409	115.8172	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32409	115.7996	S_NORFOLK 345.00 (SNORFOLKT) 345/230/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34696	115.3417	WAPA-OG-2
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36889	114.9929	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.36889	114.9899	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31494	114.7213	HOSKINS - S_NORFOLK 345.00 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	113.6445	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33605	113.5924	ALBION - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	112.8083	NEB02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33678	112.6016	WAPA-OG-1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33605	112.3026	COLUMBUS - GENOA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32607	111.4898	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	111.2198	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	110.5002	LN-1164
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	110.4758	CLEARWATER - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32308	110.3609	DAK02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	109.9139	CLEARWATER - ONEILL 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32226	109.4837	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32437	109.3197	UTICA - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	108.6256	LN-WAPA6
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	108.6256	NEB001NPPB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	108.59	ONEILL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	108.5286	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	108.0501	FT RANDAL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	107.9725	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	107.5532	GEN560350 1-G10-51 0.6900
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31986	107.3719	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31722	107.0905	G10-51T 230.00 - HOSKINS 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.38384	107.0211	CREIGHTON - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	106.9126	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32007	106.3769	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34697	106.0226	WAPA-OG-2
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34847	105.6724	WAPA-OG-2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32414	105.1083	NEB02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32506	104.4252	NEB02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33819	103.7592	WAPA-OG-1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	103.7097	BASE CASE
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.33678	103.6895	WAPA-OG-1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37844	102.8676	LN-1164
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.37872	102.6961	LN-1164
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32308	102.6348	DAK02WAPAB2
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32386	101.6818	DAK02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31217	101.2034	NORFOLK - NORTH NORFOLK 115KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	100.8015	GEN560228 1-G08-86N2 0.6900
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32725	100.6428	LN-1267
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32725	100.6056	EMMET - ONEILL 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32725	100.5106	ATKINSON - EMMET 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	100.3468	GEN659118 1-LARAMIE RIVER UNIT1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32725	100.2688	ATKINSON - STUART 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32725	100.1682	AINSWORTH - STUART 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	100.1225	GEN640026 1-AINSWORTH WIND
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31641	100.1123	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	99.9	LN-WAPA6
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	99.9	NEB001NPPB2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31986	99.7	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31881	99.6	GEN640421 1-CROFTON HILLS WIND
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31882	99.6	GEN560350 1-G10-51 0.6900
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.29271	99.5	HOSKINS - NORTH NORFOLK 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.30122	99.5	HOSKINS (HOSKN T4) 345/115/13.8KV TRANSFORMER CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34786	99.4	FT RANDAL - SPENCER 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32057	99.4	FT RANDAL - SIOUX CITY 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32074	99.3	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34822	99.3	LN-WAPA6
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34822	99.3	NEB001NPPB2
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.34822	99.3	ONEILL - SPENCER 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31233	99.2	HOSKINS - RAUN 345KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.32138	99.1	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - HARTINGTON 115KV CKT 1	120	0.08108	114.689	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - HARTINGTON 115KV CKT 1	120	0.08108	107.6318	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - HARTINGTON 115KV CKT 1	120	0.08108	104.9905	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - HARTINGTON 115KV CKT 1	120	0.08167	104.2876	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	132.6206	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	131.7778	NEB02WAPAB2
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	131.6718	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	127.5689	BERSFORD - MANNING 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	122.0461	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	121.8406	NEB02WAPAB2
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	121.7302	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	121.4206	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09NR	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11884	119.4282	NEB02WAPAB2
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	118.5921	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	118.2272	NEB02WAPAB2
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	118.1188	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	118.0694	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	116.9528	BERSFORD - MANNING 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11502	116.5642	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11992	116.1869	NEB02WAPAB2
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11992	116.1142	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	113.5374	BERSFORD - MANNING 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11502	111.5568	BERSFORD - MANNING 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	111.4789	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	107.9118	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12032	107.8765	BELDEN - HARTINGTON 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11992	105.8032	BELDEN - HARTINGTON 115KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11614	104.5408	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.09889	103.0763	FT RANDAL - UTICA JCT 230KV CKT 1
FDNS	9	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.11502	102.5663	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.10338	99.4	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.12671	99.2	LN-1163
FDNS	09ALL	0	14G	G13_032	TO->FROM	MANNING - SPIRIT MOUND 115KV CKT 1	128	0.05726	101.626	GAVINS POINT - YANKON JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	FROM->TO	MEADOWGROVE 230.00 - S_NORFOLK 230.00 230KV CKT 1	320	0.13292	99.9	KELLY - MEADOWGROVE 230.00 230KV CKT 1
FDNS	06ALL	0	14G	G13_032	FROM->TO	TUCXFR345230	300	0.0366	120.7	BASE CASE
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	208.3049	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10003	205.9838	NEB02WAPAB2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10003	205.8538	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	200.8425	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0862	195.9227	FT RANDAL - UTICA JCT 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10003	191.0308	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	190.6199	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	189.2908	NEB02WAPAB2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	189.1544	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	186.8289	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	185.0671	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	183.5245	NEB02WAPAB2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	183.3899	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	183.0679	BERSFORD - MANNING 115KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0862	179.418	FT RANDAL - UTICA JCT 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	177.5656	BERSFORD - MANNING 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0862	174.5943	FT RANDAL - UTICA JCT 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	174.3335	BELDEN - HARTINGTON 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	169.7888	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10004	168.5854	BELDEN - HARTINGTON 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09719	164.3655	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	161.0818	LN-1163
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10977	160.876	WAPA-OG-2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	160.795	COUNTY LINE - NELIGH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	160.716	BATTLE CREEK - COUNTY LINE 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	160.5054	BASE CASE
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08794	160.4429	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	159.8867	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08998	155.9276	BELDEN - TWIN CHURCH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08887	153.8531	HOSKINS - RAUN 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	153.1995	GEN659103 1-ANTELOPE VALLEY UNIT1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	153.1995	GEN659107 2-ANTELOPE VALLEY UNIT2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09096	152.8609	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09096	152.8014	ALBION - PETERSBURG 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	152.7299	GEN659111 2-LELAND OLDS UNIT2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0829	152.6392	FT THOMPSON - LETCHER 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.12445	151.79	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0822	151.7776	RAUN - SIOUX CITY 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09522	150.6657	MEADOWGROVE 115.00 - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09522	150.6632	MEADOWGROVE 230.00 (MEADOWGROVE) 230/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08364	150.4883	G10-51T 230.00 - TWIN CHURCH 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	146.0528	LN-1163
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	145.7668	COUNTY LINE - NELIGH 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	145.6868	BATTLE CREEK - COUNTY LINE 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	144.9681	BASE CASE
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	144.8475	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10977	144.1283	WAPA-OG-2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08795	142.6618	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08998	141.2188	BELDEN - TWIN CHURCH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	140.9934	GEN640431 1-LAREDO.GEN1W0.6900
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	140.1409	LN-1163
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	139.8699	BASE CASE
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	139.8586	COUNTY LINE - NELIGH 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	139.7766	BATTLE CREEK - COUNTY LINE 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08189	139.2699	SIOUX FALLS - SPLIT ROCK 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	139.0612	GEN659103 1-ANTELOPE VALLEY UNIT1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	139.0612	GEN659107 2-ANTELOPE VALLEY UNIT2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10983	138.9149	BATTLE CREEK - NORTH NORFOLK 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.12445	138.7206	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	138.5888	GEN659111 2-LELAND OLDS UNIT2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0829	138.4162	FT THOMPSON - LETCHER 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.10977	138.051	WAPA-OG-2
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09097	138.0222	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08221	137.9699	RAUN - SIOUX CITY 345KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09097	137.9615	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08795	137.6887	SIOUX CITY - TWIN CHURCH 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08888	137.6055	HOSKINS - RAUN 345KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08998	136.1009	BELDEN - TWIN CHURCH 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	135.7829	MITCHELL - TRIPP JCT 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	134.4403	GEN659103 1-ANTELOPE VALLEY UNIT1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	134.4403	GEN659107 2-ANTELOPE VALLEY UNIT2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	134.4034	TYNDALL - WHITE SWAN 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	133.9671	GEN659111 2-LELAND OLDS UNIT2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.0829	133.7845	FT THOMPSON - LETCHER 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08221	133.3972	RAUN - SIOUX CITY 345KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	133.1467	MENNO JCT - TRIPP JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	132.9872	FT RANDAL - WHITE SWAN 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09097	132.9541	PETERSBRG.N7115.00 - PETERSBURG 115KV CKT Z1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09097	132.8949	ALBION - PETERSBURG 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08888	132.6057	HOSKINS - RAUN 345KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.12445	131.7693	NELIGH - PETERSBRG.N7115.00 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	131.1501	MENNO JCT - UTICA 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	129.0836	GEN640421 1-CROFTON HILLS WIND
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	128.07	SIOUX FALLS - VFODNES 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	127.8988	GEN652577 3-GAVINS POINT
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	127.8299	GEN652575 1-GAVINS POINT
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	127.8299	GEN652576 2-GAVINS POINT

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	126.9422	RASMUSN - SIOUX CITY 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08189	125.6706	SIOUX FALLS - SPLIT ROCK 230KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	123.6351	GEN659116 1-SPIRIT MOUND UNIT1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	123.6351	GEN659117 2-SPIRIT MOUND UNIT2
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	123.435	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	122.7874	MITCHELL - TRIPP JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	121.3686	GEN562438 1-G13-032 0.6900
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08189	121.1094	SIOUX FALLS - SPLIT ROCK 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	120.1506	MENNO JCT - TRIPP JCT 115KV CKT 1
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	119.513	UTICA JCT - VFODNES 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	119.4934	TYNDALL - WHITE SWAN 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	118.4382	MITCHELL - TRIPP JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	118.1452	MENNO JCT - UTICA 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	118.0735	FT RANDAL - WHITE SWAN 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	117.9988	GEN640421 1-CROFTON HILLS WIND
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	115.8023	MENNO JCT - TRIPP JCT 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	115.5294	SIOUX FALLS - VFODNES 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	114.4475	TYNDALL - WHITE SWAN 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	114.2927	RASMUSN - SIOUX CITY 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07726	113.7932	MENNO JCT - UTICA 115KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	113.5876	GEN652575 1-GAVINS POINT
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	113.5876	GEN652576 2-GAVINS POINT
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	113.5874	GEN652577 3-GAVINS POINT
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	113.3459	GEN640421 1-CROFTON HILLS WIND
FDNS	09ALL	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	113.0921	GEN640418 1-ELKHORN RIDGE WIND
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.09042	113.0278	FT RANDAL - WHITE SWAN 115KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	111.2077	SIOUX FALLS - VFODNES 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	110.7591	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	110.019	RASMUSN - SIOUX CITY 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	109.5533	GEN659116 1-SPIRIT MOUND UNIT1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	109.5533	GEN659117 2-SPIRIT MOUND UNIT2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	108.9627	GEN652575 1-GAVINS POINT
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	108.9626	GEN652576 2-GAVINS POINT
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	108.9625	GEN652577 3-GAVINS POINT
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	107.1277	GEN562438 1-G13-032 0.6900
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	107.089	GEN562438 1-G13-032 0.6900
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	107.0443	UTICA JCT - VFODNES 230KV CKT 1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07668	106.4786	RASMUSN - UTICA JCT 230KV CKT 1
FDNS	09G13_032	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	105.1941	GEN640418 1-ELKHORN RIDGE WIND
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	104.9511	GEN659116 1-SPIRIT MOUND UNIT1
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	104.9511	GEN659117 2-SPIRIT MOUND UNIT2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.07739	102.7269	UTICA JCT - VFODNES 230KV CKT 1
FDNS	09NR	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	120	0.09827	100.9727	NEB02WAPAB2
FDNS	9	0	14G	G13_032	TO->FROM	UTICA - YANKON JCT 115KV CKT 1	66	0.08304	100.5262	GEN640418 1-ELKHORN RIDGE WIND
FDNS	09ALL	2	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31932	102.7493	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	2	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31932	102.565	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
FDNS	09ALL	2	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31932	103.45	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	2	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31932	103.2618	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	G10-51T 230.00 - TWIN CHURCH 230KV CKT 1	320	0.06486	101.7202	G10-51T 230.00 - RASMUSN 230KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	114.3601	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	110.7683	NEB02WAPAB2
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	110.6948	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	109.7001	BERSFORD - MANNING 115KV CKT 1
FDNS	09G13_032	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	105.876	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	104.0192	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	102.822	NEB02WAPAB2
FDNS	09G13_032	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	102.758	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05461	102.419	NEB02WAPAB2
FDNS	09G13_032	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	101.2178	BERSFORD - MANNING 115KV CKT 1
FDNS	9	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	101.0791	NEB02WAPAB2
FDNS	9	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	101.0138	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	100.9677	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	100.7137	BELDEN - HARTINGTON 115KV CKT 1
FDNS	9	2	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	99.4	BERSFORD - MANNING 115KV CKT 1
FDNS	09ALL	3	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31932	102.7561	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	3	14G	G13_032	TO->FROM	BATTLE CREEK - COUNTY LINE 115KV CKT 1	120	0.31932	102.5719	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
FDNS	09ALL	3	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31932	103.4567	NELIGH.EAST3345.00 (NELIGH.E T1) 345/115/13.8KV TRANSFORMER CKT 1
FDNS	09ALL	3	14G	G13_032	TO->FROM	COUNTY LINE - NELIGH 115KV CKT 1	120	0.31932	103.2686	HOSKINS - NELIGH.EAST3345.00 345KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	G10-51T 230.00 - TWIN CHURCH 230KV CKT 1	320	0.06486	101.7224	G10-51T 230.00 - RASMUSN 230KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	114.3529	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	110.764	NEB02WAPAB2
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	110.6906	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	109.6914	BERSFORD - MANNING 115KV CKT 1

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	09G13_032	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	105.8702	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	9	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	104.013	MANNING - SPIRIT MOUND 115KV CKT 1
FDNS	09G13_032	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	102.8191	NEB02WAPAB2
FDNS	09G13_032	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	102.7553	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09NR	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05461	102.4121	NEB02WAPAB2
FDNS	09G13_032	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	101.2118	BERSFORD - MANNING 115KV CKT 1
FDNS	9	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	101.0759	NEB02WAPAB2
FDNS	9	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	101.0107	GAVINS POINT - HARTINGTON 115KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	100.9588	BERSFORD - SIOUX FALLS 115KV CKT 1
FDNS	09ALL	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05574	100.7085	BELDEN - HARTINGTON 115KV CKT 1
FDNS	9	3	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.06108	99.4	BERSFORD - MANNING 115KV CKT 1
FDNS	09NR	4	14G	G13_032	FROM->TO	GAVINS POINT - YANKON JCT 115KV CKT 1	128	0.05569	104.8777	NEB02WAPAB2
FNSL-Blown up	01ALL	0	14G	G13_034		Non-Converged Contingency	0	0.27057	-	DBL-TGA-MATT
FDNS	00NR	0	19SP	G13_034	FROM->TO	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1	611.9	0.18395	113.7152	DBL-G1216-TH
FDNS	00NR	0	14SP	G13_034	FROM->TO	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1	611.9	0.18945	105.6068	DBL-G1216-TH
FDNS	02ALL	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03314	171.4984	DBL-WICH-THI
FDNS	00NR	0	14WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03719	166.9937	DBL-WICH-THI
FDNS	00NR	0	14SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03678	166.1756	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03361	161.7936	DBL-WICH-THI
FDNS	01NR	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03769	151.4896	DBL-WICH-THI
FDNS	2	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03321	149.6901	DBL-WICH-THI
FDNS	01G13_034	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03343	146.8122	DBL-WICH-THI
FDNS	1	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03344	146.337	DBL-WICH-THI
FDNS	00NR	0	19SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03773	145.114	DBL-WICH-THI
FDNS	00NR	0	19WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03912	144.8315	DBL-WICH-THI
FDNS	06ALL	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03317	123.8574	DBL-WICH-THI
FDNS	00NR	0	24SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03257	119.8789	DBL-WICH-THI
FDNS	6	0	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03337	114.0921	DBL-WICH-THI
FNSL	00G13_034	0	14WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03294	100.9477	DBL-WICH-THI
FNSL	0	0	14WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03296	99.1	DBL-WICH-THI
FDNS	01NR	0	14G	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.048	102.9995	DBL-TGA-MATT
FDNS	00NR	0	19SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0457	101.9484	DBL-TGA-MATT
FDNS	00NR	0	14SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.04795	100.9957	DBL-TGA-MATT
FDNS	00NR	0	24SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0456	99.8	DBL-TGA-MATT
FDNS	01NR	0	14G	G13_034	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	153	0.05051	107.9674	DBL-TGA-MATT
FDNS	01G13_034	0	14G	G13_034	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	153	0.0374	104.2242	DBL-TGA-MATT
FDNS	1	0	14G	G13_034	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	153	0.03739	103.9115	DBL-TGA-MATT
FDNS	00NR	0	14SP	G13_034	TO->FROM	FLATRDG3 - THISTLE4 138.00 138KV CKT 1	286	0.04957	108.276	DBL-WICH-THI
FDNS	00NR	0	19SP	G13_034	TO->FROM	FLATRDG3 - THISTLE4 138.00 138KV CKT 1	286	0.05015	106.6417	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11135	179.9163	DBL-WWRD-G12
FDNS	01NR	0	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11628	142.253	DBL-WWRD-G12
FDNS	01G13_034	0	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11377	135.914	DBL-WWRD-G12
FDNS	1	0	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11377	135.2862	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11173	117.2183	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11135	282.2734	DBL-WWRD-G12
FDNS	01NR	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11628	225.1583	DBL-WWRD-G12
FDNS	01G13_034	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11377	213.1123	DBL-WWRD-G12
FDNS	1	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11377	211.9348	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11173	210.9338	DBL-WWRD-G12
FDNS	2	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11335	159.2865	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0592	146.2036	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0592	146.0849	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11614	138.9332	DBL-WWRD-G12
FDNS	01NR	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.06192	134.7796	DBL-TGA-MATT
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05947	133.4406	G12-016 TAP 345.00 - MORELND 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05947	133.3491	MORELND 345.00 (MRLNDAUTO) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03668	130.9633	WOODWARD (WOODWRD2) 138/69/13.2KV TRANSFORMER CKT 1
FDNS	01G13_034	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05318	129.8511	DBL-TGA-MATT
FDNS	1	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05318	129.4104	DBL-TGA-MATT
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	128.4562	BASE CASE
FDNS	00NR	0	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11505	127.8529	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03999	126.1249	G12-016 TAP 345.00 - WOODWARD DISTRICT EHV 345KV CKT 2
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03997	126.0918	G12-016 TAP 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05189	125.3521	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	123.1696	GEN515787 1-OKLA WIND ENERGY CENTER
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03908	122.8586	IODINE - WOODWARD EHV 138KV CKT 1
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05142	122.7628	DBL-TGA-MATT
FDNS	06ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11326	122.5894	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03267	122.089	DEWEY - TALOGA 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03627	121.8915	MATHWSN7 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03627	121.8915	MATHWSN7 345.00 - TATONGA7 345.00 345KV CKT 2
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03908	121.7033	DEWEY - IODINE 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0364	121.244	DBL-WICH-THI

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05189	121.0513	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03668	120.1169	WOODWARD - WOODWARD 69KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03293	119.7702	FT SUPPLY - IODINE 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0366	119.0058	DBL-G1216-TH
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	118.9878	GEN520922 1-SLEEPING BEAR
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03818	118.7815	DBL-HTCH-BVR
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03293	118.7313	IODINE - MOORELAND 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03552	117.9702	BORDER 7345.00 - TUCO INTERCHANGE 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03552	117.0388	BORDER 7345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03493	115.4944	BUCKNER7 345.00 - SPEARVILLE 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03374	115.3498	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0334	114.6023	MATHWSN7 345.00 - WOODRING 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03421	114.4434	POTTER COUNTY INTERCHANGE (WAUK 90343-A) 345/230/13.2KV TRANSFORMER CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03513	114.2718	BEAVER CO 345.00 - BUCKNER7 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03375	114.2225	G11-17T 345.00 - SPEARVILLE 345KV CKT 1
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05142	114.1667	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03394	114.1402	THISTLE7 345.00 - WICHITA 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03394	114.1402	THISTLE7 345.00 - WICHITA 345KV CKT 2
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0333	113.9225	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03421	113.8345	SPP-SWPS-04
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03277	113.7809	WOODRING (WOODRNG2) 345/138/13.8KV TRANSFORMER CKT 1
FDNS	02ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.05142	113.4512	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03347	109.6326	RENFROW7 345.00 - VIOLA 7 345.00 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	109.6012	GEN659118 1-LARAMIE RIVER UNIT1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03118	109.5914	SANDY_CN_138138.00 - WAKITA_138 138.00 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.0318	109.2606	WOODWARD - WOODWARD EHV 138KV CKT 2
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	108.857	GEN525561 1-TOLK GEN #1 24 KV
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	108.8263	GEN560175 1-G07-44 0.5750
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	108.7798	GEN560282 1-G08-19 0.6000
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	108.6217	GEN525562 1-TOLK GEN #2 24 KV
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	108.5347	GEN531447 1-HOLCOMB GENERATOR
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03347	107.881	VIOLA 7 345.00 - WICHITA 345KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03118	107.1075	BYRON_138 138.00 - SANDY_CN_138138.00 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	106.7907	GEN560221 1-G07-62-1 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	106.7907	GEN560222 1-G07-62-2 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	106.7907	GEN560223 1-G07-62-3 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	106.7907	GEN560224 1-G07-62-4 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03118	106.6089	BYRON_138 138.00 - C_CITY_138 138.00 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03118	106.3307	C_CITY_138 138.00 - KNOBHILL 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03078	106.2942	DOVER SW - OKEENE 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03106	105.8124	MOREWOOD SW - RED HILLS WIND 138KV CKT 1
FDNS	6	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.1137	105.5062	DBL-WWRD-G12
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03106	104.2545	ELK CITY - RED HILLS WIND 138KV CKT 1
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	104.0842	GEN562023 1-G11_020_3 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	104.0842	GEN562026 1-G11_019_3 0.6900
FDNS	01ALL	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.03307	102.5903	GEN515397 1-OUSPRT 1 34.500
FDNS	00NR	0	24SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.097	102.2437	DBL-WWRD-G12
FDNS	00NR	0	14WP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	185	0.11577	100.3801	DBL-WWRD-G12
FDNS	01NR	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04171	99.3	WOODWARD (WOODWRD2) 138/69/13.2KV TRANSFORMER CKT 1
FDNS	01NR	0	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.06192	99.2	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	01NR	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.048	129.499	DBL-TGA-MATT
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	128.0098	DBL-TGA-MATT
FDNS	00NR	0	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	126.6968	DBL-TGA-MATT
FDNS	00NR	0	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	125.4265	DBL-TGA-MATT
FDNS	01G13_034	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03586	124.4474	DBL-TGA-MATT
FDNS	1	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03586	124.048	DBL-TGA-MATT
FDNS	00NR	0	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	121.2563	DBL-G1151-TG
FDNS	00NR	0	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	119.1166	DBL-TGA-MATT
FDNS	02ALL	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03595	117.2405	DBL-TGA-MATT
FDNS	00NR	0	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	117.1473	DBL-WWRD-G11
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03438	111.0636	DBL-WICH-THI
FDNS	02ALL	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03595	109.6508	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	2	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03535	109.5274	DBL-TGA-MATT
FDNS	01ALL	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03241	109.4404	DBL-G1216-TH
FDNS	02ALL	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03595	108.8543	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	00NR	0	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03735	108.7476	DBL-G1216-TH
FDNS	00NR	0	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03572	108.2566	DBL-WICH-THI
FDNS	00NR	0	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03599	107.3485	DBL-WICH-THI
FDNS	01NR	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03899	104.747	DBL-G1216-TH
FDNS	00NR	0	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03854	104.5592	DBL-G1216-TH
FDNS	00NR	0	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03887	101.7068	DBL-G1216-TH
FDNS	2	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03535	101.1404	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	00NR	0	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03548	100.6207	DBL-WICH-THI

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	01G13_034	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03174	100.4833	DBL-G1216-TH
FDNS	2	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03535	100.3029	G11_051T 345.00 - WOODWARD DISTRICT EHV 345KV CKT 1
FDNS	1	0	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03174	100.1188	DBL-G1216-TH
FDNS	00NR	0	19SP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	351	0.04518	107.2243	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	00NR	0	19WP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	361	0.04345	99.9328	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	00NR	0	24SP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	351	0.0402	99.77413	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	02ALL	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03314	181.9824	DBL-WICH-THI
FDNS	00NR	0	14SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03678	181.0555	DBL-WICH-THI
FDNS	00NR	0	14WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03719	177.2332	DBL-WICH-THI
FDNS	01ALL	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03361	172.153	DBL-WICH-THI
FDNS	01NR	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03769	161.9288	DBL-WICH-THI
FDNS	2	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03321	160.1161	DBL-WICH-THI
FDNS	00NR	0	19SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03773	159.9558	DBL-WICH-THI
FDNS	01G13_034	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03343	157.2777	DBL-WICH-THI
FDNS	1	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03344	156.8036	DBL-WICH-THI
FDNS	00NR	0	19WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03912	156.1738	DBL-WICH-THI
FDNS	00NR	0	24SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03257	136.199	DBL-WICH-THI
FDNS	06ALL	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03317	134.3674	DBL-WICH-THI
FDNS	6	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03337	124.6143	DBL-WICH-THI
FNSL	00G13_034	0	14WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03294	111.1996	DBL-WICH-THI
FNSL	0	0	14WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03296	109.3533	DBL-WICH-THI
FDNS	09ALL	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03354	103.178	DBL-WICH-THI
FDNS	9	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03359	101.9029	DBL-WICH-THI
FDNS	9	0	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03361	101.8359	DBL-WICH-THI
FDNS	02ALL	0	14G	G13_034	TO->FROM	MULLERGREN - SPEARVILLE 230KV CKT 1	318.7	0.04346	106.6214	G11-17T 345.00 - SPEARVILLE 345KV CKT 1
FDNS	01NR	0	14G	G13_034	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	153	0.05051	111.4237	DBL-TGA-MATT
FDNS	01G13_034	0	14G	G13_034	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	153	0.0374	107.6731	DBL-TGA-MATT
FDNS	1	0	14G	G13_034	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	153	0.03739	107.3598	DBL-TGA-MATT
FDNS	02ALL	0	14G	G13_034	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	153	0.03703	100.5702	DBL-TGA-MATT
FDNS	02ALL	0	14G	G13_034	FROM->TO	SPSSPPTIESB1	620	0.08509	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_034	FROM->TO	SPSSPPTIESB1	620	0.08164	102.1466	BASE CASE
FDNS	02ALL	0	14G	G13_034	FROM->TO	SPSSPPTIESC	620	0.08509	113.2757	BASE CASE
FDNS	06ALL	0	14G	G13_034	FROM->TO	SPSSPPTIESC	620	0.08164	102.1466	BASE CASE
FDNS	01ALL	0	14G	G13_034	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.09241	104.3204	DBL-WWRD-G12
FDNS	02ALL	0	14G	G13_034	TO->FROM	WOODWARD - WOODWARD EHV 138KV CKT 1	287	0.09267	99.4	DBL-WWRD-G12
FNSL	0	2	14WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03296	99	DBL-WICH-THI
FNSL	0	2	14WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03296	109.2156	DBL-WICH-THI
FDNS	09ALL	2	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03351	103.2464	DBL-WICH-THI
FDNS	9	2	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03359	101.7748	DBL-WICH-THI
FDNS	09ALL	3	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03351	103.2516	DBL-WICH-THI
FDNS	9	3	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03359	101.7786	DBL-WICH-THI
FDNS	00NR	4	14WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03719	166.956	DBL-WICH-THI
FDNS	00NR	4	14SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03678	166.0364	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03769	151.4413	DBL-WICH-THI
FDNS	00NR	4	19SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03772	144.9998	DBL-WICH-THI
FDNS	00NR	4	19WP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03912	144.9018	DBL-WICH-THI
FDNS	00NR	4	24SP	G13_034	TO->FROM	CLEARWATER - MILAN TAP 138KV CKT 1	110	0.03256	119.769	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.048	102.9744	DBL-TGA-MATT
FDNS	00NR	4	19SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0457	101.9225	DBL-TGA-MATT
FDNS	00NR	4	14SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.04795	100.9276	DBL-TGA-MATT
FDNS	00NR	4	24SP	G13_034	TO->FROM	CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	0.0456	99.7	DBL-TGA-MATT
FDNS	01NR	4	14G	G13_034	TO->FROM	EL RENO - ROMAN NOSE 138KV CKT 1	153	0.05051	107.937	DBL-TGA-MATT
FDNS	00NR	4	14SP	G13_034	TO->FROM	FLATRDG3 - THISTLE4 138.00 138KV CKT 1	286	0.04956	108.2812	DBL-WICH-THI
FDNS	00NR	4	19SP	G13_034	TO->FROM	FLATRDG3 - THISTLE4 138.00 138KV CKT 1	286	0.05015	106.6419	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	FROM->TO	FPL SWITCH - MOORELAND 138KV CKT 1	287	0.11628	142.2473	DBL-WWRD-G12
FDNS	01NR	4	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11628	225.1472	DBL-WWRD-G12
FDNS	00NR	4	19SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11614	139.0938	DBL-WWRD-G12
FDNS	01NR	4	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.06192	134.7535	DBL-TGA-MATT
FDNS	00NR	4	14SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.11505	128.0068	DBL-WWRD-G12
FDNS	00NR	4	24SP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.097	102.3183	DBL-WWRD-G12
FDNS	00NR	4	14WP	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	185	0.11577	100.4819	DBL-WWRD-G12
FDNS	01NR	4	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.04171	99.3	WOODWARD (WOODWRD2) 138/69/13.2KV TRANSFORMER CKT 1
FDNS	01NR	4	14G	G13_034	TO->FROM	FPL SWITCH - WOODWARD 138KV CKT 1	153	0.06192	99.2	G11_051T 345.00 - TATONGA7 345.00 345KV CKT 1
FDNS	01NR	4	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.048	129.4679	DBL-TGA-MATT
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0457	127.9756	DBL-TGA-MATT
FDNS	00NR	4	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04795	126.6126	DBL-TGA-MATT
FDNS	00NR	4	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	125.3462	DBL-TGA-MATT
FDNS	00NR	4	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	121.1762	DBL-G1151-TG
FDNS	00NR	4	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.04614	119.197	DBL-TGA-MATT
FDNS	00NR	4	24SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.0456	117.0686	DBL-WWRD-G11
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03438	111.0552	DBL-WICH-THI
FDNS	00NR	4	19SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03735	108.7721	DBL-G1216-TH
FDNS	00NR	4	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03572	108.1976	DBL-WICH-THI

SOLUTION	GROUP	SCENARIO	SEASON	SOURCE	DIRECTION	MONITORED ELEMENT	RATEB (MVA)	TDF	TC%LOADING (% MVA)	CONTINGENCY
FDNS	00NR	4	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03599	107.3685	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03899	104.8488	DBL-G1216-TH
FDNS	00NR	4	14SP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03854	104.5559	DBL-G1216-TH
FDNS	00NR	4	14WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03887	101.7556	DBL-G1216-TH
FDNS	00NR	4	19WP	G13_034	TO->FROM	GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	0.03548	100.6871	DBL-WICH-THI
FDNS	00NR	4	19SP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	351	0.04518	107.2826	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	00NR	4	19WP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	361	0.04345	99.9932	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	00NR	4	24SP	G13_034	TO->FROM	GRAPEVINE INTERCHANGE - NICHOLS STATION 230KV CKT 1	351	0.0402	99.72138	LAWTON EASTSIDE - OKLAUNION 345KV CKT 1
FDNS	00NR	4	14SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03678	180.912	DBL-WICH-THI
FDNS	00NR	4	14WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03719	177.1953	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03769	161.8805	DBL-WICH-THI
FDNS	00NR	4	19SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03772	159.8335	DBL-WICH-THI
FDNS	00NR	4	19WP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03912	156.2442	DBL-WICH-THI
FDNS	00NR	4	24SP	G13_034	FROM->TO	HARPER - MILAN TAP 138KV CKT 1	110	0.03256	136.0894	DBL-WICH-THI
FDNS	01NR	4	14G	G13_034	TO->FROM	ROMAN NOSE - SOUTHARD 138KV CKT 1	153	0.05051	111.3932	DBL-TGA-MATT

I: Power Flow Analysis (Constraints from Category C Contingencies)

Available upon request. Contact SPP Generation Interconnection Studies for details.

J: Group 1 Dynamic Stability Analysis Report

See POWER-tek report on next page.

Southwestern Power Pool Inc. (SPP)

Definitive Impact Study

GEN-2013-002 (Group 01)

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TABLE OF CONTENTS

1. Executive Summary

This report presents the results of impact study comprising of power factor and stability analyses of the proposed interconnection projects under DISIS-2013-002 Group 01 (the Project) as described in the following table.

Table 1.1: Interconnection Request

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2013-025	50.0	Vestas V100 VCSS (583733)	Matthewson 345kV (515497)
GEN-2013-034	73.6	Siemens 2.3MW (583803)	Tap Beaver-Woodward 345kV (562440)

Power factor analysis and transient stability simulations were performed for the Projects in service at its full output. SPP provided three base cases for Winter-2014, Summer-2015, and Summer-2024, each comprising of a power flow and corresponding dynamics database. The previous queued request projects are already modeled in the base cases.

The power factor analysis consists of running all N-1, three phase contingencies shown in the Fault Definitions table (Table 3 in the RFP) in power flow to advise the necessary power factor at the point of interconnection (POI) for each contingency.

The power factor analysis indicates that interconnection request GEN-2013-025 is required to provide reactive power as indicated in Tables 3.2.2 through 3.2.4. GEN-2013-025 will need additional means of providing reactive power as the project machines have limited var capability, 0.98 lagging (supplying vars) and 0.96 leading (absorbing vars). Similarly, the interconnection request GEN-2013-034 is required to provide reactive power as indicated in Tables 3.2.2 through 3.2.4. GEN-2013-024 may need additional means of providing reactive power as the machine capability of 0.90 lagging (supplying vars) and 0.90 leading (absorbing vars) may not be sufficient to provide the required power factor at the point of interconnection (Tap Beaver-Woodward double circuit 345kV) based on the contingencies studied.

Per the SPP OATT, the Interconnection Customer will be required to provide 95% lagging (supplying vars) and 95% leading (absorbing vars) at the POI.

To offset the capacitive effects of the collector system and transmission line of the wind farm under low wind or no wind conditions, the inductive reactive support analysis was performed for winter-2014 scenario. The analysis indicates that at POI (Matthewson 345kV 515497) total 9.0MVAR reactor is required (3.7 MVAR at Bus 581006 and 5.3MVAR at Bus 581007) to maintain zero MVAR flow at POI. Similarly, at POI (Tap Beaver-Woodward 345kV 562440) 2.5MVAR reactor is required at Bus 583800 to maintain zero MVAR flow at POI.

There are no impacts on the stability performance of the SPP system for the contingencies simulated on the supplied base cases. The study Projects stayed on-line and stable for all simulated faults. The Project stability simulations with forty four (44) specified test disturbances did not show instability problems in the SPP system and oscillations were damped out.

2. Introduction

2.1. Project Overview and Assumptions

The DISIS-2013-002 Group 01 Impact Study is a generation interconnection study performed by POWER-tek Global Inc. for Southwest Power Pool (SPP). This report presents the results of impact study comprising of power factor and stability analyses of the proposed interconnection projects under DISIS-2013-002 Group 01 ("The Projects") as described in Table 2.1.1 below:

Table 2.1.1: Interconnection Requests

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2013-025	50	Vestas V100 VCSS (583733)	Matthewson 345kV (515497)
GEN-2013-034	73.6	Siemens 2.3MW (583803)	Tap Beaver-Woodward double circuit 345kV (562440)

Figure 2.1.1 and Figure 2.1.2 respectively shows the single line diagram for the interconnection of the Projects to present and planned system of SPP. This arrangement was modeled and studied in power flow cases for these projects.

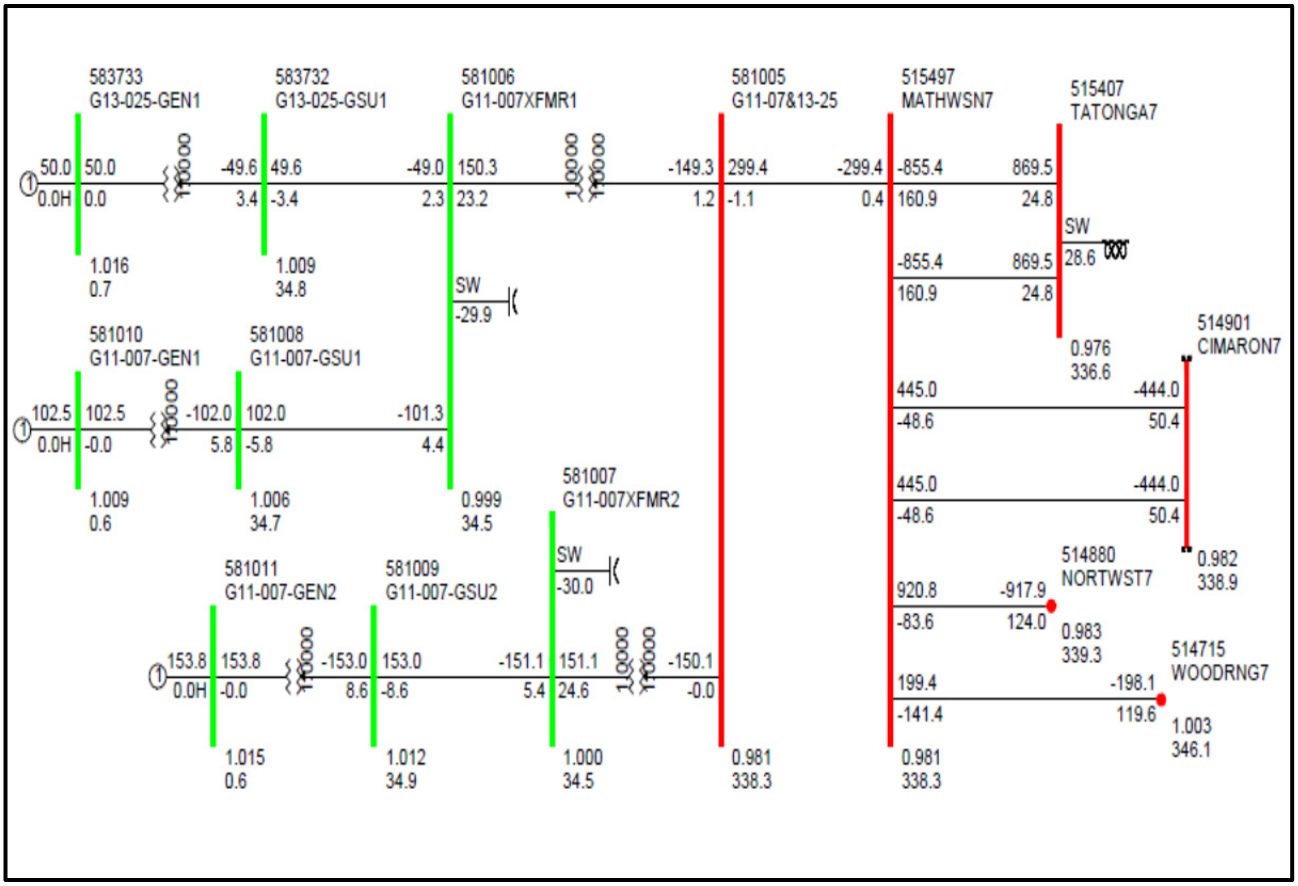

Figure 2.1.1: Power Flow Single Line Diagram for GEN-2013-025 and surrounding system components

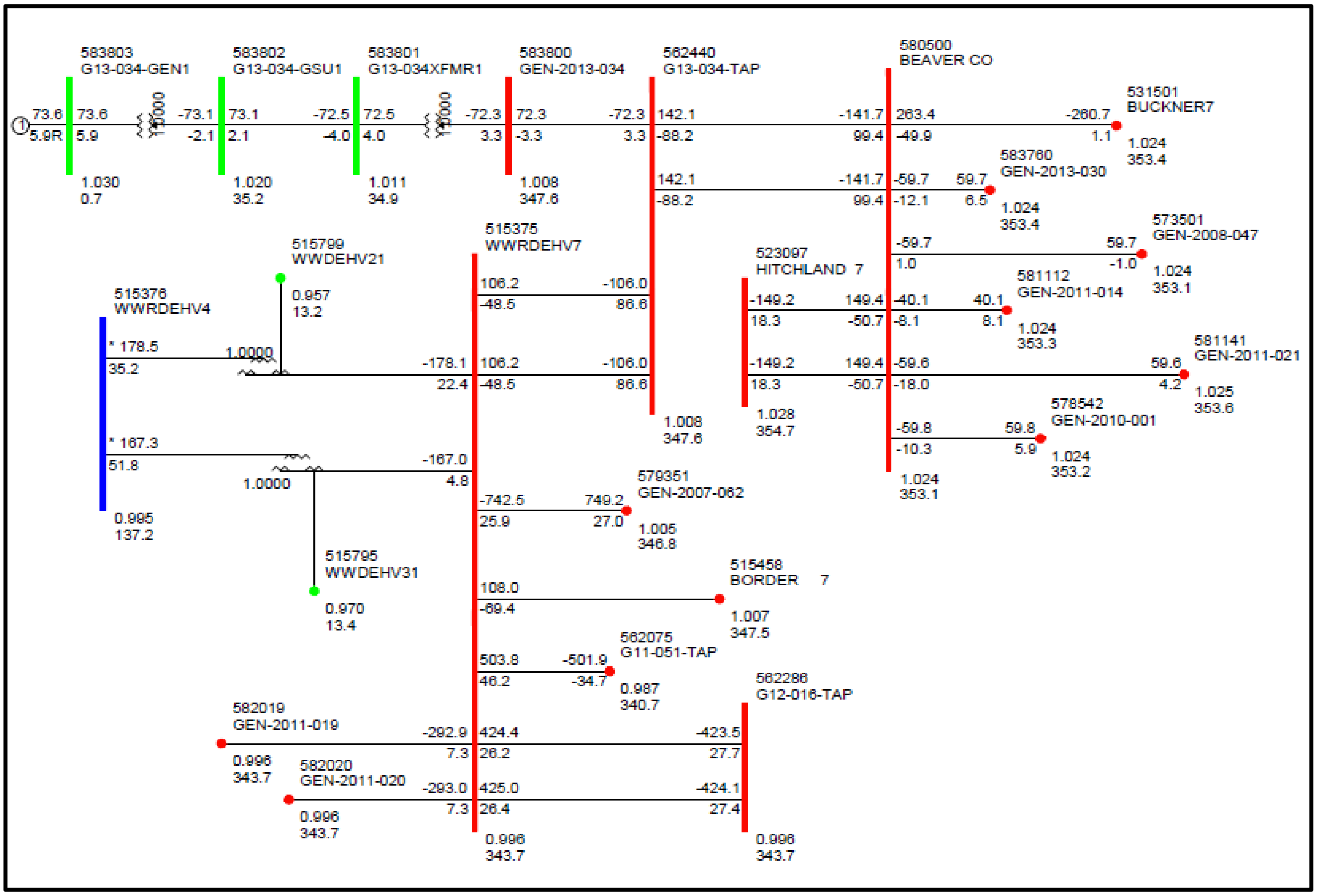

Figure 2.1.2: Power Flow Single Line Diagram for GEN-2013-034 and surrounding system components

Appendix-D contains the machines, interconnection, and machines user model parameters.

Table 2.1.2 below shows the list of prior queued projects modeled in the base case.

Table 2.1.2: List of previous queued request projects

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2001-014	94.5	Suzlon 2.1MW	Fort Supply 138kV (520920)
GEN-2001-037	102	GE 1.5MW	Moorland – Woodward 138kV (515785)
GEN-2005-008	120	GE 1.5MW	Woodward 138kV (514785)
GEN-2006-024S	18.9	Suzlon 2.1MW	Buffalo Bear 69kV (521120)
GEN-2006-046	132	Mitsubishi 2.4MW	Dewey 138kV (514787)
GEN-2007-021	200	GE 1.6MW	Tatonga 345kV (515407)

Request	Size (MW)	Wind Turbine Model	Point of Interconnection
GEN-2007-043	200	GE 1.6	Minco 345kV (514801)
GEN-2007-044	299.2	GE 1.6MW	Tatonga 345kV (515407)
GEN-2007-050	170.2	Siemens 2.3MW	Woodward 138kV (515376)
GEN-2007-062	765	GE 1.5MW	Woodward 345kV (515375)
GEN-2008-003	101.2	Siemens 2.3MW	Woodward 138kV (515376)
GEN-2008-019	300	Mitsubishi 2.4MW	Tatonga 345kV (515407)
GEN-2008-029	250.5	GE 1.5MW	Woodward 138kV (515376)
GEN-2008-044	197.8	Siemens SWT 2.3MW	Tatonga 345kV (515407)
GEN-2010-011	29.7	Siemens SWT 2.3MW	Tatonga 345kV (515407) (Addition to Gen-2008-044 34.5kV bus (515450)
GEN-2010-040	298.5	RePower 2.05MW	Cimarron 345kV (514901)
GEN-2011-007	250.2	RePower 2.05MW	Mathewson 345kV (515497)
GEN-2011-010	100.8	GE 1.6MW	Minco 345kV (514801)
GEN-2011-019	299	Siemens 2.3MW	Woodward 345kV (515375)
GEN-2011-020	299	Siemens 2.3MW	Woodward 345kV (515375)
GEN-2011-051	104.4	Vestas V90 1.8MW	Tap on the Woodward - Tatonga 345kV line (G11_051-TAP, 562075)
GEN-2011-054	299	Siemens 2.3MW	Cimarron 345kV (514901)
GEN-2012-016	280 Summer 312 Winter	GENROU	Tap Woodward-Thistle 345kV (562286)
GEN-2012-031	200.1	Siemens 2.3 (SWTVS4)	Cimarron 345kV (514901)
GEN-2013-003	328 Summer 360 Winter (see note)	GENROU (583323,583326)	Tap Woodward (515375)-Thistle (539801) 345kV line (562286)

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is dependent on the assumptions made with respect to other generation additions and transmission improvements planned by other entities. Changes in the assumptions of the timing of other generation additions or transmission improvements may affect this study's conclusions.

2.2. Objectives

The objectives of the study are to conduct power factor analysis and to determine the impact on system stability of interconnecting the proposed wind farms to SPP's transmission system.

2.3. Models and Simulations Tools Used

Version 32 of the Siemens, PSS/E^{TM} power system simulation program was used in this study.

SPP provided its latest stability database cases for winter-2014, summer-2015, and summer-2024 peak seasons. The Project's PSS/E model had been developed prior to this study and was included in the power flow case and the dynamics database. Machine, interconnection and dynamic model data for the Project plant is provided in Appendix D.

Power flow single line diagram of the projects in summer-2015 peak condition are shown in Figure 2.1.1 and Figure 2.1.2 respectively. These Figures shows that wind farms model includes representation of the radial transmission line, the substation transformer from transmission voltage to 345 kV to 34.5V. The remainder of each wind farm is represented by lumped equivalents including a generator, a step-up transformer, and collector system impedance. No special modeling is required of line relays in these cases, except for the special modeling related to the wind-turbine tripping.

All generators in Areas 520, 524, 525, 526, 531, 534, and 536 were monitored.

3. Power Factor Analysis

3.1. Methodology

Power factor analysis was conducted for the Project using the following methodology:

1. Replace the wind farm by a generator at the high side bus 345 kV, 138 kV, 115kV, or 69 kV bus, as applicable, with the MW of the wind farms at that point of interconnection.
2. Turn off the wind farm as modeled (as well as previous queued projects at the same point of interconnection).
3. Model a var generator at the Project's high voltage side, 345 kV, 138 kV, 115kV, or 69kV bus, as applicable. The var generator is set to hold a voltage schedule at the POI consistent with the voltage schedule in the provided power flow cases for summer and winter or 1.0 p.u. voltage, whichever is higher.
4. Perform the steady state contingency analysis to determine the power factor necessary at the POI for each contingency.
5. If the required power factor at the POI is beyond the capability of the studied wind turbines to meet (at the POI) capacitor banks may be considered for the stability analysis. The preference is to locate the capacitance banks on the 34.5 kV customer side. Factors to sizing capacitor banks include:
    - 5.1. The ability of the wind farm to meet FERC Order 661A (low voltage ride through) with and without capacitor banks.
    - 5.2. The ability of the wind farm to meet FERC Order 661A (wind farm recovery to pre-fault voltage).
    - 5.3. If wind farms trips on high voltage, power factor lower than unity may be required.

3.2. Analysis

Analysis was performed for the proposed Projects with all prior queued projects in service. A var generator was modeled at the point of interconnection and was set to hold a voltage schedule at the POI consistent with the voltage schedule in the provided power flow cases OR 1 p.u. whichever is higher. The voltages for these Projects are summarized in Table 3.2.1. All upgrades and instructions were made in the base cases. No other changes were made in the base cases provided, other than the addition of the var generators. Contingency analysis was run for provided list of contingencies.

Table 3.2.1: POI voltages for the summer and winter peak cases

Request	Point of Interconnection	Size (MW)	Base Case Voltage (p.u.)		
			Winter 2014 Peak	Summer 2015 Peak	Summer 2024 Peak
GEN-2013-025	Matthewson 345kV (515497)	50.0	0.9806	0.988	0.9812
GEN-2013-034	Tap Beaver-Woodward 345kV (562440)	73.6	1.007	1.007	1.006

The details of the var requirement during contingencies are highlighted in Table 3.2.2, 3.2.3 and 3.2.4. The highest and the lowest values obtained are highlighted in these tables.

1. For 2014 winter case (GEN-2013-025 analysis): The maximum var generator supply is 593.4 MVARs at 0.46 (lagging power factor) for the outage of 515497 [MATHWSN7 345.0] TO BUS 514715 [WOODRNG7 345.0] CKT outage. The minimum var requirement is 143.1 MVAR at 0.91 (lagging power factor) for outage of 515375 [WWRDEHV7 345.0] TO BUS 562075 [G11-051-TAP 345.0] CKT outage.
2. For 2014 winter case (GEN-2013-034 analysis): The maximum var generator supply is 66.9 MVARs at 0.74 (lagging power factor) for the outage of 580500 [BEAVER CO 345.0] TO BUS 523097 [HITCHLAND 7 345.0] and 580500 [BEAVER CO 345.0] TO BUS 562440 [G13-034-TAP 345.0] CKTs outage. The minimum var requirement is -189.3 MVAR at 0.36 (leading power factor) for outage of 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] and 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] CKTs outage.

Note: The high var requirements are seen due to 0.986 p.u. voltage at POI in provided base case, and as per methodology the var generator is modeled with 1 p.u. voltage for power factor analysis methodology.

Table 3.2.2: Var Generator Output in 2014 Winter Peak Case for DISIS-2013-002 (Group 01)
2014 Winter Peak Case Power Factor Study:

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					**Analysis for GEN-2013-025**		**Analysis for GEN-2013-034**	
						GEN MW at POI **306.3**		GEN MW at POI **73.6**	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
	Base Case MVAR Flow				N/A	404.4	0.60	-14.8	0.98
FLT01-3PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	408.1	0.60	8.0	0.99
FLT03-3PH	580500	BEAVER CO 345.00	531501	BUCKNER7 345.00	CKT 1	432.0	0.58	21.4	0.96
FLT05-3PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	414.9	0.59	55.1	0.80
FLT07-3PH	562440	G13-034-TAP 345.00	515375	WWRDEHV7 345.00	CKT 1	404.5	0.60	-81.5	0.67
FLT09-3PH	531501	BUCKNER7 345.00	531469	SPERVIL7 345.00	CKT 1	440.6	0.57	11.7	0.99
FLT11-3PH	531501	BUCKNER7 345.00	531449	HOLCOMB7 345.00	CKT 1	404.6	0.60	-11.3	0.99
FLT13-3PH	523853	FINNEY 7345.00	531449	HOLCOMB7 345.00	CKT 1	420.9	0.59	3.5	1.00
FLT15-3PH	523853	FINNEY 7345.00	523097	HITCHLAND 7345.00	CKT 1	417.3	0.59	11.2	0.99

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					**Analysis for GEN-2013-025**		**Analysis for GEN-2013-034**	
						GEN MW at POI **306.3**		GEN MW at POI **73.6**	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
FLT17-3PH	523097	HITCHLAND 7345.00	523961	POTTER_CO 7345.00	CKT 1	405.8	0.60	-2.7	1.00
FLT19-3PH	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1	143.1	0.91	32.5	0.91
FLT21-3PH	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1	535.9	0.50	13.5	0.98
	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1				
FLT22-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	535.9	0.50	13.5	0.98
	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1				
FLT23-1PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	143.8	0.91	10.3	0.99
	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1				
FLT24-1PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	417.6	0.59	66.9	0.74
	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1				
FLT25-1PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	413.1	0.60	-12.7	0.99
	580500	BEAVER CO 345.00	515375	WWRDEHV7 345.00	CKT 1				
FLT26-3PH	523095	HITCHLAND 6230.00	523155	OCHILTREE 6230.00	CKT 1	405.7	0.60	-11.6	0.99
FLT28-3PH	523095	HITCHLAND 6230.00	523309	MOORE_CNTY6 230.00	CKT 1	406.0	0.60	-15.4	0.98
FLT30-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	375.2	0.63	-10.0	0.99
	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 2				
FLT31-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	377.6	0.63	-4.3	1.00
	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1				
FLT32-3PH	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 1	432.9	0.58	-189.3	0.36
	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 2				
FLT33-3PH	515376	WWRDEHV4 138.00	514000	KEENAN-1 138.00	CKT 1	367.4	0.64	-9.3	0.99
FLT35-3PH	515376	WWRDEHV4 138.00	514785	WOODWRD4 138.00	CKT 1	405.1	0.60	-11.1	0.99

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					Analysis for GEN-2013-025		Analysis for GEN-2013-034	
						GEN MW at POI 306.3		GEN MW at POI 73.6	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
FLT37-3PH	515376	WWRDEHV4 138.00	514796	IODINE-4 138.00	CKT 1	407.3	0.60	-9.2	0.99
FLT39-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	410.4	0.60	-31.2	0.92
FLT41-3PH	515375	WWRDEHV7 345.00	515458	BORDER 7345.00	CKT 1	429.7	0.58	30.9	0.92
FLT43-1PH	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1	377.6	0.63	-4.3	1.00
FLT44-1PH	515497	MATHWSN7 345.00	514715	WOODRNG7 345.00	CKT 1	593.4	0.46	37.5	0.89

3. For 2015 summer case (GEN-2013-025 analysis): The maximum var generator supply is 466.6 MVARs at 0.57 (lagging power factor) for the outage of 515497 [MATHWSN7 345.0] TO BUS 514715 [WOODRNG7 345.0] CKT outage. The minimum var requirement is 73.9 MVAR at 0.97 (lagging power factor) for outage of 515375 [WWRDEHV7 345.0] TO BUS 562075 [G11-051-TAP 345.0] CKT outage.
4. For 2015 summer case (GEN-2013-034 analysis): The maximum var generator supply is 62.6 MVARs at 0.76 (lagging power factor) for the outage of 580500 [BEAVER CO 345.0] TO BUS 523097 [HITCHLAND 7 345.0] and 580500 [BEAVER CO 345.0] TO BUS 562440 [G13-034-TAP 345.0] CKTs outage. The minimum var requirement is -179.3 MVAR at 0.38 (leading power factor) for outage of 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] and 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] CKTs outage.

Note: The high var requirements are seen due to 0.986 p.u. voltage at POI in provided base case, and as per methodology the var generator is modeled with 1 p.u. voltage for power factor analysis methodology.

Table 3.2.3: Var Generator Output in 2015 Summer Peak Case for DISIS-2013-002 (Group 01)

2015 Summer Peak Case Power Factor Study:

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					Analysis for GEN-2013-025		Analysis for GEN-2013-034	
						GEN MW at POI 306.3		GEN MW at POI 73.6	
Cont. Name	**From Bus (# & Name)**			**To Bus (# & Name)**	**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
	Base Case MVAR Flow				N/A	273.5	0.75	-15.0	0.98
FLT01-3PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	278.1	0.74	5.5	1.00
FLT03-3PH	580500	BEAVER CO 345.00	531501	BUCKNER7 345.00	CKT 1	295.8	0.72	17.7	0.97

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					**Analysis for GEN-2013-025**		**Analysis for GEN-2013-034**	
						GEN MW at POI **306.3**		GEN MW at POI **73.6**	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
FLT05-3PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	286.2	0.73	52.3	0.82
FLT07-3PH	562440	G13-034-TAP 345.00	515375	WWRDEHV7 345.00	CKT 1	274.9	0.74	-74.0	0.71
FLT09-3PH	531501	BUCKNER7 345.00	531469	SPERVIL7 345.00	CKT 1	306.3	0.71	-10.9	0.99
FLT11-3PH	531501	BUCKNER7 345.00	531449	HOLCOMB7 345.00	CKT 1	273.7	0.75	5.4	1.00
FLT13-3PH	523853	FINNEY 7345.00	531449	HOLCOMB7 345.00	CKT 1	290.6	0.73	5.4	1.00
FLT15-3PH	523853	FINNEY 7345.00	523097	HITCHLAND 7345.00	CKT 1	281.7	0.74	1.0	1.00
FLT17-3PH	523097	HITCHLAND 7345.00	523961	POTTER_CO 7345.00	CKT 1	277.3	0.74	-9.9	0.99
FLT19-3PH	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1	73.9	0.97	30.6	0.92
FLT21-3PH	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1	389.9	0.62	20.8	0.96
	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1				
FLT22-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	389.9	0.62	20.8	0.96
	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1				
FLT23-1PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	74.3	0.97	13.6	0.98
	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1				
FLT24-1PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	289.8	0.73	62.6	0.76
	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1				
FLT25-1PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	285.4	0.73	-8.9	0.99
	580500	BEAVER CO 345.00	515375	WWRDEHV7 345.00	CKT 1				
FLT26-3PH	523095	HITCHLAND 6230.00	523155	OCHILTREE 6230.00	CKT 1	275.2	0.74	-13.9	0.98
FLT28-3PH	523095	HITCHLAND 6230.00	523309	MOORE_CNTY6 230.00	CKT 1	275.6	0.74	-19.4	0.97
FLT30-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	250.2	0.77	-10.7	0.99
	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 2				

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					Analysis for GEN-2013-025		Analysis for GEN-2013-034	
						GEN MW at POI **306.3**		GEN MW at POI **73.6**	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
FLT31-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	277.1	0.74	-3.4	1.00
	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1				
FLT32-3PH	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 1	318.7	0.69	-179.3	0.38
	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 2				
FLT33-3PH	515376	WWRDEHV4 138.00	514000	KEENAN-1 138.00	CKT 1	244.3	0.78	-7.5	0.99
FLT35-3PH	515376	WWRDEHV4 138.00	514785	WOODWRD4 138.00	CKT 1	274.4	0.74	-12.0	0.99
FLT37-3PH	515376	WWRDEHV4 138.00	514796	IODINE-4 138.00	CKT 1	278.0	0.74	-9.5	0.99
FLT39-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	279.8	0.74	-28.6	0.93
FLT41-3PH	515375	WWRDEHV7 345.00	515458	BORDER 7345.00	CKT 1	296.4	0.72	32.3	0.92
FLT43-1PH	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1	277.1	0.74	-3.4	1.00
FLT44-1PH	515497	MATHWSN7 345.00	514715	WOODRNG7 345.00	CKT 1	446.6	0.57	41.9	0.87

5. For 2024 summer case (GEN-2013-025 analysis): The maximum var generator supply is 540.9 MVARs at 0.49 (lagging power factor) for the outage of 515497 [MATHWSN7 345.0] TO BUS 514715 [WOODRNG7 345.0] CKT outage. The minimum var requirement is 349.1 MVAR at 0.66 (lagging power factor) for outage of 515497 [MATHWSN7 345.0] TO BUS 514901 [CIMARON7 345.0] and 515497 [MATHWSN7 345.0] TO BUS 514901 [CIMARON7 345.0] CKTs outage.
6. For 2024 summer case (GEN-2013-034 analysis): The maximum var generator supply is 67.0 MVARs at 0.74 (lagging power factor) for the outage of 515497 [MATHWSN7 345.0] TO BUS 514715 [WOODRNG7 345.0] CKT outage. The minimum var requirement is -171.9 MVAR at 0.39 (leading power factor) for outage of 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] and 515375 [WWRDEHV7 345.0] TO BUS 562440 [G13-034-TAP 345.0] CKTs outage.

Note: The high var requirements are seen due to 0.986 p.u. voltage at POI in provided base case, and as per methodology the var generator is modeled with 1 p.u. voltage for power factor analysis methodology.

Table 3.2.3: Var Generator Output in 2024 Summer Peak Case for DISIS-2013-002 (Group 01)

2024 Summer Peak Case Power Factor Study:

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					Analysis for GEN-2013-025		Analysis for GEN-2013-034	
						GEN MW at POI 306.3		GEN MW at POI 73.6	
Cont. Name	From Bus (# & Name)		To Bus (# & Name)		ID	MVAR at POI	P.F at POI	MVAR at POI	P.F at POI
	Base Case MVAR Flow				N/A	398.5	0.61	-8.1	0.99
FLT01-3PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	403.0	0.61	10.7	0.99
FLT03-3PH	580500	BEAVER CO 345.00	531501	BUCKNER7 345.00	CKT 1	430.8	0.58	27.2	0.94
FLT05-3PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	412.7	0.60	55.7	0.80
FLT07-3PH	562440	G13-034-TAP 345.00	515375	WWRDEHV7 345.00	CKT 1	398.8	0.61	-69.4	0.73
FLT09-3PH	531501	BUCKNER7 345.00	531469	SPERVIL7 345.00	CKT 1	442.5	0.57	18.3	0.97
FLT11-3PH	531501	BUCKNER7 345.00	531449	HOLCOMB7 345.00	CKT 1	399.0	0.61	-4.5	1.00
FLT13-3PH	523853	FINNEY 7345.00	531449	HOLCOMB7 345.00	CKT 1	423.3	0.59	16.9	0.97
FLT15-3PH	523853	FINNEY 7345.00	523097	HITCHLAND 7345.00	CKT 1	412.9	0.60	12.4	0.99
FLT17-3PH	523097	HITCHLAND 7345.00	523961	POTTER_CO 7345.00	CKT 1	397.9	0.61	-4.5	1.00
FLT19-3PH	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1	377.3	0.63	-2.7	1.00
FLT21-3PH	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1	510.4	0.51	41.9	0.87
	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1				
FLT22-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	510.4	0.51	41.9	0.87
	515407	TATONGA7 345.00	515497	MATHWSN7 345.00	CKT 1				
FLT23-1PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	357.4	0.65	-19.5	0.97
	515375	WWRDEHV7 345.00	562075	G11-051-TAP 345.00	CKT 1				
FLT24-1PH	580500	BEAVER CO 345.00	523097	HITCHLAND 7345.00	CKT 1	433.5	0.58	65.1	0.75
	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1				

	Rated MW of Wind Farms OR at POI (MW) Rated MVAR of Wind Farms OR at POI (MVAR)					Analysis for GEN-2013-025		Analysis for GEN-2013-034	
						GEN MW at POI **306.3**		GEN MW at POI **73.6**	
Cont. Name	**From Bus (# & Name)**		**To Bus (# & Name)**		**ID**	**MVAR at POI**	**P.F at POI**	**MVAR at POI**	**P.F at POI**
FLT25-1PH	580500	BEAVER CO 345.00	562440	G13-034-TAP 345.00	CKT 1	433.5	0.58	-7.3	1.00
	580500	BEAVER CO 345.00	515375	WWRDEHV7 345.00	CKT 1				
FLT26-3PH	523095	HITCHLAND 6230.00	523155	OCHILTREE 6230.00	CKT 1	400.9	0.61	-8.6	0.99
FLT28-3PH	523095	HITCHLAND 6230.00	523309	MOORE_CNT Y6 230.00	CKT 1	399.8	0.61	-10.0	0.99
FLT30-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	349.1	0.66	-1.5	1.00
	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 2				
FLT31-3PH	515497	MATHWSN7 345.00	514901	CIMARON7 345.00	CKT 1	362.8	0.65	9.2	0.99
	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1				
FLT32-3PH	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 1	441.9	0.57	-171.9	0.39
	515375	WWRDEHV7 345.00	562440	G13-034-TAP 345.00	CKT 2				
FLT33-3PH	515376	WWRDEHV4 138.00	514000	KEENAN-1 138.00	CKT 1	366.0	0.64	-2.2	1.00
FLT35-3PH	515376	WWRDEHV4 138.00	514785	WOODWRD4 138.00	CKT 1	399.5	0.61	-6.0	1.00
FLT37-3PH	515376	WWRDEHV4 138.00	514796	IODINE-4 138.00	CKT 1	403.1	0.61	-3.6	1.00
FLT39-3PH	515375	WWRDEHV7 345.00	562286	G12-016-TAP 345.00	CKT 1	404.7	0.60	-22.9	0.95
FLT41-3PH	515375	WWRDEHV7 345.00	515458	BORDER 7345.00	CKT 1	407.5	0.60	25.2	0.95
FLT43-1PH	515497	MATHWSN7 345.00	514880	NORTWST7 345.00	CKT 1	362.8	0.65	9.2	0.99
FLT44-1PH	515497	MATHWSN7 345.00	514715	WOODRNG7 345.00	CKT 1	540.9	0.49	67.0	0.74

3.3. Conclusions

The power factor analysis indicates the DISIS-2013-002 (Group 01) interconnection requests i.e., GEN-2013-025 and GEN-2013-034 are required to maintain the SPP standard power factor at the point of interconnection i.e., (Matthewson 345kV 515497) and (Tap Beaver-Woodward double circuit 345kV 562440) based on the contingencies studied.

Per the SPP OATT, the Interconnection Customer will be required to provide 95% lagging (supplying vars) and 95% leading (absorbing vars) at the POI.

4. Inductive Reactive Support Analysis

To offset the capacitive effects of the collector system and transmission line of the wind farm under low wind or no wind conditions, analysis was performed for winter-2014 scenario to calculate the Inductive Reactive Support at point of interconnection for each interconnection request under project DISIS-2013-002 (Group 01).

Following methodology was adopted as communicated by SPP:

1. Switch the generator and capacitor bank (if installed) out of service with the collector system as modeled remaining in service.
2. Calculate the amount of inductive reactive support required at the 34.5kV collector buses which would result in zero VAR flow at the POI.

The inductive reactive support analysis performed for winter-2014 scenario which indicates that at POI (Matthewson 345kV 515497) total 9.0MVAR reactor is required (3.7 MVAR at Bus 581006 and 5.3MVAR at Bus 581007) to maintain zero MVAR flow at POI. Similarly, at POI (Tap Beaver-Woodward 345kV 562440) 2.5MVAR reactor is required at Bus 583800 to maintain zero MVAR flow at POI that at POI (Matthewson 345kV 515497).

The single line diagram showing the inductive reactive requirement for Gen-2013-025 and Gen-2013-034 are respectively shown in Figure 4.1.1 and 4.1.2:

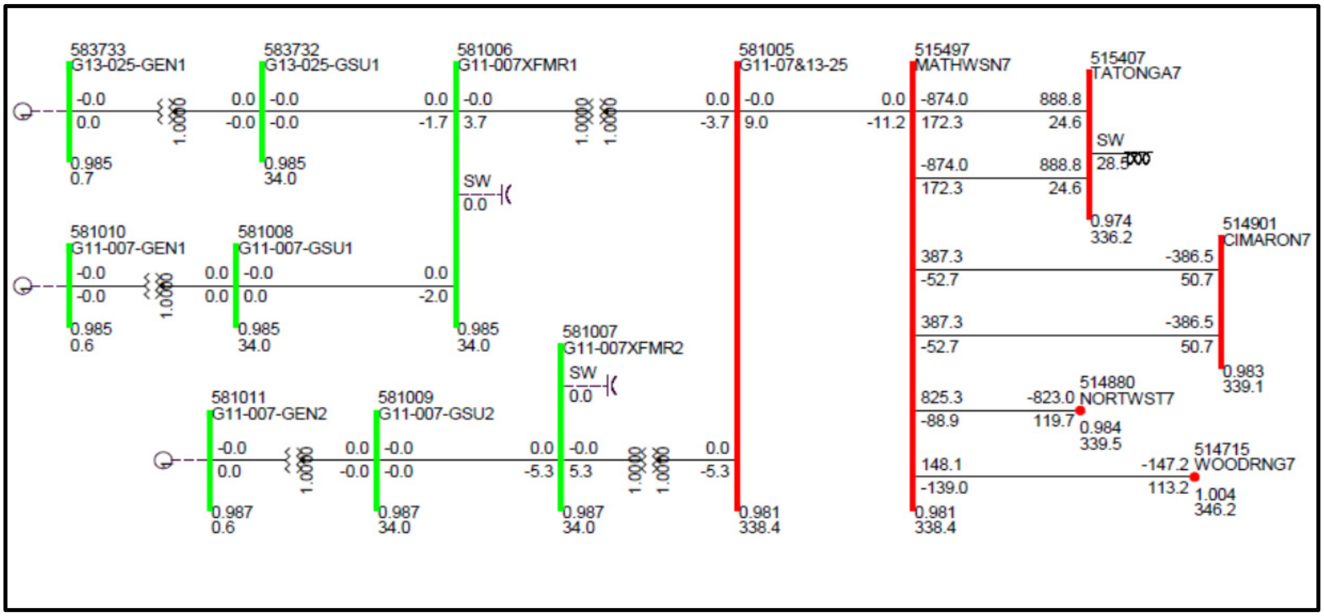

Figure 4.1.1: Inductive Reactive Requirement for GEN-2013-025

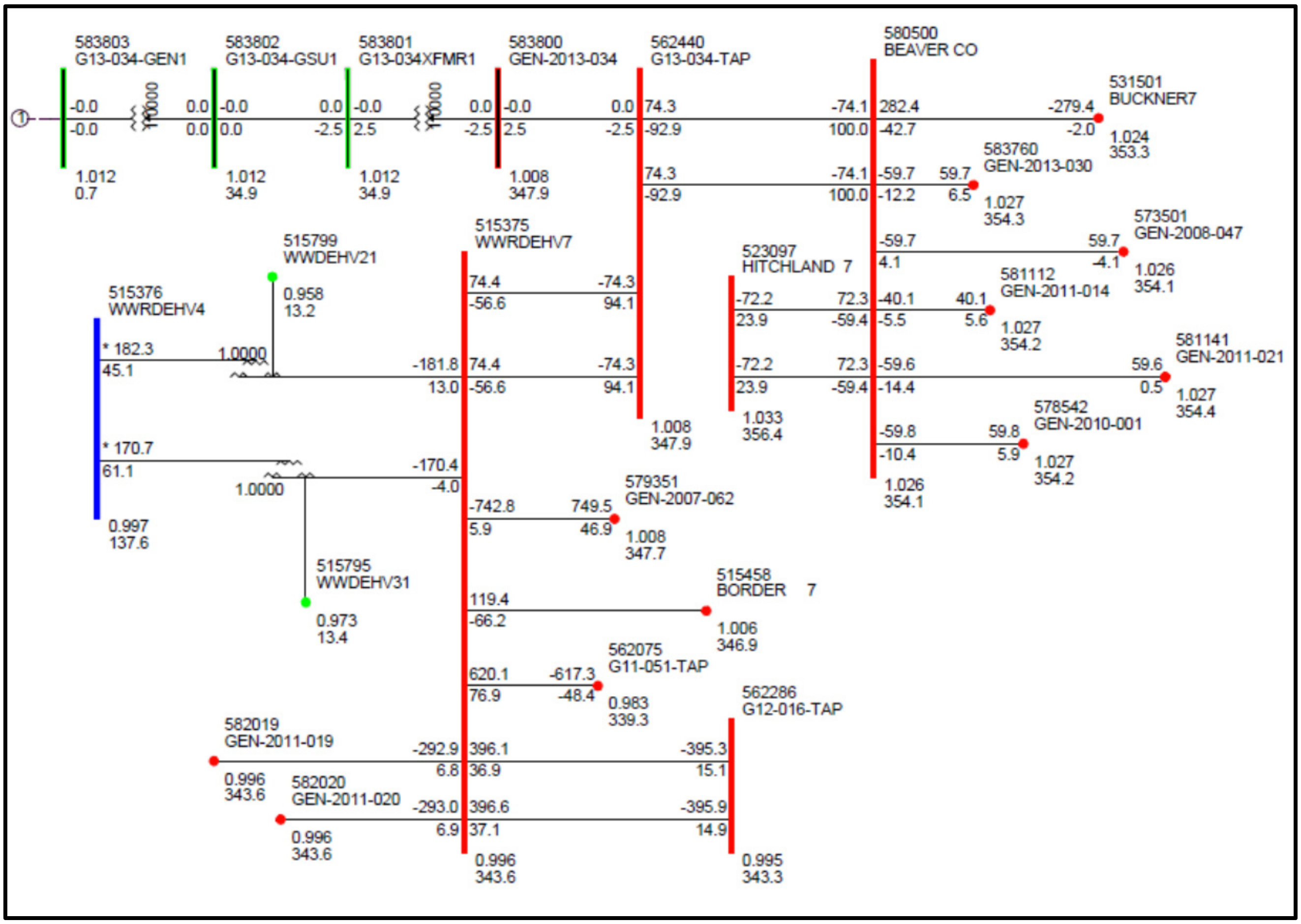

Figure 4.1.2: Inductive Reactive Requirement for GEN-2013-034

5. Stability Analysis

5.1. Faults Simulated

Forty Four (44) faults were considered for the transient stability simulations which included three phase faults, as well as single phase line faults, at the locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location. As per the SPP current practice to compute the fault levels, the fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. Concurrently and previously queued projects as respectively shown in Table-1 and Table-2 of the study request i.e., (GEN-2006-046, GEN-2007-021, GEN-2007-043, GEN-2007-044, GEN-2007-050, GEN-2007-062, GEN-2008-003, GEN-2008-019, GEN-2008-029, GEN-2008-044, GEN-2010-011, GEN-2010-040, GEN-2011-007, GEN-2011-010, GEN-2011-007, GEN-2011-019, GEN-2011-020, GEN-2011-051, GEN-2011-054, GEN-2012-016, GEN-2012-031, GEN-2013-003, other neighboring machines, as well as areas number 520, 524, 525, 526, 531, 534, and 536 were monitored during all the simulations. Table 5.1.1 shows the list of simulated contingencies. This table also shows the fault clearing time and the time delay before re-closing for all the study contingencies.

Simulations were performed with a 0.1-second steady-state run followed by the appropriate disturbance as described in Table 5.1.1. Simulations were run for minimum 15-second duration to confirm proper machine damping.

Table 5.1.1 summarizes the overall results for all faults simulations. Complete sets of plots for winter-2014, summer-2015, and summer-2024 peak seasons for each fault are included in Appendices A, B and C respectively.

Table 5.1.1: List of simulated faults for stability analysis

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
1	FLT01-3PH	3 phase fault on the Beaver Co. (580500) to Hitchland (523097) 345kV line circuit 1, near Beaver Co.. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
2	FLT02-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
3	FLT03-3PH	3 phase fault on the Beaver Co. (580500) to Buckner (531501) 345kV line, near Beaver Co.. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
4	FLT04-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
5	FLT05-3PH	3 phase fault on the Beaver Co. (580500) to GEN-2013-034 Tap (562440) 345kV line, near Beaver Co.. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
6	FLT06-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
7	FLT07-3PH	3 phase fault on the GEN-2013-034 Tap (562440) to Woodward (515375) 345kV line circuit 1, near GEN-2013-034 Tap. a. Apply fault at the GEN-2013-034 Tap 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.	Stable	Stable	Stable
8	FLT08-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
9	FLT09-3PH	3 phase fault on the Buckner (531501) to Spearville (531469) 345kV line, near Buckner. a. Apply fault at the Buckner 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.	Stable	Stable	Stable
10	FLT10-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
11	FLT11-3PH	3 phase fault on the Buckner (531501) to Holcomb (531449) 345kV line, near Buckner. a. Apply fault at the Buckner 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.	Stable	Stable	Stable
12	FLT12-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
13	FLT13-3PH	3 phase fault on the Finney (523853) to Holcomb (531449) 345kV line, near Finney. a. Apply fault at the Finney 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.	Stable	Stable	Stable
14	FLT14-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
15	FLT15-3PH	3 phase fault on the Finney (523853) to Hitchland (523097) 345kV line, near Finney. a. Apply fault at the Finney 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.	Stable	Stable	Stable
16	FLT16-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
17	FLT17-3PH	3 phase fault on the Hitchland (523097) to Potter Co (523961) 115kV line, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
18	FLT18-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
19	FLT19-3PH	3 phase fault on the Woodward (515375) to GEN-2011-051 Tap (562075) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
20	FLT20-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
21	FLT21-3PH	**Prior Outage of Tatonga to Mathewson 345kV circuit 1.** 3 phase fault on the Woodward to GEN-2012-016 Tap 345kV line. a. Prior outage Tatonga (515407) 345kV to Mathewson (515497) (solve network for steady state solution). b. 3 phase fault on the Woodward (515375) to GEN-2012-016 Tap (562286) 345kV circuit 1, near Woodward 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).	Stable	Stable	Stable
22	FLT22-3PH	**Prior Outage of Woodward to GEN-2012-016 Tap 345kV.** 3 phase fault on the Tatonga to Matthewson circuit 1. a. Prior outage Woodward (515375) 345kV to GEN-2012-016 Tap (562286) 345kV circuit 1 (solve network for steady state solution). b. 3 phase fault on the Tatonga (515407) to Mathewson (515497) 345kV circuit 1, near Tatonga 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
23	FLT23-1PH	**Woodward 345kV Stuck Breaker** a. Apply single phase fault at the Woodward (515375) 345kV bus on the Woodward – GEN-2011-051 Tap (562075) 345kV line. b. Wait 16 cycles, and then drop Woodward (515375) 345kV to GEN-2012-016 Tap (531448) 345kV Ckt 1. c. Trip Woodward to GEN-2011-051 Tap 345kV and remove the fault	Stable	Stable	Stable
24	FLT24-1PH	**Beaver Co 345kV Stuck Breaker** a. Apply single phase fault at the Beaver Co (580500) 345kV bus on the Beaver Co – GEN-2013-034 Tap (562440) 345kV line circuit 1. b. Wait 16 cycles, and then drop Beaver Co (580500) 345kV to Hitchland (523097) 345kV Ckt 1. c. Trip Beaver Co to GEN-2013-034 Tap 345kV and remove the fault.	Stable	Stable	Stable
25	FLT25-1PH	**GEN-2013-034 Tap 345kV Stuck Breaker** a. Apply single phase fault at the GEN-2013-034 (562440) 345kV bus on the GEN-2013-034 – Woodward (515375) 345kV line circuit 1. b. Wait 16 cycles, and then drop Beaver (580500) 345kV to GEN-2013-034 Tap (562440) 345kV line Circuit1. c. Trip GEN-2013-034 Tap to Woodward 345kV and remove the fault.	Stable	Stable	Stable
26	FLT26-3PH	3 phase fault on the Hitchland (523095) to Ochiltree (523155) 230kV line, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
27	FLT27-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
28	FLT28-3PH	3 phase fault on the Hitchland (523095) to Moore Co (523309) 230kV line, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
29	FLT29-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
30	FLT30-3PH	**Prior Outage of Mathewson to Cimarron 345kV circuit 1.** 3 phase fault on the Mathewson to Cimarron 345kV circuit 2 line. a. Prior outage Mathewson (515497) 345kV to Cimarron (514901) 345kV circuit 1 (solve network for steady state solution). b. 3 phase fault on the Mathewson (515497) 345kV to Cimarron (514901) 345kV circuit 2, near Mathewson 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).	Stable	Stable	Stable
31	FLT31-3PH	**Prior Outage of Mathewson to Cimarron 345kV circuit 1.** 3 phase fault on the Mathewson to Northwest 345kV line. a. Prior outage Mathewson (515497) 345kV to Cimarron (514901) 345kV circuit 1 (solve network for steady state solution). b. 3 phase fault on the Mathewson (515497) 345kV to Northwest (514880) 345kV, near Mathewson 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).	Stable	Stable	Stable
32	FLT32-3PH	**Prior Outage of Woodward to GEN-2013-034 Tap 345kV circuit 1.** 3 phase fault on the Woodward to GEN-2013-034 Tap 345kV line circuit 2. a. Prior outage Woodward (515375) 345kV to GEN-2012-034 Tap (562440) 345kV circuit 1 (solve network for steady state solution). b. 3 phase fault on the Woodward (515375) 345kV to GEN-2012-034 Tap (562440) 345kV circuit 2, near Woodward 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).	Stable	Stable	Stable

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
33	FLT33-3PH	3 phase fault on the Woodward EHV (515376) to Keenan (514000) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
34	FLT34-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
35	FLT35-3PH	3 phase fault on the Woodward EHV (515376) to Woodward (514785) 138kV circuit 1 line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
36	FLT36-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
37	FLT37-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
38	FLT38-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
39	FLT39-3PH	3 phase fault on the Woodward (515375) to GEN-2012-016 Tap (562286) 345kV circuit 1 line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
40	FLT40-1PH	*Single phase fault and sequence like previous*			

Cont. #	Contingency Name	Description	2014 Winter Results	2015 Summer Results	2024 Summer Results
41	FLT41-3PH	3 phase fault on the Woodward (515375) to Border (515458) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.	Stable	Stable	Stable
42	FLT42-1PH	*Single phase fault and sequence like previous*	Stable	Stable	Stable
43	FLT43-1PH	**Mathewson 345kV Stuck Breaker Scenario 1** a. Apply single phase fault at the Mathewson (515497) 345kV bus on the Mathewson – Cimarron (514901) 345kV line circuit 1. b. Wait 16 cycles, and then drop Mathewson (515497) 345kV to Northwest (514880) 345kV line. c. Trip Mathewson to Cimarron 345kV circuit 1 and remove the fault.	Stable	Stable	Stable
44	FLT43-1PH	**Mathewson 345kV Stuck Breaker Scenario 2** a. Apply single phase fault at the Mathewson (515497) 345kV bus on the Mathewson – Tatonga (515407) 345kV line circuit 1. b. Wait 16 cycles, and then drop Mathewson (515497) 345kV to Woodring (514715) 345kV line. c. Trip Mathewson to Tatonga 345kV circuit 1 and remove the fault.	Stable	Stable	Stable

5.2. Simulation Results

There are no impacts on the stability performance of the SPP system for the contingencies tested on the SPP provided base cases.

6. Conclusions

The findings of the impact study for the proposed interconnection projects under DSIS-2013-002 (Group 01) considered 100% of their proposed installed capacity is as follows:

1. The power factor analysis indicates that both the projects GEN-2013-025 and Gen-2013-034 interconnection requests are required to maintain the SPP standard power factor at the point of interconnection i.e., (Matthewson 345kV 515497) and (Tap Beaver-Woodward double circuit 345kV 562440) based on the contingencies studied. Per the SPP OATT, the Interconnection Customer will be required to provide 95% lagging (supplying vars) and 95% leading (absorbing vars) at the POI.

2. To offset the capacitive effects of the collector system and transmission line of the wind farm under low wind or no wind conditions, the inductive reactive support analysis was performed for winter-2014 scenario. The analysis indicates that at POI (Matthewson 345kV 515497) total 9.0MVAR reactor is required (3.7 MVAR at Bus 581006 and 5.3MVAR at Bus 581007) to maintain zero MVAR flow at POI. Similarly, at POI (Tap Beaver-Woodward 345kV 562440) 2.5MVAR reactor is required at Bus 583800 to maintain zero MVAR flow at POI.

3. There are no impacts on the stability performance of the SPP system for the contingencies tested on the provided base cases. The study machines stayed on-line and stable for all simulated faults. The Project stability simulations with forty four (44) specified test disturbances did not show instability problems in the SPP system. Any oscillations were damped out.

7. Appendix A: 2014 Winter Peak Case Stability Run Plots

8. Appendix B: 2015 Summer Peak Case Stability Run Plots

9. Appendix C: 2024 Summer Peak Case Stability Run Plots

10. Appendix D: Project Model Data

K: Group 2 Dynamic Stability Analysis Report

See Excel report on next page.

SPP DISIS-2013-002 Group 2
Definitive Impact Study

Final Report for

Southwest Power Pool

Prepared by:
Excel Engineering, Inc.
Project # 130621

January 9, 2014

Principal Contributor:

William Quaintance, P.E.

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0. Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the States of **Oklahoma** and **Texas**.

William Quaintance
Oklahoma License Number 24320
Texas License Number 104268

Excel Field Services, Inc.
Oklahoma Firm License Number 5844

Minnesota Excel Engineering, Inc.
Texas Firm License Number 7970

1. Background and Scope

The SPP DISIS-2013-002 Group 2 Definitive Impact Study is a generation interconnection study performed by Excel Engineering, Inc. for its non-affiliated client, Southwest Power Pool (SPP). Its purpose is to study the impacts of interconnecting the projects shown in Table 1-1. The in-service date assumed for the generation addition was 2014.

Table 1-1. Interconnection Requests Evaluated in this Study

Request	Size (MW)	Generator Type	Point of Interconnection	Gen Buses
GEN-2013-030	300	Vestas 2.0 MW VCSS (583763, 583766)	Beaver County 345kV (580500)	583763 583766

The prior-queued and equally-queued requests shown in Table 1-2 were included in this study, and the wind and solar farms were dispatched to 100% of rated capacity.

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

Request	Size (MW)	Generator Type	Point of Interconnection	Gen Buses
GEN-2002-008	240	GE 1.5MW	Hitchland 345kV (523097)	523121 523122 523123
GEN-2002-009	79.8	Suzlon 2.1MW	Hansford 115kV (523195)	523201
GEN-2003-020	159.1	GE 1.5 MW	Carson Co. 115kV (523924)	523941 523942
GEN-2006-020S	20	DeWind D8.2 2.0MW	Tap on Hitchland – Sherman Tap 115kV line (560200)	579138
GEN-2006-044	370	DeWind D9.2 2.0MW	Hitchland 345kV (523097)	522809 522811 522812 523107
GEN-2007-046	199.5	GE 1.5MW	Hitchland 115kV (523093)	579298
GEN-2008-047	300	GE 1.5MW	Tap on Hitchland to Woodward 345kV line (580500)	573506 573510
GEN-2010-001	300	Suzlon 2.1MW	Tap on Hitchland to Woodward 345kV line (580500)	578545 578548
GEN-2010-014	358.8	Siemens 2.3MW	Hitchland 345kV (523097)	576400 576410
GEN-2011-014	201	Siemens 3.0MW	Tap on Hitchland to Woodward 345kV line (580500)	581115

Request	Size (MW)	Generator Type	Point of Interconnection	Gen Buses
GEN-2011-021	299	Siemens 2.3MW	Tap on Hitchland to Woodward 345kV line (580500)	581146 581147
GEN-2011-022	299	Siemens 2.3MW	Hitchland 345kV (523097)	581153 581154
ASGI-2011-002	10 increase, 20 total	DeWind D8.2 2.0MW	Herring 115kV (523359)	523354

The study included stability analysis of each proposed interconnection request. Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping relays disabled. A power factor analysis was performed for the wind and solar farms in Table 1-1.

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on Excel's knowledge of the electric power system and on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is sensitive to the assumptions made with respect to generation additions and transmission improvements being contemplated. Changes in the assumptions of the timing of other generation additions or transmission improvements will affect this study's conclusions.

2. Executive Summary

The SPP DISIS-2013-002 Group 2 Definitive Impact Study evaluated the impacts of interconnecting the Table 1-1 study projects to the SPP transmission system.

No stability problems were found in this study. All generators remained online and stable, and transmission voltages were acceptable.

Final power factor requirements for the study projects are listed in Table 4-2. Final shunt reactor requirements are listed in Table 4-3. Based on these results, shunt capacitors and shunt reactors will need to be added to GEN-2013-030.

With the assumptions in this study, the study projects should be able to reliably interconnect to the SPP transmission system. Any change in system or plant models or assumptions could change these results.

3. Study Development and Assumptions

3.1 Simulation Tools

The Siemens Power Technologies, Inc. PSS/E power system simulation program Version 32.2 was used in this study.

3.2 Models Used

SPP provided stability cases for 2014 winter peak, 2015 summer peak, and 2024 summer peak seasons. These cases included the study and prior-queued projects. A power flow one-line diagram of the study project is shown in Figure 3-1.

The study plant transmission lines and substation transformers are modeled explicitly in the power flow cases. The wind and solar collector systems and generators are modeled as a single equivalent for each substation transformer. Steady-state and dynamic model data for the study plants are given in Appendix D.

One-line diagrams of the SPP 345 kV system in the study area for each base case are shown in Appendix E.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind and solar generation tripping.

3.3 Monitored Facilities

All generators and transmission buses in Areas 520, 524, 525, 526, 531, 534, and 536 were monitored.

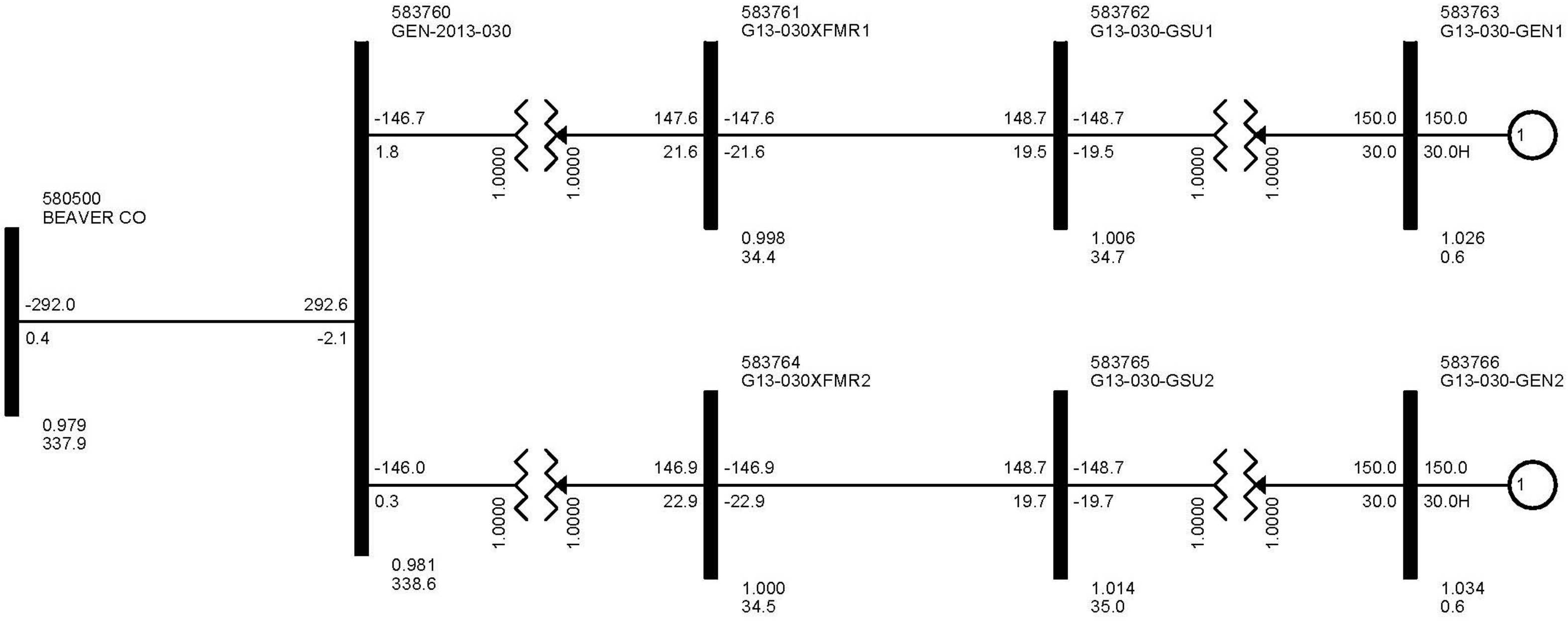

Figure 3-1. Power Flow One-line for GEN-2013-030

3.4 Performance Criteria

Wind generators must comply with FERC Order 661A on low voltage ride through for wind farms. Therefore, the wind generators should not trip off line for faults for under voltage relay actuation. If a wind generator trips off line, an appropriately sized SVC or STATCOM device may need to be specified to keep the wind generator on-line for the fault. SPP was consulted to determine if the addition of an SVC or STATCOM is warranted for the specific condition.

Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping disabled to check for stability issues.

3.5 Performance Evaluation Methods

A power factor analysis was performed for all study projects that are wind farms. The power factor analysis consisted of modeling a var generator in each wind farm holding a voltage schedule at the POI. The voltage schedule was set to the higher of the voltage with the wind farm off-line or 1.0 per unit.

If the required power factor at the POI is beyond the capability of the studied wind turbines, then capacitor banks would be considered. Factors used in sizing capacitor banks would include two requirements of FERC Order 661A: the ability of the wind farm to ride through low voltage with and without capacitor banks and the ability of the wind farm to recover to pre-fault voltage. If a wind generator trips on high voltage, a leading power factor may be required.

A shunt reactor size was determined for each wind or solar plant connecting at 230 kV or higher in order to compensate for line and cable capacitance and maintain zero Mvar flow at the POI when the plant generators and capacitors are off-line.

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

Stability analysis was performed for each proposed interconnection request. Faults were simulated on transmission lines at the POIs and on other nearby transmission equipment. The faults in Table 3-1 were run for each case (three phase and single phase as noted).

Table 3-1. Fault Definitions

Cont. No.	Contingency Name	Contingency Description
1	FLT01-3PH	3 phase fault on the Beaver Co. (580500) to Hitchland (523097) 345kV line circuit 1, near Beaver Co. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	Single phase fault and sequence like previous
3	FLT03-3PH	3 phase fault on the Beaver Co. (580500) to Buckner (531501) 345kV line, near Beaver Co. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	Single phase fault and sequence like previous
5	FLT05-3PH	3 phase fault on the Beaver Co. (580500) to GEN-2013-034 Tap (562440) 345kV line, near Beaver Co. a. Apply fault at the Beaver Co. 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	Single phase fault and sequence like previous
7	FLT07-3PH	3 phase fault on the GEN-2013-034 Tap (562440) to Woodward (515375) 345kV line circuit 1, near GEN-2013-034 Tap. a. Apply fault at the GEN-2013-034 Tap 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	Single phase fault and sequence like previous
9	FLT09-3PH	3 phase fault on the Buckner (531501) to Spearville (531469) 345kV line, near Buckner. a. Apply fault at the Buckner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	Single phase fault and sequence like previous
11	FLT11-3PH	3 phase fault on the Buckner (531501) to Holcomb (531449) 345kV line, near Buckner. a. Apply fault at the Buckner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	Single phase fault and sequence like previous
13	FLT13-3PH	3 phase fault on the Finney (523853) to Holcomb (531449) 345kV line, near Finney. a. Apply fault at the Finney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	Single phase fault and sequence like previous

Cont. No.	Contingency Name	Contingency Description
15	FLT15-3PH	3 phase fault on the Finney (523853) to Hitchland (523097) 345kV line, near Finney. a. Apply fault at the Finney 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	Single phase fault and sequence like previous
17	FLT17-3PH	3 phase fault on the Hitchland (523097) to Potter Co (523961) 345kV line, near Hitchland. a. Apply fault at the Hitchland 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	Single phase fault and sequence like previous
19	FLT19-3PH	3 phase fault on the Woodward (515375) to GEN-2011-051 Tap (562075) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	Single phase fault and sequence like previous
21	FLT21-3PH	Prior Outage of Tatonga to Mathewson 345kV circuit 1. 3 phase fault on the Beaver Co. to GEN-2013-034 Tap. a. Prior outage Tatonga (515407) 345kV to Mathewson (515497) (solve network for steady state solution). b. 3 phase fault on the Beaver Co. (580500) to GEN-2013-034 Tap (562440) 345kV circuit 1, near Beaver Co. 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
22	FLT22-3PH	Prior Outage of Beaver to GEN-2013-034 345kV circuit 1. 3 phase fault on the Beaver Co. to GEN-2013-034 Tap circuit 2. a. Prior outage Beaver (580500) 345kV to GEN-2013-034 Tap (562440) 345kV circuit 1 (solve network for steady state solution). b. 3 phase fault on the Beaver Co. (580500) to GEN-2013-034 Tap (562286) 345kV circuit 2, near Beaver Co. 345kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
23	FLT23-1PH	Woodward 345kV Stuck Breaker a. Apply single phase fault at the Woodward (515375) 345kV bus on the Woodward – GEN-2011-051 Tap (562075) 345kV line. b. Wait 16 cycles, and then drop Woodward (515375) 345kV to GEN-2012-016 Tap (531448) 345kV Ckt 1. c. Trip Woodward to GEN-2011-051 Tap 345kV and remove the fault.
24	FLT24-1PH	Beaver Co 345kV Stuck Breaker a. Apply single phase fault at the Beaver Co (580500) 345kV bus on the Beaver Co – GEN-2013-034 Tap (562440) 345kV line circuit 1. b. Wait 16 cycles, and then drop Beaver Co (580500) 345kV to Hitchland (523097) 345kV Ckt 1. c. Trip Beaver Co to GEN-2013-034 Tap 345kV and remove the fault.

Cont. No.	Contingency Name	Contingency Description
25	FLT25-1PH	Hitchland 345kV Stuck Breaker a. Apply single phase fault at the Hitchland (523097) 345kV bus on the Hitchland – Beaver Co. (580500) 345kV line circuit 1. b. Wait 16 cycles, and then drop Hitchland (523097) 345kV to Hitchland (523095) 230kV/(523091) 13.2 transformer Ckt 1. c. Trip Hitchland to Beaver Co. 345kV and remove the fault.
26	FLT26-3PH	3 phase fault on the Hitchland (523095) to Ochiltree (523155) 230kV line, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
27	FLT27-1PH	Single phase fault and sequence like previous
28	FLT28-3PH	3 phase fault on the Hitchland (523095) to Moore Co (523309) 230kV line, near Hitchland. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
29	FLT29-1PH	Single phase fault and sequence like previous
30	FLT30-3PH	3 phase fault on the Hitchland (523095) 230kV to Hitchland (523093) 115kV/(523092) 13.2kV transformer, near Hitchland 230kV. a. Apply fault at the Hitchland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
31	FLT31-3PH	3 phase fault on the Moore Co (523309) to Potter Co (523959) 230kV line, near Moore Co. a. Apply fault at the Moore Co 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	Single phase fault and sequence like previous
33	FLT33-3PH	3 phase fault on the Moore Co (523309) to Potter Co (523959) 230kV line, near Moore Co. a. Apply fault at the Moore Co 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-1PH	Single phase fault and sequence like previous
35	FLT35-3PH	3 phase fault on the Woodward EHV (515376) to Keenan (514000) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	Single phase fault and sequence like previous

Cont. No.	Contingency Name	Contingency Description
37	FLT37-3PH	3 phase fault on the Woodward EHV (515376) to Woodward (514785) 138kV circuit 1 line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
38	FLT38-1PH	Single phase fault and sequence like previous
39	FLT39-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV. a. Apply fault at the Woodward EHV 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
40	FLT40-1PH	Single phase fault and sequence like previous
41	FLT41-3PH	3 phase fault on the Woodward (515375) to GEN-2012-016 Tap (562286) 345kV circuit 1 line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-1PH	Single phase fault and sequence like previous
43	FLT43-3PH	3 phase fault on the Woodward (515375) to Border (515458) 345kV line, near Woodward. a. Apply fault at the Woodward 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT44-1PH	Single phase fault and sequence like previous

4. Results and Observations

4.1 Stability Analysis Results

Table 4-1 summarizes the results. Figure 4-1 through Figure 4-2 show representative summer peak season plots for faults at the POI's of the study projects. Complete sets of plots for all base cases for each fault and each project are included in Appendix A.

For all faults near Beaver Co., the response of the electric power of the GEN-2013-030 Vestas generators was lightly damped. Modal analysis with the PSS/PLT program calculated a damping ratio of 0.0179, which meets the SPP requirement on rotor angles of greater than or equal to 0.0081633.

Otherwise, there were no stability problems found during any of the other simulations. No other generators tripped or went unstable, and voltages recovered to acceptable levels.

Table 4-1. Summary of Stability Results

Cont. No.	Contingency Name	Contingency Description	14WP Results	15SP Results	24SP Results
1	FLT01-3PH	3 phase fault on the Beaver Co. (580500) to Hitchland (523097) 345kV line circuit 1, near Beaver Co.	OK	OK	OK
2	FLT02-1PH	Single phase fault and sequence like previous	OK	OK	OK
3	FLT03-3PH	3 phase fault on the Beaver Co. (580500) to Buckner (531501) 345kV line, near Beaver Co.	OK	OK	OK
4	FLT04-1PH	Single phase fault and sequence like previous	OK	OK	OK
5	FLT05-3PH	3 phase fault on the Beaver Co. (580500) to GEN-2013-034 Tap (562440) 345kV line, near Beaver Co.	OK	OK	OK
6	FLT06-1PH	Single phase fault and sequence like previous	OK	OK	OK
7	FLT07-3PH	3 phase fault on the GEN-2013-034 Tap (562440) to Woodward (515375) 345kV line circuit 1, near GEN-2013-034 Tap.	OK	OK	OK
8	FLT08-1PH	Single phase fault and sequence like previous	OK	OK	OK
9	FLT09-3PH	3 phase fault on the Buckner (531501) to Spearville (531469) 345kV line, near Buckner.	OK	OK	OK
10	FLT10-1PH	Single phase fault and sequence like previous	OK	OK	OK
11	FLT11-3PH	3 phase fault on the Buckner (531501) to Holcomb (531449) 345kV line, near Buckner.	OK	OK	OK
12	FLT12-1PH	Single phase fault and sequence like previous	OK	OK	OK
13	FLT13-3PH	3 phase fault on the Finney (523853) to Holcomb (531449) 345kV line, near Finney.	OK	OK	OK
14	FLT14-1PH	Single phase fault and sequence like previous	OK	OK	OK
15	FLT15-3PH	3 phase fault on the Finney (523853) to Hitchland (523097) 345kV line, near Finney.	OK	OK	OK
16	FLT16-1PH	Single phase fault and sequence like previous	OK	OK	OK
17	FLT17-3PH	3 phase fault on the Hitchland (523097) to Potter Co (523961) 345kV line, near Hitchland.	OK	OK	OK
18	FLT18-1PH	Single phase fault and sequence like previous	OK	OK	OK
19	FLT19-3PH	3 phase fault on the Woodward (515375) to GEN-2011-051 Tap (562075) 345kV line, near Woodward.	OK	OK	OK
20	FLT20-1PH	Single phase fault and sequence like previous	OK	OK	OK
21	FLT21-3PH	Prior Outage of Tatonga to Mathewson 345kV circuit 1. 3 phase fault on the Beaver Co. to GEN-2013-034 Tap.	OK	OK	OK
22	FLT22-3PH	Prior Outage of Beaver to GEN-2013-034 345kV circuit 1. 3 phase fault on the Beaver Co. to GEN-2013-034 Tap circuit 2.	OK	OK	OK
23	FLT23-1PH	Woodward 345kV Stuck Breaker	OK	OK	OK
24	FLT24-1PH	Beaver Co 345kV Stuck Breaker	OK	OK	OK
25	FLT25-1PH	Hitchland 345kV Stuck Breaker	OK	OK	OK
26	FLT26-3PH	3 phase fault on the Hitchland (523095) to Ochiltree (523155) 230kV line, near Hitchland.	OK	OK	OK
27	FLT27-1PH	Single phase fault and sequence like previous	OK	OK	OK

Cont. No.	Contingency Name	Contingency Description	14WP Results	15SP Results	24SP Results
28	FLT28-3PH	3 phase fault on the Hitchland (523095) to Moore Co (523309) 230kV line, near Hitchland.	OK	OK	OK
29	FLT29-1PH	Single phase fault and sequence like previous	OK	OK	OK
30	FLT30-3PH	3 phase fault on the Hitchland (523095) 230kV to Hitchland (523093) 115kV/(523092) 13.2kV transformer, near Hitchland 230kV.	OK	OK	OK
31	FLT31-3PH	3 phase fault on the Moore Co (523309) to Potter Co (523959) 230kV line, near Moore Co.	OK	OK	OK
32	FLT32-1PH	Single phase fault and sequence like previous	OK	OK	OK
33	FLT33-3PH	3 phase fault on the Moore Co (523309) to Potter Co (523959) 230kV line, near Moore Co.	OK	OK	OK
34	FLT34-1PH	Single phase fault and sequence like previous	OK	OK	OK
35	FLT35-3PH	3 phase fault on the Woodward EHV (515376) to Keenan (514000) 138kV line, near Woodward EHV.	OK	OK	OK
36	FLT36-1PH	Single phase fault and sequence like previous	OK	OK	OK
37	FLT37-3PH	3 phase fault on the Woodward EHV (515376) to Woodward (514785) 138kV circuit 1 line, near Woodward EHV.	OK	OK	OK
38	FLT38-1PH	Single phase fault and sequence like previous	OK	OK	OK
39	FLT39-3PH	3 phase fault on the Woodward EHV (515376) to Iodine (514796) 138kV line, near Woodward EHV.	OK	OK	OK
40	FLT40-1PH	Single phase fault and sequence like previous	OK	OK	OK
41	FLT41-3PH	3 phase fault on the Woodward (515375) to GEN-2012-016 Tap (562286) 345kV circuit 1 line, near Woodward.	OK	OK	OK
42	FLT42-1PH	Single phase fault and sequence like previous	OK	OK	OK
43	FLT43-3PH	3 phase fault on the Woodward (515375) to Border (515458) 345kV line, near Woodward.	OK	OK	OK
44	FLT44-1PH	Single phase fault and sequence like previous	OK	OK	OK

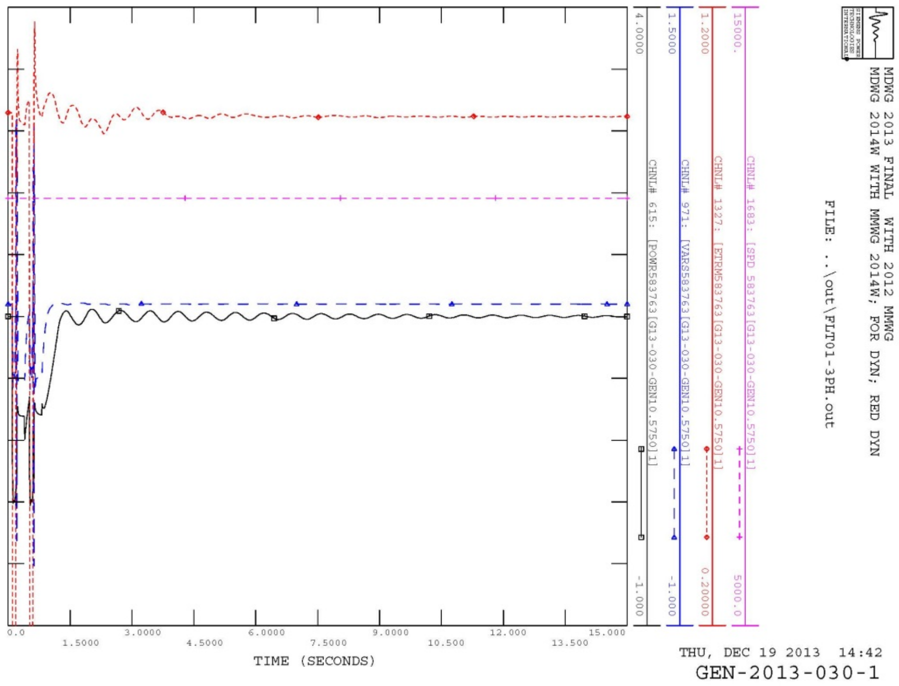

Figure 4-1. GEN-2013-030 Unit 1 Plot for Fault 1, a 3 phase fault on the Beaver Co. (580500) to Hitchland (523097) 345kV line, at Beaver Co.

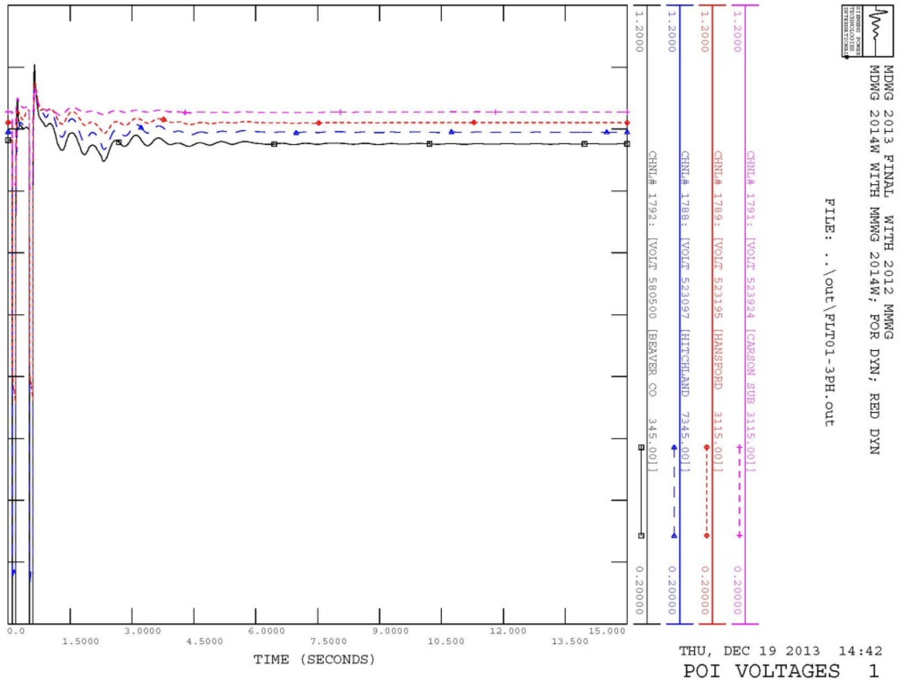

Figure 4-2. POI Voltage Plot for Fault 1, a 3 phase fault on the Beaver Co. (580500) to Hitchland (523097) 345kV line, at Beaver Co.

4.2 Power Factor Requirements

All stability faults were tested as power flow contingencies to determine the power factor requirements for the wind and solar farm study projects to maintain scheduled voltage at their respective points of interconnection (POI). The voltage schedules are set equal to the voltages at the POIs before the projects are added, with a minimum of 1.0 per unit. Fictitious reactive power sources were added to the study projects to maintain scheduled voltage during all studied contingencies. The MW and Mvar injections from the study projects at the POIs were recorded and the resulting power factors were calculated for all contingencies for summer peak and winter peak cases. The most leading and most lagging power factors determine the minimum power factor range capability that the study projects must install before commercial operation.

If more than one study project shared a single POI, the projects were grouped together and a common power factor requirement was determined for those study projects. This ensures that none of the study projects is required to provide more or less than its fair share of the reactive power requirements at a single POI. *Prior-queued* projects at the same POI, if any, were not grouped with the study projects because their interconnection requirements were determined in previous studies. The voltage schedules of prior-queued and study projects at the same POI were coordinated.

Per FERC and SPP Tariff requirements, if the power factor needed to maintain scheduled voltage is less than 0.95 lagging, then the requirement is limited to 0.95 lagging. The lower limit for leading power factor requirement is also 0.95. If a project never operated leading under any contingency, then the leading requirement is set to 1.0. The same applies on the lagging side.

The final power factor requirements are shown in Table 4-2 below. These are only the minimum power factor ranges based on steady-state analysis. Based on these results and the reactive power capability of the GEN-2013-030 Vestas generators, capacitors will need to be added to GEN-2013-030.

The full details for each contingency in summer and winter peak cases are given in Appendix C.

In a separate test, for each study project that is a wind or solar plant, the generators and capacitors (if any) were turned off in the base case (Figure 4-3). The resulting reactive power injection at the POI comes from the capacitance of the project's transmission lines and collector cables. Shunt reactors were added at the plant substation 34.5 kV buses to bring the POI Mvar flow down to zero (Figure 4-4). Final shunt reactor requirements are listed in Table 4-3. Note that the table lists nominal Mvar rating while the one-line diagrams show actual Mvar output at the specific voltages in the base case. The results shown are for the 2014WP case. The other two cases were almost identical since the plant design is the same in all cases.

Table 4-2. Power Factor Requirements [a]

Request	Size (MW)	Generator Model	Point of Interconnection	Final PF Requirement	
				Lagging [b]	Leading [c]
GEN-2013-030	300	Vestas 2.0 MW VCSS	Beaver County 345kV (580500)	0.964	1.0

Notes:

a. For each plant, the table shows the minimum required power factor capability at the point of interconnection that must be designed and installed with the plant. The power factor capability at the POI includes the net effect of the generators, transformers, line impedances, and any reactive compensation devices installed on the plant side of the meter. Installing more capability than the minimum requirement is acceptable.

b. Lagging is when the generating plant is supplying reactive power to the transmission grid, like a shunt capacitor. In this situation, the alternating current sinusoid “lags” behind the alternating voltage sinusoid, meaning that the current peaks shortly after the voltage.

c. Leading is when the generating plant is taking reactive power from the transmission grid, like a shunt reactor. In this situation, the alternating current sinusoid “leads” the alternating voltage sinusoid, meaning that the current peaks shortly before the voltage.

d. Electrical need is lower, but PF requirement limited to 0.95 by FERC order.

Table 4-3. Shunt Reactor Requirements

Request	Size (MW)	Generator Model	Point of Interconnection	Total Shunt Reactor Requirement at 34.5 kV buses (Mvar)
GEN-2013-030	300	Vestas 2.0 MW VCSS	Beaver County 345kV (580500)	14.2

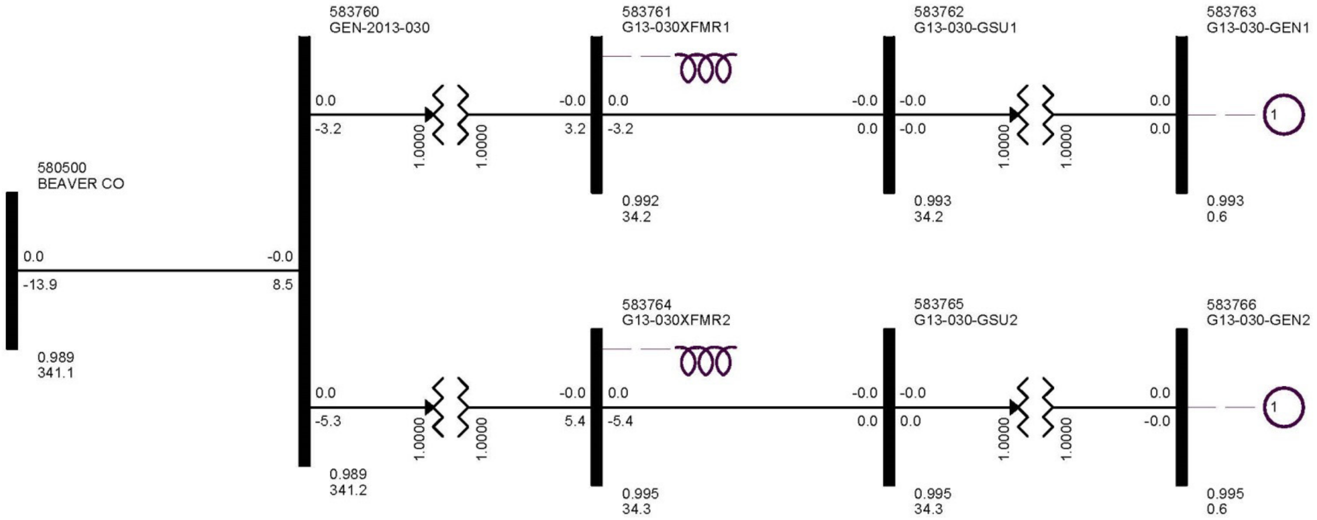

Figure 4-3. GEN-2013-030 One-line Diagram in 2014WP Case with Generators Off

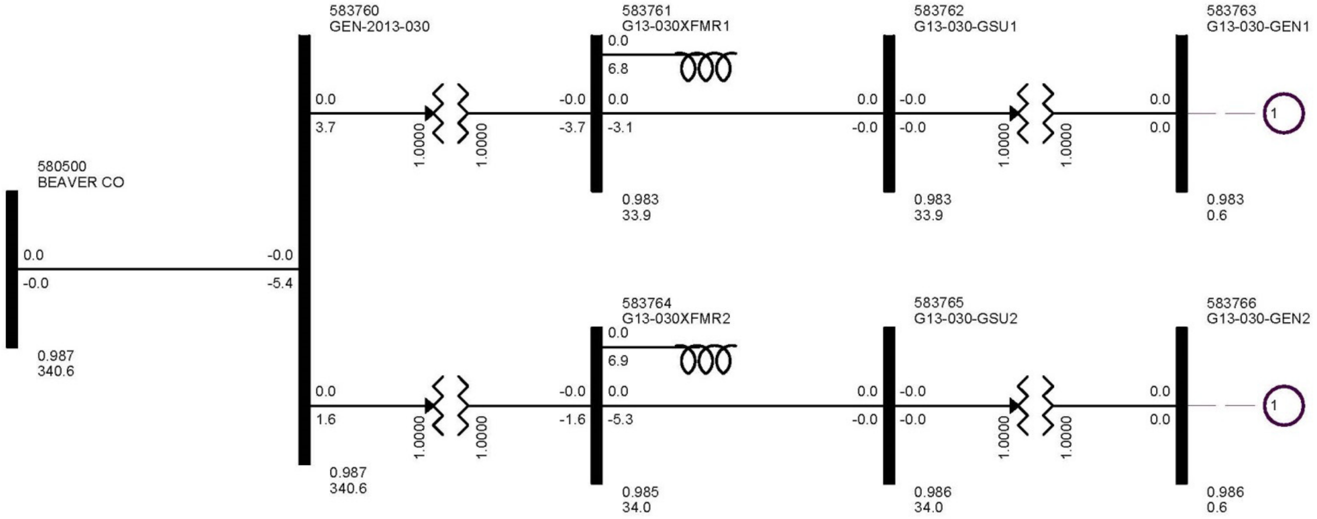

Figure 4-4. GEN-2013-030 One-line Diagram in 2014WP Case with Generators Off and Shunt Reactors Added

5. Conclusions

The SPP DISIS-2013-002 Group 2 Definitive Impact Study evaluated the impacts of interconnecting the projects shown below.

Table 5-1. Interconnection Requests Evaluated in this Study

Request	Size	Generator Type	Point of Interconnection	Gen Buses
GEN-2013-030	300	Vestas 2.0 MW VCSS (583763, 583766)	Beaver County 345kV (580500)	583763 583766

No stability problems were found in this study. All generators remained online and stable, and transmission voltages were acceptable.

Final power factor requirements for the study projects are listed in Table 4-2. Final shunt reactor requirements are listed in Table 4-3. Based on these results, shunt capacitors and shunt reactors will need to be added to GEN-2013-030.

With the assumptions in this study, the study projects should be able to reliably interconnect to the SPP transmission system. Any change in system or plant models or assumptions could change these results.

L: Group 4/11 Dynamic Stability Analysis Report

See Quanta report on next page.

DISIS 2013-002

Group 4

Definitive Interconnection System Impact Study

January 31, 2014

Submitted To:
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EXECUTIVE SUMMARY

The Southwest Power Pool (SPP), on behalf of generation interconnection customers, desires a definitive interconnection system impact study for a group of generators in west central Kansas collectively referred to as Group 4. Group 4 consists of two generators:

- ASGI-2013-004 - 27.6 MW summer, 36.6 MW winter power plant connected at the Morris 115kV Substation.
- GEN-2013-033 – A 28 MW increase to GEN-2006-031 connected to the Knoll 115kV Substation.

There are 14 previously queued generators in Group 4.

SPP requested a stability analysis for the queued generator projects in Group 4. No Low Voltage Ride Through (LVRT) or power factor analysis was performed as there were no wind farms in Group 4. SPP did not request an Available Transfer Capability (ATC) study as part of this study.

- Both generators were stable for all conditions studied.
- Neither generator tripped off line under any fault condition.
- Both generators meet the rotor angle damping requirements.
- Both generators recovered to the pre-contingency voltage following all studied fault disturbances.

TABLE OF CONTENTS

1. INTRODUCTION

The Southwest Power Pool (hereafter referred to as SPP) commissioned Quanta Technology to study the impact of a group of generators in the SPP interconnection queue referred to as Group 4. The sites studied are in southwest Kansas near Garden City (ASGI-2013-004) and west central Kansas near Hays (GEN-2013-033).

The sites studied were:

- ASGI-2013-004 - 27.6 MW summer, 36.6 MW winter power plant connected at the Morris 115kV Substation.
- GEN-2013-033 – A 28 MW increase to GEN-2006-031 connected to the Knoll 115kV Substation.

SPP did not request an Available Transfer Capability (ATC) study.

SPP requested a stability analysis for all of the generation in Group 4. Quanta Technology performed a dynamics study utilizing SPP's list of faults as follows:

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

2. No power factor or LVRT studies were performed as there were no wind farms in Group 4.

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

2. STUDY METHODOLOGY

SPP provided 2015 summer peak and 2014 winter peak and 2024 summer peak load flow cases in PSS/E format. Table 2-1 below shows the total demand and generation in the monitored areas.

Table 2-1 Description of Study Areas

Area #	Area Name	2015 Summer Peak		2014 Winter Peak		2024 Summer Peak	
		Load (MW)	Generation (MW)	Load (MW)	Generation (MW)	Load (MW)	Generation (MW)
525	WFEC	1,465.3	1,653.7	1,336.8	1,490.9	1,668.2	1,670.5
526	SPS	6,339.7	7,074.5	4,441.0	5,398.7	7,674.7	8,911.1
531	MIDW	414.1	1,187.5	296.0	1,197.5	466.1	1,187.5
534	SUNC	1,309.7	2,819.0	895.5	2,401.9	1,461.3	2,904.7
536	WERE	6,048.2	5,738.3	4,106.0	4,379.7	6,526.4	6,180.4
640	NPPD	3,818.6	3,407.4	2,817.3	2,888.0	4,403.1	4,026.6

2.1 POWER FACTOR ANALYSIS

No power factor analysis was performed since there are no wind farms in Group 4.

2.2 DYNAMIC ANALYSIS

The study areas shown in Table 2-1 were monitored in the dynamic analysis.

The transmission line and transformer faults were simulated and synchronous machine rotor angles and wind turbine generator speeds were monitored to check whether synchronism is maintained following fault removal.

Line faults were simulated in the following fashion:

1. Apply fault to a line near one of its buses.
2. Clear fault after five (5) cycles by tripping the faulted line.
3. Wait 20 cycles and reclose the tripped line into the fault.
4. Leave fault on for five (5) cycles, then trip the line and remove the fault.

Transformer faults were simulated in the following fashion:

1. Apply fault at the identified bus terminal of the transformer.
2. Clear fault after five (5) cycles by tripping the faulted transformer.

Note that no reclosing was considered for the above transformer faults.

Table 2-2 Fault Descriptions

Cont. No.	Description
1	3 phase fault on the Morris (531430) to Dobson (531419) 115kV line, near Morris.
2	Single phase fault and sequence like previous
3	3 phase fault on the Morris (531430) to Irsik & Doll (531478) 115kV line, near Morris.
4	Single phase fault and sequence like previous
5	3 phase fault on the Dobson (531419) to Lowe Tap (531425) 115kV line, near Dobson.
6	Single phase fault and sequence like previous
7	3 phase fault on the Dobson (531419) to Gano (531493) 115kV line, near Dobson.
8	Single phase fault and sequence like previous
9	3 phase fault on the Dobson (531419) to KS Ave WTP (531480) 115kV line, near Dobson.
10	Single phase fault and sequence like previous
11	3 phase fault on the Garden City PP (531445) to Holcomb (531448) 115kV line, near Garden City PP.
12	Single phase fault and sequence like previous
13	3 phase fault on the Garden City PP (531445) to Southwind Tap (531476) 115kV line, near Garden City PP.
14	Single phase fault and sequence like previous
15	3 phase fault on the Holcomb (531448) to Jones (531379) 115kV line, near Holcomb.
16	Single phase fault and sequence like previous
17	3 phase fault on the Holcomb (531448) to Plymell (531393) 115kV line, near Holcomb.
18	Single phase fault and sequence like previous
19	3 phase fault on the Holcomb (531449) 345kV to Holcomb (531448) 115kV/(531450) 13.8kV transformer ckt 1, near Holcomb 115kV.
20	3 phase fault on the Setab (531465) 345kV to Setab (531464) 115kV/(531259) 13.8kV transformer, near Holcomb 115kV.
21	Prior Outage of Morris to Irsik & Doll 115kV. 3 phase fault on the GEN-2012-002 to Scott City.
22	Prior Outage of GEN-2012-002 to Scott City 115kV. 3 phase fault on the Holcomb 345/115/13.8kV transformer circuit 2.
23	Prior Outage of Buckner to Spearville 345kV. 3 phase fault on the Holcomb to Setab 345kV.
24	Holcomb 115kV Stuck Breaker
25	3 phase fault on the Knoll (530561) to Saline (530551) 115kV line, near Knoll.
26	Single phase fault and sequence like previous
27	3 phase fault on the Knoll (530561) to N Hays (530581) 115kV line, near Knoll.
28	Single phase fault and sequence like previous

Cont. No.	Description
29	3 phase fault on the Knoll (530561) to Red Line (530605) 115kV line, near Knoll.
30	Single phase fault and sequence like previous
31	3 phase fault on the Knoll (530558) 230kV to Knoll (530561) 115kV/(530629) 11.49kV transformer, near Knoll 115kV.
32	3 phase fault on the S Hays (530582) 230kV to S Hays (530553) 115kV/(530632) 12.47kV transformer, near S Hays 115kV.
33	3 phase fault on the Post Rock (530583) to Axtell (640065) 345kV line, near Post Rock 345kV.
34	Single phase fault and sequence like previous
35	3 phase fault on the Post Rock (530583) to GEN-2012-011 Tap (562334) 345kV line, near Post Rock 345kV.
36	Single phase fault and sequence like previous
37	Prior Outage of Smoky Hills to Summit 230kV. 3 phase fault on the S Hays to Mullergren 230kV.
38	Prior Outage of Knoll to N Hays 115kV. 3 phase fault on the Ross Beach to GEN-2010-048 Tap 11kV.
39	Knoll 115kV Stuck Breaker
40	3 phase fault on the Mingo (531451) to Setab (531465) 345kV line, near Mingo 345kV.
41	Single phase fault and sequence like previous
42	3 phase fault on the Holcomb (531449) to Buckner (531501) 345kV line, near Holcomb 345kV.
43	Single phase fault and sequence like previous
44	3 phase fault on the Spearville (531469) to Clark Co (539800) 345kV line, near Spearville 345kV.
45	Single phase fault and sequence like previous

Single phase to ground faults were simulated by applying an admittance[1] at the faulted bus representing the negative and zero sequence equivalent impedance. Table 2-3 presents equivalent reactors used in the transient stability study.

Table 2-3 Equivalent Reactors (MVAR) for Single Line to Ground Faults

Faulted Bus No.	Name	kV	MVA	Fault Numbers

---

[1] The admittance were calculated to attain a voltage at the faulted bus of 0.60 pu in the 2024 Summer Case. Values in the other cases are expected to be slightly lower.

Faulted Bus No.	Name	kV	MVA	Fault Numbers
530561	Knoll	115	1620	26, 28, 30, 39
530583	Post Rock	345	3420	34, 36
531419	Dobson	115	1759	6, 8, 10
531430	Morris	115	1073	2, 4
531445	Garden City	115	2060	12, 14
531448	Holcomb	115	3766	16, 18, 24
531449	Holcomb	345	5060	43
531451	Mingo	345	2593	41
531469	Spearville	345	6735	45

Another important aspect of the dynamic analysis was to check FERC Order 661A compliance for wind generating plants. No wind generating plants were considered for this study.

3. PROJECT DESCRIPTION

Following is a table of the proposed generators in Group 4.

Table 3-1: Points of Interconnection for Group 4

Request	Size (MW)	Turbine Model	Point Of Interconnection		
			Common Name	Bus #	Name in Model
ASGI-2013-004-	27.6 Summer 36.6 Winter	GENSAL (583693)	Morris 115kV Substation	531430	Morris 115kV
GEN-2013-012	28 (increase to GEN-2006-03)	GENSAL (Bus 530675, Machine ID 10)	Knoll 115kV Substation	530561	Knoll 115kV 7

As illustrated below, the sites of the interconnections in Group 4 are in west-central Kansas at Knoll (GEN-2013-033) and southwest Kansas at Morris (ASGI-2013-004).

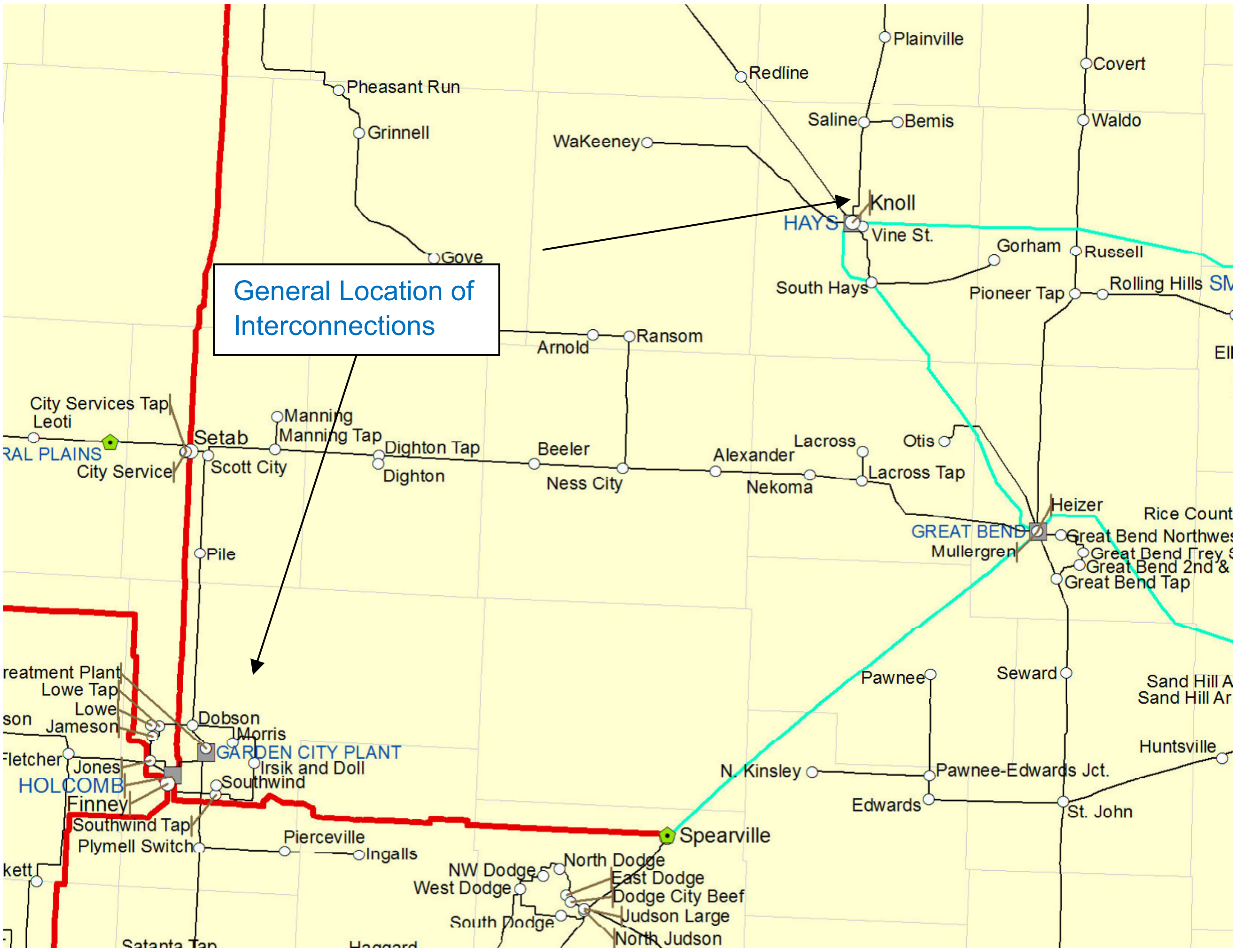


Figure 3-1 Geographical Location of Group 4 Project

One-line diagrams of the interconnections of ASGI-2013-004 and GEN-2013-033 are shown in Figures 3-2 and 3-3 respectively. All voltages and line flows are from the 2015 summer peak base case. Both one-line diagrams use this following color code for nominal voltages:

Red	**345 kV**
Blue	**230 kV**
Black	**lower voltage levels**

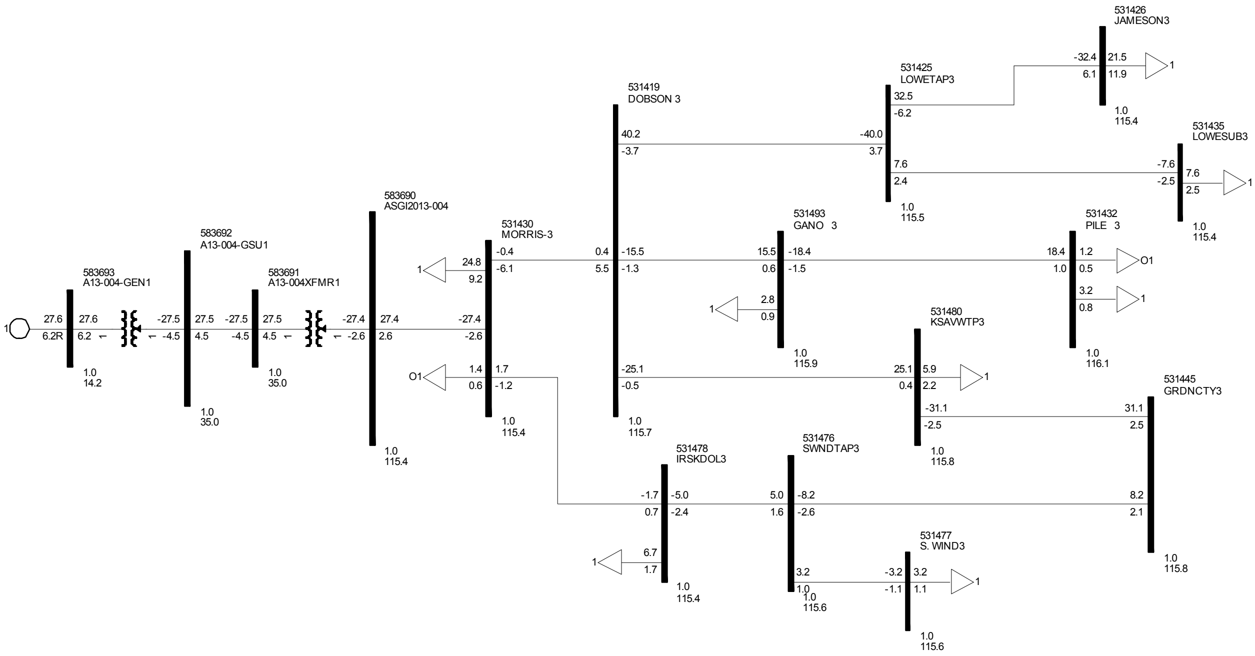


Figure 3-2 ASGI-2013-004 One-Line Diagram

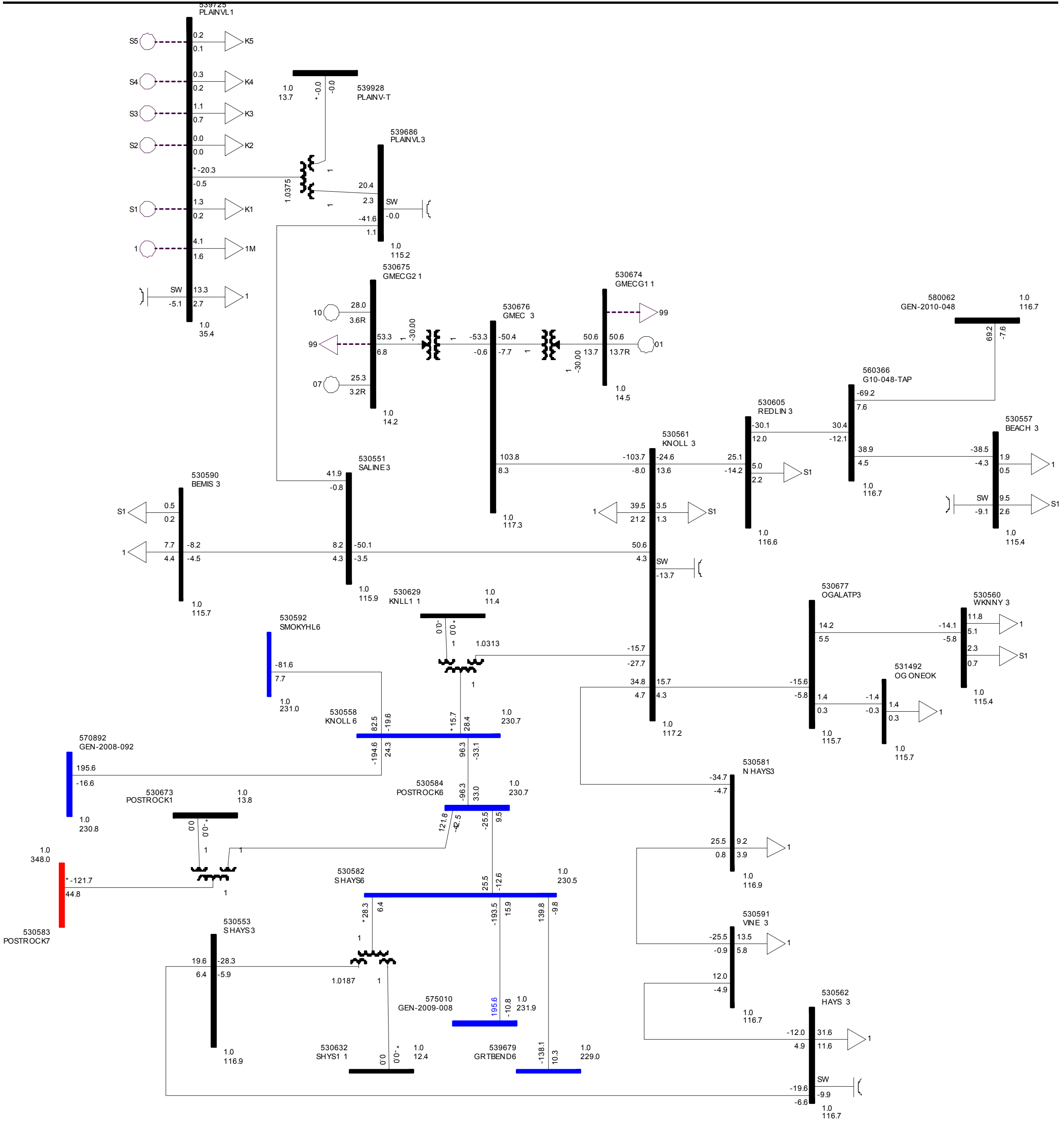


Figure 3-3 GEN-2013-033 One-Line Diagram

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

GEN-2013-033

- Combustion Turbine
  - Increase in active power capability: 28 MW
  - Power factor: 90% lagging, 95% leading
- Interconnection
  - Voltage: 115kV
  - Location: Knoll 115 kV bus
  - Transformer: One step-up transformer connecting to the 115kV
  - Transformer 1
    - MVA: Rate A - 65, Rate B -65
    - Voltage: 115/13.8 kV
    - X: 8.83% on 39 MVA

ASGI-2013-004

- Combustion Turbine
  - Active power capability: 27.6 MW Summer; 36.6 MW Winter
  - Power factor: 90% lagging, 95% leading
- Interconnection
  - Voltage: 115kV
  - Location: Morris 115 kV bus
  - Transformers: One step-up transformers connecting to the 34.5 kV and one tie transformer to the 115kV bus
  - Transformer 1
    - MVA: Rate A – 52.5, Rate B -52.5
    - Voltage: 34.5/13.8 kV
    - X: 6.984% on 31.5 MVA
  - Transformer 2
    - MVA: Rate A – 41.7, Rate B -41.7
    - Voltage: 34.5/115 kV
    - X: 6.297% on 25 MVA

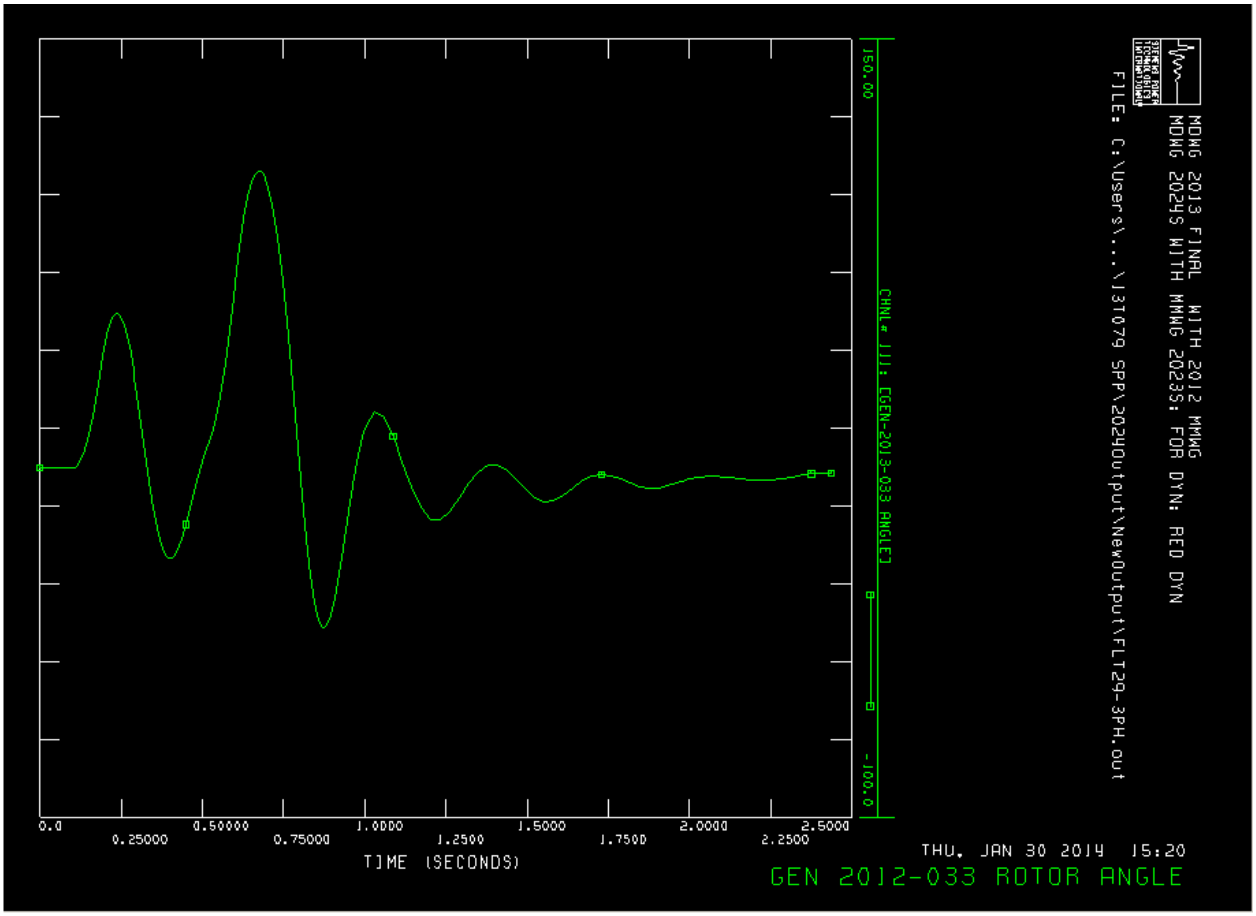
4. POWER FACTOR RESULTS

No power factor analysis was performed since there were no wind farms in Group 4.

5. TRANSIENT STABILITY RESULTS

Dynamic simulations were performed using each fault noted in Table 2-2. All faults were cleared after five (5) cycles. Faulted transmission lines were reclosed into the fault 20 cycles after the initial clearing, then cleared and locked out after five (5) more cycles. Faulted transformers, stuck breakers and faults with a prior outage were not reclosed.

The proposed units were stable for all faults simulated in all cases. Three phase faults near Knoll (Faults number 25, 27, 29, 31) caused oscillations of the monitored parameters of GEN-2013-033, which persisted for almost two seconds. An example is shown in Figure 5-1.



SPP's Rotor Angle Damping Requirements are shown in Appendix 1. The rotor angle plot shown in Figure 5-1 technically does not meet SPPR, because the second peak is higher than the first. However, this is because the line is reclosed into the fault at t=31 cycles (0.5167 seconds) and cleared when the line locks out 5 cycles later (t=0.6000 seconds. However if only peaks considered after all faults and switching are completed, SPPR is clearly satisfied. SPPR5 is satisfied whether the first or second peak is taken as the base.

Table 5-1 Simulation Results

Cont . No.	Description	2014 WP Outcome	2015 SP Outcome	2024 SP Outcome
1	3 phase fault on the Morris (531430) to Dobson (531419) 115kV line, near Morris.	Stable and well damped	Stable and well damped	Stable and well damped
2	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
3	3 phase fault on the Morris (531430) to Irsik & Doll (531478) 115kV line, near Morris.	Stable and well damped	Stable and well damped	Stable and well damped
4	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
5	3 phase fault on the Dobson (531419) to Lowe Tap (531425) 115kV line, near Dobson.	Stable and well damped	Stable and well damped	Stable and well damped
6	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
7	3 phase fault on the Dobson (531419) to Gano (531493) 115kV line, near Dobson.	Stable and well damped	Stable and well damped	Stable and well damped
8	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
9	3 phase fault on the Dobson (531419) to KS Ave WTP (531480) 115kV line, near Dobson.	Stable and well damped	Stable and well damped	Stable and well damped
10	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
11	3 phase fault on the Garden City PP (531445) to Holcomb (531448) 115kV line, near Garden City PP.	Stable and well damped	Stable and well damped	Stable and well damped
12	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
13	3 phase fault on the Garden City PP (531445) to Southwind Tap (531476) 115kV line, near Garden City PP.	Stable and well damped	Stable and well damped	Stable and well damped
14	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
15	3 phase fault on the Holcomb (531448) to Jones (531379) 115kV line, near Holcomb.	Stable and well damped	Stable and well damped	Stable and well damped
16	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
17	3 phase fault on the Holcomb (531448) to	Stable and	Stable and	Stable and

Cont . No.	Description	2014 WP Outcome	2015 SP Outcome	2024 SP Outcome
	Plymell (531393) 115kV line, near Holcomb.	well damped	well damped	well damped
18	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
19	3 phase fault on the Holcomb (531449) 345kV to Holcomb (531448) 115kV/(531450) 13.8kV transformer ckt 1, near Holcomb 115kV.	Stable and well damped	Stable and well damped	Stable and well damped
20	3 phase fault on the Setab (531465) 345kV to Setab (531464) 115kV/(531259) 13.8kV transformer, near Holcomb 115kV.	Stable and well damped	Stable and well damped	Stable and well damped
21	Prior Outage of Morris to Irsik & Doll 115kV. 3 phase fault on the GEN-2012-002 to Scott City.	Stable and well damped	Stable and well damped	Stable and well damped
22	Prior Outage of GEN-2012-002 to Scott City 115kV. 3 phase fault on the Holcomb 345/115/13.8kV transformer circuit 2.	Stable and well damped	Stable and well damped	Stable and well damped
23	Prior Outage of Buckner to Spearville 345kV. 3 phase fault on the Holcomb to Setab 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
24	Holcomb 115kV Stuck Breaker			
25	3 phase fault on the Knoll (530561) to Saline (530551) 115kV line, near Knoll.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.
26	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
27	3 phase fault on the Knoll (530561) to N Hays (530581) 115kV line, near Knoll.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.
28	Single phase fault and sequence like previous	Stable and	Stable and	Stable and

Cont . No.	Description	2014 WP Outcome	2015 SP Outcome	2024 SP Outcome
		well damped	well damped	well damped
29	3 phase fault on the Knoll (530561) to Red Line (530605) 115kV line, near Knoll.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.
30	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
31	3 phase fault on the Knoll (530558) 230kV to Knoll (530561) 115kV/(530629) 11.49kV transformer, near Knoll 115kV.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.
32	3 phase fault on the S Hays (530582) 230kV to S Hays (530553) 115kV/(530632) 12.47kV transformer, near S Hays 115kV.	Stable and well damped	Stable and well damped	Stable and well damped
33	3 phase fault on the Post Rock (530583) to Axtell (640065) 345kV line, near Post Rock 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
34	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
35	3 phase fault on the Post Rock (530583) to GEN-2012-011 Tap (562334) 345kV line, near Post Rock 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
36	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
37	Prior Outage of Smoky Hills to Summit 230kV. 3 phase fault on the S Hays to Mullergren 230kV.	Stable and well damped	Stable and well damped	Stable and well damped
38	Prior Outage of Knoll to N Hays 115kV. 3 phase fault on the Ross Beach to GEN-2010-048 Tap 11kV.	Stable and well damped	Stable and well damped	Stable and well damped

Cont. No.	Description	2014 WP Outcome	2015 SP Outcome	2024 SP Outcome
39	Knoll 115kV Stuck Breaker	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.	ASGI 2013-004 stable and well damped. GEN-2013-033 acceptable but more oscillatory.
40	3 phase fault on the Mingo (531451) to Setab (531465) 345kV line, near Mingo 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
41	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
42	3 phase fault on the Holcomb (531449) to Buckner (531501) 345kV line, near Holcomb 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
43	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped
44	3 phase fault on the Spearville (531469) to Clark Co (539800) 345kV line, near Spearville 345kV.	Stable and well damped	Stable and well damped	Stable and well damped
45	Single phase fault and sequence like previous	Stable and well damped	Stable and well damped	Stable and well damped

6. ROTOR ANGLE DAMPING AND VOLTAGE RECOVERY REQUIREMENT

Rotor angle damping and voltage recovery as determined via dynamic simulation were checked against all contingencies. Rotor angle plots for ASGI-2013-004 are provided in Appendix A and POI voltage recovery plots for ASGI-2013-004 are provided in Appendix C. Rotor angle plots for GEN-2013-033 are provided in Appendix B and POI voltage recovery plots for GEN-2013-033 are provided in Appendix D. Each of these Appendices is in three parts: Part 1 for 2014 Winter conditions, part 2 for 2015 Spring conditions, and part 3 for 2024 Summer conditions

Visual inspection of worst case rotor angle swing plots showed compliance with Rotor angle damping requirement.

If the voltage recovers post-fault to a steady-state level consistent with the steady-state simulation, the generator interconnection is considered stable from a voltage standpoint. In these dynamic simulations, real loads are modeled as constant current and reactive loads are modeled as constant admittance; i.e. MW loads are proportional to voltage and MVAR loads are proportional to voltage squared. In contrast, loads are modeled as constant MW and constant MVAR in steady-state simulations. Therefore, due to differences in load modeling, minor differences in voltages are to be expected between dynamic and steady-state simulations.

The post fault voltage recovery was found to be within the criterion of 0.7 PU to 1.2 PU for both units following clearing of all faults, in all cases.

As neither plant is a wind farm FERC Order 661A (low voltage ride through and wind farm recovery to pre-fault voltage) does not apply.

7. CONCLUSIONS

Based on the results of dynamic simulation studies, the following findings apply to Group 4, consisting of GEN-2013-033 and ASGI-2013-004:

- Both generators were stable for all conditions studied.
- Neither generator tripped off line under any fault condition.
- Both generators meet the rotor angle damping requirements.
- Both generators recovered to the pre-contingency voltage following all studied fault disturbances.

APPENDIX 1

ROTOR ANGLE DAMPING REQUIREMENT

Machine Rotor Angles shall exhibit well damped angular oscillations [as defined below] and acceptable power swings following a disturbance on the Bulk Electric System for all NERC Category A, B and C events.

Well damped angular oscillations shall meet one of the following two requirements when calculated directly from the rotor angle:

1. Successive Positive Peak Ratio (SPPR) must be less than or equal to 0.95 where SPPR is calculated as follows:

$$\text{SPPR} = \frac{\text{Peak Rotor Angle of } 2^{nd} \text{ Positive Swing Peak}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Swing Peak}} \leq 0.95$$

-or- Damping Factor % = (1 – SPPR) x 100% $\geq$ 5%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio $\geq$ 0.0081633

2. Successive Positive Peak Ratio Five (SPPR5) must be less than or equal to 0.774 where SPPR5 is calculated as follows:

$$\text{SPPR5} = \frac{\text{Peak Rotor Angle of } 5^{th} \text{ Positive Swing Peak}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Swing Peak}} \leq 0.774$$

-or- Damping Factor % = (1 – SPPR) x 100% $\geq$ 22.6%

The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio $\geq$ 0.0081633

Qualitatively, these Requirements are shown in Figure 1 below.

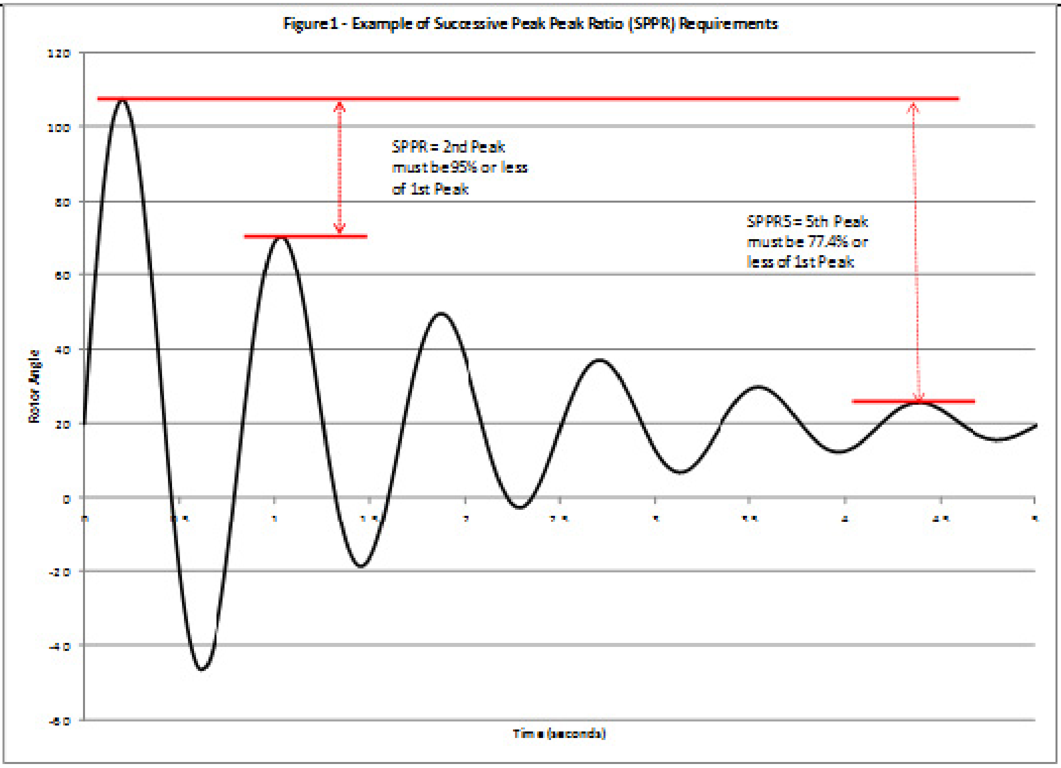


Figure 1 - Example of Successive Peak Peak Ratio (SPPR) Requirements

M: Group 5 Dynamic Stability Analysis Report

See Excel report on next page

SPP DISIS-2013-002 Group 5
Definitive Impact Study

Final Report for

Southwest Power Pool

Prepared by:
Excel Engineering, Inc.
Project # 130624

January 9, 2014

Principal Contributor:

William Quaintance, P.E.

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0. Certification

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the Laws of the State of **Texas**.

William Quaintance
Texas License Number 104268

Minnesota Excel Engineering, Inc.
Texas Firm License Number 7970

1. Background and Scope

The SPP DISIS-2013-002 Group 5 Definitive Impact Study is a generation interconnection study performed by Excel Engineering, Inc. for its non-affiliated client, Southwest Power Pool (SPP). Its purpose is to study the impacts of interconnecting the projects shown in Table 1-1. The in-service date assumed for the generation addition was 2014.

Table 1-1. Interconnection Requests Evaluated in this Study

Request	Size (MW)	Generator Type	Point of Interconnection	Gen Buses
GEN-2013-031	332 Summer 370 Winter	GENROU	Bushland 230kV (524267)	583773 583776

The prior-queued and equally-queued requests shown in Table 1-2 were included in this study, and the wind and solar farms were dispatched to 100% of rated capacity.

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

Request	Size (MW)	Generator Type	Point of Interconnection	Gen Buses
GEN-2002-022	239.2	Siemens 2.3MW	Bushland 230kV (524267)	524285 524287
GEN-2006-047	239.4	Suzlon 2.1 MW	Buffalo Lk 230kV (560009)	579198
GEN-2007-048	400	Furhlander 2.5MW	Amarillo South – Swisher 230kV line (560164)	579310 579311
GEN-2008-051	322	Siemens 2.3MW	Potter 345kV (523961)	524292 524295
GEN-2008-088	50.6	Siemens 2.3MW	Vega 69kV (523888)	576800
ASGI-2013-001	11.5	Siemens 2.3MW	PanTex South 115kV(523945)	583543

The study included stability analysis of each proposed interconnection request. Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping relays disabled. A power factor analysis was performed for the wind and solar farms in Table 1-1.

ATC (Available Transfer Capability) studies were not performed as part of this study. These studies will be required at the time transmission service is actually requested. Additional transmission upgrades may be required based on that analysis.

Study assumptions in general have been based on Excel's knowledge of the electric power system and on the specific information and data provided by SPP. The accuracy of the conclusions contained within this study is sensitive to the assumptions made with respect to generation additions and transmission improvements being contemplated. Changes in the assumptions of the timing of other generation additions or transmission improvements will affect this study's conclusions.

2. Executive Summary

The SPP DISIS-2013-002 Group 5 Definitive Impact Study evaluated the impacts of interconnecting the Table 1-1 study projects to the SPP transmission system.

Study project GEN-2013-031 and two prior projects GEN-2002-022 and GEN-2006-047 went unstable following Fault 44, a NERC Category C3 outage of Buffalo to Deaf Smith and Potter County to Bushland 230kV lines. As a result, these plants will have to be curtailed following the outage of either of these transmission lines, in preparation for the outage of the other line. Later-queued plants will be curtailed before earlier-queued plants. The amount of curtailment will depend on the generation levels of the plants at the time of curtailment. Details of the curtailment plan will be determined by the transmission system operator.

With the assumptions in this study, the study project should be able to reliably interconnect to the SPP transmission system. Any change in system or plant models or assumptions could change these results.

3. Study Development and Assumptions

3.1 Simulation Tools

The Siemens Power Technologies, Inc. PSS/E power system simulation program Version 32.2 was used in this study.

3.2 Models Used

SPP provided stability cases for 2014 winter peak, 2015 summer peak, and 2024 summer peak seasons. These cases included the study and prior-queued projects. A power flow one-line diagram of the study project is shown in Figure 3-1.

The study plant transmission lines and substation transformers are modeled explicitly in the power flow cases. The wind and solar collector systems and generators are modeled as a single equivalent for each substation transformer. Steady-state and dynamic model data for the study plants are given in Appendix D.

One-line diagrams of the SPP 345 and 230 kV systems in the study area for each base case are shown in Appendix E.

No special modeling is required of line relays in these cases, except for the special modeling related to the wind and solar generation tripping.

3.3 Monitored Facilities

All generators and transmission buses in Areas 520, 524, 525, 526, 531, 534, and 536 were monitored.

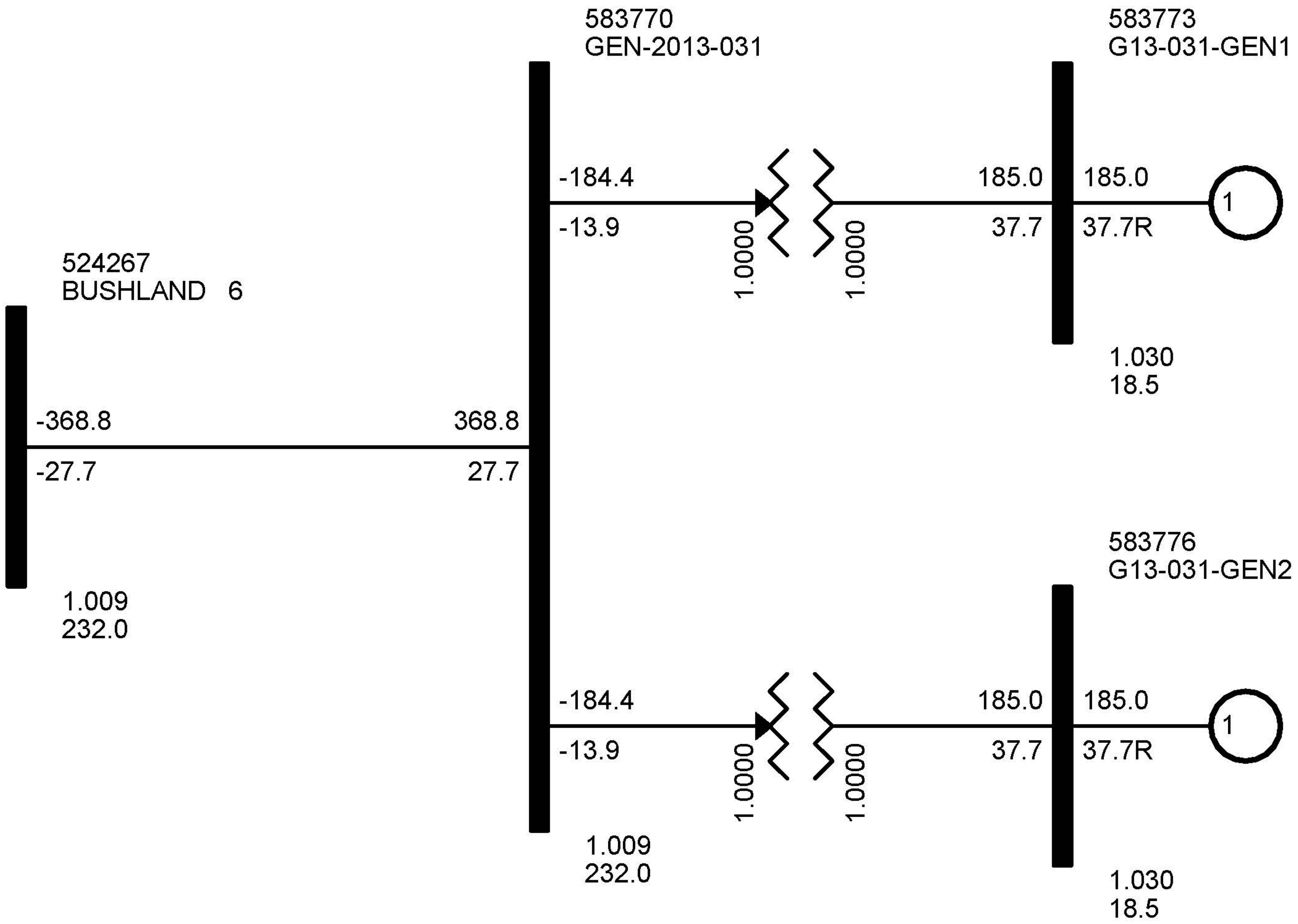

Figure 3-1. Power Flow One-line for GEN-2013-031

3.4 Performance Criteria

Wind generators must comply with FERC Order 661A on low voltage ride through for wind farms. Therefore, the wind generators should not trip off line for faults for under voltage relay actuation. If a wind generator trips off line, an appropriately sized SVC or STATCOM device may need to be specified to keep the wind generator on-line for the fault. SPP was consulted to determine if the addition of an SVC or STATCOM is warranted for the specific condition.

Contingencies that resulted in a prior-queued project tripping off-line, if any, were re-run with the prior-queued project's voltage and frequency tripping disabled to check for stability issues.

3.5 Performance Evaluation Methods

A power factor analysis was performed for all study projects that are wind or solar farms. The power factor analysis consisted of modeling a var generator in each wind farm holding a voltage schedule at the POI. The voltage schedule was set to the higher of the voltage with the wind farm off-line or 1.0 per unit.

If the required power factor at the POI is beyond the capability of the studied wind turbines, then capacitor banks would be considered. Factors used in sizing capacitor banks would include two requirements of FERC Order 661A: the ability of the wind farm to ride through low voltage with and without capacitor banks and the ability of the wind farm to recover to pre-fault voltage. If a wind generator trips on high voltage, a leading power factor may be required.

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

Stability analysis was performed for each proposed interconnection request. Faults were simulated on transmission lines at the POIs and on other nearby transmission equipment. The faults in Table 3-1 were run for each case (three phase and single phase as noted).

Table 3-1. Fault Definitions

Cont. No.	Contingency Name	Contingency Description
1	FLT01-3PH	3 phase fault on the Bushland (524267) to Potter County (523959) 230kV line, near Bushland. a. Apply fault at the Bushland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	Single phase fault and sequence like previous
3	FLT03-3PH	3 phase fault on the Bushland (524267) to Buffalo (560009) 230kV line, near Bushland. a. Apply fault at the Bushland 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	Single phase fault and sequence like previous
5	FLT05-3PH	3 phase fault on the Plant X (525481) to Potter County (523959) [Newhart (525461) in 15SP and 24SP] 230kV line, near Plant X. a. Apply fault at the Plant X 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	Single phase fault and sequence like previous
7	FLT07-3PH	3 phase fault on the Plant X (525481) to Deaf Smith (524623) 230kV line, near Plant X. a. Apply fault at the Plant X 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	Single phase fault and sequence like previous
9	FLT09-3PH	3 phase fault on the Plant X (525481) to Tolk East (525524) 230kV line, near Plant X. a. Apply fault at the Plant X 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	Single phase fault and sequence like previous
11	FLT11-3PH	3 phase fault on the Plant X (525481) to Tolk West (525531) 230kV ckt1 line, near Plant X. a. Apply fault at the Plant X 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	Single phase fault and sequence like previous
13	FLT13-3PH	3 phase fault on the Plant X (525481) to Sundown (526435) 230kV line, near Plant X. a. Apply fault at the Plant X 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	Single phase fault and sequence like previous

Cont. No.	Contingency Name	Contingency Description
15	FLT15-3PH	3 phase fault on the Potter County (523959) to Moore County (523309) 230kV line, near Potter County. a. Apply fault at the Potter County 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	Single phase fault and sequence like previous
17	FLT17-3PH	3 phase fault on the Potter County (523959) to Harrington East (523979) 230kV line, near Potter County. a. Apply fault at the Potter County 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	Single phase fault and sequence like previous
19	FLT19-3PH	3 phase fault on the Potter County (523959) to Rolling Hills (524010) 230kV line, near Potter County. a. Apply fault at the Potter County 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	Single phase fault and sequence like previous
21	FLT21-3PH	3 phase fault on the Harrington_Mid (523978) to Harrington West (523977) 230kV line, near Harrington_Mid. a. Apply fault at the Harrington_Mid 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	Single phase fault and sequence like previous
23	FLT23-3PH	3 phase fault on the Harrington_Mid (523978) to Harrington East (523979) 230kV line, near Harrington_Mid. a. Apply fault at the Harrington_Mid 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	Single phase fault and sequence like previous
25	FLT25-3PH	3 phase fault on the Harrington_Mid (523978) to Nichols (524044) 230kV line, near Harrington_Mid. a. Apply fault at the Harrington_Mid 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-1PH	Single phase fault and sequence like previous
27	FLT27-3PH	3 phase fault on the Harrington_Mid (523978) to Randall (524365) 230kV line, near Harrington_Mid. a. Apply fault at the Harrington_Mid 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-1PH	Single phase fault and sequence like previous

Cont. No.	Contingency Name	Contingency Description
29	FLT29-3PH	3 phase fault on the Nichols (524044) to Hutchison (523551) 230kV line, near Nichols. a. Apply fault at the Nichols 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-1PH	Single phase fault and sequence like previous
31	FLT31-3PH	3 phase fault on the Nichols (524044) to Grapevine (523771) 230kV line, near Nichols. a. Apply fault at the Nichols 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
32	FLT32-1PH	Single phase fault and sequence like previous
33	FLT33-3PH	3 phase fault on the Nichols (524044) to Amarillo South (524415) 230kV line, near Nichols. a. Apply fault at the Nichols 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-1PH	Single phase fault and sequence like previous
35	FLT35-3PH	3 phase fault on the Potter County (523961) to Hitchland (523097) 345kV line, near Potter County. a. Apply fault at the Potter County 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	Single phase fault and sequence like previous
37	FLT37-3PH	3 phase fault on the Bushland (524267) 230kV to Bushland (524266) 115kV/(524263) 13.2kV transformer, near Bushland 230kV. a. Apply fault at the Bushland 230kV bus. b. Leave fault on for 5 cycles, then trip the transformer and remove fault.
38	FLT38-3PH	3 phase fault on the Deaf Smith (524623) 230kV to Deaf Smith (524622) 115kV/(524621) 13.8kV ckt2 transformer, near Deaf Smith 230kV. a. Apply fault at the Deaf Smith 230kV bus. b. Leave fault on for 5 cycles, then trip the transformer and remove fault.
39	FLT39-3PH	3 phase fault on the Plant X (525481) 230kV to Plant X (525480) 115kV/(525479) 13.2kV transformer, near Plant X 230kV. a. Apply fault at the Plant X 230kV bus. b. Leave fault on for 5 cycles, then trip the transformer and remove fault.
40	FLT40-3PH	3 phase fault on the Potter County (523959) 230kV to Potter County (523951) 115kV/(523950) 13.2kV transformer, near Potter County 230kV. a. Apply fault at the Potter County 230kV bus. b. Leave fault on for 5 cycles, then trip the transformer and remove fault.
41	FLT41-3PH	3 phase fault on the Potter County (523959) 230kV to Potter County (523961) 345kV/(523957) 13.2kV transformer, near Potter County 230kV. a. Apply fault at the Potter County 230kV bus. b. Leave fault on for 5 cycles, then trip the transformer and remove fault.

Cont. No.	Contingency Name	Contingency Description
42	FLT42-3PH (2014WP only)	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Plant X to Potter County 230kV. a. Prior outage Buffalo (560009) 230kV to Deaf Smith (524623) 230kV (solve network for steady state solution). b. 3 phase fault on the Potter County (523959) 230kV to Plant X (525481) 230kV, near Potter County 230kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
43	FLT43-3PH (2015SP and 2024SP only)	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Newhart 230kV. a. Prior outage Buffalo (560009) 230kV to Deaf Smith (524623) 230kV (solve network for steady state solution). b. 3 phase fault on the Potter County (523959) 230kV to Newhart (525461) 230kV, near Potter County 230kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
44	FLT44-3PH	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County 230kV to Bushland 230kV. a. Prior outage Buffalo (560009) 230kV to Deaf Smith (524623) 230kV (solve network for steady state solution). b. 3 phase fault on the Potter County (523959) 230kV to Bushland (524267) 230kV, near Potter County 230kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
45	FLT45-1PH	Bushland 230kV Stuck Breaker a. Single phase fault at the Bushland (524267) 230kV bus. b. Clear fault after 16cycles by removing fault from the Bushland (524267) 230kV bus, and c. Drop Bushland (524267) 230kV to Bushland (524266) 115kV/(524263) 13.2kV transformer, and d. Trip Bushland (524267) to Potter County (523959) 230kV line..
46	FLT46-3PH (2024SP only)	3 phase fault on the Potter Co (523959) to CHAN/TASCOS (523869) 230kV line, near Potter Co. a. Apply fault at the Potter Co 230kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

4. Results and Observations

4.1 Stability Analysis Results

Table 4-1 summarizes the results. Figure 4-1 through Figure 4-2 show representative summer peak season plots for faults at the POI's of the study projects. Complete sets of plots for all base cases for each fault and each study and prior project are included in Appendix A. Transient voltage details are given in Appendix B.

Fault 44 was unstable (Figure 4-3 through Figure 4-6) in all three base cases. This is a NERC Category C3 outage of the Buffalo - Deaf Smith and Potter Count - Bushland 230 kV lines. The plants GEN-2002-002, GEN-2006-047, and GEN-2013-031 go unstable because their total 810 MW is left feeding through the Bushland 168 MVA 230/115 kV transformer and series connected 177 MVA Bushland-Hillside 115 kV line. Because this is a NERC Category C3 fault, adjustments can be made between the two line outages. In this case, GEN-2002-002, GEN-2006-047, and GEN-2013-031 will have to reduce some or all generation after the first line goes out, in preparation for the next line outage. Earlier-queued plants will have priority over later-queued plants. Required reductions may depend on the output of the plants at the time of the curtailment.

A few three-phase faults (FLT21, FLT23, FLT25, FLT27, FLT29, FLT31, and FLT33) at Harrington and Nichols 230 kV buses resulted in transient voltages below 70% at KINGSMILL, LLANO_WND, and MIDSTRM_TP 115 kV lines. These results are ignored due to the simple model of the 80 MW power plant at LLANO_WND 115. The plant is modeled directly on the LLANO_WND 115 kV bus with no transformers or other collector impedance.

With a value of 69.8%, Bushland 230 kV bus voltage violated the 70% criterion for a single time step after fault clearing in the 2014WP case. This minor violation is not considered significant.

Otherwise, there were no stability problems found during any of the other simulations. No other generators tripped or went unstable, and voltages recovered to acceptable levels.

Table 4-1. Summary of Stability Results

Cont. No.	Contingency Name	Contingency Description	14WP Results	15SP Results	24SP Results
1	FLT01-3PH	3 phase fault on the Bushland (524267) to Potter County (523959) 230kV line, near Bushland.	OK	OK	OK
2	FLT02-1PH	Single phase fault and sequence like previous	OK	OK	OK
3	FLT03-3PH	3 phase fault on the Bushland (524267) to Buffalo (560009) 230kV line, near Bushland.	OK	OK	OK
4	FLT04-1PH	Single phase fault and sequence like previous	OK	OK	OK
5	FLT05-3PH	3 phase fault on the Plant X (525481) to Potter County (523959) [Newhart (525461) in 15SP and 24SP] 230kV line, near Plant X.	OK	OK	OK

Cont. No.	Contingency Name	Contingency Description	14WP Results	15SP Results	24SP Results
6	FLT06-1PH	Single phase fault and sequence like previous	OK	OK	OK
7	FLT07-3PH	3 phase fault on the Plant X (525481) to Deaf Smith (524623) 230kV line, near Plant X.	OK	OK	OK
8	FLT08-1PH	Single phase fault and sequence like previous	OK	OK	OK
9	FLT09-3PH	3 phase fault on the Plant X (525481) to Tolk East (525524) 230kV line, near Plant X.	OK	OK	OK
10	FLT10-1PH	Single phase fault and sequence like previous	OK	OK	OK
11	FLT11-3PH	3 phase fault on the Plant X (525481) to Tolk West (525531) 230kV ckt1 line, near Plant X.	OK	OK	OK
12	FLT12-1PH	Single phase fault and sequence like previous	OK	OK	OK
13	FLT13-3PH	3 phase fault on the Plant X (525481) to Sundown (526435) 230kV line, near Plant X.	OK	OK	OK
14	FLT14-1PH	Single phase fault and sequence like previous	OK	OK	OK
15	FLT15-3PH	3 phase fault on the Potter County (523959) to Moore County (523309) 230kV line, near Potter County.	OK	OK	OK
16	FLT16-1PH	Single phase fault and sequence like previous	OK	OK	OK
17	FLT17-3PH	3 phase fault on the Potter County (523959) to Harrington East (523979) 230kV line, near Potter County.	OK	OK	OK
18	FLT18-1PH	Single phase fault and sequence like previous	OK	OK	OK
19	FLT19-3PH	3 phase fault on the Potter County (523959) to Rolling Hills (524010) 230kV line, near Potter County.	OK	OK	OK
20	FLT20-1PH	Single phase fault and sequence like previous	OK	OK	OK
21	FLT21-3PH	3 phase fault on the Harrington_Mid (523978) to Harrington West (523977) 230kV line, near Harrington_Mid.	OK	OK	OK
22	FLT22-1PH	Single phase fault and sequence like previous	OK	OK	OK
23	FLT23-3PH	3 phase fault on the Harrington_Mid (523978) to Harrington East (523979) 230kV line, near Harrington_Mid.	OK	OK	OK
24	FLT24-1PH	Single phase fault and sequence like previous	OK	OK	OK
25	FLT25-3PH	3 phase fault on the Harrington_Mid (523978) to Nichols (524044) 230kV line, near Harrington_Mid.	OK	OK	OK
26	FLT26-1PH	Single phase fault and sequence like previous	OK	OK	OK
27	FLT27-3PH	3 phase fault on the Harrington_Mid (523978) to Randall (524365) 230kV line, near Harrington_Mid.	OK	OK	OK
28	FLT28-1PH	Single phase fault and sequence like previous	OK	OK	OK
29	FLT29-3PH	3 phase fault on the Nichols (524044) to Hutchison (523551) 230kV line, near Nichols.	OK	OK	OK
30	FLT30-1PH	Single phase fault and sequence like previous	OK	OK	OK
31	FLT31-3PH	3 phase fault on the Nichols (524044) to Grapevine (523771) 230kV line, near Nichols.	OK	OK	OK
32	FLT32-1PH	Single phase fault and sequence like previous	OK	OK	OK
33	FLT33-3PH	3 phase fault on the Nichols (524044) to Amarillo South (524415) 230kV line, near Nichols.	OK	OK	OK
34	FLT34-1PH	Single phase fault and sequence like previous	OK	OK	OK

Cont. No.	Contingency Name	Contingency Description	14WP Results	15SP Results	24SP Results
35	FLT35-3PH	3 phase fault on the Potter County (523961) to Hitchland (523097) 345kV line, near Potter County.	OK	OK	OK
36	FLT36-1PH	Single phase fault and sequence like previous	OK	OK	OK
37	FLT37-3PH	3 phase fault on the Bushland (524267) 230kV to Bushland (524266) 115kV/(524263) 13.2kV transformer, near Bushland 230kV.	OK	OK	OK
38	FLT38-3PH	3 phase fault on the Deaf Smith (524623) 230kV to Deaf Smith (524622) 115kV/(524621) 13.8kV ckt2 transformer, near Deaf Smith 230kV.	OK	OK	OK
39	FLT39-3PH	3 phase fault on the Plant X (525481) 230kV to Plant X (525480) 115kV/(525479) 13.2kV transformer, near Plant X 230kV.	OK	OK	OK
40	FLT40-3PH	3 phase fault on the Potter County (523959) 230kV to Potter County (523951) 115kV/(523950) 13.2kV transformer, near Potter County 230kV.	OK	OK	OK
41	FLT41-3PH	3 phase fault on the Potter County (523959) 230kV to Potter County (523961) 345kV/(523957) 13.2kV transformer, near Potter County 230kV.	OK	OK	OK
42	FLT42-3PH (2014WP only)	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Plant X to Potter County 230kV.	OK	OK	OK
43	FLT43-3PH (2015SP and 2024SP only)	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Newhart 230kV.	OK	OK	OK
44	FLT44-3PH	Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County 230kV to Bushland 230kV.	G02-02, G06-47, G13-31 unstable	G02-02, G06-47, G13-31 unstable	G02-02, G06-47, G13-31 unstable
45	FLT45-1PH	Bushland 230kV Stuck Breaker	OK	OK	OK
46	FLT46-3PH (2024SP only)	3 phase fault on the Potter Co (523959) to CHAN/TASCOS (523869) 230kV line, near Potter Co.	OK	OK	OK

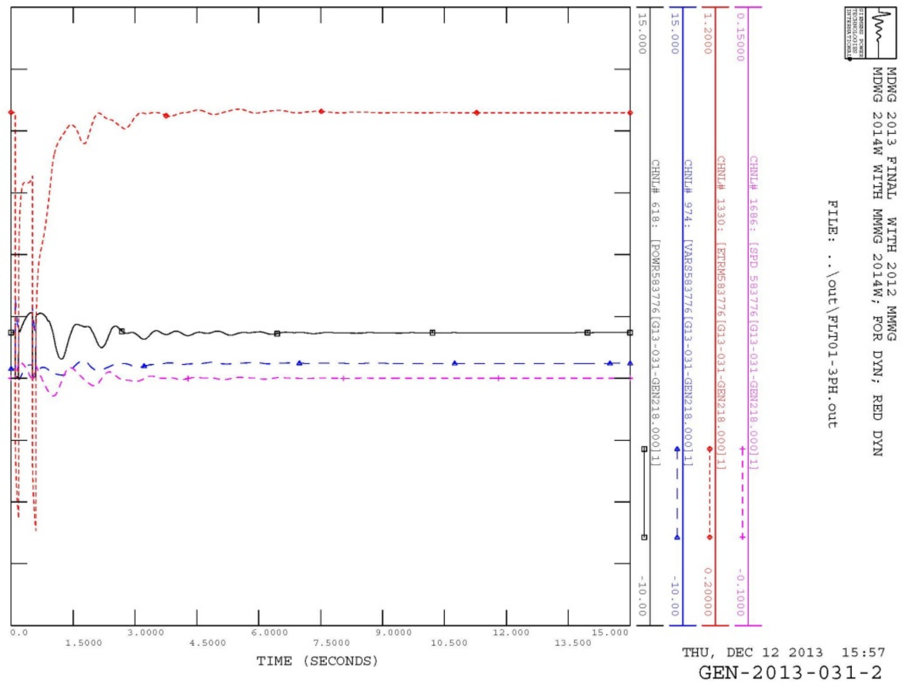

Figure 4-1. GEN-2013-031 Plot for Fault 1, a 3 phase fault on the Bushland (524267) to Potter County (523959) 230kV line, at Bushland

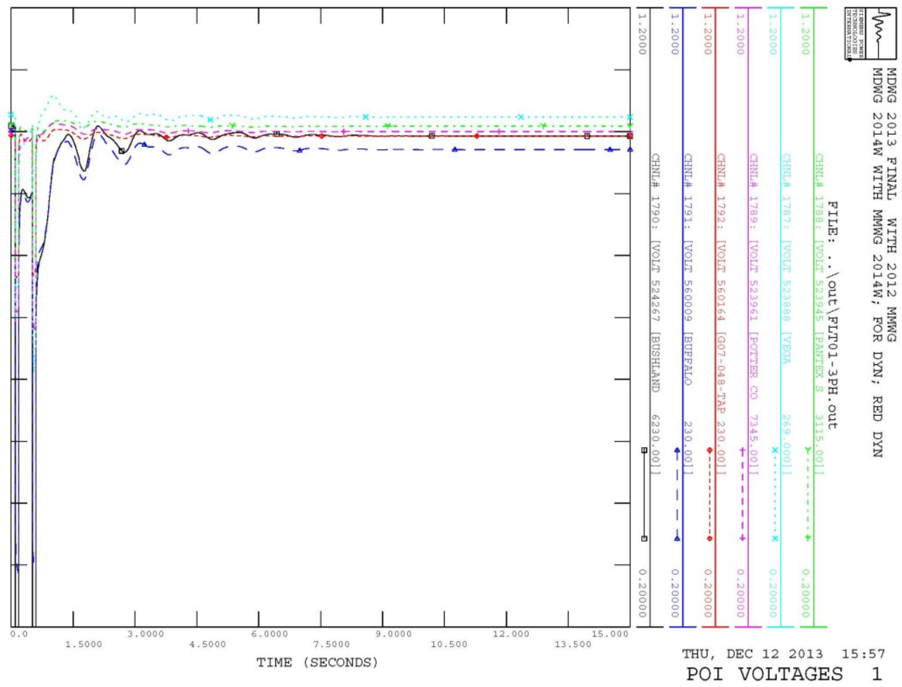

Figure 4-2. POI Voltage Plot for Fault 1, a 3 phase fault on the Bushland (524267) to Potter County (523959) 230kV line, at Bushland

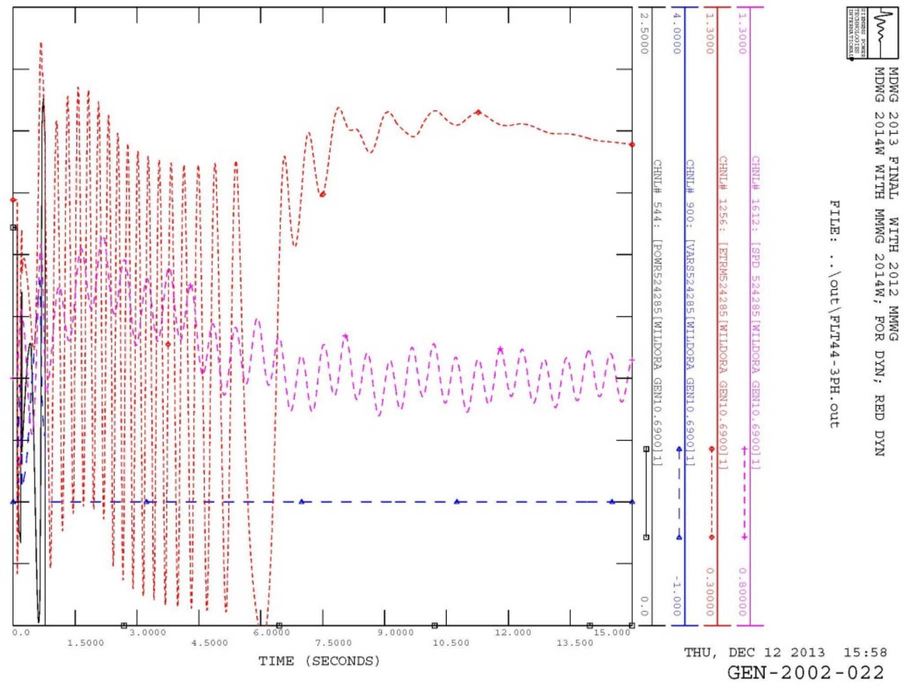

Figure 4-3. GEN-2002-022 Plot for Fault 44, Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Bushland 230kV

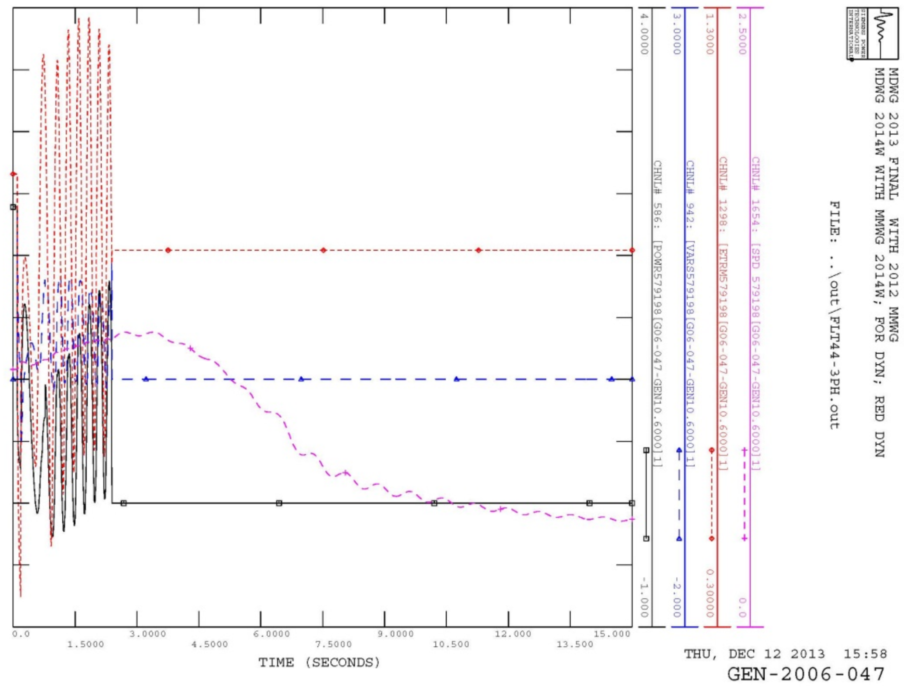

Figure 4-4. GEN-2006-047 Plot for Fault 44, Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Bushland 230kV

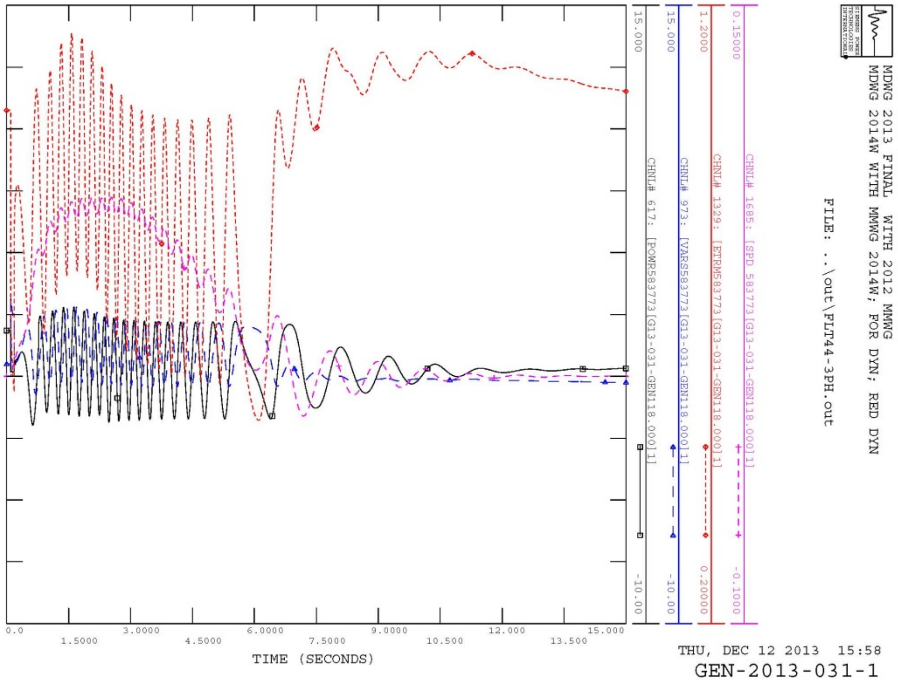

Figure 4-5. GEN-2013-031 Plot for Fault 44, Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Bushland 230kV

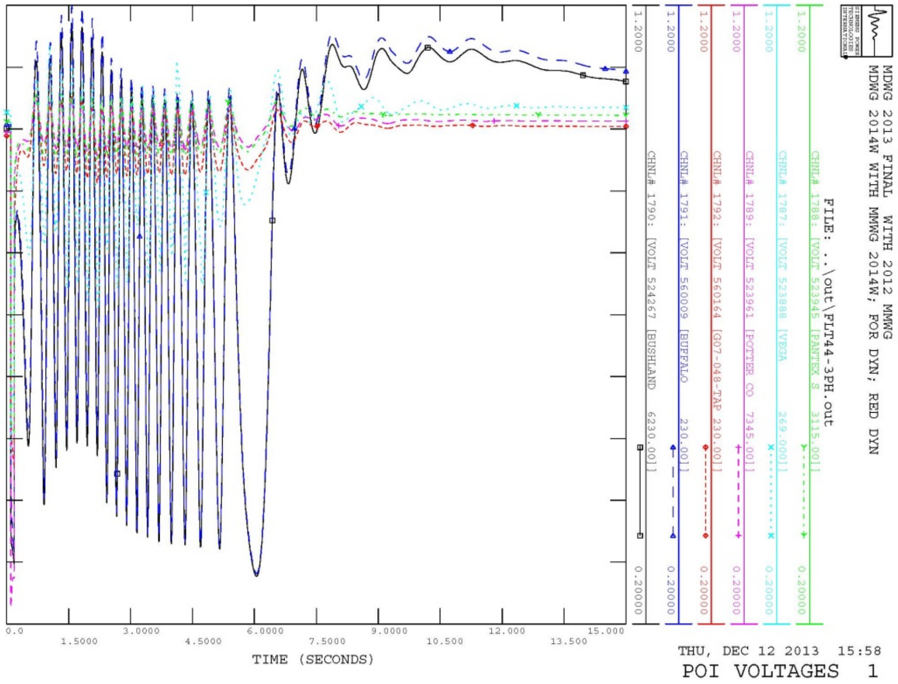

Figure 4-6. POI Voltage Plot for Fault 44, Prior Outage of Buffalo to Deaf Smith 230kV, then 3 phase fault on the Potter County to Bushland 230kV

4.2 Power Factor Requirements

Power factor analysis is not required because the study plant uses traditional synchronous generators.

5. Conclusions

The SPP DISIS-2013-002 Group 5 Definitive Impact Study evaluated the impacts of interconnecting the projects shown below.

Table 5-1. Interconnection Requests Evaluated in this Study

Request	Size	Generator Type	Point of Interconnection	Gen Buses
GEN-2013-031	332 Summer 370 Winter	GENROU	Bushland 230kV (524267)	583773 583776

Study project GEN-2013-031 and two prior projects GEN-2002-022 and GEN-2006-047 went unstable following Fault 44, a NERC Category C3 outage of Buffalo to Deaf Smith and Potter County to Bushland 230kV lines. As a result, these plants will have to be curtailed following the outage of either of these transmission lines, in preparation for the outage of the other line. Later-queued plants will be curtailed before earlier-queued plants. The amount of curtailment will depend on the generation levels of the plants at the time of curtailment. Details of the curtailment plan will be determined by the transmission system operator.

With the assumptions in this study, the study project should be able to reliably interconnect to the SPP transmission system. Any change in system or plant models or assumptions could change these results.

N: Group 6 Dynamic Stability Analysis Report

See S&C Electric report on next page.

S&C ELECTRIC COMPANY
Excellence Through Innovation

DISIS-2013-002 (GROUP 6)

LITTLE ROCK, AR

SOUTHWEST POWER POOL (SPP)

DEFINITIVE INTERCONNECTION SYSTEM IMPACT STUDY

S&C PROJECT NUMBER: 7726

REVISION: 0

FINAL REPORT

CONFIDENTIAL

JANUARY 28, 2014

REPORT REVISION HISTORY:

REV	DATE	PREPARED BY	REVIEWED BY	DESCRIPTION
A	1/27/2014	MA	SK	Issued for comments
0	1/28/2014	MA	SK	Final report issued

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1. EXECUTIVE SUMMARY

S&C Electric Company has performed a Definitive Interconnection System Impact Study, DISIS-2013-002 (Group 6), in response to a request through Southwest Power Pool (SPP) tariff studies. Group 6 includes two (2) generation interconnection study projects. One of the interconnection study projects, i.e. ASGI-2013-005, is a 19.8 MW wind farm project and the other one, i.e., GEN-2013-022, is a 25 MW solar plant. Group 6 and prior-queued projects specified in the scope of work were studied at 100% output power using the 2014 Winter Peak Case and the 2015 and 2024 Summer Peak Cases provided by SPP.

SPP requires that interconnection request projects meet a voltage schedule at the point of interconnection (POI) consistent with the voltage in the SPP base case or nominal voltage, whichever is higher. The power factor requirements for renewable energy interconnection projects are specified by SPP for N-1 contingencies (or N-2 contingencies if applicable). Power factor analysis for the wind generation and solar generation study projects revealed that the solar plant represented by GEN-2013-022 and the wind farm represented by ASGI-2013-005 are required to maintain a power factor of 95% lagging to 95% leading at the POI per FERC requirements.

Transient stability analysis indicated that Group 6 is expected to successfully ride-through each N-1 and N-2 fault contingency specified by SPP and the nearby areas will retain angular, frequency and voltage stability. Group 6 is expected to successfully interconnect into the transmission system at the desired location without reduction in output power. Furthermore, all the study projects and nearby generators in the study area meet rotor angular damping and transient voltage recovery requirements as specified in Appendix A of the scope of work.

2. INTRODUCTION

S&C Electric Company has performed a **D**efinitive **I**nterconnection **S**ystem **I**mpact **S**tudy DISIS-2012-002 (Group 6) in response to a request through the Southwest Power Pool (SPP) Tariff studies. Group 6 includes the projects listed in Table 1.

Table 1: Study Projects in Group 6

Project	Size (MW)	Generator Model	Point of Interconnection
ASGI-2013-005	19.8 MW	Vestas V82 1.65 MW (583283)	FE-Clovis 115 kV (524808)
GEN-2013-022	25.0 MW	Solaron 500 kW (583313)	Caprock 115 kV (524486)

ASGI-2013-005 is a new wind farm project and GEN-2013-022is a new solar farm project. Group 6 and prior-queued projects were studied at 100% output power using 2014 winter and 2015 and 2024 summer peak cases provided by SPP.

3. TRANSMISSION SYSTEM AND STUDY AREA

The study projects in Group 6 will interconnect into Southwestern Public Service Co. (SPS, Area #526). In addition to these areas, the following areas were also monitored:

- American Electric Power West. (AEPW, Area #520)
- Oklahoma Gas & Electric (OKGE, Area #524)
- Western Farmers Electric Cooperative. (WFEC, Area #525)
- Midwest Energy (MIDW, Area #531)
- Sunflower Electric Power Corporation (SUNC, Area #534)
- Westar Energy, Inc. (WERE, Area #536).

4. POWER FLOW BASE CASES

DISIS-2013-002 (Group 6) and prior-queued projects were modeled as aggregates of generating units. The aggregate models were part of the base case supplied by SPP. The following power flow base cases were provided by SPP:

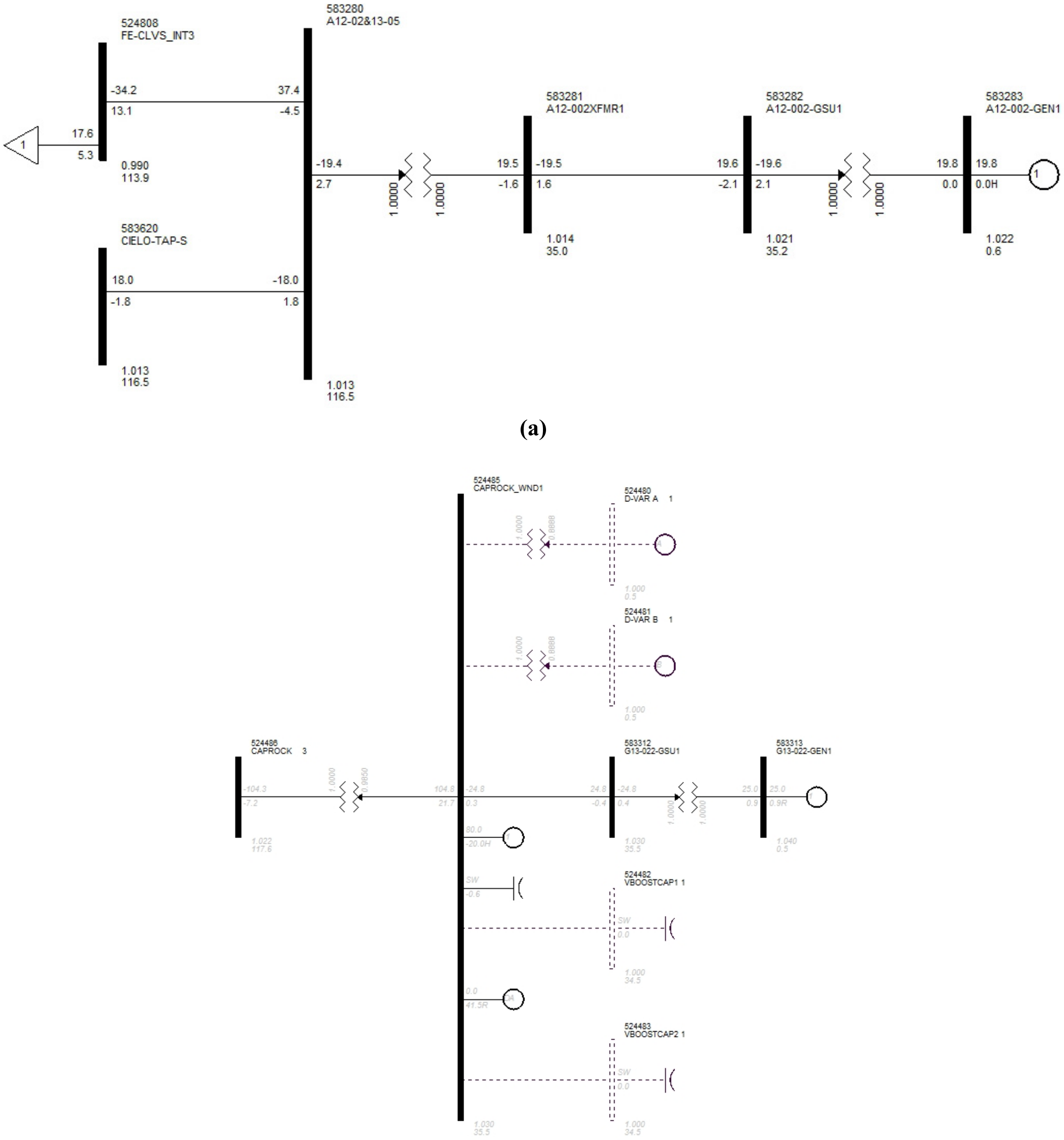
MDWG13-14WP_DIS1302_G06 – 2014 Winter Peak Case, which includes aggregate representation of interconnect requests for DISIS-2013-002 (Group 6) and prior-queued projects at 100% output power.

MDWG13-15SP_DIS1302_G06 – 2015 Summer Peak Case, which includes aggregate representation of interconnect requests for DISIS-2013-002 (Group 6) and prior-queued projects at 100% output power.

MDWG13-24SP_DIS1302_G06 – 2024 Summer Peak Case, which includes aggregate representation of interconnect requests for DISIS-2013-002 (Group 6) and prior-queued projects at 100% output power.

5. POWER FLOW MODEL

The study projects and prior-queued projects were modeled as aggregates of generating units. The aggregate models were part of the base case supplied by SPP. Figure1 depicts simplified one-line diagrams for the two (2) study projects.



(a)

(b)

Fig.1. Simplified one-line diagrams for study projects (a) ASGI-2013-005 and (b) GEN-2013-022.

6. POWER FACTOR REQUIREMENTS AT THE POINT OF INTERCONNECTION

SPP has specific voltage requirements for interconnecting renewable energy projects (wind farm, solar plant, etc.). These projects must maintain the power factor required to hold a voltage schedule at the POI consistent with the voltage schedule in the provided base case or 1.0 pu voltage, the higher of the two. The voltage requirements must also be met during single (or N-2, if applicable) transmission facility outage contingencies specified by SPP.

6.1. FACILITY OUTAGE CONTINGENCIES

The base case voltages at the point of interconnection for the three peak cases (winter 2014, summer 2015 and summer 2024) are listed in Table 2. The power factor requirements are applied to both renewable energy projects. Therefore, ASGI-2013-005 must keep the power factor required to hold 1.0 pu voltage at the POI, whereas GEN-2013-022 must keep the power factor required to hold the voltage at the POI according to the voltage schedule shown in Table 2. The transmission facility outage contingencies specified by SPP are listed in Table 3. Tables 4 to 6 show the power factor required to maintain the aforesaid voltage schedules at the POI during the occurrence of the contingencies listed in Table 3. Note that the cases that power factor requirements exceed 0.95 leading/lagging value are highlighted in red font.

Table 2: Base Case Voltage at the Point of Interconnection of the Generation Interconnection Requests

Request	Point of Interconnection	2014 Winter Peak (pu)	2015 Summer Peak (pu)	2024 Summer Peak (pu)
ASGI-2013-005	FE-Clovis 115 kV (524808)	0.998	0.994	0.993
GEN-2013-022	Caprock 115 kV (524486)	1.038	1.026	1.024

Table 3: List of Outages for the Power Factor Analysis

Outage No.	Description
0	System Intact (Base Case)
1	Outage of the Norton (524502) to FE-Tucumcari (524509) 115-kV line
2	Outage of the Pleasant Hill (524768) to E Clovis (524773) 115-kV line
3	Outage of the Pleasant Hill (524768) to N Clovis Tap (524776) 115-kV line
4	Outage of the Pleasant Hill (524768) to FE-Holland (524773) 115-kV line
5	Outage of the Pleasant Hill (524770) 230kV to Pleasant Hill (524768) 115kV/(524767) 13.2kV transformer
6	Outage of the Pleasant Hill (524770) to Oasis (524875) 230-kV line
7	Outage of the Pleasant Hill (524770) to Roosevelt (524909) 230-kV line
8	Outage of the Oasis (524875) 230kV to Oasis (524874) 115kV/(524872) 13.2kV transformer
9	Outage of the FE-Clovis Int (524808) to N Clovis Tap (524776) 115-kV line
10	Outage of the FE-Clovis Int (524808) to W Clovis (524784) 115-kV line
11	Outage of the SP-Erskine (526109) to Indiana (526146) 115-kV line
12	Outage of the SP-Erskine (526109) to Carlilse (526160) 115-kV line
13	Outage of the TUCO (525830) 230kV to TUCO (525828) 115kV/(525821) 13.2kV transformer CKT 1 (Prior Outage of TUCO (525830) 230kV to TUCO (525828) 115kV/(525819) 13.2kV transformer CKT 2)
14	Outage of the Pleasant Hill (524768) 115kV to E Clovis (524773) 115-kV line (Prior Outage of Pleasant Hill (524770) 230kV to Pleasant Hill (524768) 115kV/(524767) 13.2kV transformer)
15	Outage of the TUCO (525832) to OKU (511456) 345-kV line
16	Outage of the TUCO (525832) to Sweetwater (562335) 345-kV line
17	Outage of the Eddy Co (527802) to GEN-2008-022 Tap (560007) 345-kV line
18	Outage of the Tolk (525549) to GEN-2013-013 Tap (560726) 345-kV line
19	Outage of the Tolk East (525524) to Roosevelt S (524911) 230-kV line
20	Outage of the Tolk East (525524) to Plant X (525481) 230-kV line
21	Outage of the Tolk East (525524) to TUCO (525830) 230-kV line
22	Outage of the Tolk West (525531) to Yoakum (526935) 230-kV line
23	Outage of the Tolk West (525531) to Lamb Co (525637) 230-kV line

According to FERC Order No. 661-A, interconnection projects are not typically required to operate beyond a power factor range of 0.95 leading/lagging at the POI for voltages from 0.95 to 1.05 of nominal. Based on the results of the power factor analysis, the solar plant represented by GEN-2013-022 is has power factor requirements of 0.99 lagging to 0.99 leading at the POI to maintain the required voltage schedule. Per the SPP GIA and OATT, the solar plant will have requirements of 0.95 leading to 0.95 lagging at the POI. The wind farm represented by ASGI-2013-005 is expected to require power factors exceeding the 0.95 leading/lagging in some of the contingencies, i.e., the lowest leading power factor is about 0.88 and was registered for outage no. 19 of the 2014 Winter Peak Case. Similarly, the lowest lagging power factor is 0.59 and occurred in outage no. 8 of the 2024 Summer Peak Case. The power factor analysis indicates that the wind farm represented by ASGI-2013-005 is required to maintain a power factor of 0.95 lagging to 0.95 leading at the POI per FERC requirements.

Table 4: Power Factor Requirements at the POI of the Generation Interconnection Requests for the Outages in Table 3 and the 2014 Winter Peak Case

Outage No.	ASGI-2013-005				GEN-2013-022			
	P (MW)	Q (MVAR)	Power Factor		P (MW)	Q (MVAR)	Power Factor	
0	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
1	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
2	19.8	2.8	99.01%	lagging	25.0	3.5	99.03%	lagging
3	19.8	7.9	**92.88%**	lagging	25.0	2.6	99.46%	lagging
4	19.8	2.8	99.01%	lagging	25.0	3.5	99.03%	lagging
5	19.8	7.1	**94.13%**	lagging	25.0	4.1	98.68%	lagging
6	19.8	2.4	99.27%	lagging	25.0	3.4	99.09%	lagging
7	19.8	5.7	96.10%	lagging	25.0	3.7	98.92%	lagging
8	19.8	19.7	**70.89%**	lagging	25.0	3.3	99.14%	lagging
9	19.8	-2.3	99.33%	leading	25.0	3.6	98.98%	lagging
10	19.8	5.7	96.10%	lagging	25.0	3.2	99.19%	lagging
11	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
12	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
13	19.8	0.4	99.98%	lagging	25.0	3.2	99.19%	lagging
14	19.8	10.8	**87.79%**	lagging	25.0	4.5	98.42%	lagging
15	19.8	0.0	100.00%	lagging	25.0	3.2	99.19%	lagging
16	19.8	0.0	100.00%	lagging	25.0	3.2	99.19%	lagging
17	19.8	9.1	**90.86%**	lagging	25.0	3.8	98.86%	lagging
18	19.8	2.3	99.33%	lagging	25.0	3.4	99.09%	lagging
19	19.8	-10.8	**87.79%**	leading	25.0	2.5	99.50%	lagging
20	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
21	19.8	0.3	99.99%	lagging	25.0	3.2	99.19%	lagging
22	19.8	1.1	99.85%	lagging	25.0	3.3	99.14%	lagging
23	19.8	0.4	99.98%	lagging	25.0	3.3	99.14%	lagging

Table 5: Power Factor Requirements at the POI of the Generation Interconnection Requests for the Outages in Table 3 and the 2015 Summer Peak Case

Outage No.	ASGI-2013-005				GEN-2013-022			
	P (MW)	Q (MVAR)	Power Factor		P (MW)	Q (MVAR)	Power Factor	
0	19.8	3.0	98.87%	lagging	25.0	-1.1	99.90%	leading
1	19.8	3.0	98.87%	lagging	25.0	-1.1	99.90%	leading
2	19.8	5.0	96.96%	lagging	25.0	-1.0	99.92%	leading
3	19.8	9.8	**89.62%**	lagging	25.0	-1.6	99.80%	leading
4	19.8	5.0	96.96%	lagging	25.0	-1.0	99.92%	leading
5	19.8	14.0	**81.65%**	lagging	25.0	0.2	100.00%	lagging
6	19.8	5.9	95.84%	lagging	25.0	-0.9	99.94%	leading
7	19.8	8.8	**91.38%**	lagging	25.0	-0.6	99.97%	leading
8	19.8	17.0	**75.87%**	lagging	25.0	-1.1	99.90%	leading
9	19.8	-0.1	100.00%	leading	25.0	-0.8	99.95%	leading
10	19.8	11.3	**86.85%**	lagging	25.0	-1.4	99.84%	leading
11	19.8	3.0	98.87%	lagging	25.0	-1.1	99.90%	leading
12	19.8	3.0	98.87%	lagging	25.0	-1.1	99.90%	leading
13	19.8	3.1	98.80%	lagging	25.0	-1.1	99.90%	leading
14	19.8	17.2	**75.49%**	lagging	25.0	0.6	99.97%	lagging
15	19.8	3.4	98.56%	lagging	25.0	-1.1	99.90%	leading
16	19.8	3.1	98.80%	lagging	25.0	-1.1	99.90%	leading
17	19.8	9.7	**89.80%**	lagging	25.0	-0.7	99.96%	leading
18	19.8	8.1	**92.55%**	lagging	25.0	-0.8	99.95%	leading
19	19.8	-8.4	**92.06%**	leading	25.0	-1.9	99.71%	leading
20	19.8	3.1	98.80%	lagging	25.0	-1.1	99.90%	leading
21	19.8	3.1	98.80%	lagging	25.0	-1.1	99.90%	leading
22	19.8	3.0	98.87%	lagging	25.0	-1.1	99.90%	leading
23	19.8	3.6	98.39%	lagging	25.0	-1.1	99.90%	leading

Table 6: Power Factor Requirements at the POI of the Generation Interconnection Requests for the Outages in Table 3 and the 2024 Summer Peak Case

Outage No.	ASGI-2013-005				GEN-2013-022			
	P (MW)	Q (MVAR)	Power Factor		P (MW)	Q (MVAR)	Power Factor	
0	19.8	4.8	97.19%	lagging	25.0	-2.8	99.38%	leading
1	19.8	4.8	97.19%	lagging	25.0	-2.8	99.38%	leading
2	19.8	7.1	**94.13%**	lagging	25.0	-2.6	99.46%	leading
3	19.8	12.1	**85.33%**	lagging	25.0	-3.3	99.14%	leading
4	19.8	7.1	**94.13%**	lagging	25.0	-2.6	99.46%	leading
5	19.8	14.2	**81.26%**	lagging	25.0	-1.6	99.80%	leading
6	19.8	7.5	**93.52%**	lagging	25.0	-2.6	99.46%	leading
7	19.8	10.6	**88.16%**	lagging	25.0	-2.3	99.58%	leading
8	19.8	27.1	**58.99%**	lagging	25.0	-2.6	99.46%	leading
9	19.8	-0.2	99.99%	leading	25.0	-2.3	99.58%	leading
10	19.8	15.4	**78.94%**	lagging	25.0	-3.2	99.19%	leading
11	19.8	4.8	97.19%	lagging	25.0	-2.8	99.38%	leading
12	19.8	4.8	97.19%	lagging	25.0	-2.8	99.38%	leading
13	19.8	5.0	96.96%	lagging	25.0	-2.8	99.38%	leading
14	19.8	17.2	**75.49%**	lagging	25.0	-1.3	99.87%	leading
15	19.8	9.5	**90.16%**	lagging	25.0	-2.5	99.50%	leading
16	19.8	8.1	**92.55%**	lagging	25.0	-2.6	99.46%	leading
17	19.8	25.2	**61.78%**	lagging	25.0	-1.5	99.82%	leading
18	19.8	6.1	95.57%	lagging	25.0	-2.7	99.42%	leading
19	19.8	3.1	98.80%	lagging	25.0	-3.0	99.29%	leading
20	19.8	5.7	96.10%	lagging	25.0	-2.8	99.38%	leading
21	19.8	8.1	**92.55%**	lagging	25.0	-2.6	99.46%	leading
22	19.8	6.2	95.43%	lagging	25.0	-2.7	99.42%	leading
23	19.8	6.6	**94.87%**	lagging	25.0	-2.7	99.42%	leading

7. TRANSIENT STABILITY ANALYSIS

Transient stability analysis was performed for the fault contingencies listed in Table 7, which were specified by SPP. The prior-queued projects monitored are listed in Table 8.

Single line-to-ground faults were simulated in a manner consistent with currently accepted practices, i.e. to assume that a single line-to-ground fault will cause a positive-sequence voltage drop at the fault location to 60% of nominal.

Table 7: Fault Contingencies Defined by SPP

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Norton (524502) to FE-Tucumcari (524509) 115-kV line, near Norton. a. Apply fault at the Norton 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Disconnect generator ASGI-2013-002 Ceilo Tucumcari (583613) d. Disconnect generator GEN-2011-046 Quay County (524471)
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the Pleasant Hill (524768) to E Clovis (524773) 115-kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on the Pleasant Hill (524768) to N Clovis Tap (524776) 115-kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Pleasant Hill (524768) to FE-Holland (524773) 115-kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Pleasant Hill (524770) 230kV to Pleasant Hill (524768) 115kV/(524767) 13.2kV transformer, near Pleasant Hill 230kV. a. Apply fault at the Pleasant Hill 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer.
10	FLT10-3PH	3 phase fault on the Pleasant Hill (524770) to Oasis (524875) 230-kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.

Cont. No.	Cont. Name	Description
11	FLT11-1PH	*Single phase fault and sequence like previous*
12	FLT12-3PH	3 phase fault on the Pleasant Hill (524770) to Roosevelt (524909) 230-kV line, near Pleasant Hill. a. Apply fault at the Pleasant Hill 230-kV 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.
13	FLT13-1PH	*Single phase fault and sequence like previous*
14	FLT14-3PH	3 phase fault on the Oasis (524875) 230kV to Oasis (524874) 115kV/(524872) 13.2kV transformer, near Oasis 230kV. a. Apply fault at the Oasis 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer
15	FLT15-3PH	3 phase fault on the FE-Clovis Int (524808) to N Clovis Tap (524776) 115-kV line, near FE-Clovis Int. a. Apply fault at the near FE-Clovis Int 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*
17	FLT17-3PH	3 phase fault on the FE-Clovis Int (524808) to W Clovis (524784) 115-kV line, near FE-Clovis Int. a. Apply fault at the near FE-Clovis Int 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the SP-Erskine (526109) to Indiana (526146) 115-kV line, near SPErskine. a. Apply fault at the near SP-Erskine 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the SP-Erskine (526109) to Carlilse (526160) 115-kV line, near SPErskine. a. Apply fault at the near SP-Erskine 115-kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	*Single phase fault and sequence like previous*
23	FLT23-3PH	**Prior Outage of TUCO (525830) 230kV to TUCO (525828) 115kV/(525819) 13.2kV transformer CKT 2**. 3 phase fault on the TUCO (525830) 230kV to TUCO (525828) 115kV/(525821) 13.2kV transformer CKT 1, near TUCO 115kV. a. Prior outage TUCO (525830) 230kV to TUCO (525828) 115kV/(525819) 13.2kV transformer CKT 2 (solve network for steady state solution). b. 3 phase fault on the TUCO (525830) 230kV to TUCO (525828) 115kV/(525821) 13.2kV transformer CKT 1, near TUCO 115kV. c. Leave fault on for 5 cycles, then trip the faulted transformer.
24	FLT24-3PH	**Prior Outage of Pleasant Hill (524770) 230kV to Pleasant Hill (524768) 115kV/(524767) 13.2kV transformer**. 3 phase fault on the Pleasant Hill (524768)

Cont. No.	Cont. Name	Description
		115kV to E Clovis (524773) 115kV, near Pleasant Hill 115kV. a. Prior outage Pleasant Hill (524770) 230kV to Pleasant Hill (524768) 115kV/(524767) 13.2kV transformer (solve network for steady state solution). b. 3 phase fault on the Pleasant Hill (524768) 115kV to E Clovis (524773) 115kV, near Pleasant Hill 115kV. c. Leave fault on for 5 cycles, then trip the faulted line in (b).
25	FLT25-3PH	3 phase fault on the TUCO (525832) to OKU (511456) 345kV line, near TUCO. a. Apply fault at the near TUCO 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-1PH	*Single phase fault and sequence like previous*
27	FLT27-3PH	3 phase fault on the TUCO (525832) to Sweetwater (562335) 345kV line, near TUCO. a. Apply fault at the near TUCO 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-1PH	*Single phase fault and sequence like previous*
29	FLT29-3PH	3 phase fault on the Eddy Co (527802) to GEN-2008-022 Tap (560007) 345kV line, near Eddy Co. a. Apply fault at the near Eddy Co 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-1PH	*Single phase fault and sequence like previous*
31	FLT31-3PH	3 phase fault on the Tolk (525549) to GEN-2013-013 Tap (560726) 345kV line, near Tolk. a. Apply fault at the near Tolk 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
32	FLT32-1PH	*Single phase fault and sequence like previous*
33	FLT33-3PH	3 phase fault on the Tolk East (525524) to Roosevelt S (524911) 230-kV line, near Tolk East. a. Apply fault at the near Tolk East 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
34	FLT34-1PH	*Single phase fault and sequence like previous*
35	FLT35-3PH	3 phase fault on the Tolk East (525524) to Plant X (525481) 230-kV line, near Tolk East. a. Apply fault at the near Tolk East 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
36	FLT36-1PH	*Single phase fault and sequence like previous*
37	FLT37-3PH	3 phase fault on the Tolk East (525524) to TUCO (525830) 230-kV line, near Tolk East. a. Apply fault at the near Tolk East 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
38	FLT38-1PH	*Single phase fault and sequence like previous*
39	FLT39-3PH	3 phase fault on the Tolk West (525531) to Yoakum (526935) 230-kV line, near Tolk West. a. Apply fault at the near Tolk West 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
40	FLT40-1PH	*Single phase fault and sequence like previous*
41	FLT41-3PH	3 phase fault on the Tolk West (525531) to Lamb Co (525637) 230-kV line, near Tolk West. a. Apply fault at the near Tolk West 230-kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
42	FLT42-1PH	*Single phase fault and sequence like previous*

Table 8: Prior Queued Projects

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2001-033	180	Mitsubishi 1000	San Juan Mesa 230kV (524885)
GEN-2001-036	80	Mitsubishi 1000	Norton 115kV (524502)
GEN-2006-018	170	GENSAL	Tuco 230kV (525830)
GEN-2006-026	502	GENROU (527901, 527902, 527903)	Hobbs 115kV(527891) Hobbs 230kV (527894)
GEN-2008-008	60	GE 1.5 MW	Graham 69kV (526693)
GEN-2008-022	300	GE 2.5MW	Tap on Eddy County – Tolk 345kV line (G08-022-POI, 560007)
GEN-2010-006	180 Summer 205 Winter	GENROU	Jones_bus2 230kV(526337)
ASGI-2010-010	42	GENSAL	Lovington 115kV (528334)
ASGI-2010-020	30	Nordex 2.5MW	Tap LE-Tatum to LE-Crsroads 69kV (AS10-020-POI, 560360)
GEN-2010-020	20	Emerson 0.5MW	Roswell 69kV (527563)
ASGI-2010-021	15	Mitsubishi MPS-1000A 1.0MW	Tap LE-Saundrtp to LE-Anderson 69kV (ASGI-021-POI, 560364)
GEN-2010-046	56	GENSAL	Tuco 230kV (525830)
GEN-2010-058	20	Emerson 0.5MW	Chaves County 115kV (527482)
ASGI-2011-003	10	Sany 2.0MW	Hendricks 69kV (525943)
ASGI-2011-001	27.3	Suzlon 2.1MW	Lovington 115kV (528334)
GEN-2011-025	80	GE 1.6MW	Tap on Floyd County - Crosby County 115-kV line (G11-025-POI, 562004)
GEN-2011-045	180 Summer 205 Winter	GENROU	Jones_bus2 230kV (526337)
GEN-2011-046	23 Summer 27 Winter	GENROU	Quay County 115kV (524472)
GEN-2011-048	165 Summer 175 Winter	GENROU	Mustang 230kV (527151)
ASGI-2011-004	19.8	Sany 1.8MW	Crosby 69kV (525915)
GEN-2012-001	61.2	CCWE 3.6MW (WT4)	Tap Grassland to Borden 230kV (526679)
GEN-2012-009	15 MW increase (Pgen=165MW)	GENROU	Mustang 230kV (527151)
GEN-2012-010	15 MW increase (Pgen=165MW)	GENROU	Mustang 230kV (527151)
GEN-2012-020	478	GE 1.68MW	Tuco 230kV (525830)
GEN-2012-034	7 MW increase (Pgen=172MW)	GENROU	Mustang 230kV (527151)
GEN-2012-035	7 MW increase (Pgen=172MW)	GENROU	Mustang 230kV (527151)
GEN-2012-036	7 MW increase (Pgen=172MW Summer/185MW Winter)	GENROU	Mustang 230kV (527151)
GEN-2012-037	196 Summer 203 Winter	GENROU	Tuco 345kV (525832)
ASGI-2012-002	18	Vestas	Clovis 115kV (524808)

		1.65MW V82	
GEN-2013-013	248.4	Siemens 2.3MW (583633, 583636)	Tap Eddy County (527802) – Tolk (525549) 345kV (560726)
GEN-2013-016	191 Summer 203 Winter	GENROU	(583456) Tuco 345kV (525832)
ASGI-2013-002	18.4	Siemens 2.3MW VS (583613)	Tucumcari 115kV (524509)
ASGI-2013-003	18.4	Siemens 2.3MW VS (583623)	Clovis 115kV (524808)
ASGI-2013-006	2.0	Gamesa G114 2MW (583813)	Erskine 115kV (526109)

7.1. STABILITY CRITERIA

Disturbances, including three-phase and single-phase to ground faults, should not cause synchronous and asynchronous plants to become unstable or disconnect from the transmission grid. The criterion for synchronous generator stability as defined by NERC is: “power system stability is defined as that condition in which the difference of the angular positions of synchronous machine rotor becomes constant following an aperiodic system disturbance.”

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

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

SPP has two specific transient stability requirements as summarized below. These requirements will be elaborated in more detail in the SPP Disturbance Performance Requirements provided in Appendix A. This document provides a basis for evaluating the system response during the initial transient period following a disturbance on the bulk electric system by establishing minimum requirements for machine rotor angle damping and transient voltage recovery.

- **Angular Oscillations**: for study projects that include synchronous machines, rotor angle oscillations should meet the damping requirements described in Appendix A. For other projects that do not include synchronous machines, but based on engineering judgment have questionable rotor angle oscillation, damping should also meet the requirements described in Appendix A.

- **Transient Voltage Recovery**: for the transient voltage recovery requirement in Appendix A, the bus voltages to be included are those at the point of interconnection for each study generator. Other voltages in the area should be checked for this requirement if the terminal voltage of other machines in the monitored area appears to have voltage recovery issues.

Note that the study projects in Group 6 are wind turbine generator and solar inverter and are excluded from the above requirements. The other machines monitored in the study area were evaluated against the aforementioned transient stability requirements.

7.2. TRANSIENT STABILITY RESULTS

Undisturbed runs of 20 seconds were performed with the Summer and Winter Peak Cases to verify proper initialization of dynamic models.

Transient stability analysis indicated that Group 6 is expected to successfully ride-through each fault contingency specified by SPP and the nearby areas will retain angular, frequency and voltage stability. Group 6 can successfully interconnect into the transmission system at the desired locations without reduction in output power. See Appendix B through Appendix D for further details. Group 6 is also expected to meet angular oscillation stability requirements.

Summary results of transient stability analysis are listed in Table 9.

Table 9: Summary of Transient Stability Results

Cont. No.	Cont. Name	2014 Winter Peak	2015 Summer Peak	2024 Summer Peak
1	FLT01-3PH	STABLE	STABLE	STABLE
2	FLT02-1PH	STABLE	STABLE	STABLE
3	FLT03-3PH	STABLE	STABLE	STABLE
4	FLT04-1PH	STABLE	STABLE	STABLE
5	FLT05-3PH	STABLE	STABLE	STABLE
6	FLT06-1PH	STABLE	STABLE	STABLE
7	FLT07-3PH	STABLE	STABLE	STABLE
8	FLT08-1PH	STABLE	STABLE	STABLE
9	FLT09-3PH	STABLE	STABLE	STABLE
10	FLT10-3PH	STABLE	STABLE	STABLE
11	FLT11-1PH	STABLE	STABLE	STABLE
12	FLT12-3PH	STABLE	STABLE	STABLE
13	FLT13-1PH	STABLE	STABLE	STABLE
14	FLT14-3PH	STABLE	STABLE	STABLE
15	FLT15-3PH	STABLE	STABLE	STABLE
16	FLT16-1PH	STABLE	STABLE	STABLE
17	FLT17-3PH	STABLE	STABLE	STABLE
18	FLT18-1PH	STABLE	STABLE	STABLE
19	FLT19-3PH	STABLE	STABLE	STABLE
20	FLT20-1PH	STABLE	STABLE	STABLE
21	FLT21-3PH	STABLE	STABLE	STABLE
22	FLT22-1PH	STABLE	STABLE	STABLE
23	FLT23-3PH	STABLE	STABLE	STABLE
24	FLT24-3PH	STABLE	STABLE	STABLE
25	FLT25-3PH	STABLE	STABLE	STABLE
26	FLT26-1PH	STABLE	STABLE	STABLE
27	FLT27-3PH	STABLE	STABLE	STABLE
28	FLT28-1PH	STABLE	STABLE	STABLE
29	FLT29-3PH	STABLE	STABLE	STABLE
30	FLT30-1PH	STABLE	STABLE	STABLE
31	FLT31-3PH	STABLE	STABLE	STABLE
32	FLT32-1PH	STABLE	STABLE	STABLE
33	FLT33-3PH	STABLE	STABLE	STABLE
34	FLT34-1PH	STABLE	STABLE	STABLE
35	FLT35-3PH	STABLE	STABLE	STABLE
36	FLT36-1PH	STABLE	STABLE	STABLE
37	FLT37-3PH	STABLE	STABLE	STABLE
38	FLT38-1PH	STABLE	STABLE	STABLE
39	FLT39-3PH	STABLE	STABLE	STABLE
40	FLT40-1PH	STABLE	STABLE	STABLE
41	FLT41-3PH	STABLE	STABLE	STABLE
42	FLT42-1PH	STABLE	STABLE	STABLE

8. CONCLUSIONS AND RECOMMENDATIONS

Group 6 and prior-queued projects were studied at 100% output power using “MDWG13-14WP_DIS1302_G06” (Winter 2014), “MDWG13-15SP_DIS1302_G06” (Summer 2015) and “MDWG13-24SP_DIS1302_G06” (Summer 2024) peak loading cases provided by SPP.

The results of power factor analysis indicate that the solar plant represented by GEN-2013-022 and the wind farm represented by ASGI-2013-005 are required to maintain a power factor of 0.95 lagging to 0.95 leading at the POI per FERC requirements.

Transient analysis results indicate that DISIS-2013-002 (Group 6) study projects are expected to successfully interconnect into the transmission system at 100% output power and at the desired locations. Transient stability analysis also indicate that Group 6 is expected to ride-through each N-1 and N-2 fault contingency specified by SPP and the nearby areas will retain angular, frequency and voltage stability. Thus, Group 6 is expected to meet SPP’s angular oscillation stability and transient voltage recovery requirements.

APPENDIX A: SOUTHWEST POWER POOL DISTURBANCE PERFORMANCE REQUIREMENTS

OVERVIEW

These Disturbance Performance Requirements ("Requirements") shall be applicable to the Bulk Electric System within the Southwest Power Pool Planning Area. Utilization of these Requirements applies to all registered entities within the Southwest Power Pool Planning Area. These Requirements shall not be applicable to facilities that are not part of Bulk Electric System. More stringent Requirements are at the sole discretion of each Transmission Owner.

Transient and dynamic stability assessments are generally performed to assure adequate avoidance of loss of generator synchronism and prevention of system voltage collapse within the first 20 seconds after a system disturbance. These Requirements provide a basis for evaluating the system response during the initial transient period following a disturbance on the Bulk Electric System by establishing minimum requirements for machine rotor angle damping and transient voltage recovery.

ROTOR ANGLE DAMPING REQUIREMENT

Machine Rotor Angles shall exhibit well damped angular oscillations [as defined below] and acceptable power swings following a disturbance on the Bulk Electric System for all NERC Category A, B and C events.

Well damped angular oscillations shall meet one of the following two requirements when calculated directly from the rotor angle:

1. Successive Positive Peak Ratio (SPPR) must be less than or equal to 0.95 where SPPR is calculated as follows:

$$\text{SPPR} = \frac{\text{Peak Rotor Angle of } 2^{nd} \text{ Positive Swing Peak}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Swing Peak}} \leq 0.95$$

   -or- Damping Factor % = $(1 - \text{SPPR}) \times 100\% \geq 5\%$

   The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

   Damping Ratio ≥ 0.0081633

2. Successive Positive Peak Ratio Five (SPPR5) must be less than or equal to 0.774 where SPPR5 is calculated as follows:

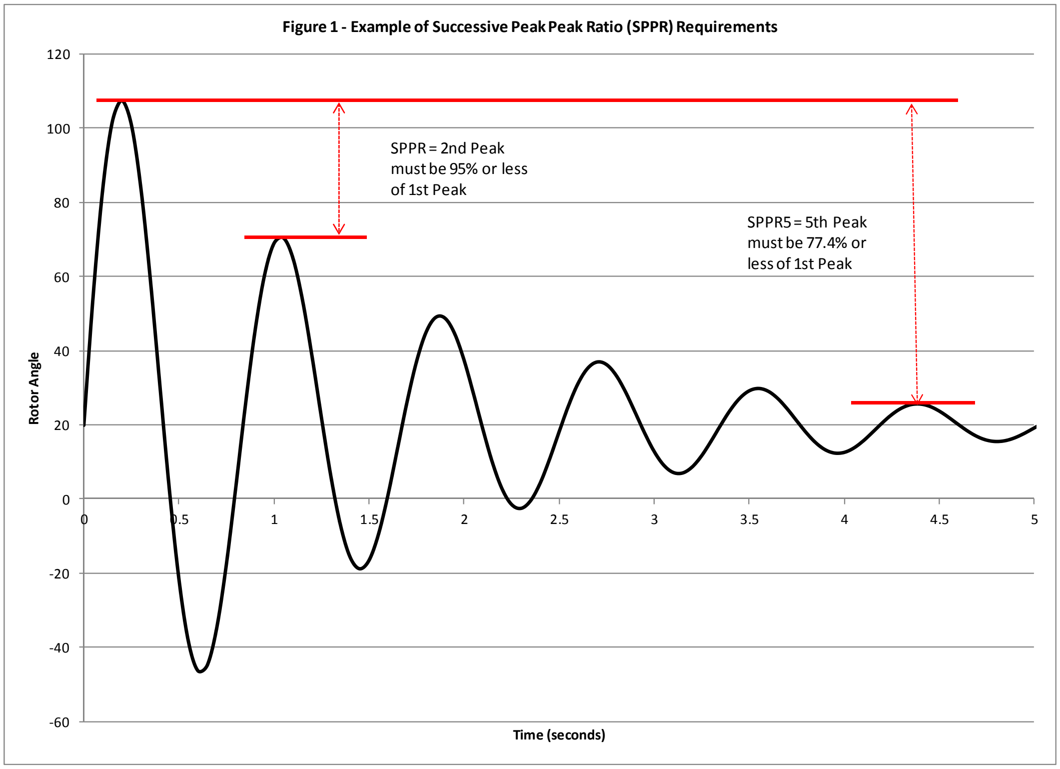
$$\text{SPPR5} = \frac{\text{Peak Rotor Angle of } 5^{th} \text{ Positive Swing Peak}}{\text{Peak Rotor Angle of } 1^{st} \text{ Positive Swing Peak}} \leq 0.774$$

   -or- Damping Factor % = $(1 - \text{SPPR}) \times 100\% \geq 22.6\%$

   The machine rotor angle damping ratio may be determined by appropriate modal analysis (i.e. Prony Analysis) where the following equivalent requirement must be met:

Damping Ratio ≥ 0.0081633

Qualitatively, these Requirements are shown below:



TRANSIENT VOLTAGE RECOVERY REQUIREMENT

Any time after a disturbance is cleared; bus voltages on the Bulk Electric System shall not swing outside of the bandwidth of 0.70 per unit to 1.20 per unit.

Qualitatively, this Requirement is shown below:

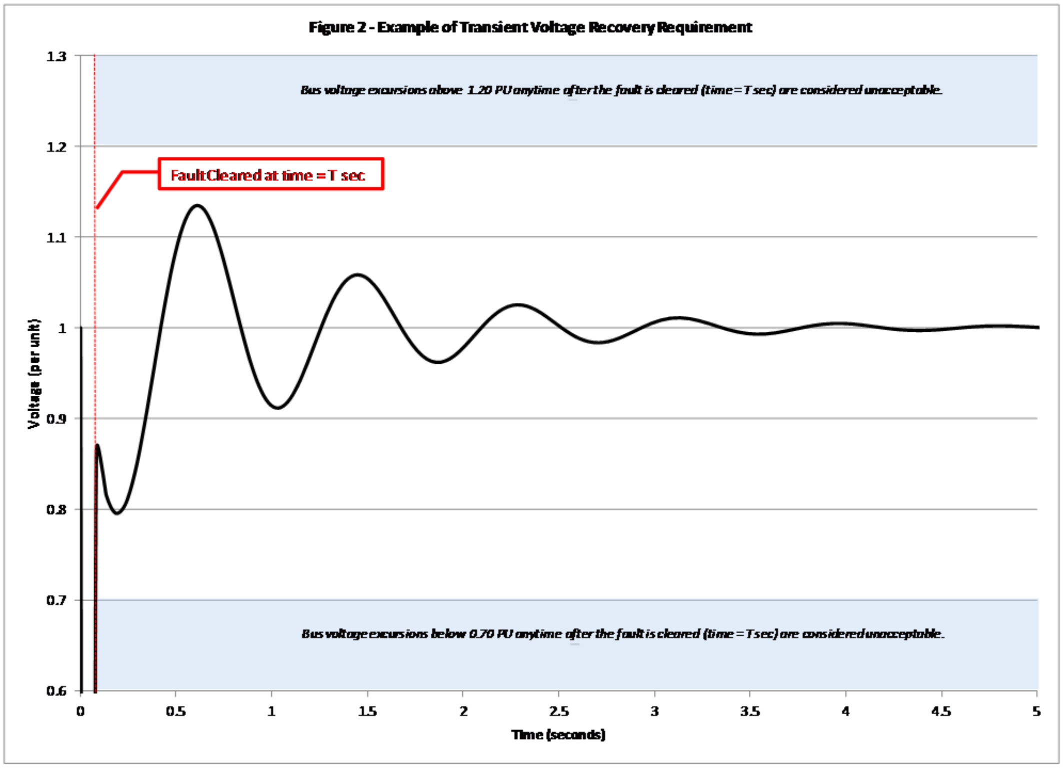


Figure 2 - Example of Transient Voltage Recovery Requirement

APPENDIX B: TRANSIENT STABILITY PLOTS FOR 2014 WINTER PEAK CASE

(SEE APPENDIX B SUBMITTED IN A SEPARATE FILE)

APPENDIX C: TRANSIENT STABILITY PLOTS FOR 2015 SUMMER PEAK CASE

(SEE APPENDIX C SUBMITTED IN A SEPARATE FILE)

APPENDIX D: TRANSIENT STABILITY PLOTS FOR 2024 SUMMER PEAK CASE

(SEE APPENDIX D SUBMITTED IN A SEPARATE FILE)

O: Group 8 Dynamic Stability Analysis Report

See MEPPI report on next page.

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Southwest Power Pool, Inc. (SPP)

Definitive Impact Study
DISIS-2013-002 (Group 8)

Final Report

PXE-0779
Revision #01

January 2014

Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Services Department
Warrendale, PA

Title: **Definitive Impact Study DISIS-2013-002 (Group 8): Final Report for PXE-0779**
Date: January 2014
Author: Nicholas W. Tenza; Engineer, Power Systems Engineering Dept. Nicholas W. Tenza
Reviewed: Elizabeth M. Cook; Sr. Engineer, Power Systems Engineering Dept. Elizabeth M. Cook

EXECUTIVE SUMMARY

SPP requested a Definitive Interconnection System Impact Study (DISIS). The DISIS required a Stability Analysis and Power Factor Analysis detailing the impacts of the interconnecting projects as shown in Table ES-1.

Table ES-1: Interconnection Projects Evaluated

Request	Size (MW)	Turbine Model	Point of Interconnection (POI)
GEN-2013-028	516.4 Summer 559.5 Winter	GENROU (583743, 583746)	Tap on Tulsa N to GRDA1 345 kV (562423)
GEN-2013-029	300	Vestas V100 VCSS 2MW (583753, 583756)	Renfrow 345 kV (515543)

SUMMARY OF STABILITY ANALYSIS

For the 2014 Winter Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line (FLT58 and FLT59). In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW, Chisolm generation was reduced to 50 MW (Pmax = 299 MW), and Flat Ridge generation was reduced to 145.5 MW (Pmax = 714 MW).

For the 2015 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line (FLT58 and FLT59). In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-

2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW).

For the 2024 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line (FLT58 and FLT59). In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW).

SUMMARY OF POWER FACTOR ANALYSIS

The Power Factor Analysis shows that GEN-2013-028 has a power factor range of 0.9910 lagging (supplying) to 0.9999 lagging (supplying). GEN-2013-028 is combined cycle generation and therefore additional reactive support is not required.

The Power Factor Analysis shows that GEN-2013-029 has a power factor range of 0.9622 lagging (supplying) to 0.9667 leading (absorbing). A total of 9.6 MVARs of additional inductive support would be required in order to compensate for the collector system and lead line charging when GEN-2013-029 is off-line such that the VAR flow at the POI is zero.

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SECTION 1: OBJECTIVES

The objective of this report is to provide Southwest Power Pool, Inc. (SPP) with the deliverables for the "Definitive Impact Study DISIS-2013-002 (Group 8)." SPP requested an Interconnection System Impact Study for GEN-2013-028 and GEN-2013-029, which requires a Stability Analysis, a Power Factor Analysis, and an Impact Study Report.

SECTION 2: BACKGROUND

The Siemens Power Technologies, Inc. PSS/E power system simulation program Version 32.2.0 was used for this study. SPP provided the stability database cases for summer peak and winter peak seasons and a list of contingencies to be examined. The model includes the study project and the previously queued projects as listed in Table 2-1 and Table 2-2, respectively. Refer to Appendix A for the steady state and dynamic model data for the study projects. Power flow one-line diagrams of GEN-2013-028 and GEN-2013-029 interconnection projects are shown in Figure 2-1 and Figure 2-2, respectively.

The Stability Analysis will determine the impacts of the new interconnecting project on the stability and voltage recovery of the nearby system 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 will be investigated. Three-phase and single-phase faults will be examined as listed in Table 2-3.

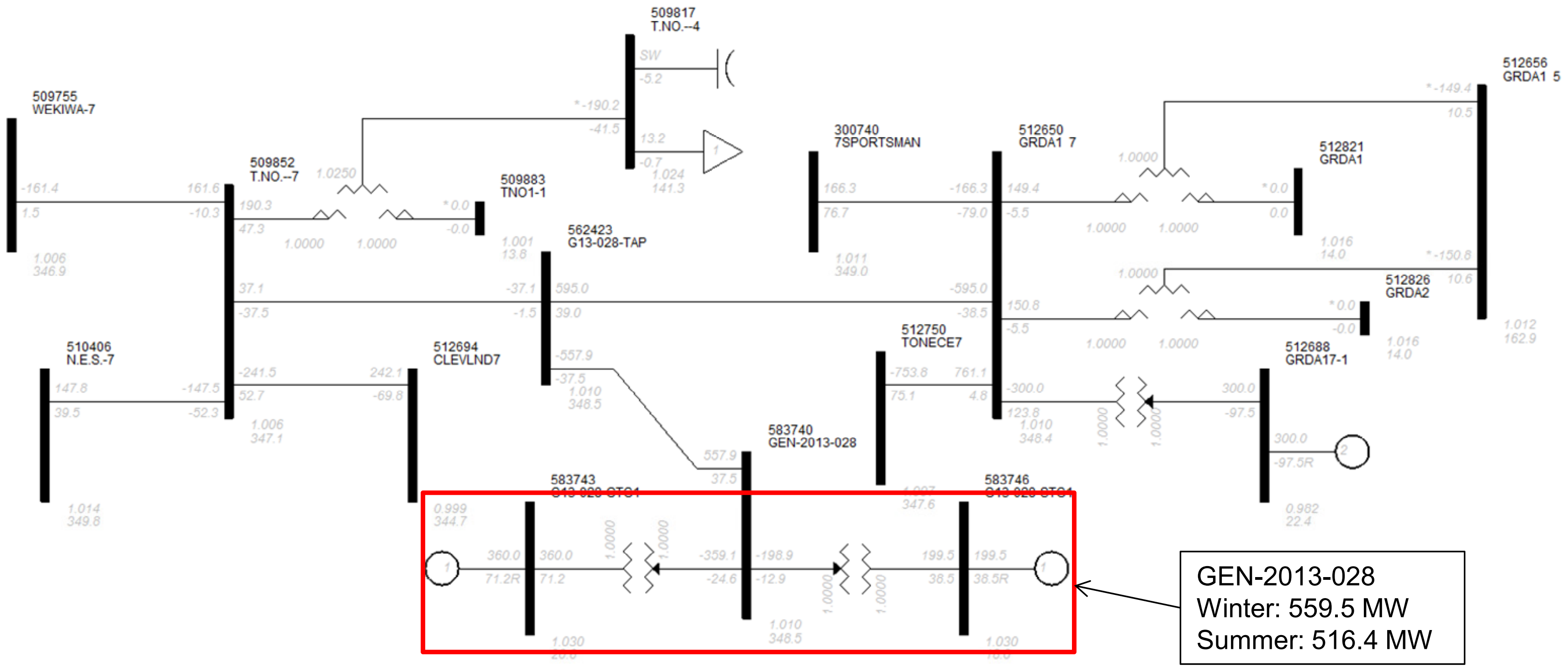
The Power Factor Analysis will determine the power factor at the point of interconnection for the wind interconnection project for pre-contingency and post-contingency conditions. Table 2-3 lists the contingencies developed from the three-phase fault definitions provided in the Group's interconnection impact study request. Additionally, an analysis of the amount of reactive compensation such that the VAR flow at the POI was zero when GEN-2013-029 is off-line was performed. Note the reactive compensation analysis is not required for GEN-2013-028 since this project uses conventional generation (combined cycle generation).

Table 2-1
Interconnection Project Evaluated

Request	Size (MW)	Turbine Model	Point of Interconnection (POI)
GEN-2013-028	516.4 Summer 559.5 Winter	GENROU (583743, 583746)	Tap on Tulsa N to GRDA1 345 kV (562423)
GEN-2013-029	300	Vestas V100 VCSS 2MW (583753, 583756)	Renfrow 345 kV (515543)

Table 2-2
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Turbine Model	Point of Interconnection (POI)
GEN-2002-004	199.5	GE.1.5MW	Latham 345kV (532800)
GEN-2005-013	199.8	Vestes V90 1.8MW	Caney River 345kV (532780)
GEN-2007-025	299.2	GE 1.6MW	Viola 345kV (532798)
GEN-2008-013	300	G.E. 1.68MW	Hunter 345kV (515476)
GEN-2008-021	1283	GENROU	Wolf Creek 345kV (532797)
GEN-2008-098	100.8	Vestas V100 1.8MW	Tap on the Wolf Creek – LaCygne 345kV line (560004)
GEN-2009-025	59.8	Siemens 2.3MW	Tap on the Deerck – Sincblk 69KV line (515528)
GEN-2010-003	100.8	Vestas V100 1.8MW	Tap on the Wolf Creek – LaCygne 345kV line (560004)
GEN-2010-005	299.2	GE 1.6MW	Viola 345kV (532798)
ASGI-2010-006	150	GE1.5MW	Remington 138kV (301369)
GEN-2010-055	4.8	GENROU	Wekiwa 138kV (509757)
GEN-2011-057	150.4	GE 1.6MW	Creswell 138kV (532981)
GEN-2012-023	115	Siemens 2.3MW	Viola 345kV (532798)
GEN-2012-027	150.7	GE 1.62MW	Shidler 138kV (510403)
GEN-2012-032	300	Vestas V112 3.0MW	Tap Rose Hill-Sooner 345kV (562318)
GEN-2012-033	98.8	GE 1.62MW	Tap Bunch Creek-South 4th 138kV(562303)
GEN-2012-040	76.5	GE 1.7MW	Chilocco 138kV (521198)
GEN-2012-041	85 Summer 121.5 Winter	GENROU	Tap Rose Hill-Sooner 345kV (562318)
GEN-2013-009	100.3	GE 1.7MW (583593)	Tap Alluwe Tap-Vinita Junction 138kV
GEN-2013-012	4 x 168.0MW Summer 4 x 215MW Winter	GENROU (514910) (514911) (514912) (514942)	Redbud 345kV (514909)



GEN-2013-028
Winter: 559.5 MW
Summer: 516.4 MW

Figure 2-1. Power flow one-line diagram for interconnection project GEN-2013-028 (559.5 MW Winter/516.4 MW Summer).

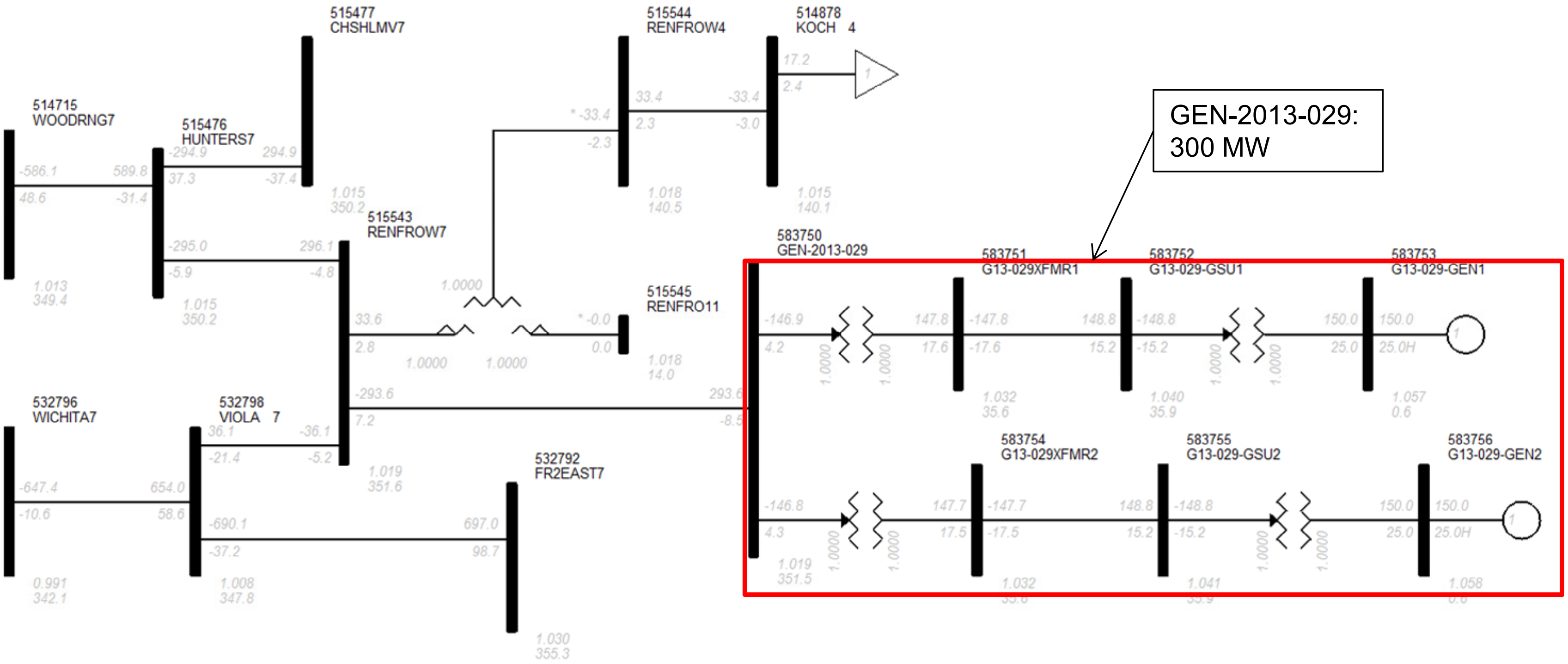


Figure 2-2. Power flow one-line diagram for interconnection project GEN-2013-029 (300 MW).

Table 2-3
Case List with Contingency Description

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the GEN-2013-028 Tap (562423) to GRDA1 (512650) 345kV line, near GEN-2013-028 Tap.
		a. Apply fault at the GEN-2013-028 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
2	FLT02-1PH	*Single phase fault and sequence like previous*
3	FLT03-3PH	3 phase fault on the GEN-2013-028 Tap (562423) to Tulsa North (509852) 345kV line, near GEN-2013-028 Tap.
		a. Apply fault at the GEN-2013-028 Tap 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
4	FLT04-1PH	*Single phase fault and sequence like previous*
5	FLT05-3PH	3 phase fault on the GRDA1 (512650) to Sportsman (300740) 345kV line, near GRDA1.
		a. Apply fault at the GRDA1 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	*Single phase fault and sequence like previous*
7	FLT07-3PH	3 phase fault on the Sportsman (300740) to Blackberry (300739) 345kV line, near Sportsman.
		a. Apply fault at the Sportsman 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
8	FLT08-1PH	*Single phase fault and sequence like previous*
9	FLT09-3PH	3 phase fault on the Blackberry (300739) to Neosho (532793) 345kV line, near Blackberry.
		a. Apply fault at the Blackberry 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
10	FLT10-1PH	*Single phase fault and sequence like previous*
11	FLT11-3PH	3 phase fault on the Blackberry (300739) to Jasper (300949) 345kV line, near Blackberry.
		a. Apply fault at the Blackberry 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	*Single phase fault and sequence like previous*
13	FLT13-3PH	3 phase fault on the GRDA1 (512650) to Tonnece (512750) 345kV line, near GRDA1.
		a. Apply fault at the GRDA1 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	*Single phase fault and sequence like previous*

Table 2-3 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
15	FLT15-3PH	3 phase fault on the Flint Creek (506935) to Brookline (549984) 345kV line, near Flint Creek.
		a. Apply fault at the Flint Creek 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	*Single phase fault and sequence like previous*
17	FLT17-3PH	3 phase fault on the Tulsa North (509852) to NES (510406) 345kV line, near Tulsa North.
		a. Apply fault at the Tulsa North 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
18	FLT18-1PH	*Single phase fault and sequence like previous*
19	FLT19-3PH	3 phase fault on the Tulsa North (509852) to Wekiwa (509755) 345kV line, near Tulsa North.
		a. Apply fault at the Tulsa North 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
20	FLT20-1PH	*Single phase fault and sequence like previous*
21	FLT21-3PH	3 phase fault on the Tulsa North (509852) to Cleveland (512694) 345kV line, near Tulsa North.
		a. Apply fault at the Tulsa North 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	*Single phase fault and sequence like previous*
23	FLT23-3PH	3 phase fault on the NES (510406) to Delaware (510380) 345kV line, near NES.
		a. Apply fault at the Tulsa North 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	*Single phase fault and sequence like previous*
25	FLT25-3PH	3 phase fault on the NES (510406) to Oneta (509807) 345kV line, near NES.
		a. Apply fault at the NES 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
26	FLT26-1PH	*Single phase fault and sequence like previous*
27	FLT27-3PH	3 phase fault on the Clarksville (509745) to Chamber Springs (506945) 345kV line, near Clarksville.
		a. Apply fault at the Clarksville 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.
28	FLT28-1PH	*Single phase fault and sequence like previous*

Table 2-3 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
29	FLT29-3PH	**Prior Outage of the NES (510406) – Tulsa North (509852) 345kV line,** then --
		3 phase fault on the NES (510406) – Oneta (509807) 345kV line near NES.
		a. Prior outage NES – Tulsa North 345kV (solve for steady state).
		b. Apply fault at the NES 345kV bus on the NES (510406) – Oneta (509807) 345kV line.
		c. Clear fault after 5 cycles by tripping the faulted line.
		d. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-3PH	**Prior Outage of the NES (510406) – Tulsa North (509852) 345kV line,** then --
		3 phase fault on the NES (510406) – Delaware (510380) 345kV line near NES.
		a. Prior outage NES – Tulsa North 345kV (solve for steady state).
		b. Apply fault at the NES 345kV bus on the NES (510406) – Delaware (510380) 345kV line.
		c. Clear fault after 5 cycles by tripping the faulted line.
		d. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
31	FLT31-1PH	**GRDA1 Stuck Breaker**
		a. Apply single phase fault at the GRDA1 (512650) 345kV bus on the GRDA1 (512650) – Tonnece (512750) 345kV line near NES.
		b. Wait 16 cycles, and then drop GRDA1 (512650) 345kV/GRDA1 (512656) 161kV/(512821) 13.8kV transformer ckt 1.
		c. Trip GRDA1 to Tonnece 345kV and remove the fault.
32	FLT32-3PH	3 phase fault on the GRDA1 345kV (512650) to GRDA1 (512656) 161kV/(512821) 13.8kV transformer, near the 345kV bus.
		a. Apply fault at the GRDA1 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted transformer.
33	FLT33-3PH	3 phase fault on the Sportsman 345kV (300740) / Sportsman (300741) 161kV transformer, near the 345kV bus.
		a. Apply fault at the Sportsman 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted transformer.
34	FLT34-3PH	3 phase fault on the Sportsman (300741) to Choteau (300069) 161kV line, near Sportsman.
		a. Apply fault at the Sportsman 161kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
35	FLT35-1PH	*Single phase fault and sequence like previous*
36	FLT36-3PH	3 phase fault on the Renfro (514880) to Hunter (515476) 345kV line, near Renfro.
		a. Apply fault at the Renfro 345kV bus.
		b. Clear fault after 5 cycles by tripping the faulted line.
		c. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
37	FLT37-1PH	*Single phase fault and sequence like previous*
38	FLT38-3PH	3 phase fault on the Renfro (514880) to Viola (532798) 345kV line, near Renfro.
		a. Apply fault at the Renfro 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.
39	FLT39-1PH	*Single phase fault and sequence like previous*

Table 2-3 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
40	FLT40-3PH	3 phase fault on the Viola (532798) to Wichita (532796) 345kV line, near Viola. a. Apply fault at the Viola 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.
41	FLT41-1PH	*Single phase fault and sequence like previous*
42	FLT42-3PH	3 phase fault on the Wichita (532796) to Benton (532791) 345kV line, near Wichita. a. Apply fault at the Wichita 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.
43	FLT43-1PH	*Single phase fault and sequence like previous*
44	FLT44-3PH	3 phase fault on the Wichita (532796) to Benton (532791) 345kV line, near Wichita. a. Apply fault at the Wichita 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
45	FLT45-1PH	*Single phase fault and sequence like previous*
46	FLT46-3PH	3 phase fault on the Wichita (532796) to Emporia EC (532768) 345kV line, near Wichita. a. Apply fault at the Wichita 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.
47	FLT47-1PH	*Single phase fault and sequence like previous*
48	FLT48-3PH	3 phase fault on the Rose Hill (532794) to GEN-2012-032 Tap (562299) 345kV line, near Rose Hill. a. Apply fault at the Rose Hill 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
49	FLT49-1PH	*Single phase fault and sequence like previous*
50	FLT50-3PH	3 phase fault on the GEN-2012-041 Tap (562318) to Sooner (514803) 345kV line, near GEN-2012-041 Tap. a. Apply fault at the GEN-2012-041 Tap 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.
51	FLT51-1PH	*Single phase fault and sequence like previous*
52	FLT52-3PH	3 phase fault on the Sooner (514803) to Cleveland (512694) 345kV line, near Sooner. a. Apply fault at the Sooner 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.
53	FLT53-1PH	*Single phase fault and sequence like previous*

Table 2-3 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
54	FLT54-3PH	3 phase fault on the Redbud (514909) to RSS (509782) 345kV line, near Redbud.
		a. Apply fault at the Redbud 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.
55	FLT55-1PH	*Single phase fault and sequence like previous*
56	FLT56-3PH	3 phase fault on the Hunter (515476) to Woodring (514715) 345kV line, near Hunter.
		a. Apply fault at the Hunter 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.
57	FLT57-1PH	*Single phase fault and sequence like previous*
58	FLT58-3PH	**Prior Outage of the Hunter (515476) to Woodring (514715) 345kV line,** then 3 phase fault on the Viola (532798) to Wichita (532796) 345kV line near Viola.
		a. Prior outage Hunter – Woodring 345kV (solve for steady state).
		b. Apply fault at the Viola 345kV bus on the Viola (532798) to Wichita (532796) 345kV line.
		c. Clear fault after 5 cycles by tripping the faulted line.
		d. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
59	FLT59-3PH	**Prior Outage of the Viola (532798) to Wichita (532796) 345kV line,** then 3 phase fault on the Hunter (515476) to Woodring (514715) 345kV line near Hunter.
		a. Prior outage Viola – Wichita 345kV (solve for steady state).
		b. Apply fault at the Hunter 345kV bus on the Hunter (515476) to Woodring (514715) 345kV line.
		c. Clear fault after 5 cycles by tripping the faulted line.
		d. Wait 20 cycles, and then re-close the line in (b) back into the fault.
		e. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
60	FLT60-1PH	**Renfro Stuck Breaker**
		a. Apply single phase fault at the Renfro (515543) 345kV bus on the Renfro – Hunter (532798) 345kV line.
		b. Wait 16 cycles, and then drop Renfro (515543) 345kV/Renfro (515544) 138kV/(515545) 13.8kV transformer ckt 1.
		c. Trip Renfro to Hunter 345kV and remove the fault.
61	FLT61-3PH	3 phase fault on the Renfro (515543) 345kV to Renfro (515544) 138kV/(515545) 13.8kV transformer at the 345kV bus.
		a. Apply fault at the Renfro 345kV bus.
		b. Clear fault after 5.5 cycles by tripping the transformer
62	FLT62-3PH	3 phase fault on the Woodring (514715) 345kV to Woodring (514714) 138kV/(515770) 13.8kV transformer at the 345kV bus.
		a. Apply fault at the Woodring 345kV bus.
		b. Clear fault after 5.5 cycles by tripping the transformer
63	FLT63-3PH	3 phase fault on the Wichita (532796) 345kV to Evans (533040) 138kV/(532830) 13.8kV transformer at the 345kV bus.
		a. Apply fault at the Wichita 345kV bus.
		b. Clear fault after 5.5 cycles by tripping the transformer

SECTION 3: STABILITY ANALYSIS

The objective of the stability analysis was to determine the impacts of the new wind farms on the stability and voltage recovery on the SPP transmission system. If problems with stability or voltage recovery were identified the need for reactive compensation or system upgrades were investigated.

Approach

The 2014 Winter Peak, 2015 Summer Peak, and the 2024 Summer Peak power flows provided by SPP were examined prior to the Stability Analysis to ensure they contained the proposed study project (GEN-2013-028 and GEN-2013-029) modeled at 100% of the nameplate rating and any previously queued projects listed in Table 2-2. There was no suspect power flow data in the study area. The dynamic datasets were also verified and stable initial system conditions (i.e., “flat lines”) were achieved. Three-phase and single line-to-ground faults listed in Table 2-3 were examined. Single-phase fault impedances were calculated to result in a voltage of approximately 60% of the pre-fault voltage. Refer to Table 3-1 for a list of the calculated single-phase fault impedances used for this analysis.

Table 3-1
Calculated Single-Phase Fault Impedances

Ref. No.	Casename	Single-Phase Fault Impedance (MVA)		
		2014 Winter Peak	2015 Summer Peak	2024 Summer Peak
2	FLT02-1PH	-10125.0	-10125.0	-10125.0
4	FLT04-1PH	-10125.0	-10125.0	-10125.0
6	FLT06-1PH	-10125.0	-10125.0	-10125.0
8	FLT08-1PH	-9312.5	-9312.5	-9312.5
10	FLT10-1PH	-4437.5	-4437.5	-4437.5
12	FLT12-1PH	-4437.5	-4437.5	-4437.5
14	FLT14-1PH	-10125.0	-10125.0	-10125.0
16	FLT16-1PH	-5656.3	-5656.3	-5656.3
18	FLT18-1PH	-9312.5	-9312.5	-9312.5
20	FLT20-1PH	-9312.5	-9312.5	-9312.5
22	FLT22-1PH	-9312.5	-9312.5	-9312.5
24	FLT24-1PH	-8500.0	-8500.0	-8500.0
26	FLT26-1PH	-8500.0	-8500.0	-8500.0
28	FLT28-1PH	-7687.5	-7687.5	-7687.5
31	FLT31-1PH	-10125.0	-10125.0	-10125.0
35	FLT35-1PH	-7281.3	-7281.3	-7281.3
37	FLT37-1PH	-3015.6	-3015.6	-3015.6
39	FLT39-1PH	-3015.6	-3015.6	-3015.6
41	FLT41-1PH	-3218.8	-3218.8	-3218.8
43	FLT43-1PH	-7687.5	-7687.5	-7687.5
45	FLT45-1PH	-7687.5	-7687.5	-7687.5
47	FLT47-1PH	-7687.5	-7687.5	-7687.5
49	FLT49-1PH	-6468.8	-6468.8	-6468.8
51	FLT51-1PH	-4843.8	-4843.8	-4843.8
53	FLT53-1PH	-8500.0	-8500.0	-8500.0
55	FLT55-1PH	-8906.3	-8906.3	-8906.3
57	FLT57-1PH	-3828.1	-3828.1	-3828.1
60	FLT60-1PH	-3015.6	-3015.6	-3015.6

Bus voltages and previously queued generation in the study area were monitored in addition to the bus voltages in the following areas:

- 520 AEPW
- 523 GRDA
- 524 OKGE

- 525 WFEC
- 536 WERE
- 540 GMO
- 541 KCPL
- 544 EMDE

The results of the analysis determined if reactive compensation or system upgrades were required to obtain acceptable system performance. If additional reactive compensation was required, the size, type, and location were determined. The proposed reactive reinforcements would ensure the wind farm meets FERC Order 661A low voltage requirements and return the wind farm to its pre-disturbance operating voltage. If the results indicated the need for fast responding reactive support, dynamic support such as an SVC or STATCOM was investigated. If tripping of the prior queued projects was observed during the stability analysis (for under/over voltage or under/over frequency) the simulations were re-ran with the prior queued project's voltage and frequency tripping disabled.

Results

The Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output.

However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability for all three years. The steady-state N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line (FLT58 and FLT59). In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and a combination of generation at Chisolm and Flat Ridge (near GEN-2013-029) was reduced to lesser amounts (refer to the section below for acceptable generation for each year).

Note that Contingency #58 and Contingency #59 are N-1-1 contingencies in reference to the Stability Analysis and are simulated as a prior line outage in steady-state, followed by a 3-phase fault on the corresponding line. During steady-state conditions, Contingency #58 and Contingency #59 are considered N-2 contingencies and are topologically identical.

Refer to Table 3-2 for a summary of the Stability Analysis results for the cases listed in Table 2-3.

Table 3-2
Stability Analysis Summary of Results

Ref. No.	Casename	2014 Winter		2015 Summer		2024 Summer	
		Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?
1	FLT01-3PH	Yes	Yes	Yes	Yes	Yes	Yes
2	FLT02-1PH	Yes	Yes	Yes	Yes	Yes	Yes
3	FLT03-3PH	Yes	Yes	Yes	Yes	Yes	Yes
4	FLT04-1PH	Yes	Yes	Yes	Yes	Yes	Yes
5	FLT05-3PH	Yes	Yes	Yes	Yes	Yes	Yes
6	FLT06-1PH	Yes	Yes	Yes	Yes	Yes	Yes
7	FLT07-3PH	Yes	Yes	Yes	Yes	Yes	Yes
8	FLT08-1PH	Yes	Yes	Yes	Yes	Yes	Yes
9	FLT09-3PH	Yes	Yes	Yes	Yes	Yes	Yes
10	FLT10-1PH	Yes	Yes	Yes	Yes	Yes	Yes
11	FLT11-3PH	Yes	Yes	Yes	Yes	Yes	Yes
12	FLT12-1PH	Yes	Yes	Yes	Yes	Yes	Yes
13	FLT13-3PH	Yes	Yes	Yes	Yes	Yes	Yes
14	FLT14-1PH	Yes	Yes	Yes	Yes	Yes	Yes
15	FLT15-3PH	Yes	Yes	Yes	Yes	Yes	Yes
16	FLT16-1PH	Yes	Yes	Yes	Yes	Yes	Yes
17	FLT17-3PH	Yes	Yes	Yes	Yes	Yes	Yes
18	FLT18-1PH	Yes	Yes	Yes	Yes	Yes	Yes
19	FLT19-3PH	Yes	Yes	Yes	Yes	Yes	Yes
20	FLT20-1PH	Yes	Yes	Yes	Yes	Yes	Yes
21	FLT21-3PH	Yes	Yes	Yes	Yes	Yes	Yes
22	FLT22-1PH	Yes	Yes	Yes	Yes	Yes	Yes
23	FLT23-3PH	Yes	Yes	Yes	Yes	Yes	Yes
24	FLT24-1PH	Yes	Yes	Yes	Yes	Yes	Yes
25	FLT25-3PH	Yes	Yes	Yes	Yes	Yes	Yes
26	FLT26-1PH	Yes	Yes	Yes	Yes	Yes	Yes
27	FLT27-3PH	Yes	Yes	Yes	Yes	Yes	Yes
28	FLT28-3PH	Yes	Yes	Yes	Yes	Yes	Yes
29	FLT29-3PH	Yes	Yes	Yes	Yes	Yes	Yes
30	FLT30-3PH	Yes	Yes	Yes	Yes	Yes	Yes
31	FLT31-1PH	Yes	Yes	Yes	Yes	Yes	Yes
32	FLT32-3PH	Yes	Yes	Yes	Yes	Yes	Yes
33	FLT33-3PH	Yes	Yes	Yes	Yes	Yes	Yes

Table 3-2 (Continued)
Stability Analysis Summary of Results

Ref. No.	Casename	2014 Winter		2015 Summer		2024 Summer	
		Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?
34	FLT34-3PH	Yes	Yes	Yes	Yes	Yes	Yes
35	FLT35-1PH	Yes	Yes	Yes	Yes	Yes	Yes
36	FLT36-3PH	Yes	Yes	Yes	Yes	Yes	Yes
37	FLT37-1PH	Yes	Yes	Yes	Yes	Yes	Yes
38	FLT38-3PH	Yes	Yes	Yes	Yes	Yes	Yes
39	FLT39-1PH	Yes	Yes	Yes	Yes	Yes	Yes
40	FLT40-3PH	Yes	Yes	Yes	Yes	Yes	Yes
41	FLT41-1PH	Yes	Yes	Yes	Yes	Yes	Yes
42	FLT42-3PH	Yes	Yes	Yes	Yes	Yes	Yes
43	FLT43-1PH	Yes	Yes	Yes	Yes	Yes	Yes
44	FLT44-3PH	Yes	Yes	Yes	Yes	Yes	Yes
45	FLT45-1PH	Yes	Yes	Yes	Yes	Yes	Yes
46	FLT46-3PH	Yes	Yes	Yes	Yes	Yes	Yes
51	FLT51-1PH	Yes	Yes	Yes	Yes	Yes	Yes
52	FLT52-3PH	Yes	Yes	Yes	Yes	Yes	Yes
53	FLT53-1PH	Yes	Yes	Yes	Yes	Yes	Yes
54	FLT54-3PH	Yes	Yes	Yes	Yes	Yes	Yes
55	FLT55-1PH	Yes	Yes	Yes	Yes	Yes	Yes
56	FLT56-3PH	Yes	Yes	Yes	Yes	Yes	Yes
57	FLT57-1PH	Yes	Yes	Yes	Yes	Yes	Yes
58	FLT58-3PH	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
59	FLT59-3PH	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
60	FLT60-1PH	Yes	Yes	Yes	Yes	Yes	Yes
61	FLT61-3PH	Yes	Yes	Yes	Yes	Yes	Yes
62	FLT62-3PH	Yes	Yes	Yes	Yes	Yes	Yes
63	FLT63-3PH	Yes	Yes	Yes	Yes	Yes	Yes

[1] Fault 58 and 59 and existing violations. The generation at Chisolm and Flat Ridge were reduced to a total combination of 195.5 MW (reduced from 1,013 MW) for 2014 winter peak and 678 MW for 2015 summer peak and 2024 summer peak. The study project GEN-2013-029 was reduced to 0 MW for all three years.

2014 Winter Peak Summary

For the 2014 Winter Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output.

However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line (FLT58 and FLT59). In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW, Chisolm generation was reduced to 50 MW (Pmax = 299 MW), and Flat Ridge generation was reduced to 145.5 MW (Pmax = 714 MW). Generation outside of Area 524 – OKGE was scaled in order to maintain generation and load balance.

Refer to Figure 3-1 for a representative plot of select bus voltages during Contingency #58 (FLT58-3PH), a prior line outage of the Hunter to Woodring 345 kV line followed by a 3-phase fault on the Viola to Wichita 345 kV line, for 2014 Winter Peak conditions with reduced generation. Refer to Figure 3-2 and Figure 3-3 for a plot of the MW and Mvar, respectively, of the Chisolm and Flat Ridge generation (note: GEN-2013-029 is offline due to pre-project system instability).

Refer to Appendix B for a complete list of plots for all contingencies for 2014 Winter Peak conditions.

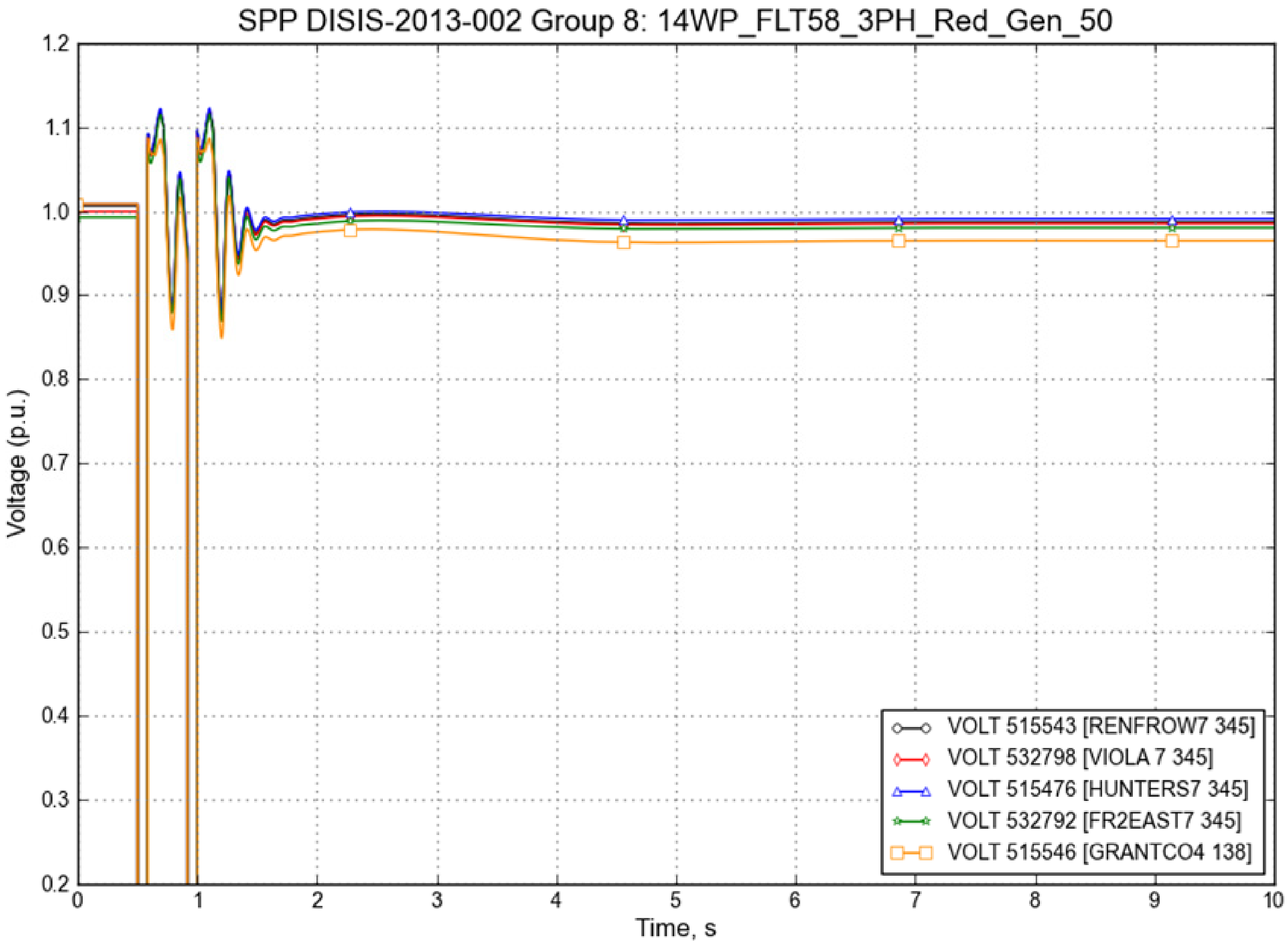


Figure 3-1. Plot of select bus voltages during Contingency #58 (FLT58-3PH) for 2014 Winter Peak conditions with reduced generation.

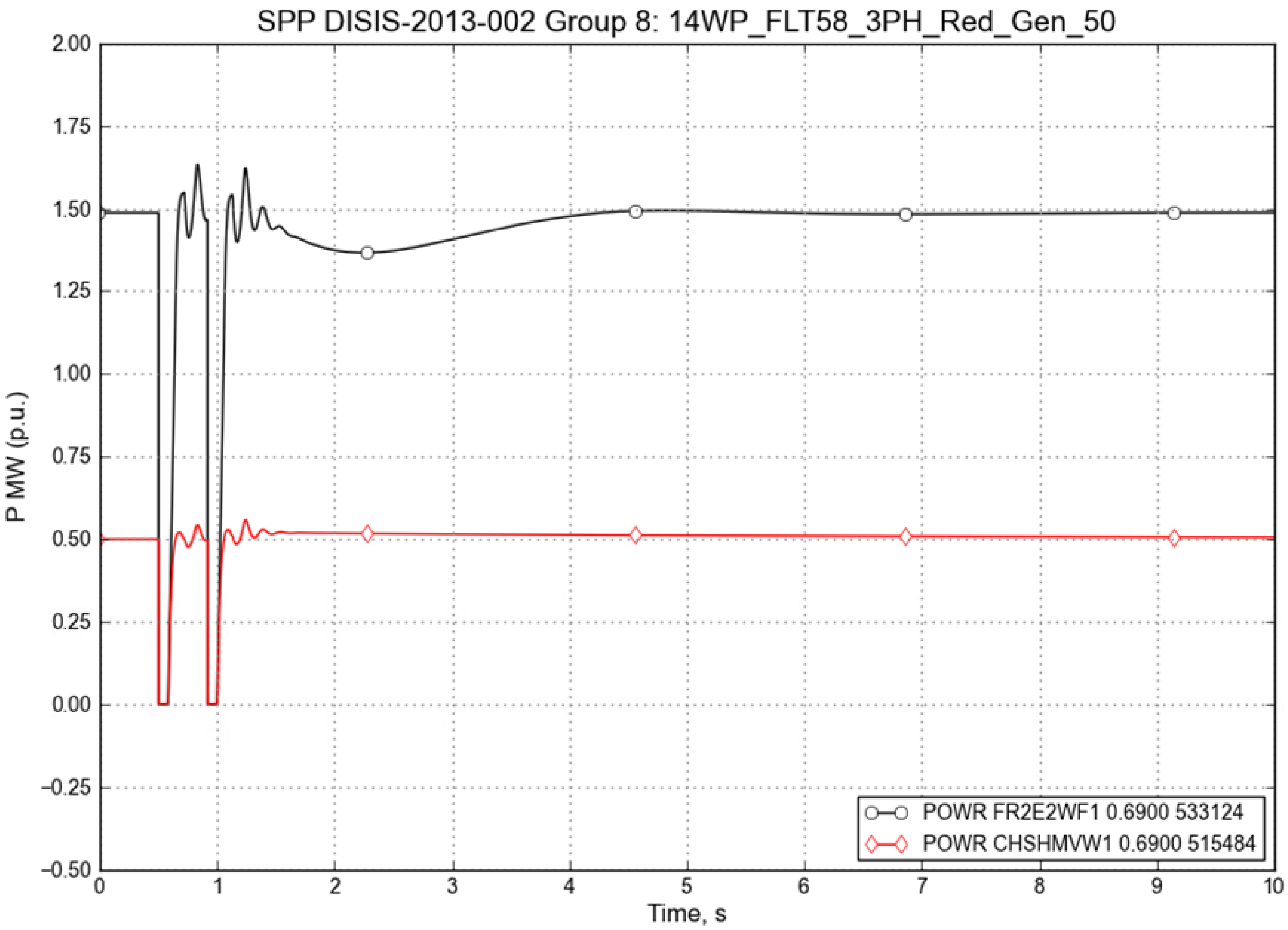


Figure 3-2. Plot of the MW for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2014 Winter Peak.

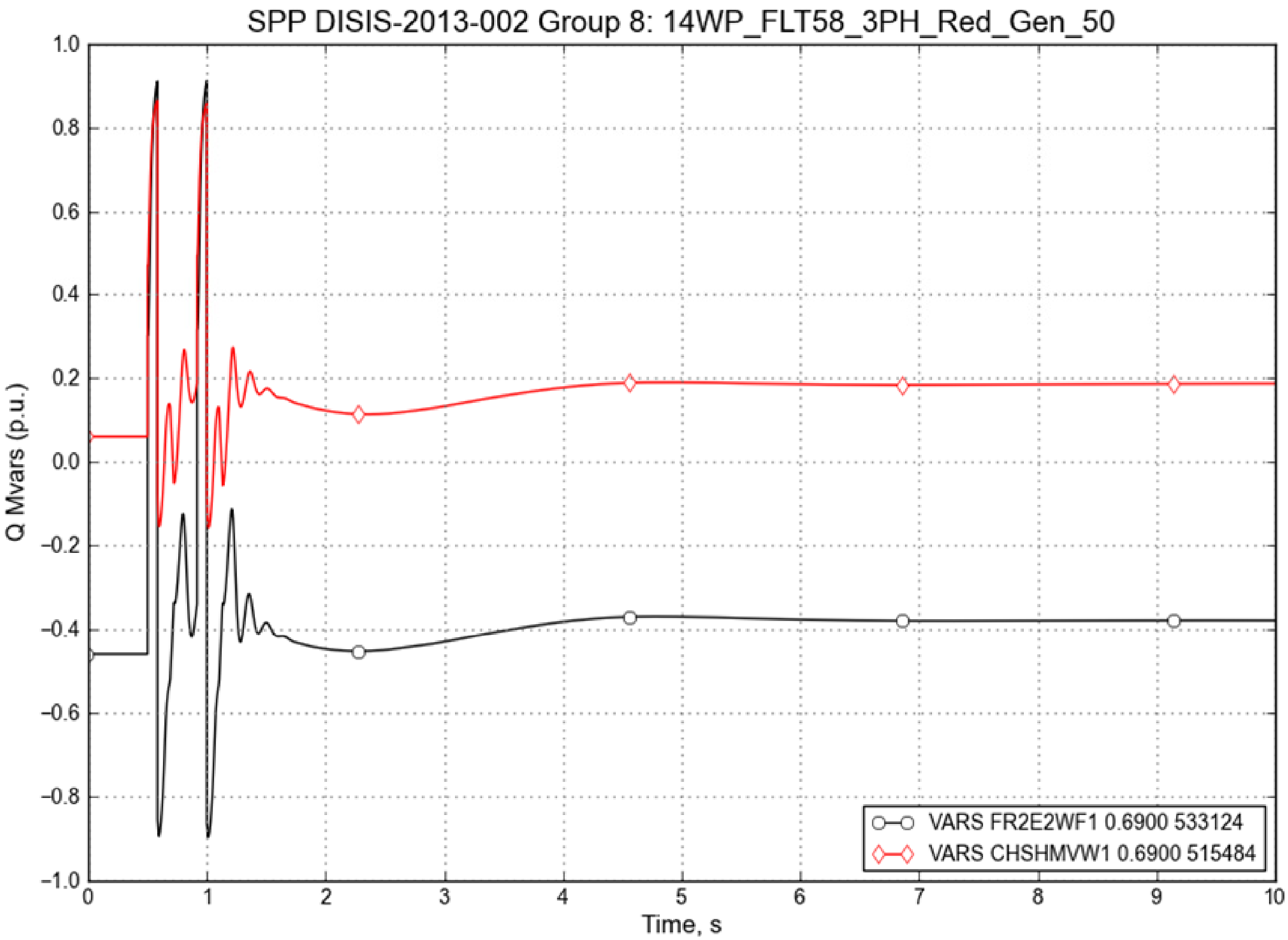


Figure 3-3. Plot of the Mvar for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2014 Winter Peak.

2015 Summer Peak Summary

For the 2015 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output.

However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line. In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW, Chisolm generation not reduced). Note that in 2015 Summer Peak and later, a 345/138 kV transformer is planned to be installed at the Viola 345 kV bus which allows for additional generation compared to 2014 Winter Peak conditions. Generation outside of Area 524 – OKGE was scaled in order to maintain generation and load balance.

Refer to Figure 3-4 for a representative plot of select bus voltages during Contingency #58 (FLT58-3PH), a prior line outage of the Hunter to Woodring 345 kV line followed by a 3-phase fault on the Viola to Wichita 345 kV line, for 2015 Summer Peak conditions with reduced generation. Refer to Figure 3-5 and Figure 3-6 for a plot of the MW and Mvar, respectively, of the Chisolm and Flat Ridge generation (note: GEN-2013-029 is offline due to pre-project system instability).

Refer to Appendix C for a complete list of plots for all contingencies for 2015 Summer Peak conditions.

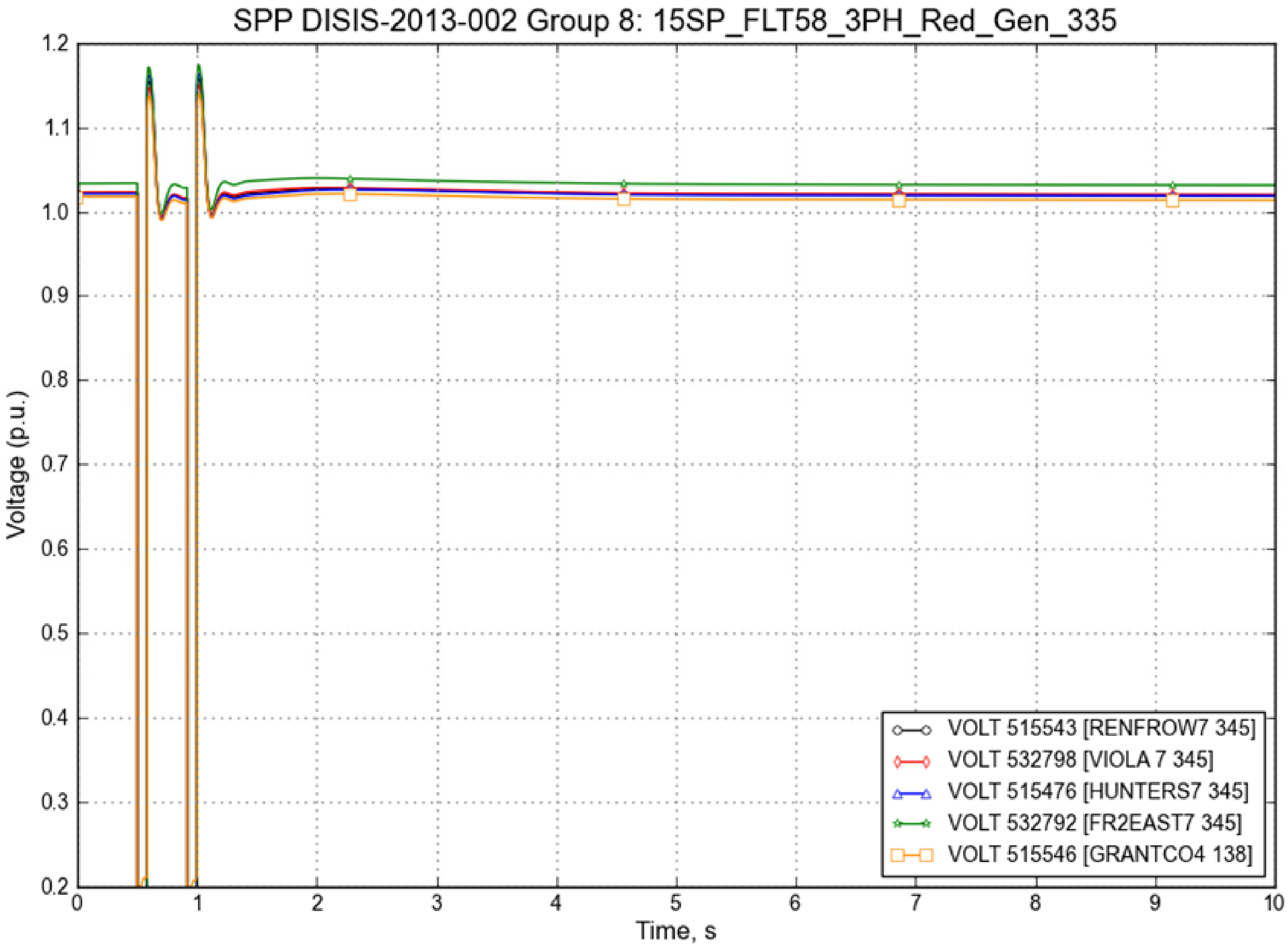


Figure 3-4. Plot of select bus voltages during Contingency #58 (FLT58-3PH) for 2015 Summer Peak conditions with reduced generation.

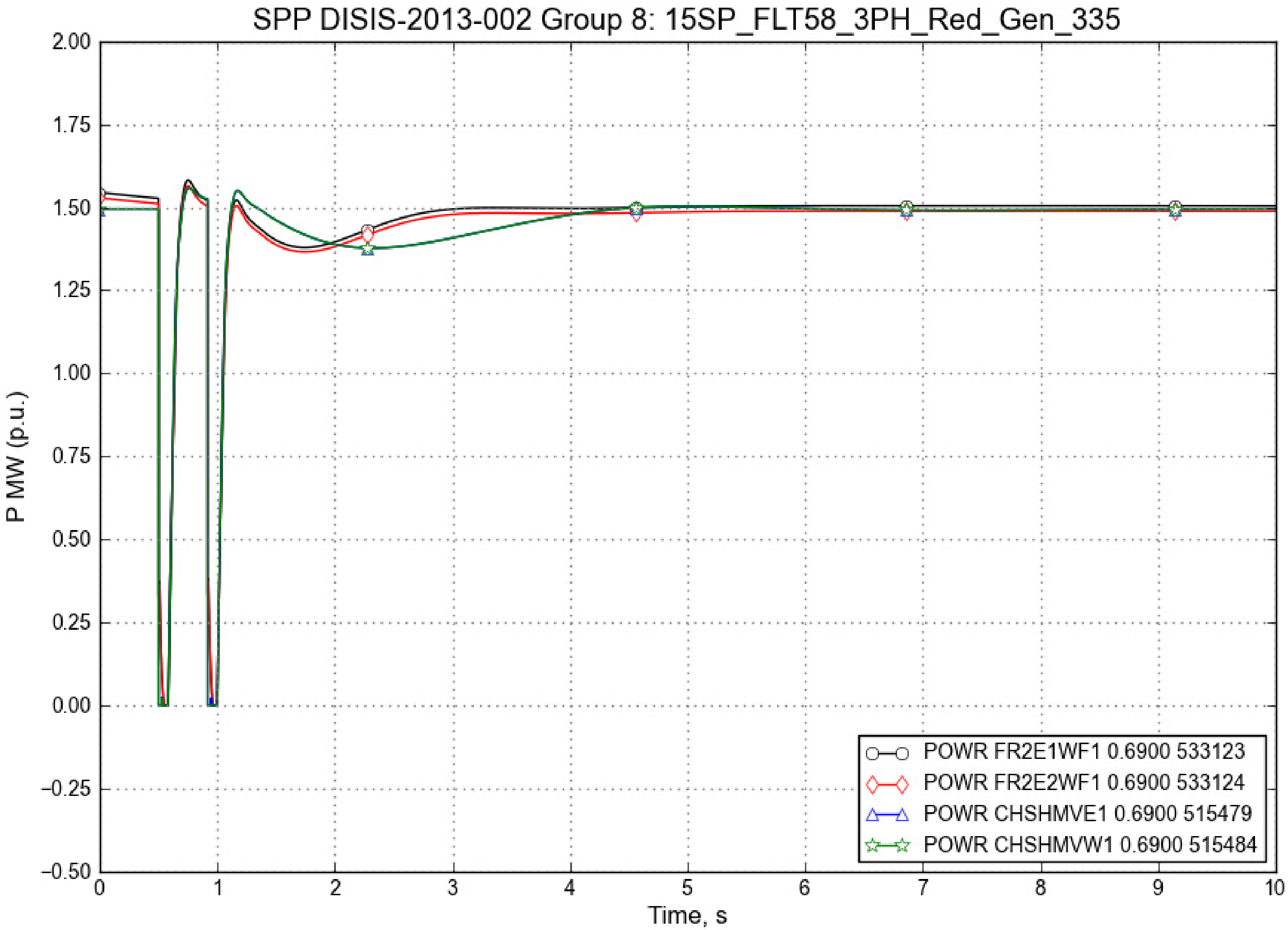


Figure 3-5. Plot of the MW for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2015 Summer Peak.

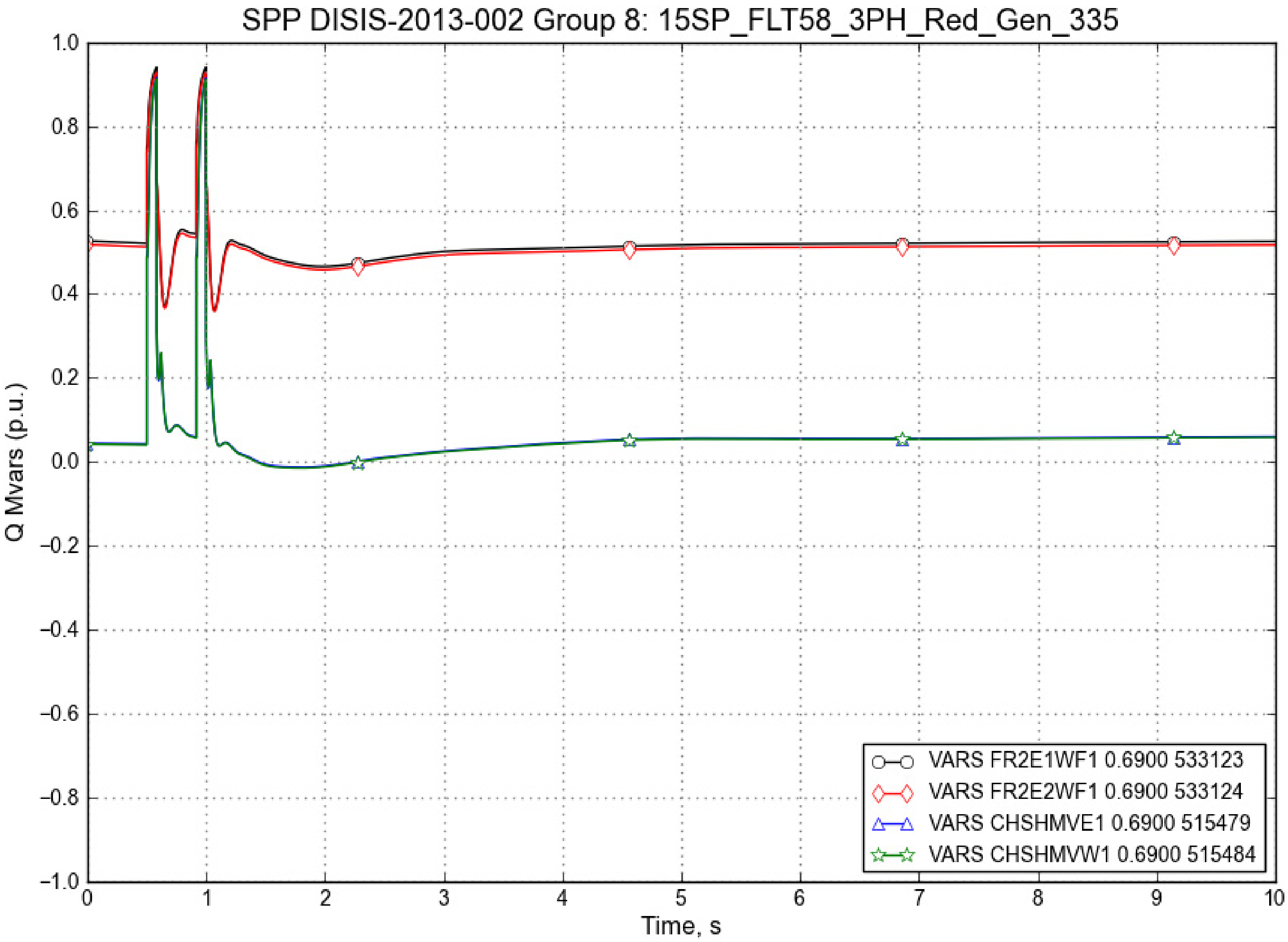


Figure 3-6. Plot of the Mvar for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2015 Summer Peak.

2024 Summer Peak Summary

For the 2024 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output.

However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line. In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW, Chisolm generation not reduced). Generation outside of Area 524 – OKGE was scaled in order to maintain generation and load balance.

Refer to Figure 3-7 for a representative plot of select bus voltages during Contingency #58 (FLT58-3PH), a prior line outage of the Hunter to Woodring 345 kV line followed by a 3-phase fault on the Viola to Wichita 345 kV line, for 2024 Summer Peak conditions with reduced generation. Refer to Figure 3-8 and Figure 3-9 for a plot of the MW and Mvar, respectively, of the Chisolm and Flat Ridge generation (note: GEN-2013-029 is offline due to pre-project system instability).

Refer to Appendix D for a complete list of plots for all contingencies for 2024 Summer Peak conditions.

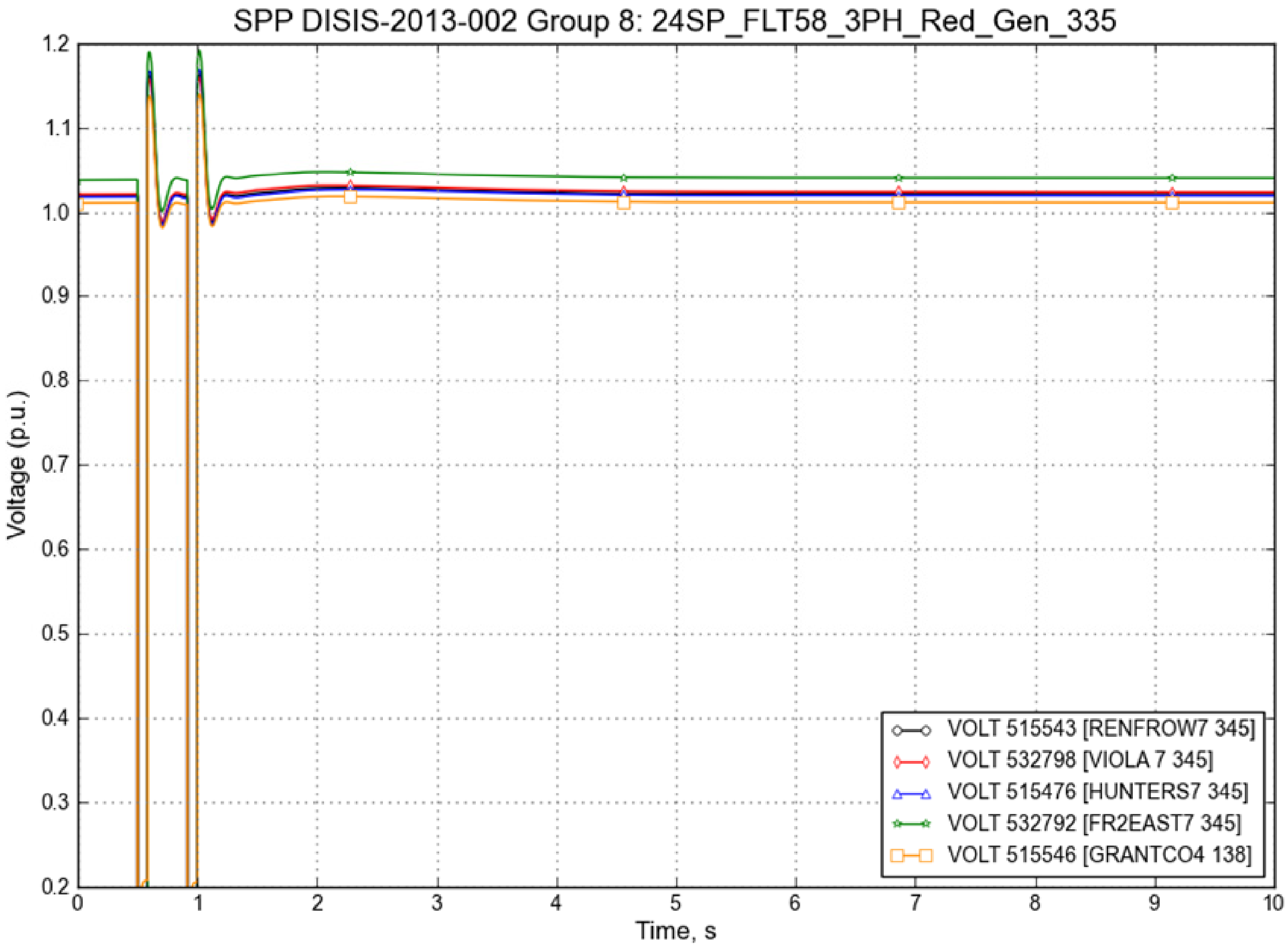


Figure 3-7. Plot of select bus voltages during Contingency #58 (FLT58-3PH) for 2024 Summer Peak conditions with reduced generation.

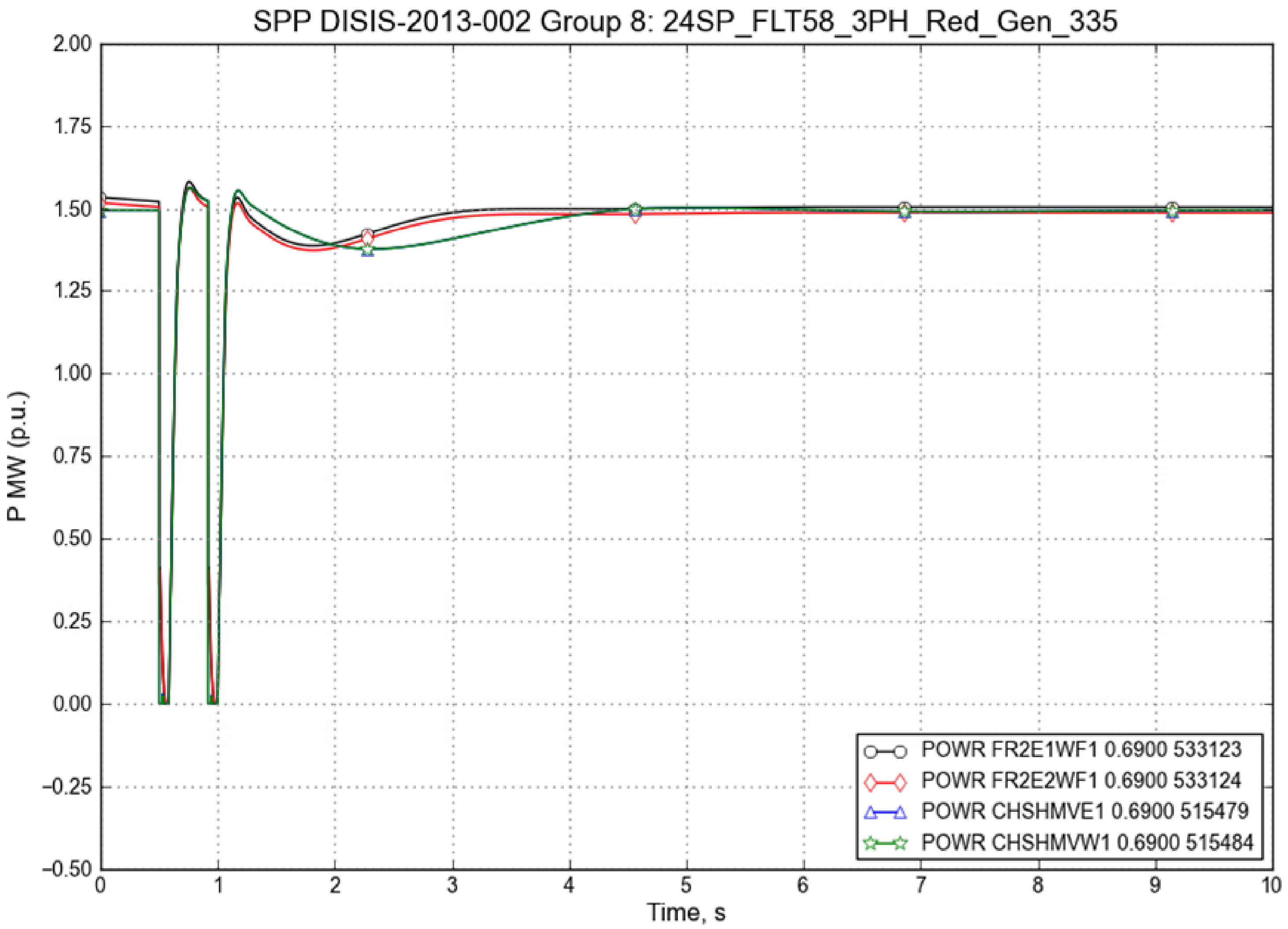


Figure 3-8. Plot of the MW for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2024 Summer Peak.

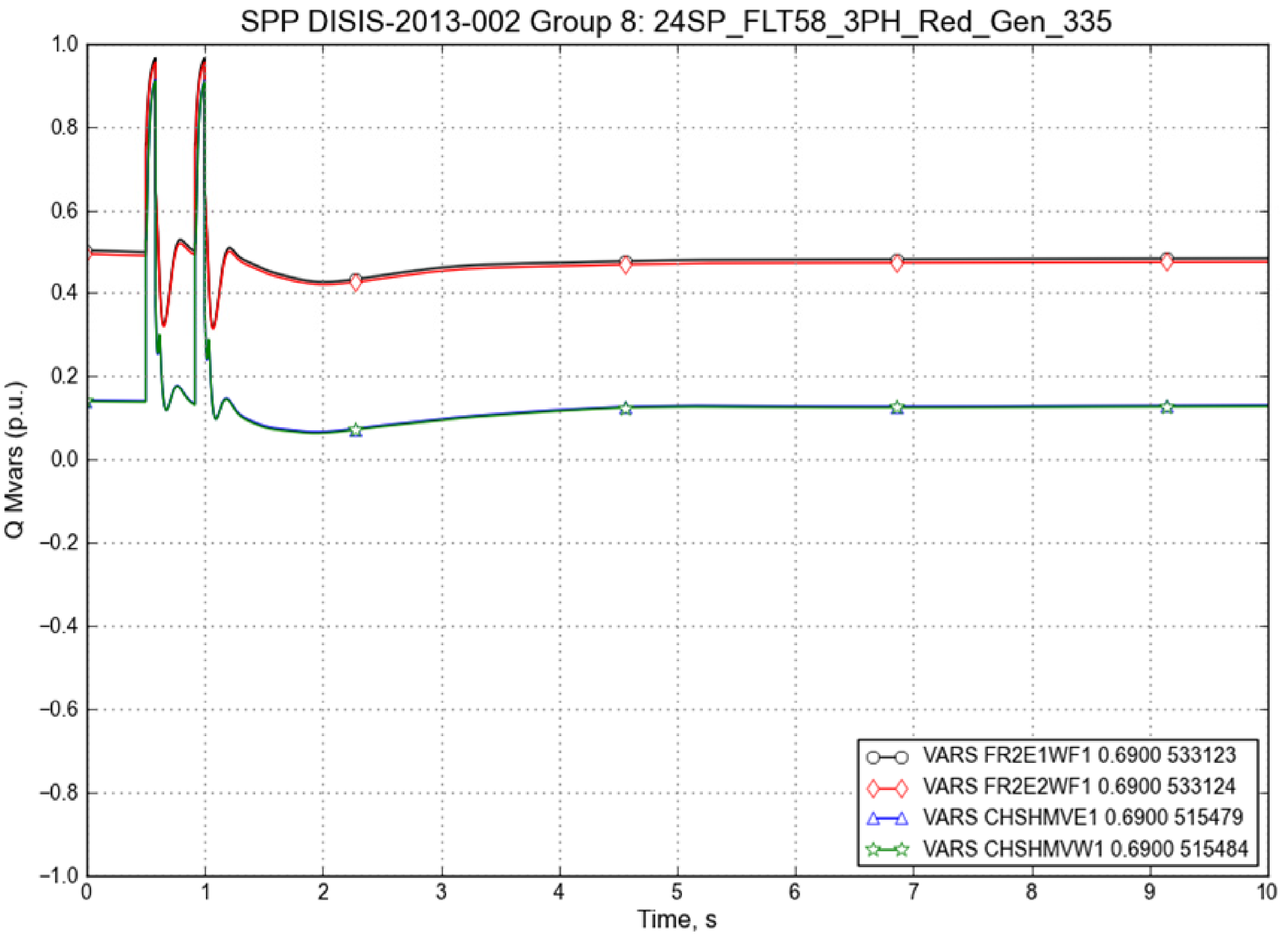


Figure 3-9. Plot of the Mvar for the Chisolm and Flat Ridge generation for Contingency #58 (FLT58-3PH) for 2015 Summer Peak.

SECTION 4: POWER FACTOR ANALYSIS

The objective of this task is to quantify the power factor at the point of interconnection for the wind farms during base case and system contingencies. SPP transmission planning practice requires interconnecting generation projects to maintain the power factor (pf) at the Point of Interconnection (POI) near unity for system intact conditions and within +/- 0.95 pf for post-contingency conditions. This is analyzed by having the wind farm maintain a prescribed voltage schedule at the point of interconnection of 1.0 p.u. voltage, or if the pre-project voltage is higher than 1.0 p.u., to maintain the pre-project voltage schedule.

The three power flows provided by SPP were examined prior to the Power Factor Analysis to ensure they contained the proposed study project modeled at 100% of the nameplate rating and any previously queued projects listed in Table 2-2. There was no suspect power flow data in the study area. The proposed study project was turned off during the power factor analysis. The wind farm was then replaced by a generator modeled at the high side bus with the same real power (MW) capability as the wind farm and open limits for the reactive power set point (Mvar). The generator was set to hold the POI scheduled bus voltage. Contingencies from the three-phase fault definitions provided in Table 2-3 were then applied and the reactive power required to maintain the bus voltage was recorded.

4.1 Study Project – GEN-2013-028

Approach

The study project (GEN-2013-028) was disabled and a generator was placed at the study project's high side bus (583740). For Winter Peak conditions, the generator was modeled with PGEN = 559.5 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. For Summer Peak conditions, the generator was modeled with PGEN = 516.4 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. All buses and transformers connected from the study project's high side bus to the GEN-2013-028 generators were disabled. The pre-project voltage at the POI (Tap on Tulsa N to GRDA 1 345 kV line – Bus 562423) for 2014 Winter Peak, 2015 Summer Peak, and 2024 Summer Peak was 1.01 p.u.

Results

The power factor was calculated for summer and winter peak conditions. Tables 4-1 shows the power factor results for GEN-2013-028 for 2014 Winter Peak, 2015 Summer Peak, and 2024 Summer Peak conditions. Note that a positive Q (Mvar) output illustrates that the generator is absorbing reactive power from the system, implying a leading power factor; a negative Q (Mvar) illustrates that the generator is supplying reactive power to the system, implying a lagging power factor. The Power Factor Analysis shows that GEN-2013-028 has a power factor range of 0.9910 lagging (supplying) to 0.9999 lagging (supplying).

Table 4-1
Power Factor Analysis: GEN-2013-028 (P_{GEN} = 516.4 MW Summer/559.5 MW Winter)*

Power Factor Analysis
Power Factor Analysis: GEN-2013-028 (P_{GEN} = 516.4 MW Summer, 559.5 MW Winter)

Case	2014 Winter Peak			2015 Summer Peak			2024 Summer Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
Base	0.9978	Lagging	-37.43	0.9967	Lagging	-41.78	0.9964	Lagging	-43.70
C1	0.9999	Lagging	-7.78	0.9992	Lagging	-20.87	0.9974	Lagging	-37.11
C3	0.9973	Lagging	-41.33	0.9985	Lagging	-28.53	0.9997	Lagging	-13.01
C5	0.9977	Lagging	-38.19	0.9967	Lagging	-41.95	0.9962	Lagging	-45.19
C7	0.9978	Lagging	-36.98	0.9966	Lagging	-42.57	0.9967	Lagging	-42.17
C9	0.9975	Lagging	-39.88	0.9966	Lagging	-42.89	0.9959	Lagging	-47.12
C11	0.9978	Lagging	-37.50	0.9967	Lagging	-42.14	0.9965	Lagging	-43.35
C13	0.9971	Lagging	-42.49	0.9954	Lagging	-49.48	0.9957	Lagging	-47.79
C15	0.9978	Lagging	-36.81	0.9967	Lagging	-41.78	0.9964	Lagging	-43.70
C17	0.9954	Lagging	-54.08	0.9916	Lagging	-67.28	0.9934	Lagging	-59.77
C19	0.9977	Lagging	-37.87	0.9969	Lagging	-40.69	0.9961	Lagging	-45.71
C21	0.9986	Lagging	-29.79	0.9982	Lagging	-31.05	0.9981	Lagging	-32.19
C23	0.9975	Lagging	-40.02	0.9964	Lagging	-43.64	0.9960	Lagging	-46.08
C25	0.9976	Lagging	-38.80	0.9965	Lagging	-43.37	0.9964	Lagging	-43.85
C27	0.9973	Lagging	-41.51	0.9964	Lagging	-43.83	0.9950	Lagging	-51.74
C29	0.9951	Lagging	-55.42	0.9910	Lagging	-69.65	0.9933	Lagging	-59.87
C30	0.9954	Lagging	-53.95	0.9919	Lagging	-66.31	0.9933	Lagging	-60.02
C32	0.9978	Lagging	-37.25	0.9967	Lagging	-42.12	0.9965	Lagging	-43.40
C33	0.9978	Lagging	-37.55	0.9967	Lagging	-41.75	0.9964	Lagging	-43.90
C34	0.9976	Lagging	-38.65	0.9967	Lagging	-41.96	0.9962	Lagging	-45.32
C36	0.9978	Lagging	-37.07	0.9968	Lagging	-41.64	0.9965	Lagging	-43.25
C38	0.9978	Lagging	-37.35	0.9967	Lagging	-41.81	0.9964	Lagging	-43.77
C40	0.9975	Lagging	-39.28	0.9967	Lagging	-42.03	0.9964	Lagging	-44.21
C42	0.9978	Lagging	-37.29	0.9968	Lagging	-41.65	0.9965	Lagging	-43.56
C44	0.9978	Lagging	-37.41	0.9967	Lagging	-41.74	0.9964	Lagging	-43.76
C46	0.9977	Lagging	-37.81	0.9967	Lagging	-41.98	0.9964	Lagging	-44.12
C48	0.9976	Lagging	-38.65	0.9966	Lagging	-42.88	0.9961	Lagging	-45.63
C50	0.9979	Lagging	-36.16	0.9969	Lagging	-41.05	0.9967	Lagging	-42.24
C52	0.9966	Lagging	-46.22	0.9938	Lagging	-57.86	0.9936	Lagging	-58.85
C54	0.9977	Lagging	-37.86	0.9966	Lagging	-42.50	0.9962	Lagging	-44.86
C56	0.9979	Lagging	-36.55	0.9968	Lagging	-41.36	0.9967	Lagging	-42.20
C58	0.9981	Lagging	-34.56	0.9973	Lagging	-40.84	0.9974	Lagging	-40.40
C59	0.9981	Lagging	-34.56	0.9973	Lagging	-40.84	0.9974	Lagging	-40.40
C61	0.9978	Lagging	-37.41	0.9967	Lagging	-41.78	0.9964	Lagging	-43.70
C62	0.9978	Lagging	-37.44	0.9967	Lagging	-41.99	0.9964	Lagging	-43.95
C63	0.9978	Lagging	-37.36	0.9967	Lagging	-41.74	0.9964	Lagging	-43.65

*The scheduled voltage for the POI (Tap on Tulsa N to GRDA1 345 kV) was 1.01 p.u. for all three study years.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

4.2 Study Project – GEN-2013-029

Approach

The study project (GEN-2013-029) was disabled and a generator was placed at the study project's high side bus (583750). The generator was modeled with PGEN = 300 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. All buses and transformers connected from the study project's high side bus to the GEN-2013-029 generators were disabled. The pre-project voltage at the POI (Renfrow 345 kV – Bus 515543) for 2014 Winter Peak, 2015 Summer Peak, and 2024 Summer Peak was 1.014 p.u., 1.019 p.u., and 1.006 p.u., respectively.

Results

The power factor was calculated for 2014 Winter Peak, 2015 Summer Peak, and 2024 Summer Peak conditions. Table 4-2 shows the power factor results for GEN-2013-029. Note that a positive Q (Mvar) output illustrates that the generator is absorbing reactive power from the system, implying a leading power factor; a negative Q (Mvar) illustrates that the generator is supplying reactive power to the system, implying a lagging power factor. The Power Factor Analysis shows that GEN-2013-029 as a power factor range of 0.9622 lagging (supplying) to 0.9667 leading (absorbing).

The reactive compensation required to off-set the charging of the collector system and lead line was calculated by modeling GEN-2013-029 off-line and calculating the amount of inductive capacity required at the 34.5kV collector buses which would result in zero VAR flow at the 345kV POI. The results are shown in Figure 4-1. A total of 9.6 MVAR of inductive support would be needed to off-set the line charging of the 34.5kV collector system and the 345kV lead line. This reactive compensation was not included, modeled off-line, in the calculation of reactive requirements for the base case or contingency conditions studied.

Table 4-2
Power Factor Analysis: GEN-2013-029 (P_{GEN}=300 MW)*

Power Factor Analysis

Power Factor Analysis: GEN-2013-029 (P_{GEN} = 300 MW)

Case	2014 Winter Peak			2015 Summer Peak			2024 Summer Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
Base	0.9995	Leading	9.14	0.9952	Leading	29.49	0.9779	Leading	64.15
C1	0.9996	Leading	8.50	0.9954	Leading	28.89	0.9784	Leading	63.34
C3	0.9995	Leading	9.08	0.9952	Leading	29.46	0.9780	Leading	64.03
C5	0.9995	Leading	9.12	0.9952	Leading	29.59	0.9778	Leading	64.29
C7	0.9995	Leading	9.03	0.9953	Leading	29.06	0.9784	Leading	63.45
C9	0.9996	Leading	8.22	0.9951	Leading	29.69	0.9776	Leading	64.61
C11	0.9995	Leading	9.50	0.9950	Leading	30.25	0.9772	Leading	65.25
C13	0.9996	Leading	8.39	0.9954	Leading	28.87	0.9784	Leading	63.40
C15	0.9995	Leading	9.15	0.9952	Leading	29.49	0.9779	Leading	64.15
C17	0.9995	Leading	9.12	0.9952	Leading	29.51	0.9779	Leading	64.17
C19	0.9996	Leading	8.68	0.9953	Leading	29.23	0.9779	Leading	64.10
C21	0.9997	Leading	7.20	0.9956	Leading	28.08	0.9790	Leading	62.52
C23	0.9995	Leading	9.30	0.9953	Leading	29.20	0.9784	Leading	63.39
C25	0.9996	Leading	8.70	0.9953	Leading	29.27	0.9779	Leading	64.15
C27	0.9994	Leading	9.96	0.9952	Leading	29.61	0.9782	Leading	63.66
C29	0.9997	Leading	7.45	0.9956	Leading	28.23	0.9779	Leading	64.17
C30	0.9995	Leading	9.88	0.9952	Leading	29.48	0.9783	Lagging	63.47
C32	0.9995	Leading	9.10	0.9952	Leading	29.46	0.9779	Leading	64.14
C33	0.9995	Leading	9.15	0.9952	Leading	29.49	0.9779	Leading	64.14
C34	0.9995	Leading	9.24	0.9952	Leading	29.51	0.9779	Leading	64.12
C36	0.9978	Lagging	-19.86	0.9969	Leading	23.86	0.9929	Leading	35.85
C38	0.9973	Leading	22.18	0.9997	Leading	7.77	0.9959	Leading	27.35
C40	0.9707	Lagging	-74.25	0.9998	Leading	6.53	0.9949	Leading	30.47
C42	0.9994	Leading	10.27	0.9992	Leading	12.13	0.9814	Leading	58.65
C44	1.0000	Lagging	-0.11	0.9971	Leading	23.00	0.9824	Leading	57.08
C46	1.0000	Lagging	-0.90	0.9972	Leading	22.38	0.9831	Leading	55.78
C48	0.9999	Leading	3.86	0.9960	Leading	26.92	0.9807	Leading	59.80
C50	0.9999	Leading	4.27	0.9948	Leading	30.69	0.9793	Leading	62.02
C52	0.9999	Leading	3.81	0.9955	Leading	28.41	0.9812	Leading	58.96
C54	0.9995	Leading	9.55	0.9951	Leading	29.85	0.9780	Leading	64.03
C56	0.9622	Lagging	-84.91	0.9957	Lagging	-27.87	0.9943	Lagging	-32.26
C58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
C61	0.9995	Leading	9.51	0.9951	Leading	29.91	0.9760	Leading	66.90
C62	0.9998	Leading	5.24	0.9947	Leading	30.90	0.9769	Leading	65.68
C63	0.9948	Leading	30.85	0.9864	Leading	50.02	0.9667	Leading	79.42

*The scheduled voltage for the POI (Renfrow 345 kV) was 1.014 p.u. for 2014 winter peak, 1.019 p.u. for 2015 summer peak, and 1.006 p.u. for 2024 summer peak conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

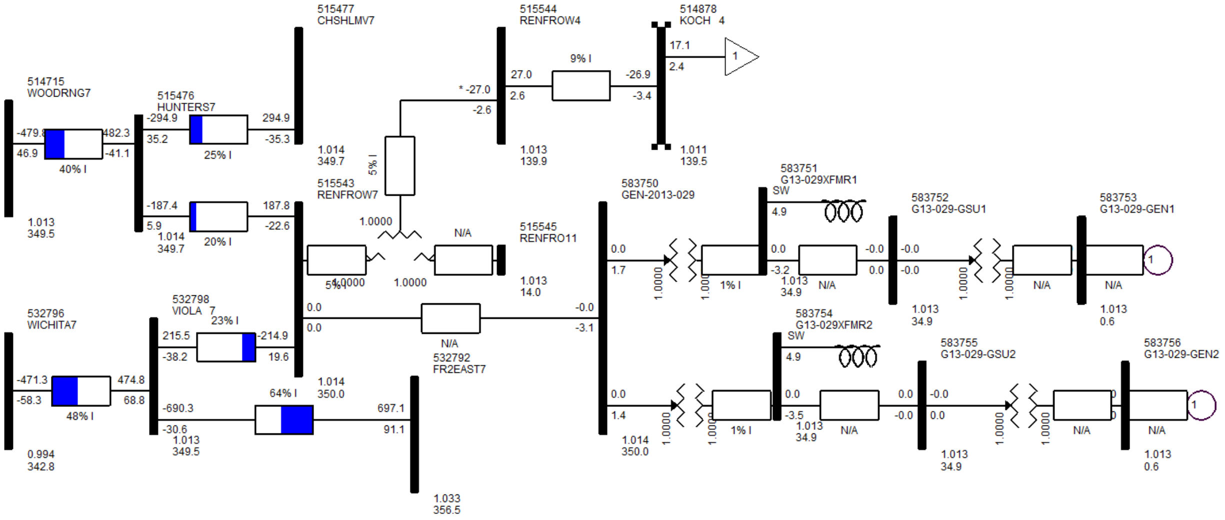


Figure 4-1. Power flow one-line diagram for illustrating the amount of reactive compensation required to off-set the charging of the collector system.

SECTION 5: CONCLUSIONS

Stability Analysis

For the 2014 Winter Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line. In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW, Chisolm generation was reduced to 50 MW (Pmax = 299 MW), and Flat Ridge generation was reduced to 145.5 MW (Pmax = 714 MW).

For the 2015 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line. In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW).

For the 2024 Summer Peak case, the Stability Analysis determined that there was no wind turbine tripping, low voltage recovery, or system instability that occurs from interconnecting GEN-2013-028 and GEN-2013-029 at 100% output. However, a steady-state pre-project (existing) N-2 contingency resulted in low system voltages and system instability. The N-2 contingency that resulted in low system voltages and system instability was the loss of the Woodring to Hunter 345 kV line and the Viola to Wichita 345 kV line. In order to obtain acceptable steady-state voltages and achieve dynamic system stability, the GEN-2013-029 project was reduced to 0 MW and the Flat Ridge generation was reduced to 379 MW (Pmax = 714 MW).

Power Factor Analysis

The Power Factor Analysis shows that GEN-2013-028 has a power factor range of 0.9910 lagging (supplying) to 0.9999 lagging (supplying). GEN-2013-028 is combined cycle generation and therefore additional reactive support is not required.

The Power Factor Analysis shows that GEN-2013-029 has a power factor range of 0.9622 lagging (supplying) to 0.9667 leading (absorbing). A total of 9.6 MVARs of additional inductive support would be required in order to compensate for the collector system and lead line charging when GEN-2013-029 is off-line such that the VAR flow at the POI is zero.

P: Group 9/10 Dynamic Stability Analysis Report

See MEPPI report on next page.

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Southwest Power Pool, Inc. (SPP)

DISIS-2013-002 (Group 09)
Definitive Impact Study

Final Report

PXE-0777
Revision #00

January 2014

Submitted By:
Mitsubishi Electric Power Products, Inc. (MEPPI)
Power Systems Engineering Services Department
Warrendale, PA

Title: **DISIS-2013-002 (Group 09) Definitive Impact Study: Final Report for PXE-0777**
Date: January 2014
Author: David E. Roop; Engineer I, Power Systems Engineering Dept. *David E. Roop*
Reviewed: Elizabeth M. Cook; Sr. Engineer, Power Systems Engineering Dept. *Elizabeth M. Cook*
Nicholas W. Tenza; Engineer I, Power Systems Engineering Dept. *Nicholas W. Tenza*

EXECUTIVE SUMMARY

SPP requested a Definitive Interconnection System Impact Study (DISIS). The DISIS required a Stability Analysis and Power Factor Analysis detailing the impacts of the interconnecting projects as shown in Table ES-1.

Table ES-1: Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2013-019	73.6	Siemens 2.3MW (583703)	Tap Sheldon-Folsom – Pleasant Hill 115kV (560746)
GEN-2013-021	229.5	GE 100m 1.70MW (583723)	Ogallala 230kV (640302)
GEN-2013-032	204.0	GE 1.7MW (583783)	Neligh 115kV (640293)

SUMMARY OF STABILITY ANALYSIS

When interconnecting GEN-2013-019 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2014 GGSSI Winter Peak case, 2015 Summer Peak case, 2015 GGSSI Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

When interconnecting GEN-2013-021 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2015 Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

For the 2014 GGSSI Winter Peak case, instability was observed as a result of contingency FLT92-1PH, located in Table 2-4 of this report. Stability issues are corrected if the output power of GEN-2013-021 is reduced to 200 MW during this case. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 125 MW. If the full output of GEN-

2013-021 is desired for the 2014 GGSSI Winter Peak case, reactive power solutions can be discussed.

For the 2015 GGSSI Summer Peak case, instability was observed as a result of contingency FLT91-1PH, located in Table 2-4 of this report. No stability issues are observed if the output power of GEN-2013-021 is reduced to 169 MW. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 40 MW. If the full output of GEN-2013-021 is desired for the 2015 GGSSI Summer Peak case, reactive power solutions can be discussed.

When interconnecting GEN-2013-032 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2014 GGSSI Winter Peak case, 2015 Summer Peak case, 2015 GGSSI Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

Note that for the 2014 GGSSI Winter Peak case, a steady-state pre-project (existing) stuck breaker contingency resulted in low system voltages and system instability. The pre-existing stuck breaker contingency that resulted in low system voltages and system instability was Gentleman Stuck Breaker 3322 (FLT91-1PH).

SUMMARY OF POWER FACTOR ANALYSIS

The Power Factor Analysis shows that GEN-2013-019 has a power factor range of 0.944 lagging (supplying) to 0.965 leading (absorbing). Additional inductive support required to compensate for the collector system was not determined as the GEN-2013-019 point of interconnection is below 230kV.

The Power Factor Analysis shows that GEN-2013-021 has a power factor range of 0.894 lagging (supplying) to 0.979 leading (absorbing). A total of 24.5 MVAR of additional inductive support would be required in order to compensate for the collector system and lead line charging when GEN-2013-021 is off-line such that the VAR flow at the POI is zero.

The Power Factor Analysis shows that GEN-2013-032 has a power factor range of 0.999 leading (absorbing) to 0.977 leading (absorbing). Additional inductive support required to compensate for the collector system was not determined as the GEN-2013-032 point of interconnection is below 230kV.

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SECTION 1: OBJECTIVES

The objective of this report is to provide Southwest Power Pool, Inc. (SPP) with the deliverables for the "GEN-2013-002 (Group 09) Definitive Impact Study." SPP requested an Interconnection System Impact Study for GEN-2013-019, GEN-2013-021, and GEN-2013-032 which require a Stability Analysis, a Power Factor Analysis, and an Impact Study Report.

SECTION 2: BACKGROUND

The Siemens Power Technologies, Inc. PSS/E power system simulation program Version 32.2.0 was used for this study. SPP provided the stability database cases for summer peak and winter peak seasons and a list of contingencies to be examined. The model includes the study project, the previously queued projects, and the adjacent WAPA generators, as listed in Table 2-1, Table 2-2, and Table 2-3 respectively. Refer to Appendix A for the steady state and dynamic model data for the study projects. A power flow one-line diagram of GEN-2013-019 interconnection projects is shown in Figure 2-1. A power flow one-line diagram of GEN-2013-021 interconnection projects is shown in Figure 2-2. A power flow one-line diagram of GEN-2013-032 interconnection projects is shown in Figure 2-3.

The Stability Analysis will determine the impacts of the new interconnecting project on the stability and voltage recovery of the nearby system 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 will be investigated. Three-phase and single-phase faults will be examined as listed in Table 2-4. Additional three-phase and single-phase faults will be examined for the 2024 future summer peak and 2015 GGSSI summer peak seasons in Table 2-5 and Table 2-6 respectively.

The Power Factor Analysis will determine the power factor at the point of interconnection for the wind interconnection project for pre-contingency and post-contingency conditions. Table 2-4, Table 2-5, and Table 2-6 lists the contingencies developed from the three-phase fault definitions provided in the Group's interconnection impact study request. Additionally, an analysis of the amount of reactive compensation such that the VAR flow at the POI was zero when GEN-2013-021 is off-line was performed.

Table 2-1
Interconnection Projects Evaluated

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2013-019	73.6	Siemens 2.3MW (583703)	Tap Sheldon-Folsom – Pleasant Hill 115kV (560746)
GEN-2013-021	229.5	GE 100m 1.70MW (583723)	Ogallala 230kV (640302)
GEN-2013-032	204.0	GE 1.7MW (583783)	Neligh 115kV (640293)

Table 2-2
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2003-021N	75	GE 1.5MW	Tap on the Ainsworth – Calamus 115kV line (640050)
GEN-2004-005N	30	GE 1.5MW	St Francis 115kV (640351)
GEN-2004-023N	75	GENROU	Columbus 115kV (640119)
GEN-2006-020N	42	Vestas 3.0MW	Bloomfield 115kV (640084)
GEN-2006-037N1	75	GE 1.5MW	Broken Bow 115kV (640089)
GEN-2006-038N005	79.5	GE 1.5MW	Broken Bow 115kV (640089)
GEN-2006-038N019	79.5	Generic wind turbine 1.5MW	Petersburg 115kV (640444)
GEN-2006-044N	40.5	GE 1.5MW	Petersburg 115kV (640444)
GEN-2007-011N08	81	Vestas 3.0MW	Bloomfield 115kV (640084)
GEN-2008-086N02 (replaced by GEN-2013-004)	199.5	GE 1.5MW	Tap on the Columbus – Ft Randall 230kV line (560006)
GEN-2008-119O	60	GE 1.5MW	S1399 161kV (646399)
GEN-2008-123N	89.7	SMK203	Tap on the Pauline – Guide Rock 115kV (560137)
GEN-2009-040	73.8	Vestas V90 1.8MW	Marshall 115kV (533349)
GEN-2010-041	10.5	GE 1.5MW	S1399 161kV (646399)
GEN-2010-051	200	GE 1.6MW	Tap on the Twin Church – Hoskins 230kV line (560347)

Table 2-2 (Continued)
Previously Queued Nearby Interconnection Projects Included

Request	Size (MW)	Generator Model	Point of Interconnection
GEN-2011-018 (replaced by GEN-2013-008)	73.6	Siemens 2.3MW	Steele County 115kV (640426)
GEN-2011-027	120	GE 1.85MW	Tap Twin Church-Hoskins 230kV (560347)
GEN-2011-055	52.8	GE 1.6MW	South Sterling 69kV (S969, 647969)
GEN-2011-056	3.6 MW increase (Pgen=21.6MW)	GENSAL	Jeffrey 115kV (640238)
GEN-2011-056A	3.6 MW increase (Pgen=21.6MW)	GENSAL	Johnson 1 115kV (640240)
GEN-2011-056B	4.5 MW increase (Pgen=213.5MW)	GENSAL	Johnson 2 115kV (640242)
GEN-2012-018	200	GE 1.6MW	GEN-2010-051 230kV Tap (560347)
GEN-2012-021	4.8 MW	GENROU	84th & Bluff 115kV (650275)
GEN-2012-005	81	GE 1.62MW -583503	Tap Fort Randall (652509) – Columbus (640133) 230kV (560718)
GEN-2013-002	50.6	Siemens 2.3MW (583523)	Tap Sheldon (640278) – Folsom (650242) 115kV (560746)
GEN-2013-004	6 MW increase to GEN-2008-038N02 (Pgen=206.5MW)	GE 1.75MW (579469, 579569)	Tap Fort Randall (652509) – Columbus (640133) 230kV (560006)
GEN-2013-005	73.5	GE 1.75MW -583553	Tap Fort Randall (652509) – Columbus (640133) 230kV (640540)
GEN-2013-006	50.6	Siemens 2.3MW -583563	Tap Fort Randall (652509) – Columbus (640133) 230kV (640540)
GEN-2013-008	1.2MW increase to GEN-2011-018 (Pgen=74.8MW)	GE 1.7MW -582318	Steele City (640426) 115kV
GEN-2013-014	25.5	GE 1.7MW -583643	Tap Pauline (640313) – Guide Rock (640206) 115kV (560137)
GEN-2013-015	125.8	GE 1.7MW -583653	Tap Pauline (640313) – Hildreth (640222) 115kV (560733)

Table 2-3
WAPA Generators

Bus #	Bus Name	Pmax (MW)	kV	Unit ID
652546	FTRDL12G	43.0	13.80	1
652546	FTRDL12G	43.0	13.80	2
652547	FTRDL34G	43.0	13.80	3
652547	FTRDL34G	43.0	13.80	4
652548	FTRDL56G	43.0	13.80	5
652548	FTRDL56G	44.0	13.80	6
652549	FTRDL78G	44.0	13.80	7
652549	FTRDL78G	44.0	13.80	8
652575	GAVINS1G	31.0	13.80	1
652576	GAVINS2G	31.0	13.80	2
652577	GAVINS3G	30.0	13.80	3
659116	SPIRI71G	52.0	13.80	1
659117	SPIRI72G	52.0	13.80	2

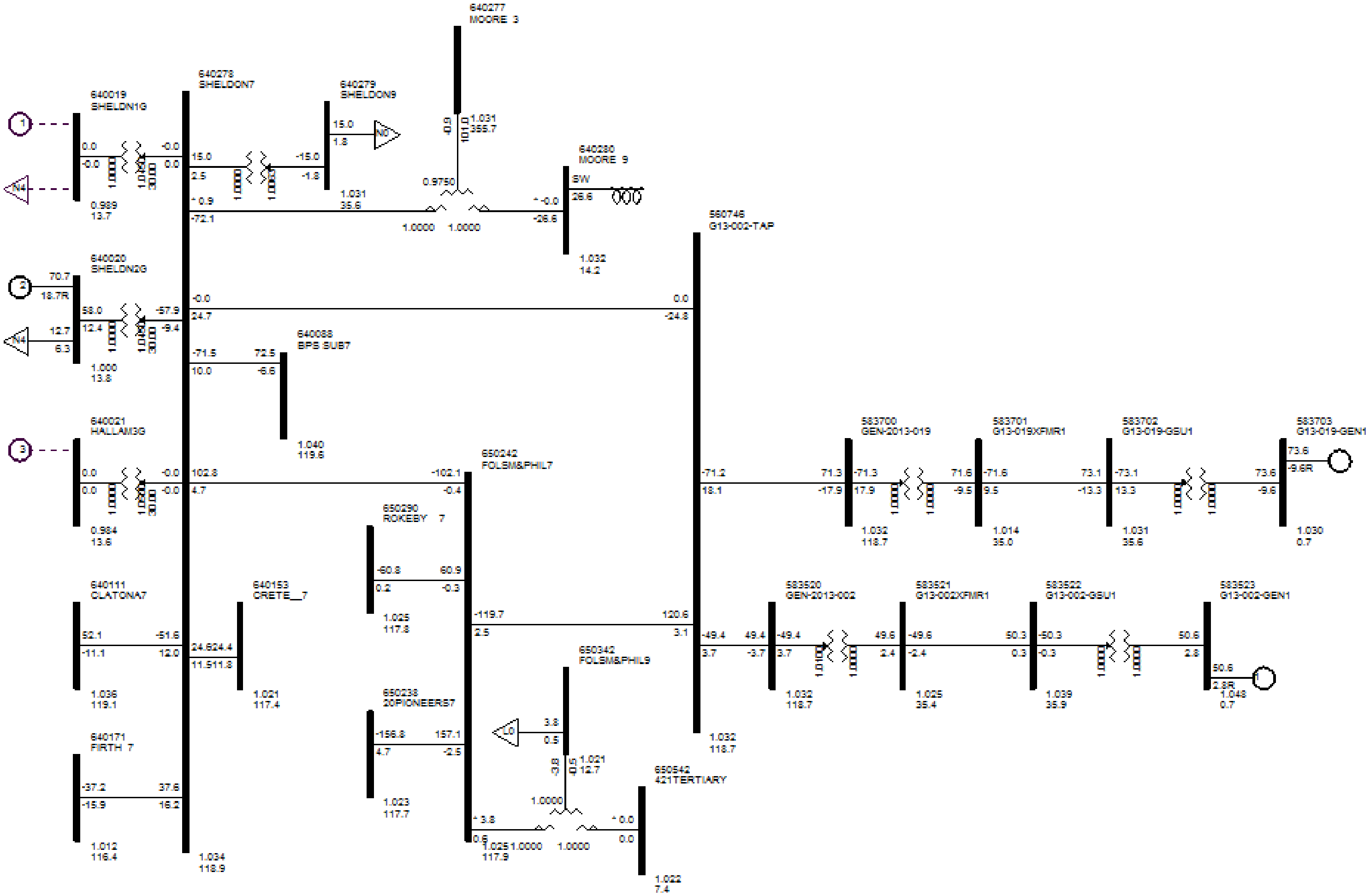

Figure 2-1. Power flow one-line diagram for interconnection project GEN-2013-019 (73.6 MW).

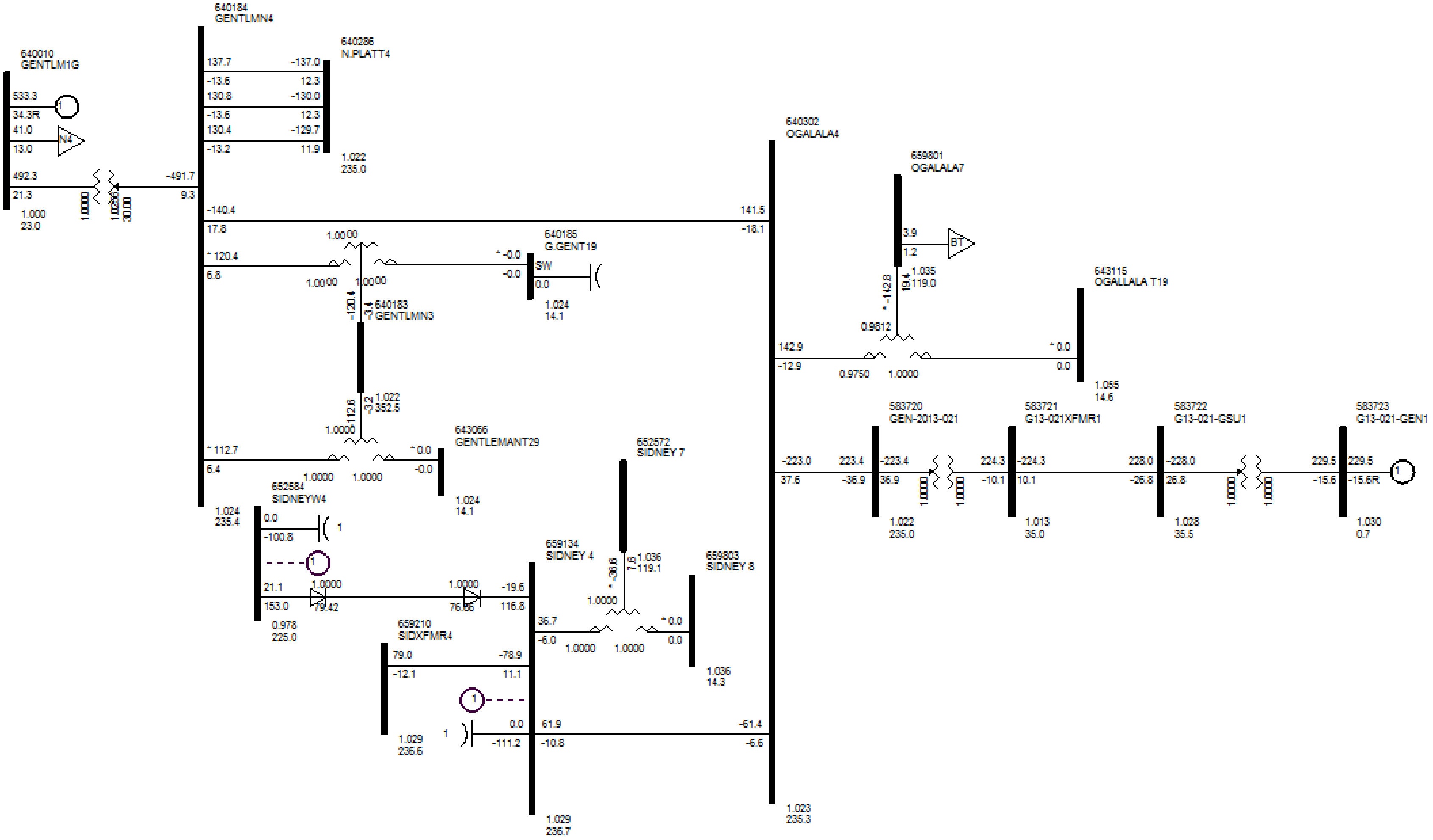

Figure 2-2. Power flow one-line diagram for interconnection project GEN-2013-021 (229.5 MW).

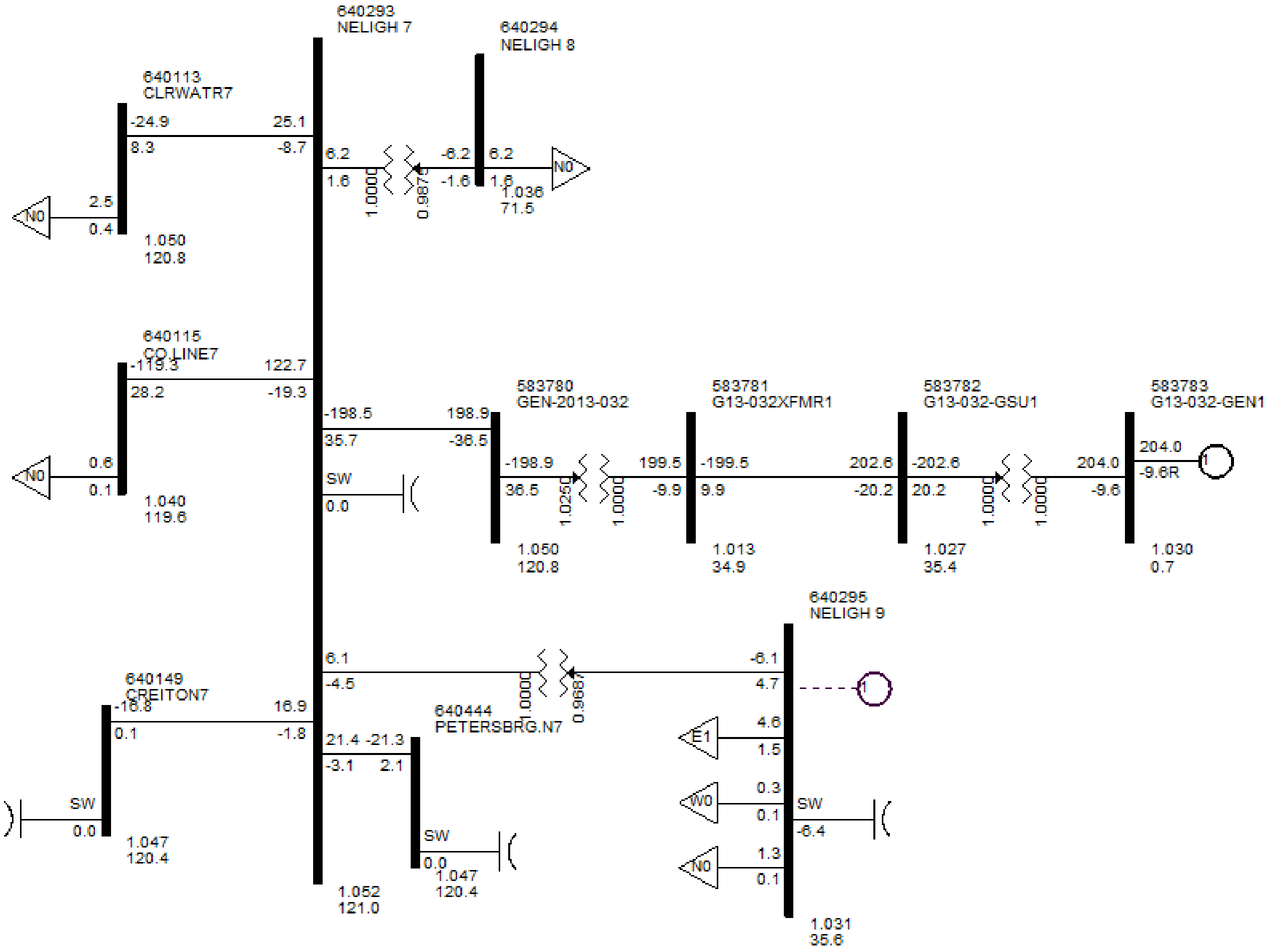

Figure 2-3. Power flow one-line diagram for interconnection project GEN-2013-032 (204.0 MW).

Table 2-4
Case List with Contingency Description

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the G13-002-Tap (560746) to Sheldon (640278) 115kV near G13-002-Tap. a. Apply fault at G13-002-Tap 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
2	FLT02-3PH	3 phase fault on the G13-002-Tap (560746) to Folsom & Pleasant Hill (650242) 115kV near G13-002-Tap. a. Apply fault at G13-002-Tap 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
3	FLT03-3PH	3 phase fault on the Sheldon (640278) to BPS Sub (640088) 115kV near Sheldon. a. Apply fault at Sheldon 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
4	FLT04-3PH	3 phase fault on the Sheldon (640278) to Crete (640153) 115kV near Sheldon. a. Apply fault at Sheldon 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
5	FLT05-3PH	3 phase fault on the Sheldon (640278) to Clatonia (640111) 115kV near Sheldon. a. Apply fault at Sheldon 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
6	FLT06-3PH	3 phase fault on the Sheldon (560746) to Firth (640171) 115kV near Sheldon. a. Apply fault at Sheldon 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
7	FLT07-3PH	3 phase fault on the Folsom & Pleasant Hill (650242) to 20th & Pioneer (650238) 115kV near Folsom. a. Apply fault at Folsom 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
8	FLT08-3PH	3 phase fault on the Folsom & Pleasant Hill (650242) to Rokeby (650290) 115kV near Folsom. a. Apply fault at Folsom 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
9	FLT09-3PH	3 phase fault on the Beatrice (640076) to BPS Sub (640088) 115kV near Beatrice. a. Apply fault at Beatrice 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
10	FLT10-3PH	3 phase fault on the Beatrice (640076) to Harbine (640208) 115kV near Beatrice. a. Apply fault at Beatrice 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
11	FLT11-3PH	3 phase fault on the Beatrice (640076) to Steinauer (640361) 115kV near Beatrice. a. Apply fault at Beatrice 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
12	FLT12-3PH	3 phase fault on the Humboldt (640235) to Steinauer (640361) 115kV near Humboldt. a. Apply fault at Humboldt 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
13	FLT13-3PH	3 phase fault on the Harbine (640208) to Fairbury (640169) 115kV near Harbine. a. Apply fault at Harbine 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
14	FLT14-3PH	3 phase fault on the Rokeby (650290) to NW68Holdrg (650214) 115kV near Rokeby. a. Apply fault at Rokeby 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
15	FLT15-3PH	3 phase fault on the Rokeby (650290) to 27&Plr (650229) 115kV near Rokeby. a. Apply fault at Rokeby 115kV bus. b. Clear fault after 6.5 cycles by tripping faulted line.
16	FLT16-3PH	3 phase fault on the Moore (640277) to Cooper (640139) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
17	FLT17-3PH	3 phase fault on the Moore (640277) to McCool (640271) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.

Table 2-4 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
18	FLT18-3PH	3 phase fault on the Moore (640277) to Pauline (640312) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
19	FLT19-3PH	3 phase fault on the Moore (640277) to NW68Holdrg (650114) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
20	FLT20-3PH	3 phase fault on the Moore (640277) to 103&Rokeby (650189) 345kV line, near Moore. a. Apply fault at the Moore 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
21	FLT21-3PH	3 phase fault on the Ogallala (640302) to Sidney (659134) 230kV line, near Ogallala. a. Apply fault at the Ogallala 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
22	FLT22-3PH	3 phase fault on the Ogallala (640302) to Gentleman (640184) 230kV line, near Ogallala. a. Apply fault at the Ogallala 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
23	FLT23-3PH	3 phase fault on the North Platte (640286) to Crooked Creek (640093) 230kV line, near North Platte. a. Apply fault at the North Platte 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
24	FLT24-3PH	3 phase fault on the Grand Island (652571) to Sweetwater (640374) 345kV Ckt 1 line, near Grand Island. a. Apply fault at the Grand Island 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
25	FLT25-3PH	3 phase fault on the Sweetwater (640374) to Axtell (640065) 345kV line, near Sweetwater. a. Apply fault at the Sweetwater 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
26	FLT26-3PH	3 phase fault on the Gentleman (640183) to Red Willow (640325) 345kV line, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
27	FLT27-3PH	3 phase fault on the Red Willow (640325) to Mingo (531451) 345kV line, near Red Willow. a. Apply fault at the Red Willow 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
28	FLT28-3PH	3 phase fault on the Sidney (659133) to Stegall (659135) 345kV line, near Sidney. a. Apply fault at the Sidney 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
29	FLT29-3PH	3 phase fault on the Ogallala (659801) to Keystone (640253) 115kV line, near Ogallala. a. Apply fault at the Ogallala 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
30	FLT30-3PH	3 phase fault on the Ogallala (659801) to Roscoe (659809) 115kV line, near Ogallala. a. Apply fault at the Ogallala 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
31	FLT31-3PH	3 phase fault on the Ogallala (659801) to Brule (640091) 115kV line, near Ogallala. a. Apply fault at the Ogallala 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
32	FLT32-3PH	3 phase fault on the Ogallala (659801) to Grant (659800) 115kV circuit 1, near Ogallala. a. Apply fault at the Ogallala 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
33	FLT33-3PH	3 phase fault on the Big Springs (640068) to Blue Creek (640086) 115kV line, near Big Springs. a. Apply fault at the Big Springs 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
34	FLT34-3PH	3 phase fault on the Big Springs (640068) to Julesburg Tap (640246) 115kV line, near Big Springs. a. Apply fault at the Big Springs 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.

Table 2-4 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
35	FLT35-3PH	3 phase fault on the North Platte (640287) to Maloney (640265) 115kV line, near North Platte. a. Apply fault at the North Platte 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
36	FLT36-3PH	3 phase fault on the Red Willow (640326) to Beverly (640082) 115kV line, near Red Willow. a. Apply fault at the Red Willow 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
37	FLT37-3PH	3 phase fault on the Neligh (640293) to Clearwater (640113) 115kV line, near Neligh. a. Apply fault at the Neligh 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
38	FLT38-3PH	3 phase fault on the Neligh (640293) to County Line (640115) 115kV line, near Neligh. a. Apply fault at the Neligh 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
39	FLT39-3PH	3 phase fault on the Neligh (640293) to Creighton (640149) 115kV line, near Neligh. a. Apply fault at the Neligh 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
40	FLT40-3PH	3 phase fault on the Neligh (640293) to Petersburg N (640444) 115kV line, near Neligh. a. Apply fault at the Neligh 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
41	FLT41-3PH	3 phase fault on the Albion (640054) to Genoa (640181) 115kV line, near Albion. a. Apply fault at the Albion 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
42	FLT42-3PH	3 phase fault on the Albion (640054) to Spalding (640347) 115kV line, near Albion. a. Apply fault at the Albion 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
43	FLT43-3PH	3 phase fault on the North Norfolk (640296) to Battle Creek (640072) 115kV line, near North Norfolk. a. Apply fault at the North Norfolk 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
44	FLT44-3PH	3 phase fault on the Belden (640080) to Hartington (640212) 115kV line, near Belden. a. Apply fault at the Belden 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
45	FLT45-3PH	3 phase fault on the Gavins Point (652511) to Yankton Jcn (660006) 115kV line, near Gavins Point. a. Apply fault at the Gavins Point 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
46	FLT46-3PH	3 phase fault on the Gavins Point (652511) to Bloomfield (640084) 115kV line, near Gavins Point. a. Apply fault at the Gavins Point 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
47	FLT47-3PH	3 phase fault on the Ft Randle (652510) to Spencer (640349) 115kV line, near Ft Randle. a. Apply fault at the Ft Randle 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
48	FLT48-3PH	3 phase fault on the Ainsworth Wind (640050) to Calamus (640096) 115kV line, near Ainsworth Wind. a. Apply fault at the Ainsworth Wind 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
49	FLT49-3PH	3 phase fault on the Ft Randle (652509) to GEN-2012-005T (560718) 230kV line, near Ft Randle. a. Apply fault at the Ft Randle 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
50	FLT50-3PH	3 phase fault on the Ft Thompson (652506) to Grand Island (652571) 345kV line, near Ft Thompson. a. Apply fault at the Ft Thompson 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
51	FLT51-3PH	3 phase fault on the Meadow Grove (640540) to Columbus (640133) 230kV line, near Meadow Grove. a. Apply fault at the Meadow Grove 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.

Table 2-4 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
52	FLT52-3PH	3 phase fault on the Meadow Grove (640540) to South Norfolk (560101) 230kV line, near Meadow Grove. a. Apply fault at the Meadow Grove 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
53	FLT53-3PH	3 phase fault on the Petersburg (640318) to Petersburg North (640444) 115kV line, near Petersburg. a. Apply fault at the Petersburg 115kV bus. b. Clear fault after 6.5 cycles by tripping the faulted line.
54	FLT54-3PH	3 phase fault on the NW68Holdrg (650114) 345kV to NW68Holdrg (650214) 115kV/(650314) 13.8kV transformer at the 345kV bus. a. Apply fault at the NW68Holdrg 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
55	FLT55-3PH	3 phase fault on the Moore (640277) 345kV to Sheldon (640278) 115kV/(640280) 13.8kV transformer at the 345kV bus. a. Apply fault at the Moore 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
56	FLT56-3PH	3 phase fault on the Ogallala (640302) 230kV to Ogallala (659801) 115kV/(643115) 13.8kV transformer at the 230kV bus. a. Apply fault at the Ogallala 230kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
57	FLT57-3PH	3 phase fault on the Gentleman (640183) 345kV to Gentleman (640184) 230kV/(640185) 13.8kV CKT 1 transformer at the 345kV bus. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
58	FLT58-3PH	3 phase fault on the South Norfolk (560100) 345kV to South Norfolk (560101) 230kV/(56102) 13.8kV CKT 1 transformer at the 345kV bus. a. Apply fault at the South Norfolk 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
59	FLT59-3PH	3 phase fault on the Meadow Grove (640540) 230kV to Meadow Grove (560008) 115kV/(560005) 13.8kV CKT 1 transformer at the 230kV bus. a. Apply fault at the Meadow Grove 230kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
60	FLT60-3PH	**Prior outage of GEN-2013-002 & GEN-2013-019 Tap (560746) – Sheldon (640278) 115kV** with a 3-phase fault near Sheldon (640278) on Sheldon – Folsom & Pleasant Hill (650242) 115kV Ckt 1. a. Prior outage of GEN-2013-002 & -019 Tap (560746) to Sheldon (640278) 115kV line (network back at steady state) b. Apply 3-phase fault at Sheldon (640278) 115kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Sheldon (640278) to Folsom & Pl Hill (650242) 115kV Ckt 1
61	FLT61-3PH	**Prior outage of GEN-2013-002 & GEN-2013-019 Tap (560746) – Folsom & Pleasant Hill (650242) 115kV** with a 3-phase fault near Sheldon (640278) on Sheldon – Folsom & Pleasant Hill (650242) 115kV Ckt 1. a. Prior outage of GEN-2013-002 & -019 Tap (560746) to Folsom & Pleasant Hill (650242) 115kV line (network back at steady state) b. Apply 3-phase fault at Sheldon (640278) 115kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Sheldon (640278) to Folsom & Pl Hill (650242) 115kV Ckt 1
62	FLT62-3PH	**Prior outage of GEN-2013-002 & GEN-2013-019 Tap (560746) – Folsom & Pleasant Hill (650242) 115kV** with a 3-phase fault near Sheldon (640278) on Sheldon – Folsom & Pleasant Hill (650242) 115kV Ckt 1. a. Prior outage of GEN-2013-002 & -019 Tap (560746) to Folsom & Pleasant Hill (650242) 115kV line (network back at steady state) b. Apply 3-phase fault at Sheldon (640278) 115kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Sheldon (640278) to Folsom & Pl Hill (650242) 115kV Ckt 1

Table 2-4 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
63	FLT63-3PH	**Prior outage of Neligh (640293) – Creighton (640149) 115kV** with a 3-phase fault near Albion (640054) on Albion – Genoa (640181) 115kV. a. Prior outage of Neligh (640293) to Creighton (640149) 115kV line (network back at steady state) b. Apply 3-phase fault at Albion (640054) 115kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Albion (640054) to Genoa (640181) 115kV
64	FLT64-3PH	**Prior outage of Albion (640054) – Genoa (640181) 115kV** with a 3-phase fault near Neligh (640293) on Neligh – Creighton (640149) 115kV. a. Prior outage of Albion (640054) to Genoa (640181) 115kV line (network back at steady state) b. Apply 3-phase fault at Neligh (640293) 115kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Neligh (640293) to Creighton (640149) 115kV
65	FLT65-3PH	**Prior outage of Ogallala (640302) – Gentleman (640184) 230kV** with a 3-phase fault near Ogallala (640302) on Ogallala – Sidney (659134) 230kV. a. Prior outage of Ogallala (640302) to Gentleman (640184) 230kV line (network back at steady state) b. Apply 3-phase fault at Ogallala (640302) 230kV c. Run for 6.5 cycles d. Clear fault e. Trip line from Ogallala (640302) to Sidney (659134) 230kV
66	FLT66-3PH	3 phase fault on the Gentleman (640183) 345kV to Gentleman (640184) 230kV/(640185) 13.8kV CKT 1 transformer at the **230kV bus**. a. Apply fault at the Gentleman 230kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
67	FLT67-3PH	**Prior outage of Fairport (300039) - St Joe (541199) 345 kV** with a 3-phase fault near Cooper (640139) on Cooper (640139) - St Joe (541199) 345 kV. Prior outage of Fairport (300039) to St.Joe (541199) 345kV line (network back at steady state) a. Apply 3-phase fault at Cooper (640139) 345kV b. Run for 4.5 cycles c. Clear fault d. Trip line from Cooper (640139) to G10-056-Tap (560663) 345kV
68	FLT68-1PH	**SLG fault** at the S3451 (645451) end of the S3451 (645451) -S3459 (645459) and S3451 (645451) -S3454 (645454) 345kV lines. Normal clearing (4.5 cycles) a. Apply SLG fault at S3451 (645451) 345kV b. Run for 4.5 cycles c. Clear fault d. Trip line from S3451 (645451) to S3459 (645459) 345kV e. Trip line from S3451 (645451) to S3454 (645454) 345kV
69	FLT69-1PH	**SLG fault** at the S3451 (645451) end of the S3451 (645451)-Raun (635200) 345kV line, followed by a stuck breaker and the opening (4.5cycles) of transformer T4 (64545/345kv – 646251/161kV – 648351/13.8kV) at S3451. a. Apply SLG fault at S3451 (645451) 345kV b. Run for 4.5 cycles c. Trip line from S3451 (645451) to Raun (635200) 345kV d. Clear fault e. Apply SLG fault at S3451 (645451) 345kV f. Run for 10 cycles g. Disconnect three winding transformer (S3451 T4) at bus 645451/646251/648351 h. Clear fault

Table 2-4 (Continued)
Case List with Contingency Description

Cont. No.	Cont. Name	Description
70	FLT70-1PH	**SLG fault** at S1206 (646206) on the S1206 (646206) - S1232 (66232) 161kV line, followed by a stuck breaker and the opening of the S1206 (646206) - S1201 (646201) 161kV line. a. Apply SLG fault at S1206 (646206) 161kV b. Run for 8.5 cycles c. Trip line from S1206 (646206) to S1232 (646232) 161kV d. Clear fault e. Apply SLG fault at S1206 (646206) 161kV f. Run for 10.5 cycles g. Trip line from S1206 (646206) to S1201 (646201) 161kV h. Clear fault
71	FLT71-1PH	**Neligh Stuck Breaker** a. Apply single phase fault at the Neligh (640293) 115kV bus on the Neligh – Co Line (640115) 115kV line. b. Wait 16 cycles, and then drop Neligh (640293) 115kV – Clearwater (640113) 115kV. c. Trip Neligh to Co. Line 115kV and remove the fault.
72	FLT72-1PH	**Sheldon Stuck Breaker** a. Apply single phase fault at the Sheldon (640278) 115kV bus on the Sheldon – Folsom & Pleasant Hill (650242) 115kV line Circuit 1. b. Wait 16 cycles, and then drop Sheldon (640278) 115kV – Firth (640171) 115kV. c. Trip Sheldon to Folsom & Pleasant Hill 115kV and remove the fault.
73	FLT73-1PH	**Ogallala Stuck Breaker** a. Apply single phase fault at the Ogallala (640302) 230kV bus on the Ogallala – Sidney (659134) 230kV line. b. Wait 16 cycles, and then drop Ogallala (640302) 230kV / Ogallala (659801) 115kV / Ogallala (643115). c. Trip Ogallala to Sidney 230kV and remove the fault.

Table 2-5
Additional Case List for the 2024 Future Summer Peak Season

Cont. No.	Cont. Name	Description
1	FLT74-3PH	3 phase fault on the Gentleman (640183) to Cherry County (640500) 345kV line ckt 1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
2	FLT75-3PH	3 phase fault on the Cherry County (640500) to Holt County (640510) 345kV line ckt 1, near Cherry County. a. Apply fault at the Cherry County 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
3	FLT76-3PH	3 phase fault on the Holt County (640510) to Ft. Thompson (652506) 345kV line ckt 1, near Holt County. a. Apply fault at the Holt County 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
4	FLT77-3PH	3 phase fault on the Holt County (640510) to Grand Island (652571) 345kV line ckt 1, near Holt County. a. Apply fault at the Holt County 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.

Table 2-6
Additional Case List for 2014 GGSSI Winter Peak and 2015 GGSSI Summer Peak Seasons

Cont. No.	Cont. Name	Description
1	FLT78-3PH	3 phase fault on the Gentleman (640183) to Sweetwater (640374) 345kV line ckt 1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
2	FLT79-3PH	3 phase fault on the Gentleman (640183) to Sweetwater (640374) 345kV line ckt 2, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
3	FLT80-3PH	3 phase fault on the Axtell (640065) to Pauline (640312) 345kV line ckt1, near Axtell. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
4	FLT81-3PH	3 phase fault on the Gentleman (640183) to Keystone (640252) 345kV line ckt1, near Gentleman. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
5	FLT82-3PH	3 phase fault on the Keystone (640252) to Sidney (659133) 345kV line ckt1, near Keystone. a. Apply fault at the Keystone 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
6	FLT83-3PH	3 phase fault on the Axtell (640065) to Post Rock (530583) 345kV line ckt1, near Axtell. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 4.5 cycles by tripping the faulted line.
7	FLT84-3PH	3 phase fault on the Gentleman (640184) to N. Platte (640286) 230kV line ckt 1, near Gentleman. a. Apply fault at the Gentleman 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
8	FLT85-3PH	3 phase fault on the Gentleman (640184) to Ogallala(640302) 230kV line ckt 1, near Gentleman. a. Apply fault at the Gentleman 230kV bus. b. Clear fault after 5.5 cycles by tripping the faulted line.
9	FLT86-3PH	3 phase fault on the Axtell (640065) 345kV to Axtell (640066) 115kV/(640067) 13.8kV transformer at the Axtell 345kVbus. a. Apply fault at the Axtell 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
10	FLT87-3PH	3 phase fault on the Gentleman (640183) 345kV to Gentleman (640184) 230kV/(643066) 13.8kV CKT 2 transformer at the 345kV bus. a. Apply fault at the Gentleman 345kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
11	FLT88-3PH	3 phase fault on the Gentleman (640183) 345kV to Gentleman (640184) 230kV/(643066) 13.8kV CKT 2 transformer at the 230kV bus. a. Apply fault at the Gentleman 230kV bus. b. Clear fault after 5.5 cycles by tripping the transformer
12	FLT89-1PH	**SLG fault** at the Gentleman (640183) end of the Gentleman (640183) to Sweetwater (640374) ckt2 and Gentleman (640183) to Red Willow (640325) 345kV lines. Normal clearing (4.5 cycles) a. Apply SLG fault at Gentleman (640183) 345kV b. Run for 4.5 cycles, remove fault c. Trip line from Gentleman (640183) to Sweetwater (640374) ckt2 345kV. d. Trip line from Gentleman (640183) to Red Willow (640325) 345kV.
13	FLT90-1PH	**SLG fault** at the Gentleman (640184) end of the Gentleman (640184) to N. Platte (640286) ckt2 and Gentleman (640184) to N. Platte (640286) ckt3345kV lines. Normal clearing (5.5 cycles) a. Apply SLG fault at Gentleman (640184) 345kV b. Run for 5.5 cycles, remove fault c. Trip line from Gentleman (640184) to N. Platte (640286) ckt2 345kV d. Trip line from Gentleman (640184) to N. Platte (640286) ckt3 345kV
14	FLT91-1PH	**Gentleman Stuck Breaker 3322** a. Apply single phase fault at the Gentleman (640183) 345kV bus on the Gentleman to Sweetwater (640374) ckt2 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Gentleman (640183) to Sweetwater (640374) ckt2 345kV line. d. Trip line from Gentleman (640183) to Red Willow (640325).

Table 2-6 (Continued)
Additional Case List for 2014 GGSSI Winter Peak and 2015 GGSSI Summer Peak Seasons

Cont. No.	Cont. Name	Description
15	FLT92-1PH	**Gentleman Stuck Breaker 3316** a. Apply single phase fault at the Gentleman (640183) 345kV bus on the Gentleman to Keystone (640252) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip the Gentleman (640183) to Keystone (640252) ckt1 345kV line d. Disconnect three winding transformer at bus 640183/640184/643066.
16	FLT93-1PH	**Gentleman Stuck Breaker 2216** a. Apply single phase fault at the Gentleman (640184) 230kV bus on the Gentleman to N. Platte (640286) ckt1 230kV line. b. Run 16 cycles, remove fault. c. Trip line from Gentleman (640184) to N. Platte (640286) ckt1 230kV. d. Trip line from Gentleman (640184) to N. Platte (640286) ckt3 230kV.
17	FLT94-1PH	**Gentleman Stuck Breaker 2222** a. Apply single phase fault at the Gentleman (640184) 230kV bus on the Gentleman to Ogallala (640302) ckt1 230kV line. b. Run 16 cycles, remove fault. c. Trip the Gentleman (640183) to Ogallala (640320) ckt1 230V line d. Disconnect three winding transformer at bus 640183/640184/643066.
18	FLT95-1PH	**Sweetwater Stuck Breaker 3308** a. Apply single phase fault at the Sweetwater (640374) 345kV bus on the Gentleman to Sweetwater (640183) ckt1 345kV line. b. Wait 16 cycles, remove fault. c. Trip line from Gentleman (640183) to Sweetwater (640374) 345kV. d. Trip line from Sweetwater (640374) to Grand Island (652571) 345kV.
19	FLT96-1PH	**Sweetwater Stuck Breaker 3310** a. Apply single phase fault at the Sweetwater (640374) 345kV bus on the Gentleman to Sweetwater (640183) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Gentleman (640183) to Sweetwater (640374) 345kV. d. Trip line from Sweetwater (640374) to Axtell (640065) 345kV.
20	FLT97-1PH	**Keystone Stuck Breaker 3310** a. Apply single phase fault at the Keystone (640252) 345kV bus on the Keystone to Sidney (659133) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Sidney (659133) 345kV. d. Trip line from Keystone (640252) to Gentleman (640183) 345kV.
21	FLT98-1PH	**Keystone Stuck Breaker 3312** a. Apply single phase fault at the Keystone (640252) 345kV bus on the Keystone to Sidney (659133) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Sidney (659133) 345kV. d. Trip line from Keystone (640252) to Gentleman (640183) 345kV.
22	FLT99-1PH	**Keystone Stuck Breaker 3312** a. Apply single phase fault at the Keystone (640252) 345kV bus on the Keystone to Sidney (659133) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Sidney (659133) 345kV. d. Disconnect three winding transformer at bus 640252/640253/640254.
23	FLT100-1PH	**Keystone Stuck Breaker 3304** a. Apply single phase fault at the Keystone (640252) 345kV bus on the Keystone to Gentleman (640183) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Keystone (640252) to Gentleman (640183) 345kV. d. Disconnect three winding transformer at bus 640252/640253/640254.
24	FLT101-1PH	**Grand Island Stuck Breaker 1396** a. Apply single phase fault at the Grand Island (652571) 345kV bus on the Grand Island to McCool (640271) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Grand Island (652571) to McCool (640271) 345kV. d. Disconnect three winding transformer at bus 652571/640200/640271.

Table 2-6 (Continued)
Additional Case List for 2014 GGSSI Winter Peak and 2015 GGSSI Summer Peak Seasons

Cont. No.	Cont. Name	Description
25	FLT102-1PH	**Grand Island Stuck Breaker 2204** a. Apply single phase fault at the Grand Island (640200) 230kV bus on the Grand Island to Riverdale (640330) ckt1 230kV line. b. Run 16 cycles, remove fault. c. Trip line from Grand Island (640200) to Riverdale (640330) 230kV. d. Trip line from Grand Island (640200) to Hasting (640214) 230kV.
26	FLT103-1PH	**N. Platte Stuck Breaker 2204** a. Apply single phase fault at the N. Platte (640286) 230kV bus on the N. Platte to Gentleman (640184) ckt1 230kV line. b. Run 16 cycles, remove fault. c. Trip line from N. Platte (640286) to Gentleman (640184) ckt1 230kV. d. Disconnect three winding transformer at bus 640286/640287/640291.
27	FLT104-1PH	**N. Platte Stuck Breaker 2212** a. Apply single phase fault at the N. Platte (640286) 230kV bus on the N. Platte to Gentleman (640184) ckt2 230kV line. b. Run 16 cycles, remove fault. c. Trip line from N. Platte (640286) to Gentleman (640184) ckt2 230kV. d. Trip line from N. Platte (640286) to C.Creek (640093) ckt1 230kV.
28	FLT105-1PH	**Axtell Stuck Breaker 3304** a. Apply single phase fault at the Axtell (640065) 345V bus on the Axtell to Post Rock (530583) ckt1 345kV line. b. Run 16 cycles, remove fault. c. Trip line from Axtell (640065) to Post Rock (530583) ckt1 345kV. d. Disconnect three winding transformer at bus 640065/640066/640067.

SECTION 3: STABILITY ANALYSIS

The objective of the stability analysis was to determine the impacts of the new wind farms on the stability and voltage recovery on the SPP transmission system. If problems with stability or voltage recovery were identified the need for reactive compensation or system upgrades were investigated.

Approach

The 2014 winter peak, 2014 GGSSI winter peak, 2015 summer peak, 2015 GGSSI summer peak, and the 2024 summer peak power flows provided by SPP were examined prior to the Stability Analysis to ensure they contained the proposed study projects (GEN-2013-019, GEN-2013-021, GEN-2013-032) modeled at 100% of the nameplate rating and any previously queued projects listed in Table 2-2, as well as WAPA generators listed in Table 2-3. There was no suspect power flow data in the study area. The dynamic datasets were also verified and stable initial system conditions (i.e., “flat lines”) were achieved. Three-phase and single line-to-ground faults listed in Table 2-3, Table 2-4, and Table 2-5 were examined. Single-phase fault impedances were calculated to result in a voltage of approximately 60% of the pre-fault voltage. Refer to Table 3-1 and Table 3-2 for a list of the calculated single-phase fault impedances used for this analysis.

Table 3-1
Calculated Single-Phase Fault Impedances

Ref. No.	Casename	Single-Phase Fault Impedance (MVA)			
		Winter Peak 2014	Summer Peak 2015	Summer Peak 2015 GGSSI	Summer Peak 2024
68	FLT68-1PH	8500.0	8906.3	8906.3	9312.5
69	FLT69-1PH	8500.0	8906.3	8906.3	9312.5
70	FLT70-1PH	6468.8	7687.5	7687.5	7687.5
71	FLT71-1PH	1062.5	1062.5	1062.5	1626.0
72	FLT72-1PH	3625.0	4031.3	4031.3	4234.4
73	FLT73-1PH	2000.0	2000.0	2000.0	2000.0

Table 3-2
Additional Calculated Single-Phase Fault Impedances for the 2014 GGSSI Winter Peak and 2015 GGSSI Summer Peak Season

Ref. No.	Casename	Single-Phase Fault Impedance (MVA)
		Summer Peak 2015 GGSSI
12	FLT89-1PH	5046.9
13	FLT90-1PH	4437.5
14	FLT91-1PH	5046.9
15	FLT92-1PH	5046.9
16	FLT93-1PH	4437.5
17	FLT94-1PH	4437.5
18	FLT95-1PH	3625.0
19	FLT96-1PH	3625.0
20	FLT97-1PH	3015.6
21	FLT98-1PH	3015.6
22	FLT99-1PH	3015.6
23	FLT100-1PH	3015.6
24	FLT101-1PH	4031.3
25	FLT102-1PH	3625.0
26	FLT103-1PH	3015.6
27	FLT104-1PH	3015.6
28	FLT105-1PH	3218.8

Bus voltages and previously queued generation in the study area were monitored in addition to the bus voltages in the following areas:

- 531 MIDW
- 534 SUNC
- 536 WERE
- 540 GMO
- 541 KCPL
- 640 NPPD
- 645 OPPD
- 650 LES
- 652 WAPA

The results of the analysis determined if reactive compensation or system upgrades were required to obtain acceptable system performance. If additional reactive compensation was required, the size, type, and location were determined. The proposed reactive reinforcements would ensure the wind farm meets FERC Order 661A low voltage requirements and return the wind farm to its pre-disturbance operating voltage. If the results indicated the need for fast responding reactive support, dynamic support such as an SVC or STATCOM was investigated. If tripping of the prior queued projects was observed during the stability analysis (for under/over voltage or under/over frequency) the simulations were re-ran with the prior queued project's voltage and frequency tripping disabled.

Results

The Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019 or GEN-2013-032 at 100% output.

For the 2014 GGSSI Winter Peak case, instability was observed as a result of contingency FLT92-1PH, located in Table 2-4 of this report. No stability issues are observed if the output power of GEN-2013-021 is reduced to 125 MW.

For the 2015 GGSSI Summer Peak case, instability was observed as a result of contingency FLT91. No stability issues are observed if the output power of GEN-2013-021 is reduced to 169 MW.

Refer to Table 3-3, Table 3-4, and Table 3-5 for a summary of the Stability Analysis results for the cases listed in Table 2-4, Table 2-5, and Table 2-6.

2014 Winter Peak Summary

For the 2014 winter peak case, the Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019, GEN-2013-021, or GEN-2013-32 at 100% output. There were no low voltage recovery or stability issues observed for the winter peak conditions.

Refer to Figure 3-1 for a representative response plot of select bus voltages during Contingency #48 (FLT48-3PH) for winter peak conditions without mitigation.

2014 GGSSI Winter Peak Summary

For the 2014 GGSSI winter peak case, the Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019 or GEN-2013-032 at 100% output. There were no low voltage recovery or stability issues observed for the winter peak conditions. For GEN-2013-021 at 100% output, the Stability Analysis determined instability existed as a result of contingency FLT92-1PH, located in Table 2-4 of this report. Stability issues are corrected if the output power of GEN-2013-021 is reduced to 200 MW during this case. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 125 MW. If the full output of GEN-2013-021 is desired for the 2014 GGSSI winter peak case, reactive power solutions can be discussed.

Note that for the 2014 GGSSI Winter Peak case, a steady-state pre-project (existing) stuck breaker contingency resulted in low system voltages and system instability. The stuck breaker contingency that resulted in low system voltages and system instability was Gentleman Stuck Breaker 3322 (FLT91-1PH). The Gentleman Stuck Breaker 3322 contingency consists of applying a single phase fault at Gentleman 345 kV. The fault is applied for 16 cycles before being cleared and tripping the Gentleman to Sweetwater 345 kV line and the Gentleman to Red Willow 345 kV line.

2015 Summer Peak Summary

For the 2015 summer peak case, the Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019, GEN-2013-021, or GEN-2013-32 at 100% output. There were no low voltage recovery or stability issues observed for the summer peak conditions.

Refer to Figure 3-2 for a representative response plot of select bus voltages during Contingency #48 (FLT48-3PH) for summer peak conditions without mitigation.

2015 GGSSI Summer Peak Summary

For the 2015 GGSSI summer peak case, the Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019 or GEN-2013-032 at 100% output. There were no low voltage recovery or stability issues observed for the summer peak conditions. For GEN-2013-021 at 100% output, the Stability Analysis determined instability existed as a result of contingency FLT91-1PH, located in Table 2-4 of this report. Stability issues are corrected if the output power of GEN-2013-021 is reduced to 169 MW during this case. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 40 MW. If the full output of GEN-2013-021 is desired, reactive power solutions can be discussed.

Refer to Figure 3-3 for a representative response plot of select bus voltages and Figure 3-4 for a representative response plot of GEN-2013-021 during Contingency #91 (FLT91-1PH) for summer peak conditions without mitigation.

Refer to Figure 3-5 for a representative response plot of GEN-2013-021 and Figure 3-6 for a representative response plot of select bus voltages during Contingency #91 (FLT91-1PH) for summer peak conditions with real power output reduced to 169MW.

Refer to Figure 3-7 for a representative response plot of GEN-2013-021 and Figure 3-8 for a representative response plot of select bus voltages during Contingency #91 (FLT91-1PH) for summer peak conditions with real power output reduced to 40MW.

2024 Future Summer Peak Summary

For the 2024 future summer peak case, the Stability Analysis determined that there was no wind turbine tripping that occurs from interconnecting GEN-2013-019, GEN-2013-021, or GEN-2013-032 at 100% output. There were no low voltage recovery or stability issues observed for the future summer peak conditions.

Refer to Figure 3-9 for a representative response plot of select bus voltages during Contingency #48 (FLT48-3PH) for future summer peak conditions without mitigation.

Refer to Appendix B, C, D, E, and F for a complete list of plots for all contingencies for 2014 winter peak, 2015 summer peak, 2015 GGSSI summer peak, 2024 summer peak conditions, and 2014 GGSSI winter peak, respectively.

Table 3-3
Stability Analysis Summary of Results

Ref. No.	Casename	Winter 2014		Summer 2015		Summer 2015 GGSSI		Summer 2024		Winter 2014 GGSSI	
		Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?
1	FLT01-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2	FLT02-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
3	FLT03-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	FLT04-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	FLT05-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	FLT06-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
7	FLT07-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	FLT08-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	FLT09-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	FLT10-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	FLT11-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
12	FLT12-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
13	FLT13-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
14	FLT14-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
15	FLT15-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
16	FLT16-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
17	FLT17-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
18	FLT18-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
19	FLT19-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
20	FLT20-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
21	FLT21-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
22	FLT22-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
23	FLT23-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
24	FLT24-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
25	FLT25-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
26	FLT26-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[1] Note: Double circuit fault at Thistle 345 kV, no mitigation required. Bus voltages below 0.9 p.u.

Table 3-3 (Continued)
Stability Analysis Summary of Results

Ref. No.	Casename	Winter 2014		Summer 2015		Summer 2015 GGSSI		Summer 2024		Winter 2014 GGSSI	
		Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?
27	FLT27-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
28	FLT28-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
29	FLT29-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
30	FLT30-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
31	FLT31-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
32	FLT32-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
33	FLT33-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
34	FLT34-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
35	FLT35-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
36	FLT36-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
37	FLT37-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
38	FLT38-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
39	FLT39-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
40	FLT40-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
41	FLT41-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
42	FLT42-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
43	FLT43-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
44	FLT44-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
45	FLT45-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
46	FLT46-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
47	FLT47-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
48	FLT48-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
49	FLT49-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
50	FLT50-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
51	FLT51-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
52	FLT52-3PH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[1] Note: Double circuit fault at Thistle 345 kV, no mitigation required. Bus voltages below 0.9 p.u.

Table 3-4
Additional Stability Analysis Results for the 2024 Future Summer Peak Season

Ref. No.	Casename	Summer 2024	
		Stable?	Acceptable Voltages?
1	FLT74-3PH	Yes	Yes
2	FLT75-3PH	Yes	Yes
3	FLT76-3PH	Yes	Yes
4	FLT77-3PH	Yes	Yes

Table 3-5
Additional Stability Analysis Results for the 2014 GGSI Winter Peak and 2015 GGSSI Summer Peak Seasons

Ref. No.	Casename	Summer 2015 GGSSI		Winter 2014 GGSSI	
		Stable?	Acceptable Voltages?	Stable?	Acceptable Voltages?
1	FLT78-3PH	Yes	Yes	Yes	Yes
2	FLT79-3PH	Yes	Yes	Yes	Yes
3	FLT80-3PH	Yes	Yes	Yes	Yes
4	FLT81-3PH	Yes	Yes	Yes	Yes
5	FLT82-3PH	Yes	Yes	Yes	Yes
6	FLT83-3PH	Yes	Yes	Yes	Yes
7	FLT84-3PH	Yes	Yes	Yes	Yes
8	FLT85-3PH	Yes	Yes	Yes	Yes
9	FLT86-3PH	Yes	Yes	Yes	Yes
10	FLT87-3PH	Yes	Yes	Yes	Yes
11	FLT88-3PH	Yes	Yes	Yes	Yes
12	FLT89-1PH	Yes	Yes	Yes	Yes
13	FLT90-1PH	Yes	Yes	Yes	Yes
14	FLT91-1PH	No[1]	No[1]	No	No
14A	FLT91-1PH	Yes	No[2]	No	No
14B	FLT91-1PH	Yes	Yes	-	-
14C	FLT91-1PH	-	-	No[3]	No[3]
15	FLT92-1PH	Yes	Yes	No[4]	No[4]
15A	FLT92-1PH	-	-	Yes	No[5]
15B	FLT92-1PH	-	-	Yes	Yes
16	FLT93-1PH	Yes	Yes	Yes	Yes
17	FLT94-1PH	Yes	Yes	Yes	Yes
18	FLT95-1PH	Yes	Yes	Yes	Yes
19	FLT96-1PH	Yes	Yes	Yes	Yes
20	FLT97-1PH	Yes	Yes	Yes	Yes
21	FLT98-1PH	Yes	Yes	Yes	Yes
22	FLT99-1PH	Yes	Yes	Yes	Yes
23	FLT100-1PH	Yes	Yes	Yes	Yes
24	FLT101-1PH	Yes	Yes	Yes	Yes
25	FLT102-1PH	Yes	Yes	Yes	Yes
26	FLT103-1PH	Yes	Yes	Yes	Yes
27	FLT104-1PH	Yes	Yes	Yes	Yes
28	FLT105-1PH	Yes	Yes	Yes	Yes

[1] Gentleman Stuck Breaker 3322 (FLT91-1PH), stability is achieved if real power of GEN-2013-021 is reduced to 169MW.

[2] Gentleman Stuck Breaker 3322 (FLT91-1PH), stability and acceptable voltages are achieved if real power of GEN-2013-021 is reduced to 40MW.

[3] The pre-existing stuck breaker contingency that resulted in low system voltages and system instability was Gentleman Stuck Breaker 3322 (FLT91-1PH).

[4] Gentleman Stuck Breaker 3316 (FLT92-1PH), stability is achieved if real power of GEN-2013-021 is reduced to 200 MW.

[5] Gentleman Stuck Breaker 3316 (FLT92-1PH), stability and acceptable voltages are achieved if real power of GEN-2013-021 is reduced to 125 MW.

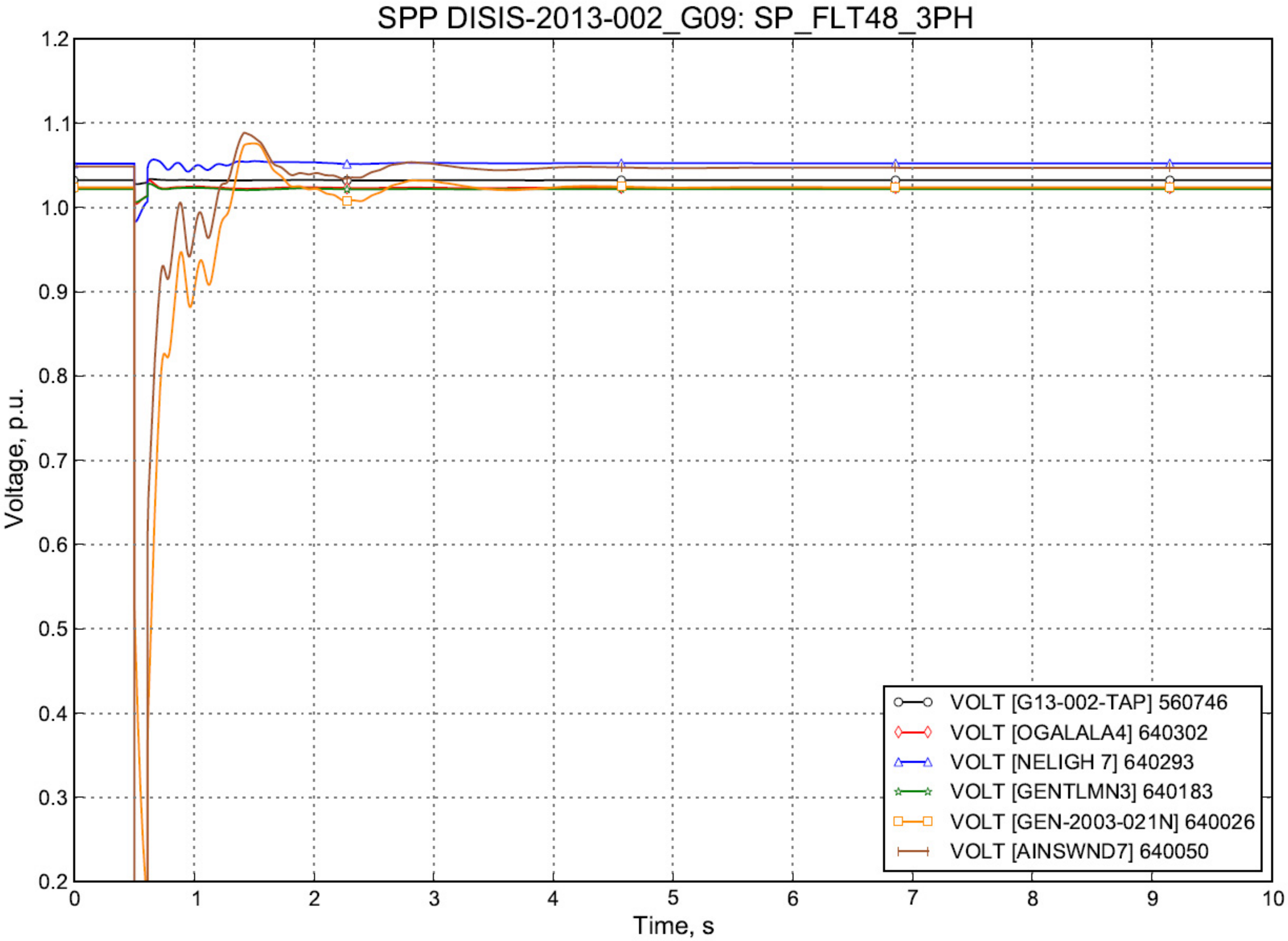

Figure 3-1. Response of select bus voltages during Contingency #48 (FLT048-3PH) for 2014 winter peak conditions.

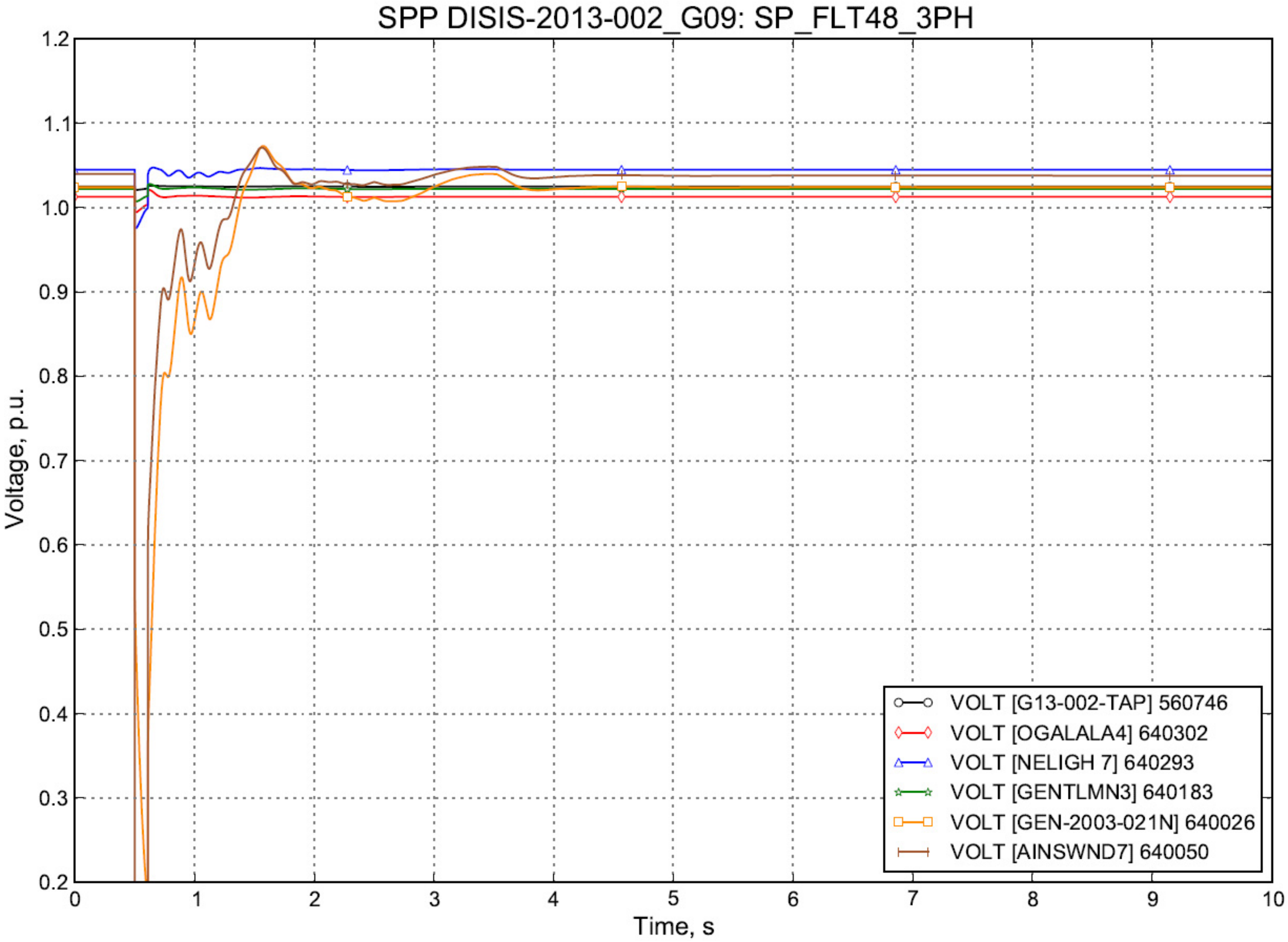

Figure 3-2. Response of select bus voltages during Contingency #48 (FLT048-3PH) for 2015 summer peak conditions.

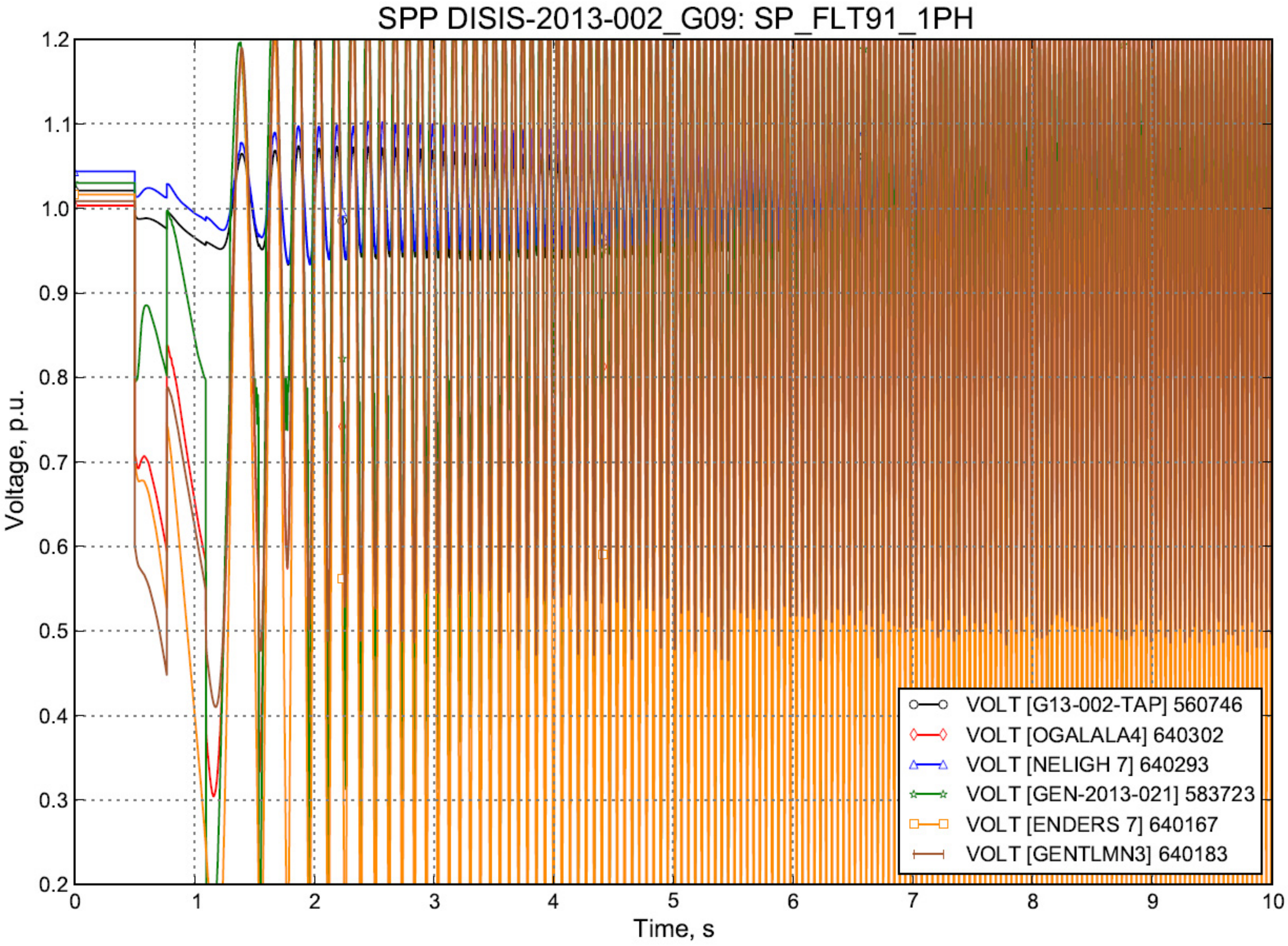

Figure 3-3. Response of select bus voltages during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions.

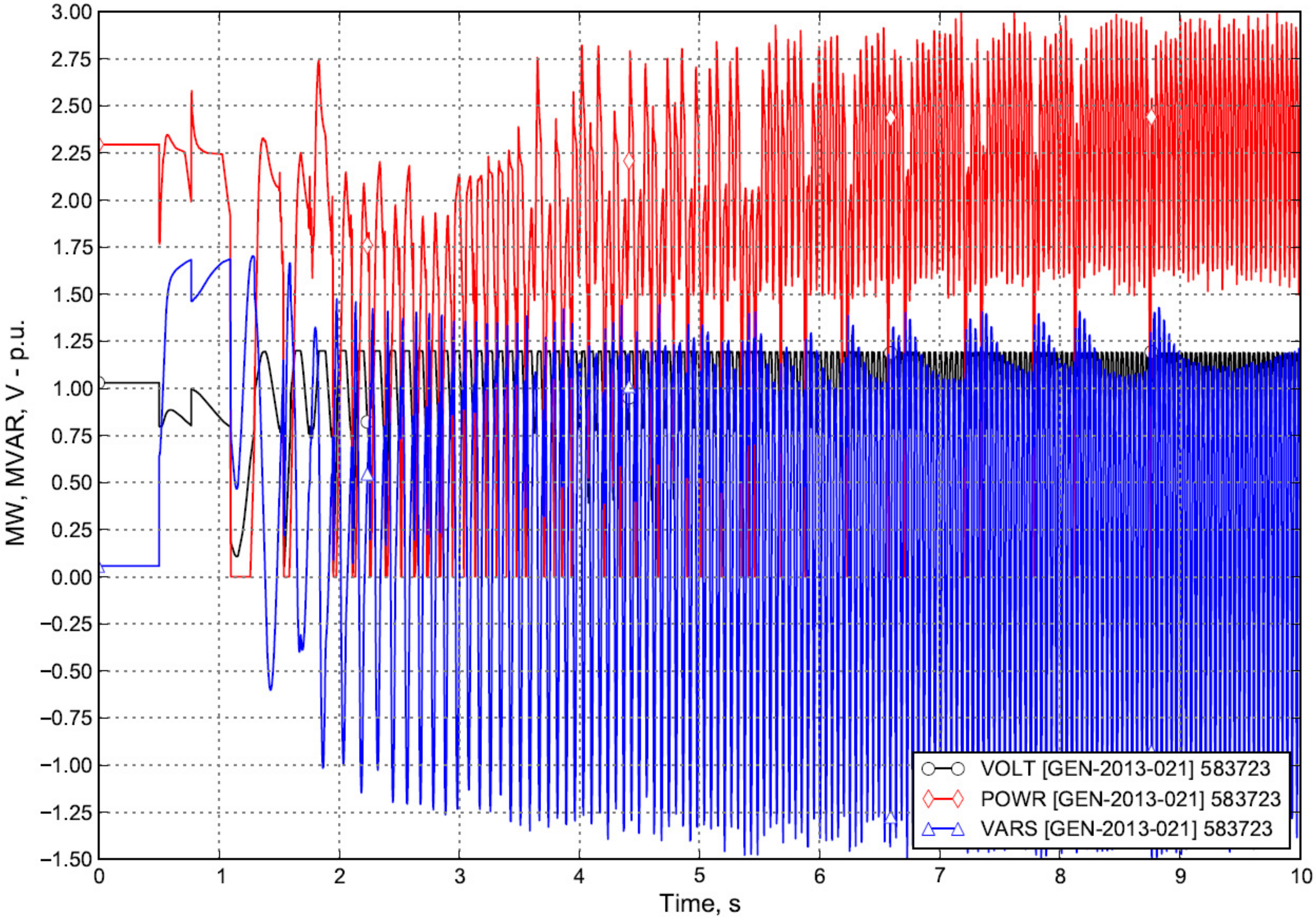

Figure 3-4. Response of GEN-013-021 during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions.

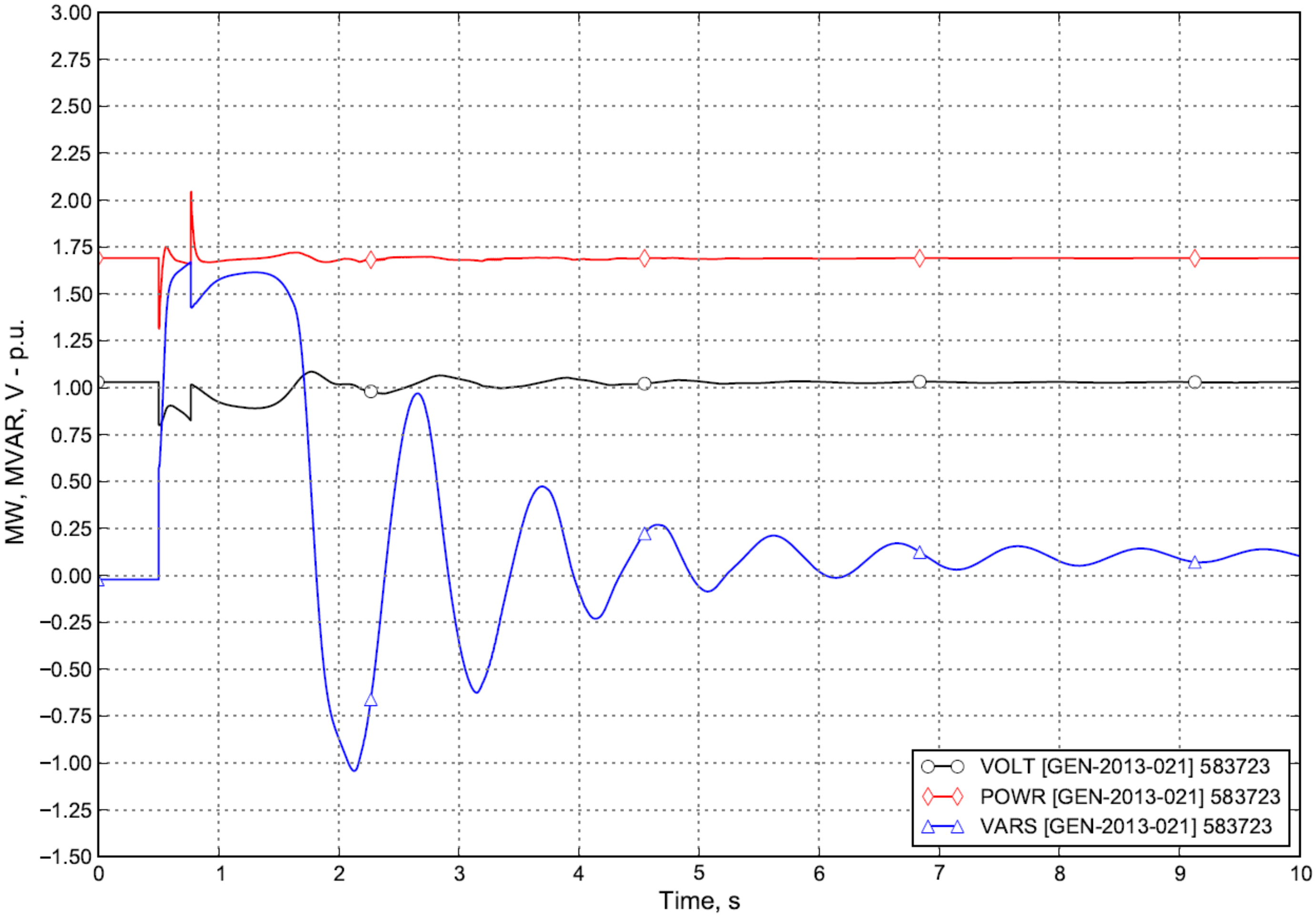

Figure 3-5. Response of GEN-2013-021 during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions with real power output reduced to 169MW.

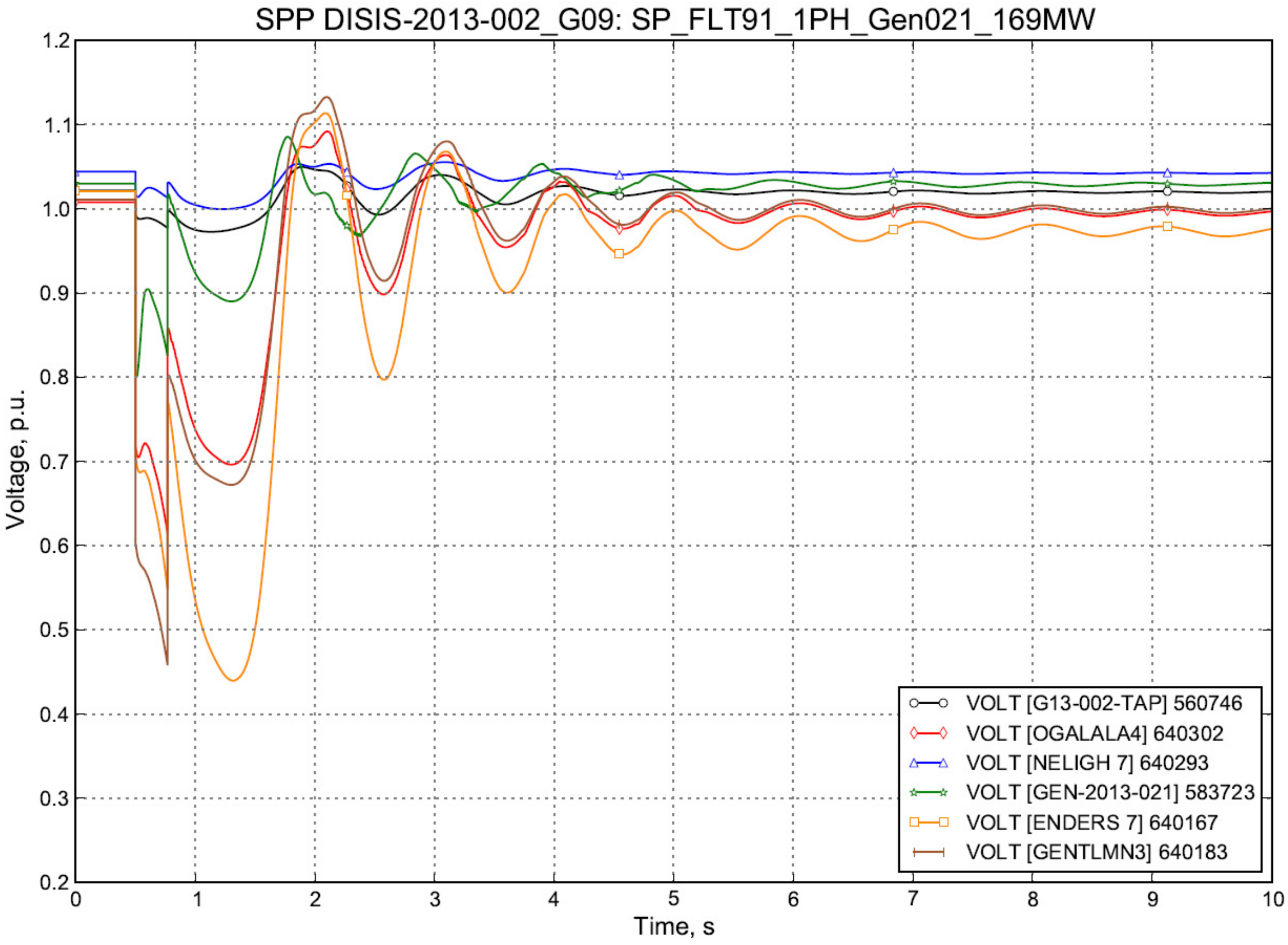

Figure 3-6. Response of select bus voltages during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions with real power output reduced to 169MW.

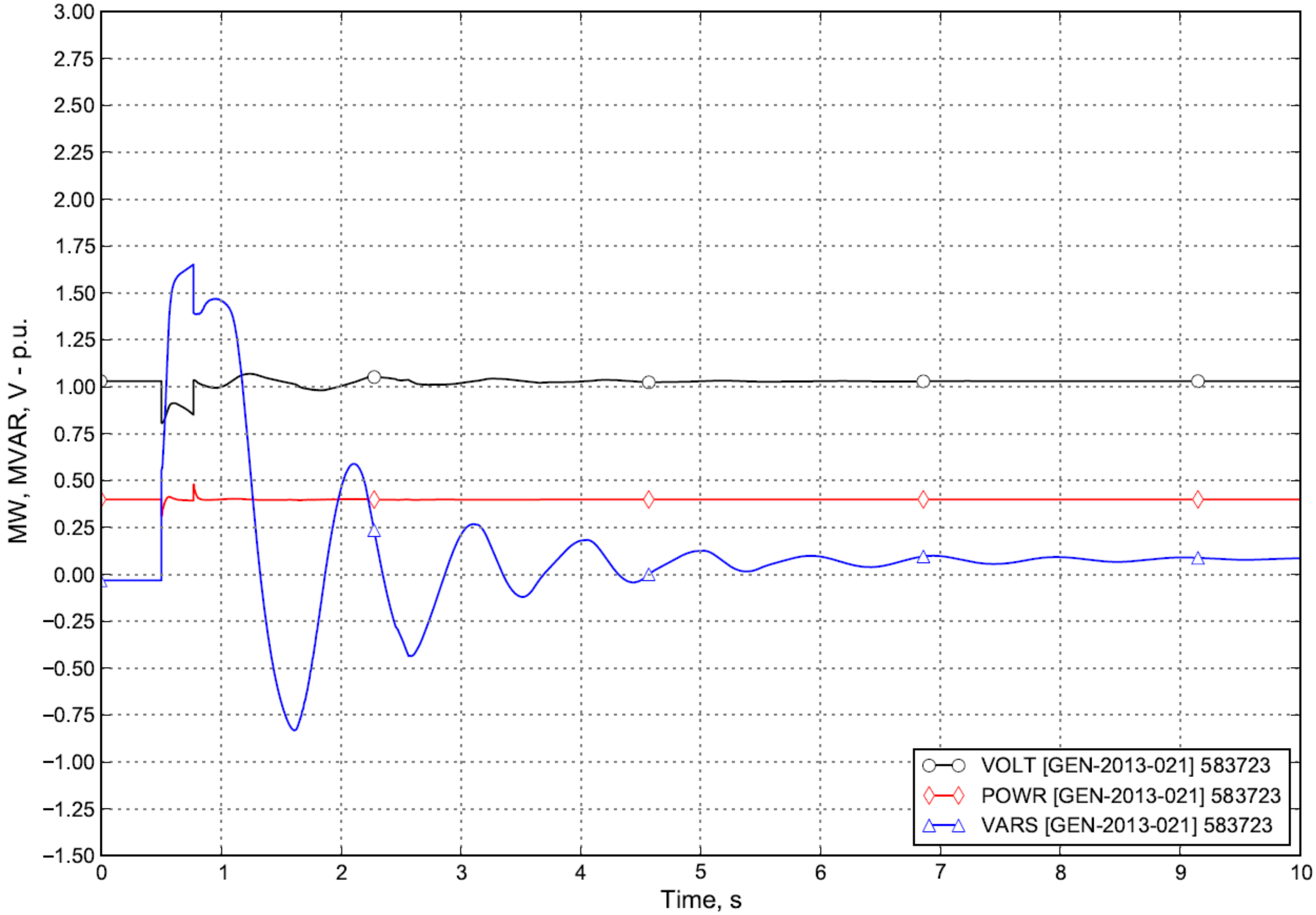

Figure 3-7. Response of GEN-2013-021 during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions with real power output reduced to 40MW.

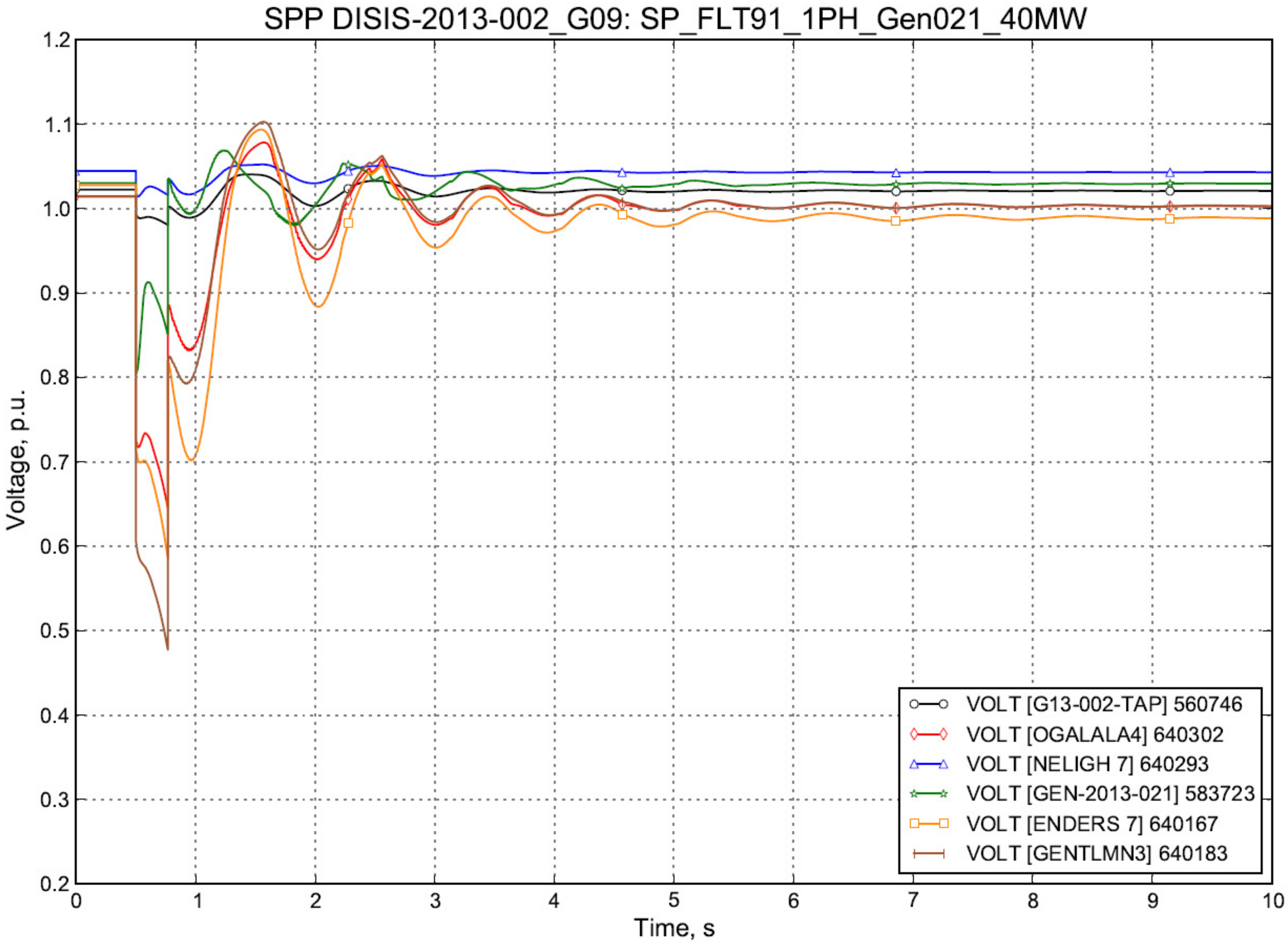

Figure 3-8. Response of select bus voltages during Contingency #91 (FLT91-3PH) for 2015 GGSSI summer peak conditions with real power output reduced to 40MW.

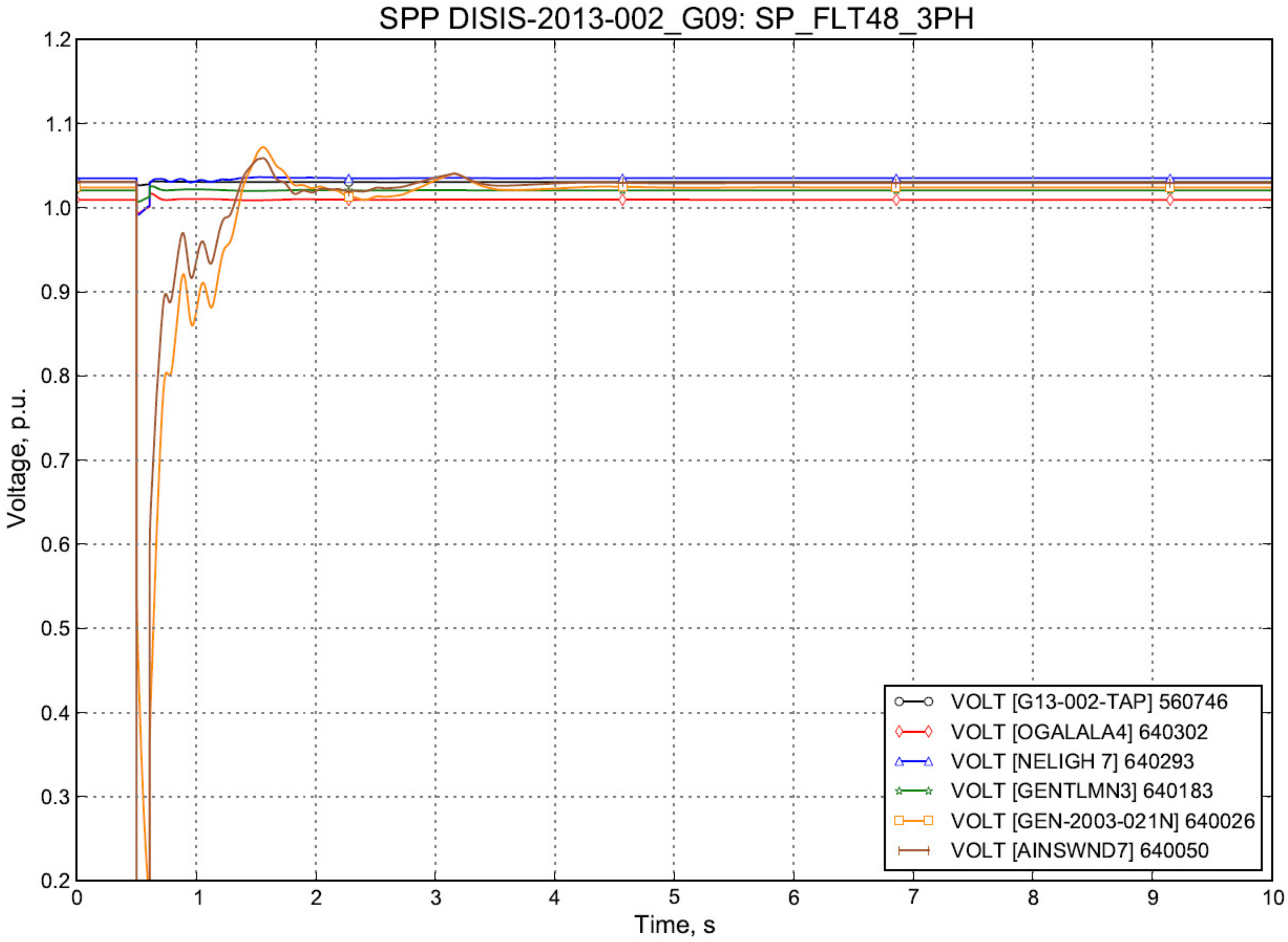

Figure 3-9. Response of select bus voltages during Contingency #48 (FLT048-3PH) for 2024 summer peak conditions.

SECTION 4: POWER FACTOR ANALYSIS

The objective of this task is to quantify the power factor at the point of interconnection for the wind farms during base case and system contingencies. SPP transmission planning practice requires interconnecting generation projects to maintain the power factor (pf) at the Point of Interconnection (POI) near unity for system intact conditions and within +/- 0.95 pf for post-contingency conditions. This is analyzed by having the wind farm maintain a prescribed voltage schedule at the point of interconnection of 1.0 p.u. voltage, or if the pre-project voltage is higher than 1.0 p.u., to maintain the pre-project voltage schedule.

The winter peak and summer peak power flows provided by SPP were examined prior to the Power Factor Analysis to ensure they contained the proposed study project modeled at 100% of the nameplate rating and any previously queued projects listed in Table 2-2, as well as WAPA generators listed in Table 2-3. There was no suspect power flow data in the study area. The proposed study project was turned off during the power factor analysis. The wind farm was then replaced by a generator modeled at the high side bus with the same real power (MW) capability as the wind farm and open limits for the reactive power set point (Mvar). The generator was set to hold the POI scheduled bus voltage. Contingencies from the three-phase fault definitions provided in Table 2-3, Table 2-4, and Table 2-5 were then applied and the reactive power required to maintain the bus voltage was recorded.

Approach

The study projects (GEN-2013-019, GEN-2013-021, GEN-2013-032) were disabled individually and a generator was placed at the wind farm's substation high side bus. The generator created for GEN-2013-019 was modeled with PGEN = 73.6 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. The generator created for GEN-2013-021 was modeled with PGEN = 229.5 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. The generator created for GEN-2013-032 was modeled with PGEN = 204.0 MW, QMin = -9999 Mvar, and QMax = 9999 Mvar. All buses and transformers connected from the study project's high side bus to the respective generator were disabled.

The pre-project voltage for the GEN-2013-019 generator Power Factor Analysis at the POI (Tap Sheldon-Folsom - Pleasant Hill 115kV) was 1.03225 p.u. for winter peak 2014 conditions, 1.02522 p.u. for winter peak 2014 GGSSI conditions, 1.02478 p.u. for summer peak 2015 conditions, 1.02117 p.u. for summer peak 2015 GGSSI conditions, and 1.03037 p.u. for summer peak 2024 conditions. The pre-project voltage for the GEN-2013-021 generator Power Factor Analysis at POI (Ogallala 230kV) was 1.02323 p.u. for winter peak 2014 conditions, 1.00857 for winter peak 2014 GGSSI conditions, 1.01257 p.u. for summer peak 2015 conditions, 1.00322 p.u. for summer peak 2015 GGSSI conditions, and 1.00938 p.u. for summer peak 2024 conditions. The pre-project voltage for the GEN-2013-032 generator Power Factor Analysis at the POI (Neligh 115kV) was 1.05198 p.u. for winter peak 2014 conditions, 1.05088 p.u. for winter peak 2014 GGSSI conditions, 1.04479 p.u. for summer peak 2015 conditions, 1.04371 p.u. for summer peak 2015 GGSSI conditions, and 1.03487 p.u. for summer peak 2024 conditions.

The reactive compensation required to off-set the charging of the collector system and lead line was calculated by modeling GEN-2013-021 off-line and calculating the size of reactors placed at the 34.5kV collector buses which would result in zero VAR flow at the 230kV POI. This reactive compensation was not included, that is it was modeled off-line, in the calculation of reactive requirements for the base case or contingency conditions studied.

Results

The power factor was calculated for 2014 winter peak, 2014 GGSSI winter peak, 2015 summer peak, 2015 GGSSI summer peak, and 2015 future summer peak conditions. Table 4-1, Table 4-2, and Table 4-3 shows the power factor results for GEN-2013-019, GEN-2013-021, GEN-2013-032 respectively. Note that a positive Q (Mvar) output illustrates that the generator is absorbing reactive power from the system, implying a leading power factor; a negative Q (Mvar) illustrates that the generator is supplying reactive power to the system, implying a lagging power factor. The Power Factor Analysis shows that GEN-2013-019 has a power factor range of 0.944 lagging (supplying) to 0.965 leading (absorbing). The Power Factor Analysis shows that GEN-2013-021 has a power factor range of 0.894 lagging (supplying) to 0.979 leading (absorbing). The Power Factor Analysis shows that GEN-2013-032 has a power factor range of 0.999 leading (absorbing) to 0.977 leading (absorbing).

The reactive compensation required to off-set the charging of the collector system and lead line was calculated by modeling GEN-2013-021 off-line and calculating the amount of inductive capacity required at the 34.5kV collector buses which would result in zero VAR flow at the 230kV POI. The results are shown in Figure 4-1. A total of 24.5 MVAR of inductive support would be needed to off-set the line charging of the 34.5kV collector system and the 230kV lead line. This reactive compensation was not included, modeled off-line, in the calculation of reactive requirements for the base case or contingency conditions studied. This analysis was completed for all study generators which interconnects to a 345kV or 230kV bus, for this study only GEN-2013-021 was analyzed.

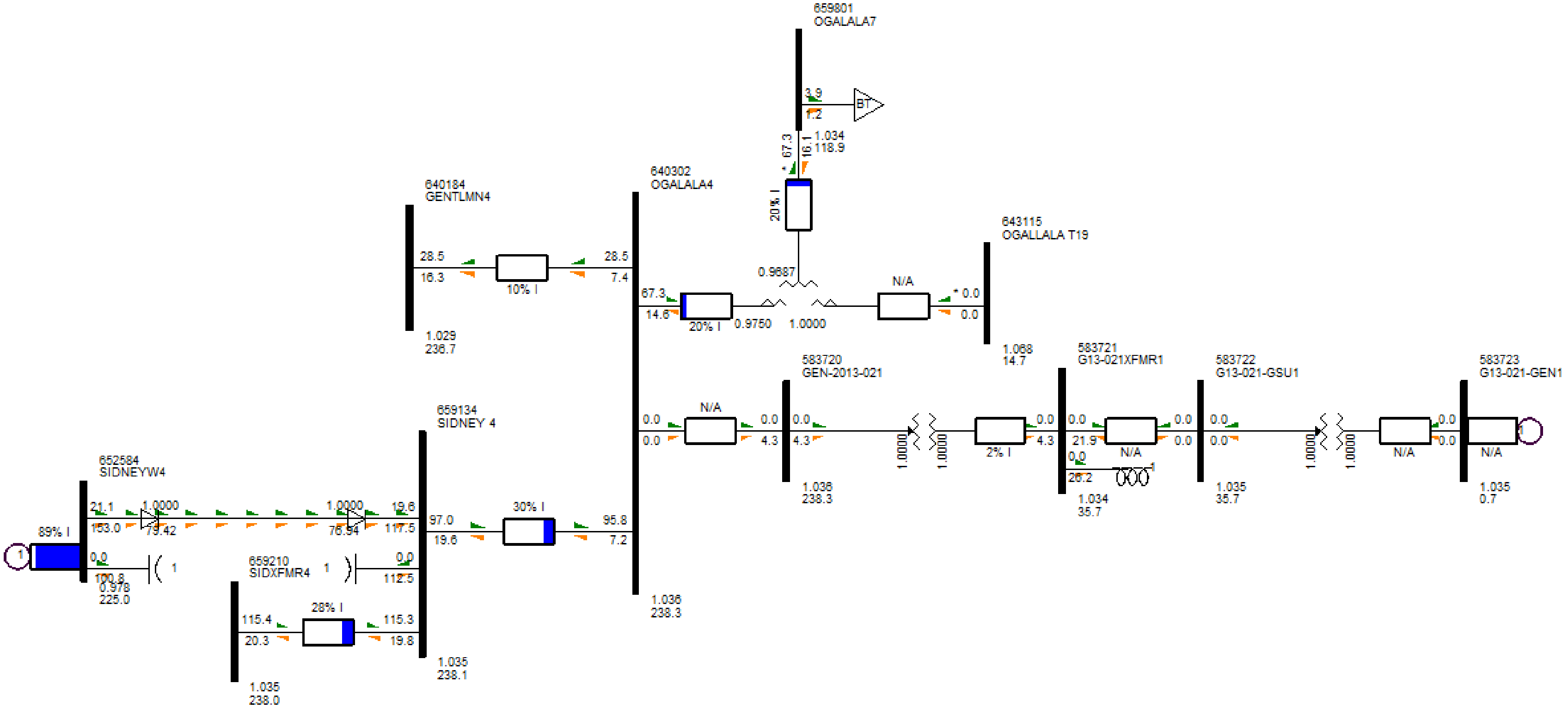

Figure 4-1. Power flow one-line diagram for illustrating the amount of reactive compensation required to off-set the charging of the GEN-2013-021 collector system

Table 4-1
Power Factor Analysis: GEN-2013-019 (P_{GEN}=73.6 MW)*

Power Factor Analysis

Power Factor Analysis: GEN-2013-019 (P_{GEN} = 73.6 MW)

Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
Base	0.9891	Leading	10.94	0.9930	Leading	8.77	0.9933	Leading	8.54	0.9950	Leading	7.39	0.9903	Leading	10.32
C1	1.0000	Lagging	-0.50	0.9997	Lagging	-1.75	0.9999	Lagging	-1.23	0.9996	Lagging	-2.19	0.9996	Lagging	-2.01
C2	0.9829	Leading	13.79	0.9862	Leading	12.34	0.9892	Leading	10.92	0.9894	Leading	10.82	0.9830	Leading	13.74
C3	0.9956	Leading	6.94	0.9997	Leading	1.93	0.9997	Leading	1.92	1.0000	Lagging	-0.11	0.9960	Leading	6.56
C4	0.9800	Leading	14.96	0.9847	Leading	13.01	0.9928	Leading	8.90	0.9944	Leading	7.82	0.9899	Leading	10.52
C5	0.9891	Leading	10.94	0.9962	Leading	6.45	0.9965	Leading	6.18	0.9983	Leading	4.35	0.9903	Leading	10.30
C6	0.9723	Leading	17.68	0.9774	Leading	15.92	0.9785	Leading	15.51	0.9799	Leading	14.98	0.9653	Leading	19.92
C7	0.9856	Leading	12.61	0.9898	Leading	10.61	0.9925	Leading	9.08	0.9932	Leading	8.60	0.9858	Leading	12.52
C8	0.9874	Leading	11.80	0.9911	Leading	9.88	0.9935	Leading	8.43	0.9950	Leading	7.35	0.9917	Leading	9.53
C9	0.9900	Leading	10.50	0.9937	Leading	8.30	0.9941	Leading	8.06	0.9956	Leading	6.90	0.9912	Leading	9.84
C10	0.9896	Leading	10.68	0.9932	Leading	8.65	0.9963	Leading	6.39	0.9971	Leading	5.60	0.9925	Leading	9.04
C11	0.9944	Leading	7.84	0.9975	Leading	5.18	0.9973	Leading	5.47	0.9985	Leading	4.01	0.9949	Leading	7.46
C12	0.9941	Leading	8.03	0.9973	Leading	5.38	0.9971	Leading	5.61	0.9984	Leading	4.16	0.9947	Leading	7.60
C13	0.9921	Leading	9.30	0.9947	Leading	7.61	0.9975	Leading	5.17	0.9979	Leading	4.77	0.9923	Leading	9.17
C14	0.9901	Leading	10.44	0.9934	Leading	8.48	0.9947	Leading	7.62	0.9959	Leading	6.66	0.9910	Leading	9.92
C15	0.9880	Leading	11.49	0.9921	Leading	9.29	0.9934	Leading	8.49	0.9951	Leading	7.34	0.9907	Leading	10.11
C16	0.9958	Leading	6.81	0.9997	Leading	1.75	0.9979	Leading	4.73	0.9993	Leading	2.67	0.9989	Leading	3.44
C17	0.9986	Leading	3.93	0.9987	Leading	3.77	0.9961	Leading	6.49	0.9952	Leading	7.27	0.9877	Leading	11.63
C18	0.9978	Leading	4.88	0.9986	Leading	3.88	0.9994	Leading	2.51	0.9994	Leading	2.63	0.9975	Leading	5.23
C19	0.9935	Leading	8.43	0.9968	Leading	5.90	0.9968	Leading	5.94	0.9975	Leading	5.17	0.9940	Leading	8.10
C20	0.9959	Leading	6.72	0.9998	Leading	1.62	0.9971	Leading	5.65	0.9989	Leading	3.39	0.9948	Leading	7.50
C21	0.9892	Leading	10.92	0.9932	Leading	8.62	0.9934	Leading	8.53	0.9950	Leading	7.39	0.9904	Leading	10.25
C22	0.9889	Leading	11.05	0.9932	Leading	8.64	0.9932	Leading	8.63	0.9949	Leading	7.48	0.9903	Leading	10.34
C23	0.9903	Leading	10.31	0.9972	Leading	5.54	0.9957	Leading	6.83	0.9982	Leading	4.40	0.9919	Leading	9.40
C24	0.9949	Leading	7.45	0.9994	Leading	2.52	0.9992	Leading	3.00	0.9997	Leading	1.88	0.9977	Leading	5.04
C25	0.9965	Leading	6.15	1.0000	Lagging	-0.46	0.9984	Leading	4.13	0.9996	Leading	1.99	0.9952	Leading	7.24
C26	0.9967	Leading	6.03	0.9905	Lagging	-10.21	0.9990	Leading	3.21	0.9994	Lagging	-2.53	0.9949	Leading	7.48
C27	0.9994	Leading	2.45	0.9436	Lagging	-25.83	0.9993	Leading	2.73	0.9957	Lagging	-6.88	0.9949	Leading	7.48
C28	0.9884	Leading	11.33	0.9925	Leading	9.10	0.9929	Leading	8.82	0.9945	Leading	7.76	0.9900	Leading	10.49

*The scheduled voltage for the POI (Tap Sheldon-Folsom - Pleasant Hill 115kV) was 1.03225 p.u. for winter peak 2014 conditions, 1.02522 for winter peak 2014 GGSSI conditions, 1.02478 p.u. for summer peak 2015 conditions, 1.02117 p.u. for summer peak 2015 GGSSI conditions, and 1.03037 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-1 (Continued)
Power Factor Analysis: GEN-2013-019 (P_{GEN}=73.6 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-019 (P_{GEN} = 73.6 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C29	0.9891	Leading	10.94	0.9931	Leading	8.70	0.9935	Leading	8.46	0.9951	Leading	7.29	0.9905	Leading	10.22
C30	0.9891	Leading	10.94	0.9931	Leading	8.66	0.9936	Leading	8.38	0.9953	Leading	7.16	0.9908	Leading	10.03
C31	0.9892	Leading	10.91	0.9930	Leading	8.73	0.9934	Leading	8.52	0.9950	Leading	7.39	0.9904	Leading	10.25
C32	0.9892	Leading	10.91	0.9931	Leading	8.67	0.9934	Leading	8.48	0.9952	Leading	7.26	0.9905	Leading	10.23
C33	0.9893	Leading	10.87	0.9932	Leading	8.61	0.9934	Leading	8.50	0.9951	Leading	7.32	0.9904	Leading	10.28
C34	0.9891	Leading	10.94	0.9930	Leading	8.73	0.9934	Leading	8.53	0.9950	Leading	7.37	0.9904	Leading	10.25
C35	0.9891	Leading	10.94	0.9930	Leading	8.76	0.9933	Leading	8.58	0.9950	Leading	7.38	0.9904	Leading	10.28
C36	0.9892	Leading	10.92	0.9933	Leading	8.58	0.9932	Leading	8.63	0.9949	Leading	7.49	0.9903	Leading	10.32
C37	0.9894	Leading	10.81	0.9930	Leading	8.73	0.9933	Leading	8.54	0.9949	Leading	7.46	0.9899	Leading	10.52
C38	0.9909	Leading	10.00	0.9950	Leading	7.38	0.9946	Leading	7.65	0.9961	Leading	6.49	0.9904	Leading	10.26
C39	0.9894	Leading	10.81	0.9933	Leading	8.58	0.9934	Leading	8.51	0.9951	Leading	7.32	0.9904	Leading	10.26
C40	0.9889	Leading	11.05	0.9928	Leading	8.89	0.9929	Leading	8.79	0.9947	Leading	7.60	0.9905	Leading	10.20
C41	0.9900	Leading	10.50	0.9939	Leading	8.16	0.9939	Leading	8.16	0.9956	Leading	6.94	0.9909	Leading	10.02
C42	0.9892	Leading	10.90	0.9934	Leading	8.52	0.9931	Leading	8.72	0.9946	Leading	7.67	0.9899	Leading	10.54
C43	0.9902	Leading	10.37	0.9943	Leading	7.89	0.9932	Leading	8.63	0.9950	Leading	7.41	0.9904	Leading	10.28
C44	0.9891	Leading	10.97	0.9931	Leading	8.72	0.9935	Leading	8.45	0.9952	Leading	7.25	0.9904	Leading	10.29
C45	0.9899	Leading	10.56	0.9937	Leading	8.29	0.9938	Leading	8.23	0.9954	Leading	7.10	0.9904	Leading	10.26
C46	0.9916	Leading	9.63	0.9953	Leading	7.17	0.9942	Leading	7.94	0.9957	Leading	6.84	0.9907	Leading	10.11
C47	0.9892	Leading	10.91	0.9931	Leading	8.66	0.9932	Leading	8.61	0.9949	Leading	7.49	0.9908	Leading	10.05
C48	0.9894	Leading	10.82	0.9938	Leading	8.24	0.9933	Leading	8.53	0.9951	Leading	7.29	0.9904	Leading	10.27
C49	0.9904	Leading	10.25	0.9944	Leading	7.79	0.9939	Leading	8.18	0.9955	Leading	7.05	0.9910	Leading	9.95
C50	0.9953	Leading	7.18	0.9995	Leading	2.35	0.9975	Leading	5.26	0.9991	Leading	3.07	0.9928	Leading	8.89
C51	0.9912	Leading	9.84	0.9954	Leading	7.09	0.9953	Leading	7.13	0.9969	Leading	5.81	0.9933	Leading	8.55
C52	0.9928	Leading	8.88	0.9965	Leading	6.20	0.9962	Leading	6.48	0.9971	Leading	5.60	0.9925	Leading	9.08
C53	0.9891	Leading	10.95	0.9927	Leading	8.94	0.9949	Leading	7.44	0.9962	Leading	6.46	0.9933	Leading	8.58
C54	0.9970	Leading	5.69	0.9983	Leading	4.33	1.0000	Leading	0.66	1.0000	Leading	0.14	0.9999	Leading	1.15
C55	0.9485	Lagging	-24.57	0.9696	Lagging	-18.57	0.9929	Lagging	-8.83	0.9976	Lagging	-5.06	0.9925	Lagging	-9.07
C56	0.9893	Leading	10.83	0.9935	Leading	8.44	0.9938	Leading	8.25	0.9956	Leading	6.94	0.9912	Leading	9.80

*The scheduled voltage for the POI (Tap Sheldon-Folsom - Pleasant Hill 115kV) was 1.03225 p.u. for winter peak 2014 conditions, 1.02522 for winter peak 2014 GGSSI conditions, 1.02478 p.u. for summer peak 2015 conditions, 1.02117 p.u. for summer peak 2015 GGSSI conditions, and 1.03037 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-1 (Continued)
Power Factor Analysis: GEN-2013-019 (P_{GEN}=73.6 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-019 (P_{GEN} = 73.6 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C57	0.9892	Leading	10.88	0.9938	Leading	8.21	0.9933	Leading	8.54	0.9951	Leading	7.35	0.9903	Leading	10.35
C58	0.9891	Leading	10.94	0.9930	Leading	8.77	0.9933	Leading	8.54	0.9950	Leading	7.39	0.9903	Leading	10.32
C59	0.9896	Leading	10.67	0.9937	Leading	8.33	0.9936	Leading	8.36	0.9953	Leading	7.15	0.9906	Leading	10.18
C60	0.9991	Lagging	-3.07	0.9974	Lagging	-5.28	0.9999	Lagging	-1.23	0.9996	Lagging	-2.19	0.9996	Lagging	-2.01
C61	0.9894	Leading	10.82	0.9928	Leading	8.86	0.9933	Leading	8.54	0.9950	Leading	7.39	0.9903	Leading	10.32
C62	0.9894	Leading	10.82	0.9928	Leading	8.86	0.9933	Leading	8.54	0.9950	Leading	7.39	0.9903	Leading	10.32
C63	0.9904	Leading	10.27	0.9944	Leading	7.85	0.9940	Leading	8.11	0.9957	Leading	6.87	0.9909	Leading	10.02
C64	0.9904	Leading	10.27	0.9944	Leading	7.85	0.9940	Leading	8.11	0.9957	Leading	6.87	0.9909	Leading	10.02
C65	0.9890	Leading	11.03	0.9933	Leading	8.53	0.9932	Leading	8.60	0.9948	Leading	7.52	0.9904	Leading	10.29
C66	0.9892	Leading	10.88	0.9938	Leading	8.21	0.9933	Leading	8.54	0.9951	Leading	7.35	0.9903	Leading	10.35
C67	0.9883	Leading	11.37	0.9920	Leading	9.36	0.9938	Leading	8.24	0.9946	Leading	7.69	0.9904	Leading	10.28
C74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9909	Leading	10.00
C75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9931	Leading	8.69
C76	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9928	Leading	8.89
C77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9918	Leading	9.50
C78	N/A	N/A	N/A	1.00	Leading	0.59	N/A	N/A	N/A	0.9987	Leading	3.79	N/A	N/A	N/A
C79	N/A	N/A	N/A	1.00	Leading	2.25	N/A	N/A	N/A	0.9973	Leading	5.46	N/A	N/A	N/A
C80	N/A	N/A	N/A	1.00	Leading	6.41	N/A	N/A	N/A	0.9975	Leading	5.19	N/A	N/A	N/A
C81	N/A	N/A	N/A	0.99	Leading	11.30	N/A	N/A	N/A	0.9930	Leading	8.76	N/A	N/A	N/A
C82	N/A	N/A	N/A	0.99	Leading	10.14	N/A	N/A	N/A	0.9924	Leading	9.12	N/A	N/A	N/A
C83	N/A	N/A	N/A	1.00	Lagging	-0.76	N/A	N/A	N/A	0.9989	Leading	3.40	N/A	N/A	N/A
C84	N/A	N/A	N/A	0.99	Leading	8.42	N/A	N/A	N/A	0.9952	Leading	7.22	N/A	N/A	N/A
C85	N/A	N/A	N/A	0.99	Leading	8.64	N/A	N/A	N/A	0.9949	Leading	7.48	N/A	N/A	N/A
C86	N/A	N/A	N/A	0.99	Leading	9.10	N/A	N/A	N/A	0.9953	Leading	7.18	N/A	N/A	N/A
C87	N/A	N/A	N/A	0.99	Leading	8.27	N/A	N/A	N/A	0.9951	Leading	7.35	N/A	N/A	N/A
C88	N/A	N/A	N/A	0.99	Leading	8.27	N/A	N/A	N/A	0.9951	Leading	7.35	N/A	N/A	N/A

*The scheduled voltage for the POI (Tap Sheldon-Folsom - Pleasant Hill 115kV) was 1.03225 p.u. for winter peak 2014 conditions, 1.02522 for winter peak 2014 GGSSI conditions, 1.02478 p.u. for summer peak 2015 conditions, 1.02117 p.u. for summer peak 2015 GGSSI conditions, and 1.03037 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-2
Power Factor Analysis: GEN-2013-021 (P_{GEN}=229.5 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-021 (P_{GEN} = 229.5 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
Base	0.9876	Leading	36.45	0.9961	Leading	20.42	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C1	0.9876	Leading	36.48	0.9961	Leading	20.46	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C2	0.9877	Leading	36.36	0.9961	Leading	20.24	0.9939	Leading	25.44	0.9975	Leading	16.11	0.9954	Leading	22.11
C3	0.9877	Leading	36.30	0.9962	Leading	20.08	0.9939	Leading	25.40	0.9976	Leading	15.87	0.9954	Leading	22.11
C4	0.9879	Leading	36.09	0.9963	Leading	19.79	0.9939	Leading	25.40	0.9976	Leading	15.83	0.9955	Leading	21.79
C5	0.9876	Leading	36.41	0.9961	Leading	20.28	0.9939	Leading	25.48	0.9975	Leading	16.14	0.9954	Leading	22.19
C6	0.9875	Leading	36.57	0.9960	Leading	20.62	0.9938	Leading	25.64	0.9975	Leading	16.32	0.9953	Leading	22.36
C7	0.9877	Leading	36.40	0.9961	Leading	20.30	0.9939	Leading	25.46	0.9975	Leading	16.14	0.9954	Leading	22.11
C8	0.9876	Leading	36.43	0.9961	Leading	20.38	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C9	0.9876	Leading	36.45	0.9961	Leading	20.41	0.9939	Leading	25.54	0.9975	Leading	16.20	0.9953	Leading	22.22
C10	0.9877	Leading	36.41	0.9961	Leading	20.39	0.9939	Leading	25.49	0.9975	Leading	16.14	0.9953	Leading	22.22
C11	0.9877	Leading	36.40	0.9961	Leading	20.26	0.9939	Leading	25.50	0.9975	Leading	16.16	0.9954	Leading	22.21
C12	0.9877	Leading	36.40	0.9961	Leading	20.27	0.9939	Leading	25.51	0.9975	Leading	16.16	0.9954	Leading	22.21
C13	0.9877	Leading	36.32	0.9962	Leading	20.04	0.9940	Leading	25.16	0.9977	Leading	15.56	0.9954	Leading	22.19
C14	0.9876	Leading	36.45	0.9961	Leading	20.40	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9954	Leading	22.20
C15	0.9876	Leading	36.44	0.9961	Leading	20.39	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.21
C16	0.9879	Leading	36.06	0.9967	Leading	18.82	0.9937	Leading	25.98	0.9977	Leading	15.54	0.9957	Leading	21.36
C17	0.9876	Leading	36.47	0.9987	Leading	11.87	0.9947	Leading	23.64	0.9988	Leading	11.13	0.9973	Leading	16.87
C18	0.9888	Leading	34.60	0.9992	Leading	9.26	0.9943	Leading	24.52	0.9985	Leading	12.71	0.9961	Leading	20.38
C19	0.9877	Leading	36.35	0.9962	Leading	20.04	0.9939	Leading	25.52	0.9975	Leading	16.18	0.9953	Leading	22.23
C20	0.9879	Leading	36.06	0.9969	Leading	18.20	0.9939	Leading	25.38	0.9977	Leading	15.60	0.9955	Leading	21.90
C21	0.9941	Leading	24.97	0.9992	Leading	8.91	0.9983	Leading	13.25	1.0000	Leading	0.75	0.9995	Leading	7.58
C22	0.9976	Leading	15.81	0.9998	Lagging	-5.03	0.9995	Lagging	-7.02	0.9952	Lagging	-22.52	0.9990	Lagging	-10.47
C23	0.9922	Leading	28.77	1.0000	Leading	1.40	0.9975	Leading	16.37	0.9996	Leading	6.44	0.9973	Leading	16.93
C24	0.9926	Leading	28.14	0.9983	Lagging	-13.45	0.9975	Leading	16.12	0.9999	Leading	2.33	0.9968	Leading	18.50
C25	0.9907	Leading	31.44	0.9997	Lagging	-5.91	0.9977	Leading	15.65	1.0000	Lagging	-1.38	0.9975	Leading	16.30
C26	0.9962	Leading	20.02	0.9693	Lagging	-58.26	1.0000	Lagging	-1.57	0.9880	Lagging	-35.81	0.9996	Leading	6.61
C27	0.9945	Leading	24.18	0.9144	Lagging	-101.57	0.9982	Leading	13.86	0.9982	Lagging	-13.88	0.9977	Leading	15.60
C28	0.9946	Leading	23.88	0.9994	Leading	7.95	0.9992	Leading	9.15	0.9999	Leading	2.80	0.9990	Leading	10.39

*The scheduled voltage for the POI (Ogallala 230kV) was 1.02323 p.u. for winter peak 2014 conditions, 1.00857 p.u. for winter peak 2014 GGSSI conditions, 1.01257 p.u. for summer peak 2015 conditions, 1.00322 p.u. for summer peak 2015 GGSSI conditions, and 1.00938 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-2 (Continued)
Power Factor Analysis: GEN-2013-021 (P_{GEN}=229.5 MW)*

Power Factor Analysis

Power Factor Analysis: GEN-2013-021 (P_{GEN} = 229.5 MW)

Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C29	0.9850	Leading	40.16	0.9946	Leading	23.84	0.9979	Leading	15.05	0.9996	Leading	6.56	0.9967	Leading	18.58
C30	0.9889	Leading	34.41	0.9972	Leading	17.15	0.9923	Leading	28.57	0.9971	Leading	17.57	0.9932	Leading	26.94
C31	0.9877	Leading	36.30	0.9957	Leading	21.46	0.9925	Leading	28.34	0.9961	Leading	20.23	0.9952	Leading	22.67
C32	0.9888	Leading	34.58	0.9969	Leading	18.11	0.9967	Leading	18.68	0.9994	Leading	8.26	0.9972	Leading	17.17
C33	0.9887	Leading	34.79	0.9968	Leading	18.29	0.9934	Leading	26.50	0.9972	Leading	17.10	0.9959	Leading	20.77
C34	0.9874	Leading	36.74	0.9959	Leading	20.83	0.9939	Leading	25.40	0.9974	Leading	16.50	0.9967	Leading	18.83
C35	0.9888	Leading	34.59	0.9964	Leading	19.40	0.9993	Leading	8.70	1.0000	Leading	1.06	0.9999	Leading	2.45
C36	0.9896	Leading	33.36	0.9970	Leading	17.86	0.9997	Leading	5.52	1.0000	Lagging	-0.87	0.9989	Lagging	-10.66
C37	0.9875	Leading	36.65	0.9959	Leading	20.76	0.9938	Leading	25.58	0.9975	Leading	16.29	0.9954	Leading	22.14
C38	0.9881	Leading	35.69	0.9967	Leading	18.72	0.9938	Leading	25.69	0.9977	Leading	15.47	0.9954	Leading	22.21
C39	0.9876	Leading	36.41	0.9961	Leading	20.32	0.9939	Leading	25.53	0.9975	Leading	16.20	0.9954	Leading	22.21
C40	0.9876	Leading	36.45	0.9961	Leading	20.42	0.9939	Leading	25.57	0.9975	Leading	16.21	0.9953	Leading	22.27
C41	0.9878	Leading	36.11	0.9964	Leading	19.47	0.9939	Leading	25.38	0.9976	Leading	15.80	0.9953	Leading	22.21
C42	0.9876	Leading	36.42	0.9962	Leading	19.97	0.9939	Leading	25.40	0.9976	Leading	15.99	0.9955	Leading	21.75
C43	0.9880	Leading	35.86	0.9966	Leading	19.10	0.9940	Leading	25.34	0.9976	Leading	15.95	0.9953	Leading	22.21
C44	0.9877	Leading	36.35	0.9962	Leading	20.17	0.9940	Leading	25.36	0.9976	Leading	15.97	0.9954	Leading	22.13
C45	0.9875	Leading	36.65	0.9960	Leading	20.51	0.9938	Leading	25.67	0.9974	Leading	16.42	0.9953	Leading	22.36
C46	0.9878	Leading	36.21	0.9964	Leading	19.64	0.9939	Leading	25.45	0.9976	Leading	15.97	0.9953	Leading	22.25
C47	0.9876	Leading	36.44	0.9961	Leading	20.30	0.9939	Leading	25.42	0.9976	Leading	16.09	0.9956	Leading	21.66
C48	0.9877	Leading	36.36	0.9966	Leading	19.06	0.9938	Leading	25.65	0.9975	Leading	16.21	0.9953	Leading	22.28
C49	0.9876	Leading	36.44	0.9961	Leading	20.36	0.9939	Leading	25.45	0.9975	Leading	16.10	0.9954	Leading	22.14
C50	0.9903	Leading	32.21	0.9993	Leading	8.53	0.9971	Leading	17.45	0.9985	Leading	12.66	0.9968	Leading	18.40
C51	0.9881	Leading	35.71	0.9968	Leading	18.32	0.9943	Leading	24.53	0.9980	Leading	14.71	0.9958	Leading	21.08
C52	0.9882	Leading	35.53	0.9967	Leading	18.61	0.9939	Leading	25.54	0.9978	Leading	15.20	0.9955	Leading	21.74
C53	0.9877	Leading	36.39	0.9960	Leading	20.50	0.9943	Leading	24.71	0.9978	Leading	15.09	0.9958	Leading	21.03
C54	0.9876	Leading	36.44	0.9961	Leading	20.36	0.9939	Leading	25.53	0.9975	Leading	16.19	0.9953	Leading	22.24
C55	0.9871	Leading	37.30	0.9956	Leading	21.64	0.9937	Leading	25.95	0.9974	Leading	16.52	0.9952	Leading	22.66
C56	0.9909	Leading	31.11	0.9955	Leading	21.86	0.9836	Leading	42.02	0.9854	Leading	39.60	0.9792	Leading	47.51

*The scheduled voltage for the POI (Ogallala 230kV) was 1.02323 p.u. for winter peak 2014 conditions, 1.00857 p.u. for winter peak 2014 GGSSI conditions, 1.01257 p.u. for summer peak 2015 conditions, 1.00322 p.u. for summer peak 2015 GGSSI conditions, and 1.00938 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-2 (Continued)
Power Factor Analysis: GEN-2013-021 (P_{GEN}=229.5 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-021 (P_{GEN} = 229.5 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C57	0.9882	Leading	35.54	0.9974	Leading	16.65	0.9942	Leading	24.79	0.9978	Leading	15.16	0.9961	Leading	20.22
C58	0.9876	Leading	36.45	0.9961	Leading	20.42	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C59	0.9877	Leading	36.35	0.9962	Leading	20.12	0.9939	Leading	25.57	0.9975	Leading	16.21	0.9953	Leading	22.22
C60	0.9877	Leading	36.38	0.9961	Leading	20.28	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C61	0.9961	Leading	20.28	0.9961	Leading	20.28	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C62	0.9961	Leading	20.28	0.9961	Leading	20.28	0.9939	Leading	25.54	0.9975	Leading	16.21	0.9953	Leading	22.22
C63	0.9965	Leading	19.29	0.9965	Leading	19.29	0.9939	Leading	25.36	0.9976	Leading	15.78	0.9953	Leading	22.21
C64	0.9965	Leading	19.29	0.9965	Leading	19.29	0.9939	Leading	25.36	0.9976	Leading	15.78	0.9953	Leading	22.21
C65	0.9999	Leading	3.82	0.9993	Lagging	-8.32	0.9967	Lagging	-18.56	0.9913	Lagging	-30.51	0.9946	Lagging	-23.85
C66	0.9882	Leading	35.54	0.9974	Leading	16.65	0.9942	Leading	24.79	0.9978	Leading	15.16	0.9961	Leading	20.22
C67	0.9961	Leading	20.22	0.9961	Leading	20.22	0.9935	Leading	26.21	0.9976	Leading	16.08	0.9954	Leading	22.21
C74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9955	Leading	21.91
C75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9974	Leading	16.71
C76	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9968	Leading	18.40
C77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9956	Leading	21.50
C78	N/A	N/A	N/A	0.9842	Lagging	-41.31	N/A	N/A	N/A	0.9998	Lagging	-4.03	N/A	N/A	N/A
C79	N/A	N/A	N/A	0.9887	Lagging	-34.72	N/A	N/A	N/A	0.9997	Lagging	-5.78	N/A	N/A	N/A
C80	N/A	N/A	N/A	0.9978	Leading	15.21	N/A	N/A	N/A	0.9983	Leading	13.57	N/A	N/A	N/A
C81	N/A	N/A	N/A	0.9842	Lagging	-41.27	N/A	N/A	N/A	0.9886	Lagging	-34.88	N/A	N/A	N/A
C82	N/A	N/A	N/A	0.9019	Lagging	-109.92	N/A	N/A	N/A	0.8936	Lagging	-115.29	N/A	N/A	N/A
C83	N/A	N/A	N/A	0.9995	Leading	7.33	N/A	N/A	N/A	0.9983	Leading	13.38	N/A	N/A	N/A
C84	N/A	N/A	N/A	0.9978	Leading	15.16	N/A	N/A	N/A	0.9985	Leading	12.46	N/A	N/A	N/A
C85	N/A	N/A	N/A	0.9998	Lagging	-5.03	N/A	N/A	N/A	0.9952	Lagging	-22.52	N/A	N/A	N/A
C86	N/A	N/A	N/A	0.9967	Leading	18.81	N/A	N/A	N/A	0.9984	Leading	13.01	N/A	N/A	N/A
C87	N/A	N/A	N/A	0.9973	Leading	17.04	N/A	N/A	N/A	0.9978	Leading	15.30	N/A	N/A	N/A
C88	N/A	N/A	N/A	0.9973	Leading	17.04	N/A	N/A	N/A	0.9978	Leading	15.30	N/A	N/A	N/A

*The scheduled voltage for the POI (Ogallala 230kV) was 1.02323 p.u. for winter peak 2014 conditions, 1.00857 p.u. for winter peak 2014 GGSSI conditions, 1.01257 p.u. for summer peak 2015 conditions, 1.00322 p.u. for summer peak 2015 GGSSI conditions, and 1.00938 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-3
Power Factor Analysis: GEN-2013-032 (P_{GEN}=204.0 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-032 (P_{GEN} = 204.0 MW)															
Case	**Winter 2014 Peak**			**Winter 2014 GGSI Peak**			**Summer 2015 Peak**			**Summer 2015 GGSSI Peak**			**Summer 2024 Peak**		
	Power Factor		**Q** (MVAR)**	**Power Factor**		**Q** (MVAR)**	**Power Factor**		**Q** (MVAR)**	**Power Factor**		**Q** (MVAR)**	**Power Factor**		**Q** (MVAR)**
Base	0.9838	Leading	37.22	0.9847	Leading	36.13	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9895	Leading	29.85
C1	0.9838	Leading	37.18	0.9847	Leading	36.08	0.9886	Leading	31.05	0.9884	Leading	31.28	0.9896	Leading	29.68
C2	0.9840	Leading	36.98	0.9849	Leading	35.82	0.9888	Leading	30.84	0.9886	Leading	31.08	0.9899	Leading	29.24
C3	0.9839	Leading	37.07	0.9849	Leading	35.88	0.9887	Leading	30.93	0.9885	Leading	31.17	0.9896	Leading	29.59
C4	0.9838	Leading	37.20	0.9847	Leading	36.07	0.9886	Leading	31.13	0.9884	Leading	31.38	0.9896	Leading	29.70
C5	0.9838	Leading	37.18	0.9848	Leading	36.02	0.9886	Leading	31.03	0.9884	Leading	31.28	0.9895	Leading	29.78
C6	0.9837	Leading	37.30	0.9846	Leading	36.21	0.9885	Leading	31.21	0.9892	Leading	30.17	0.9893	Leading	30.15
C7	0.9839	Leading	37.05	0.9849	Leading	35.91	0.9887	Leading	30.90	0.9885	Leading	31.15	0.9899	Leading	29.20
C8	0.9838	Leading	37.17	0.9847	Leading	36.05	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9894	Leading	29.89
C9	0.9838	Leading	37.23	0.9847	Leading	36.13	0.9886	Leading	31.11	0.9893	Leading	30.06	0.9895	Leading	29.86
C10	0.9838	Leading	37.20	0.9847	Leading	36.12	0.9886	Leading	31.10	0.9884	Leading	31.38	0.9894	Leading	29.88
C11	0.9838	Leading	37.16	0.9848	Leading	36.03	0.9886	Leading	31.08	0.9884	Leading	31.34	0.9895	Leading	29.79
C12	0.9838	Leading	37.17	0.9848	Leading	36.04	0.9886	Leading	31.08	0.9893	Leading	30.02	0.9895	Leading	29.80
C13	0.9838	Leading	37.20	0.9847	Leading	36.07	0.9887	Leading	30.98	0.9885	Leading	31.20	0.9894	Leading	29.87
C14	0.9838	Leading	37.22	0.9847	Leading	36.11	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9895	Leading	29.77
C15	0.9838	Leading	37.19	0.9847	Leading	36.08	0.9886	Leading	31.11	0.9893	Leading	30.06	0.9895	Leading	29.84
C16	0.9841	Leading	36.80	0.9855	Leading	35.16	0.9888	Leading	30.84	0.9887	Leading	30.93	0.9906	Leading	28.12
C17	0.9845	Leading	36.38	0.9857	Leading	34.92	0.9895	Leading	29.77	0.9899	Leading	29.22	0.9913	Leading	27.07
C18	0.9846	Leading	36.17	0.9855	Leading	35.10	0.9896	Leading	29.60	0.9899	Leading	29.28	0.9914	Leading	26.88
C19	0.9842	Leading	36.69	0.9850	Leading	35.73	0.9890	Leading	30.50	0.9888	Leading	30.79	0.9907	Leading	28.04
C20	0.9842	Leading	36.72	0.9856	Leading	35.04	0.9888	Leading	30.84	0.9887	Leading	30.91	0.9900	Leading	29.07
C21	0.9838	Leading	37.20	0.9848	Leading	36.04	0.9886	Leading	31.04	0.9885	Leading	31.27	0.9895	Leading	29.75
C22	0.9837	Leading	37.29	0.9847	Leading	36.09	0.9886	Leading	31.12	0.9884	Leading	31.32	0.9895	Leading	29.85
C23	0.9842	Leading	36.72	0.9861	Leading	34.43	0.9893	Leading	30.07	0.9895	Leading	29.74	0.9900	Leading	29.05
C24	0.9841	Leading	36.78	0.9859	Leading	34.60	0.9900	Leading	29.10	0.9901	Leading	28.94	0.9920	Leading	25.88
C25	0.9843	Leading	36.57	0.9862	Leading	34.29	0.9899	Leading	29.23	0.9904	Leading	28.54	0.9913	Leading	27.04
C26	0.9840	Leading	36.94	0.9872	Leading	32.92	0.9897	Leading	29.46	0.9905	Leading	28.33	0.9909	Leading	27.72
C27	0.9838	Leading	37.16	0.9904	Leading	28.50	0.9900	Leading	29.07	0.9903	Leading	28.60	0.9910	Leading	27.56
C28	0.9838	Leading	37.13	0.9848	Leading	35.95	0.9888	Leading	30.76	0.9886	Leading	31.02	0.9896	Leading	29.59

*The scheduled voltage for the POI (Neligh 115kV) was 1.05198 p.u. for winter peak 2014 conditions, 1.05088 p.u. for winter peak 2014 GGSSI conditions, 1.04479 p.u. for summer peak 2015 conditions, 1.04371 p.u. for summer peak 2015 GGSSI conditions, and 1.03487 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-3 (Continued)
Power Factor Analysis: GEN-2013-032 (P_{GEN}=204.0 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-032 (P_{GEN} = 204.0 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C29	0.9838	Leading	37.22	0.9847	Leading	36.13	0.9885	Leading	31.15	0.9883	Leading	31.43	0.9894	Leading	29.89
C30	0.9837	Leading	37.34	0.9846	Leading	36.27	0.9886	Leading	31.12	0.9883	Leading	31.42	0.9895	Leading	29.77
C31	0.9838	Leading	37.22	0.9847	Leading	36.11	0.9885	Leading	31.15	0.9893	Leading	30.14	0.9895	Leading	29.85
C32	0.9838	Leading	37.20	0.9847	Leading	36.08	0.9886	Leading	31.06	0.9884	Leading	31.31	0.9895	Leading	29.77
C33	0.9838	Leading	37.23	0.9847	Leading	36.12	0.9886	Leading	31.13	0.9884	Leading	31.41	0.9895	Leading	29.86
C34	0.9838	Leading	37.22	0.9847	Leading	36.12	0.9886	Leading	31.10	0.9893	Leading	30.05	0.9895	Leading	29.80
C35	0.9838	Leading	37.21	0.9847	Leading	36.15	0.9886	Leading	31.11	0.9884	Leading	31.34	0.9895	Leading	29.78
C36	0.9838	Leading	37.21	0.9848	Leading	36.01	0.9885	Leading	31.17	0.9893	Leading	30.11	0.9894	Leading	29.91
C37	0.9880	Leading	31.84	0.9873	Leading	32.83	0.9789	Leading	42.58	0.9770	Leading	44.52	0.9852	Leading	35.54
C38	0.9804	Leading	41.05	0.9824	Leading	38.78	0.9793	Leading	42.12	0.9794	Leading	42.06	0.9877	Leading	32.26
C39	0.9830	Leading	38.07	0.9843	Leading	36.61	0.9903	Leading	28.56	0.9905	Leading	28.35	0.9877	Leading	32.26
C40	0.9839	Leading	37.08	0.9838	Leading	37.19	0.9968	Leading	16.38	0.9969	Leading	16.08	0.9970	Leading	15.84
C41	0.9842	Leading	36.72	0.9856	Leading	35.01	0.9872	Leading	32.99	0.9873	Leading	32.89	0.9901	Leading	28.91
C42	0.9841	Leading	36.84	0.9842	Leading	36.70	0.9871	Leading	33.06	0.9878	Leading	32.21	0.9881	Leading	31.75
C43	0.9848	Leading	35.97	0.9855	Leading	35.09	0.9966	Leading	16.88	0.9967	Leading	16.56	0.9981	Leading	12.70
C44	0.9834	Leading	37.64	0.9848	Leading	35.99	0.9891	Leading	30.37	0.9889	Leading	30.59	0.9907	Leading	28.06
C45	0.9845	Leading	36.40	0.9868	Leading	33.48	0.9902	Leading	28.76	0.9896	Leading	29.68	0.9929	Leading	24.46
C46	0.9970	Leading	15.81	0.9976	Leading	14.14	0.9939	Leading	22.57	0.9949	Leading	20.65	0.9944	Leading	21.64
C47	0.9827	Leading	38.50	0.9843	Leading	36.60	0.9946	Leading	21.25	0.9947	Leading	21.01	0.9965	Leading	17.12
C48	0.9832	Leading	37.85	0.9828	Leading	38.31	0.9887	Leading	30.95	0.9889	Leading	30.60	0.9893	Leading	30.10
C49	0.9843	Leading	36.55	0.9840	Leading	36.96	0.9894	Leading	29.91	0.9891	Leading	30.37	0.9905	Leading	28.39
C50	0.9835	Leading	37.54	0.9848	Leading	35.99	0.9894	Leading	29.93	0.9905	Leading	28.40	0.9907	Leading	28.04
C51	0.9834	Leading	37.65	0.9852	Leading	35.45	0.9897	Leading	29.51	0.9893	Leading	30.05	0.9947	Leading	21.08
C52	0.9854	Leading	35.21	0.9873	Leading	32.85	0.9897	Leading	29.52	0.9897	Leading	29.50	0.9950	Leading	20.41
C53	0.9880	Leading	31.93	0.9894	Leading	29.95	0.9933	Leading	23.79	0.9929	Leading	24.38	0.9986	Leading	10.81
C54	0.9837	Leading	37.32	0.9846	Leading	36.19	0.9885	Leading	31.25	0.9892	Leading	30.22	0.9890	Leading	30.51
C55	0.9832	Leading	37.84	0.9842	Leading	36.65	0.9883	Leading	31.46	0.9891	Leading	30.31	0.9888	Leading	30.75
C56	0.9838	Leading	37.16	0.9848	Leading	35.96	0.9887	Leading	30.97	0.9885	Leading	31.20	0.9897	Leading	29.48

*The scheduled voltage for the POI (Neligh 115kV) was 1.05198 p.u. for winter peak 2014 conditions, 1.05088 p.u. for winter peak 2014 GGSSI conditions, 1.04479 p.u. for summer peak 2015 conditions, 1.04371 p.u. for summer peak 2015 GGSSI conditions, and 1.03487 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

Table 4-3 (Continued)
Power Factor Analysis: GEN-2013-032 (P_{GEN}=204.0 MW)*

Power Factor Analysis															
Power Factor Analysis: GEN-2013-032 (P_{GEN} = 204.0 MW)															
Case	Winter 2014 Peak			Winter 2014 GGSI Peak			Summer 2015 Peak			Summer 2015 GGSSI Peak			Summer 2024 Peak		
	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)	Power Factor		Q** (MVAR)
C57	0.9840	Leading	36.99	0.9852	Leading	35.51	0.9887	Leading	30.99	0.9885	Leading	31.18	0.9896	Leading	29.71
C58	0.9838	Leading	37.22	0.9847	Leading	36.13	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9895	Leading	29.85
C59	0.9775	Leading	44.07	0.9780	Leading	43.50	0.9793	Leading	42.21	0.9795	Leading	41.98	0.9795	Leading	41.90
C60	0.9841	Leading	36.82	0.9851	Leading	35.64	0.9886	Leading	31.05	0.9884	Leading	31.28	0.9896	Leading	29.68
C61	0.9839	Leading	37.02	0.9849	Leading	35.87	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9895	Leading	29.85
C62	0.9839	Leading	37.02	0.9849	Leading	35.87	0.9886	Leading	31.11	0.9893	Leading	30.05	0.9895	Leading	29.85
C63	0.9822	Leading	38.99	0.9845	Leading	36.32	0.9892	Leading	30.22	0.9896	Leading	29.65	0.9901	Leading	28.91
C64	0.9822	Leading	38.99	0.9845	Leading	36.32	0.9892	Leading	30.22	0.9896	Leading	29.65	0.9901	Leading	28.91
C65	0.9837	Leading	37.28	0.9848	Leading	36.03	0.9886	Leading	31.07	0.9884	Leading	31.31	0.9895	Leading	29.78
C66	0.9840	Leading	36.99	0.9852	Leading	35.51	0.9887	Leading	30.99	0.9885	Leading	31.18	0.9896	Leading	29.71
C67	0.9837	Leading	37.35	0.9845	Leading	36.33	0.9885	Leading	31.17	0.9892	Leading	30.17	0.9894	Leading	29.90
C74	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9894	Leading	29.89
C75	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9900	Leading	29.09
C76	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9907	Leading	28.04
C77	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.9915	Leading	26.72
C78	N/A	N/A	N/A	0.9866	Leading	33.74	N/A	N/A	N/A	0.9902	Leading	28.72	N/A	N/A	N/A
C79	N/A	N/A	N/A	0.9865	Leading	33.92	N/A	N/A	N/A	0.9897	Leading	29.57	N/A	N/A	N/A
C80	N/A	N/A	N/A	0.9847	Leading	36.16	N/A	N/A	N/A	0.9892	Leading	30.18	N/A	N/A	N/A
C81	N/A	N/A	N/A	0.9850	Leading	35.70	N/A	N/A	N/A	0.9889	Leading	30.65	N/A	N/A	N/A
C82	N/A	N/A	N/A	0.9848	Leading	35.97	N/A	N/A	N/A	0.9888	Leading	30.74	N/A	N/A	N/A
C83	N/A	N/A	N/A	0.9853	Leading	35.40	N/A	N/A	N/A	0.9891	Leading	30.42	N/A	N/A	N/A
C84	N/A	N/A	N/A	0.9846	Leading	36.24	N/A	N/A	N/A	0.9883	Leading	31.47	N/A	N/A	N/A
C85	N/A	N/A	N/A	0.9847	Leading	36.09	N/A	N/A	N/A	0.9884	Leading	31.32	N/A	N/A	N/A
C86	N/A	N/A	N/A	0.9848	Leading	35.99	N/A	N/A	N/A	0.9886	Leading	31.11	N/A	N/A	N/A
C87	N/A	N/A	N/A	0.9851	Leading	35.59	N/A	N/A	N/A	0.9885	Leading	31.20	N/A	N/A	N/A
C88	N/A	N/A	N/A	0.9851	Leading	35.59	N/A	N/A	N/A	0.9885	Leading	31.20	N/A	N/A	N/A

*The scheduled voltage for the POI (Neligh 115kV) was 1.05198 p.u. for winter peak 2014 conditions, 1.05088 p.u. for winter peak 2014 GGSSI conditions, 1.04479 p.u. for summer peak 2015 conditions, 1.04371 p.u. for summer peak 2015 GGSSI conditions, and 1.03487 p.u. for summer peak 2024 conditions.

**A positive Q (Mvar) output illustrates the generator is absorbing Mvars from the system, which implies a leading power factor; negative Q (Mvar) output shows the generator is supplying Mvars to the system implying a lagging power factor.

SECTION 5: CONCLUSIONS

Stability Analysis

For GEN-2013-019 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2014 GGSSI Winter Peak case, 2015 Summer Peak case, 2015 GGSSI Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

For GEN-2013-021 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2015 Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

For the 2014 GGSSI Winter Peak case, instability was observed as a result of contingency FLT92-1PH, located in Table 2-4 of this report. Stability issues are corrected if the output power of GEN-2013-021 is reduced to 200 MW during this case. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 125 MW. If the full output of GEN-2013-021 is desired for the 2014 GGSSI Winter Peak case, reactive power solutions can be discussed.

For the 2015 GGSSI Summer Peak case, instability was observed as a result of contingency FLT91-1PH, located in Table 2-4 of this report. No stability issues are observed if the output power of GEN-2013-021 is reduced to 169 MW. Acceptable voltages and stability are achieved if the output power of GEN-2013-021 is reduced to 40 MW. If the full output of GEN-2013-021 is desired for the 2015 GGSSI Summer Peak case, reactive power solutions can be discussed.

For GEN-2013-032 at 100% output, the Stability Analysis determined that there was no wind turbine tripping that occurs during the 2014 Winter Peak case, 2014 GGSSI Winter Peak case, 2015 Summer Peak case, 2015 GGSSI Summer Peak case, or 2024 Future Summer Peak case. There were no low voltage recovery or stability issues observed under these conditions.

Note that for the 2014 GGSSI Winter Peak case, a steady-state pre-project (existing) stuck breaker contingency resulted in low system voltages and system instability. The pre-existing stuck breaker contingency that resulted in low system voltages and system instability was Gentleman Stuck Breaker 3322 (FLT91-1PH).

Power Factor Analysis

The Power Factor Analysis shows that GEN-2013-019 has a power factor range of 0.944 lagging (supplying) to 0.965 leading (absorbing). Additional inductive support required to compensate for the collector system was not determined as GEN-2013-019 is below 230kV.

The Power Factor Analysis shows that GEN-2013-021 has a power factor range of 0.894 lagging (supplying) to 0.979 leading (absorbing). A total of 24.5 MVAR of additional inductive support would be required in order to compensate for the collector system and lead line charging when GEN-2013-021 is off-line such that the VAR flow at the POI is zero.

The Power Factor Analysis shows that GEN-2013-032 has a power factor range of 0.999 leading (absorbing) to 0.977 leading (absorbing). Additional inductive support required to compensate for the collector system was not determined as GEN-2013-032 is below 230kV.

The reactive compensation required to off-set the charging of the collector system and lead line was calculated by modeling GEN-2013-021 off-line and calculating the amount of inductive capacity required at the 34.5kV collector buses which would result in zero VAR flow at the 230kV POI.