Definitive Interconnection System

Southwest Power Pool
Engineering Department
Generation Interconnection

(GEN-2008-038)
December 2010

SPP RESTRICTED

Executive Summary

Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP has conducted this Definitive Interconnection System Impact Study (DISIS) for the GEN-2008-038 generation interconnection request in the SPP Generation Interconnection Queue. GEN-2008-038 is part of the DISIS-2009-001 cluster study but is relatively isolated from the other cluster study requests in that it shares no constraints with other projects in the DISIS-2009-001 cluster. This restudy is being conducted to account for inclusion of constraints and network upgrades necessary for two affected generation interconnection requests on the Associated Electric Cooperative (AECI) transmission system. This Impact Study analyzes the interconnecting of 150 MW of wind generation on the Shidler – Mound Road 138kV transmission line on the American Electric Power transmission system.

You may locate the DISIS-2009-001 cluster studies at this URL:
http://sppoasis.spp.org/documents/swpp/transmission/GenStudies.cfm?YearType=2009_Impact_Studies

Power Flow Analysis has indicated that, for the powerflow cases studied, the 150 MW of nameplate generation may be interconnected with transmission system reinforcements within the SPP transmission system.

Dynamic Stability Analysis has determined that the transmission system will remain stable with the assigned Network Upgrades and Interconnection Facilities to the Interconnection Customer and prior queued Interconnection Customers. The need for reactive compensation in accordance with Order No. 661-A has found the Customer must meet the power factor requirements for wind farms of 95% lagging and 95% leading at the point of interconnection.

The total estimated minimum cost for interconnecting the GEN-2008-038 interconnection customer is $36,484,200. These costs are shown in Table 1 Interconnection is also contingent upon higher queued AECI customers paying for certain required network upgrades. The in service date for GEN-2008-038 may be deferred until the construction of these network upgrades can be completed.

Network Constraints listed in Appendix D: and 1E: are in the local area of the new generation when this generation is injected throughout the SPP footprint for the Energy Resource (ER) Interconnection Request. Additional Network constraints will have to be verified with a Transmission Service Request (TSR) and associated studies. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

These costs do not include the Interconnection Customer Interconnection Facilities as defined by the SPP Open Access Transmission Tariff (OATT). The required interconnection costs listed in Table 1 do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP OATT.

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

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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 the GEN-2008-038 generation interconnection request in the SPP Generation Interconnection Queue. GEN-2008-038 is part of the DISIS-2009-001 cluster study but is relatively isolated from the other cluster study requests in that it shares no constraints with other projects in the DISIS-2009-001 cluster. This restudy is being conducted to account for inclusion of constraints and network upgrades necessary for two affected generation interconnection requests on the Associated Electric Cooperative (AECI) transmission system This Impact Study analyzes the interconnecting of 150 MW of wind generation on the Shidler – Mound Road 138kV transmission line on the American Electric Power (AEPW) transmission system.

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

Model Development

Previous Queued Projects

Previous queued projects within the AECI control area, AECI FS-6 and AECI FS-7 totaling 300 MW of generation are included in this study. In addition to the Base Case Upgrades, the previous queued projects and associated upgrades were assumed to be in-service and added to the Base Case models. These projects were dispatched as Energy Resources with equal distribution across the AECI footprint.

Development of Base Cases

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

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

Base Case Upgrades

The following facilities are part of the SPP Transmission Expansion Plan or the Balanced Portfolio. These facilities have been approved or are in construction stages and were assumed to be in-service at the time of dispatch and added to the base case models. The GEN-2008-038 Customer has no potential cost for the below listed projects. <u>However, the GEN-2008-038 Customers Generation Facilities in service dates may need to be delayed until the completion of the following upgrades.</u> If for some reason, construction on these projects is discontinued, additional restudies will be needed to determine the interconnection needs of the DISIS customer.

- Rose Hill – Sooner 345kV to be built by WERE/OKGE for 2010 in-service.
- Sooner – Cleveland 345kV line approved by the SPP Board of Directors as part of the Balanced Portfolio and issued an NTC in June, 2009

Contingent Upgrades

The following facilities do not yet have approval. These facilities have been assigned to higher queued interconnection customers. These facilities have been included in the models for the GEN-2008-038 study and are assumed to be in service. <u>GEN-2008-038 at this time does not have responsibility for these facilities but may later be assigned the cost of these facilities if higher queued customers (including AECI queue requests) terminate their Large Generator Interconnection Agreement (LGIA) or withdraw from the interconnection queue. The GEN-2008-038 Customer Generation Facilities in service dates may need to be delayed until the completion of the following upgrades.</u>

- Fairfax – new GRDA 138kV substation near Pawnee on the Cleveland – Stillwater 138kV transmission line assigned to AECI FS-6 (approximately 15 miles long).
- Fairfax substation rebuild assigned to AECI FS-6.
- Fairfax Tap - Shidler 138kV transmission line. New transmission line from existing Fairfax tap on Shidler-Osage 138kV line to Shider and associated upgrades assigned to AECI FS-6.
- Burbank substation rebuild assigned to AECI FS-7.
- Burbank – Fairfax 138kV transmission line rebuild assigned to AECI FS-7.
- Burbank – AECI FS-7 138kV transmission line construction assigned to AECI FS-7.
- Fairfax substation autotransformer assigned to AECI FS-7.
- Fairfax – Shidler 138kV transmission line rebuilds assigned to AECI FS-7.

Potential Upgrades Not in the Base Case

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

Identification of Network Constraints

The initial set of network constraints were found by using PTI MUST First Contingency Incremental Transfer Capability (FCITC) analysis on the entire cluster grouping dispatched at the various levels mentioned above. These constraints were then screened to determine if any of the generation interconnection requests had at least a 3% Transfer Distribution Factor (TDF) upon the constraint. Constraints that measured at least a 20% TDF from at least one interconnection request were considered for mitigation.

Interconnection Facilities

The requirement to interconnect the 150 MW of generation into the existing and proposed transmission systems in the affected areas of the SPP transmission footprint consist of the necessary facility upgrades listed in the following table. These network upgrades within the SPP transmission system total $36,484,200.

Table 1 - Network Upgrades

System Improvement	Cost (2010 Dollars)
AEPW – GEN-2008-038 Substation: Install a new four (4) breaker 138kV ring bus substation. Including all metering, protection, SCADA, other necessary equipment.	$4,885,200
AEPW – Construct approximately 31 miles 138kV radial line with 1590 ACSR conductor from Hominy load to GEN-2008-038 Substation.	$31,000,000
AEPW – Sand Springs Substation: Change out relay panels on the Hominy 138 kV line.	$599,000
Transmission Interconnection Facility Total Costs	**$36,484,200**

Network Constraints in the AEPW, OKGE, AND AECI transmission systems that were identified are shown in Appendix 1D: and 1E:. With a defined source and sink in a TSR, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

A preliminary one-line drawing for the generation interconnection request is listed in Appendix 1C:.

Powerflow

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) Criteria states that:

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

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

Powerflow Analysis

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

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

Powerflow Results

The GEN-2008-038 150 MW interconnection request is in addition to the 300 MW of previous queued generation, AECI FS-6 and AECI FS-7. Overloads were found to occur within the AECI, AEPW, OKGE, and GRDA control areas. AEPW provided the following plan to mitigate the overloads due to the addition of the request:

- Construct approximately thirty-one miles of 138kV transmission line with 1590 ACSR conductor from Hominy to the GEN-2008-038 Substation.

With the inclusion of this mitigation and related system upgrades with base case upgrades, there are no overloads found for the cases studied.

Stability Analysis

A limited stability analysis was conducted for each Interconnection Customer's facility using modified versions of the 2010 winter peak and the 2010 summer peak models. The stability analysis was conducted with all upgrades in service that were identified in the powerflow analysis. The interconnection requests were studied at 100% nameplate output. The output of the Interconnection Customer's facility was offset in each model by a reduction in output of existing online SPP generation.

Stability Results

The stability analysis is found in Appendix F:. The stability analysis revealed no stability issues with the study request. The power factor requirement was determined to be as shown in the table below.

Table 2 - Power Factor Analysis Results

Request	Size (MW)	Generator Model	Point of Interconnection	Final PF Requirement at POI		Estimated Capacitor Requirement (Mvar)
				Lagging (supplying)	Leading (absorbing)	
GEN-2008-038	150	G.E. 1.5 MW	Shidler – Mound Road 138kV	1.00	0.95	N/A

As the analysis has determined that a power factor standard is required, the Customer is required to maintain 95% lagging (providing) and 95% leading (absorbing) power factor at the point of interconnection.

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

Conclusion

The minimum cost of interconnecting the GEN-2008-038 interconnection request is estimated at $36,484,200 for the Allocated Network Upgrades and Transmission Owner Interconnection Facilities.

These interconnection costs do not include any cost of Network Upgrades determined to be required by short circuit analysis. These studies are being performed as part of the Interconnection System Facility Study that each customer has already executed.

The required interconnection costs listed in Table 1 and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request (TSR) through SPP's Open Access Same Time Information System (OASIS) as required by Attachment Z1 of the SPP Open Access Transmission Tariff (OATT).

Appendix

A: Generation Interconnection Requests Considered for Impact Study

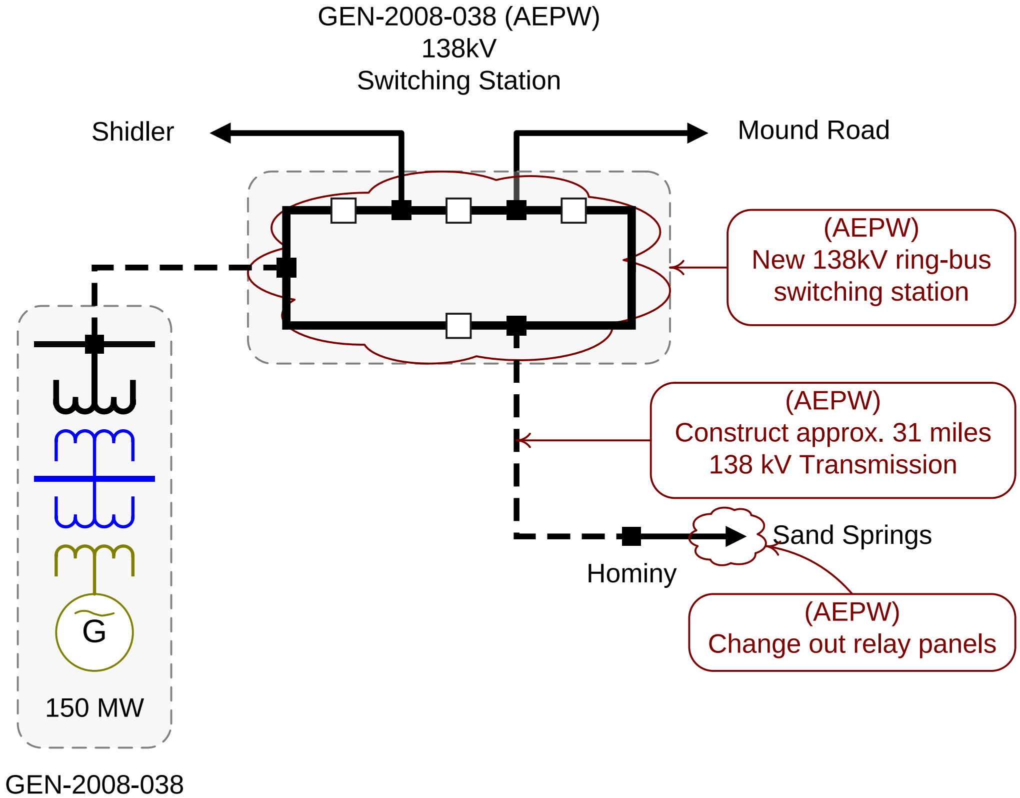
Request	Amount	Area	Requested Point of Interconnection	Proposed Point of Interconnection	Requested In-Service Date
GEN-2008-038	150	AEPW	TAP SHIDLER-WEST PAWHUSKA 138kV	TAP SHIDLER-WEST PAWHUSKA 138kV	12/1/2010
GROUPED TOTAL	**150**				

B: Prior Queued Interconnection Requests

Request	Amount	Area	Requested/Proposed Point of Interconnection	Status or In-Service Date
AECI FS-6	150	AECI	Tap Fairfax – Fairfax Tap 138kV	Under Study by AECI
AECI FS-7	150	AECI	Tap Fairfax – Fairfax Tap 138kV	Under Study by AECI
GROUPED TOTAL	**300**			

C: Proposed Point of Interconnection One line Diagrams

GEN-2008-038



D: FCITC (DC) Analysis

Season	Scenario	Source	MontCommmonName	Direction	TDF	Rating	Contingency Loading %	Contname
10G	0	G0838	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	FROM->TO	1	142.9	104.8985	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
10G	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	142.9	104.8985	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
10G	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	142.9	104.0588	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
14SP	0	G0838	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	FROM->TO	1	143	104.8252	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
14SP	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	143	104.8252	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
14SP	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	143	103.9161	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
14WP	0	G0838	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	FROM->TO	1	142.8	105.042	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
14WP	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	142.8	105.042	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
14WP	0	G0838	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	FROM->TO	1	142.8	104.3417	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'

E: ACCC Analysis

SCENARIO	SEASON	SOURCE	DIRECTION	MONTCOMMONNAME	RATEB	TDF	TC%LOADING	CONTNAME
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.4499	115.0521	'FAIRFAX TAP - SHIDLER 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.4499	115.0459	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.4	113.5973	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.4499	111.931	'OSAGE - WEBB CITY TAP 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	105.874	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	10G	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.4034	105.539	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	105.0584	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	10G	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	1	104.916	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	170	0.42495	116.3586	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	170	0.42495	116.3413	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	113.5776	'FAIRFAX TAP - SHIDLER 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	113.571	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	170	0.48192	111.183	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	170	0.48192	111.1609	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	170	0.48192	110.8041	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	170	0.48192	110.7821	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	109.8895	'OSAGE - WEBB CITY TAP 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	170	0.48192	109.0403	'DOMES - PAWHUSKA TAP 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	170	0.48192	109.0178	'DOMES - PAWHUSKA TAP 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.42495	108.5598	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	170	0.48192	107.7791	'DOMES - MOUND ROAD 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	170	0.48192	107.7563	'DOMES - MOUND ROAD 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	105.5072	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.41718	105.038	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	1	104.8909	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	104.582	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.48192	103.4602	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.48192	103.0819	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.48192	101.3295	'DOMES - PAWHUSKA TAP 138KV CKT 1'
0	14SP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	100.6677	'DOMES - PAWHUSKA TAP 138KV CKT 1'
0	14SP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	170	0.48192	100.0735	'DOMES - MOUND ROAD 138KV CKT 1'
0	14SP	G0838		FDNS-Blown up	240	0.00097	53.59607	'STEGALL - VICTORY HILL 230KV CKT 1'

SCENARIO	SEASON	SOURCE	DIRECTION	MONTCOMMONNAME	RATEB	TDF	TC%LOADING	CONTNAME
2	14SP	G0838		FDNS-Blown up	240	0.00094	53.59359	'STEGALL - VICTORY HILL 230KV CKT 1'
0	14WP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	192	0.42495	110.8048	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	192	0.42495	110.7907	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	107.4358	'FAIRFAX TAP - SHIDLER 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	107.4292	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	105.6314	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'TO->FROM'	'OSAGE - WEBB CITY TAP 138KV CKT 1'	191	0.42495	104.9392	'CLEVELANDTAP138.00 - FAIRFAX 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	1	104.9023	'G08-38T 138.00 - SHIDLER 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	104.8955	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'	143	0.46676	104.0415	'OSAGE - WEBB CITY TAP 138KV CKT 1'
0	14WP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	192	0.48192	101.1408	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	192	0.48192	101.1211	'G08-38T 138.00 - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'TO->FROM'	'FAIRFAX TAP - SHIDLER 138KV CKT 1'	192	0.48192	100.8787	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'FAIRFAX TAP - WEBB CITY TAP 138KV CKT 1'	192	0.48192	100.8591	'PAWHUSKA TAP - WEST PAWHUSKA 138KV CKT 1'
0	14WP	G0838	'FROM->TO'	'G08-38T 138.00 - SHIDLER 138KV CKT 1'	143	1	100.3112	'DOMES - PAWHUSKA TAP 138KV CKT 1'
0	14WP	G0838		FDNS-Blown up	0	0.00014	0	'5ADAIR 161.00 161/34.5KV TRANSFORMER CKT 99'
2	14WP	G0838		FDNS-Blown up	0	0.00014	0	'5ADAIR 161.00 161/34.5KV TRANSFORMER CKT 99'

F: Stability Analysis

System Impact Study
Stability Analysis

GEN-2008-038

SPP Generation Interconnection Studies

(GEN-2008-038)

November 2010

Executive Summary

A transient stability study has been performed by Southwest Power Pool (SPP) to evaluate the interconnection request GEN-2008-038 with the inclusion of prior queued projects within the Associated Electric Cooperative (AECI) transmission system.

GEN-2008-038 Interconnection Request is a wind farm of 150 MW generation capacity consisting of 100 G.E. 1.5 MW wind turbines interconnected on a tap of the Shidler – North Pawhuska 138 kV transmission line on the American Electric Power West (AEPW) transmission system.

The results of a stability analysis determined that for the addition of GEN-2008-038 the transmission system was found to remain stable for both summer and winter peak conditions. Additionally, the wind farm was found to stay connected during the contingencies that were studied, meeting the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

The power factor analysis indicated that the GEN-2008-038 wind farm will be required to maintain 95% leading and 95% lagging power factor at the point of interconnection.

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

1.0 Introduction

The GEN-2008-038 transient stability study was performed by SPP to evaluate the impacts of interconnecting the 150 MW Wind Farm to the SPP footprint.

GEN-2008-038 was studied with the inclusion of two prior queued requests, AECI FS-6 and AECI FS-7. Transient Stability studies were conducted with the full outputs (100%) for GEN-2008-038 and both prior queued requests. Table 1 describes the requests mentioned above.

Table 1: Group 14 Requests

Status	Request	Size (MW)	Turbine Model	Point of Interconnection
Under Study	GEN-2008-038	150	G.E. 1.5 MW	Shidler – N. Pawhuska 138kV
Prior Queue	AECI FS-6	150	G.E. 1.5 MW	Fairfax – Fairfax Tap 138kV
Prior Queue	AECI FS-7	150	G.E. 1.5 MW	Fairfax – Fairfax Tap 138kV

Two seasonal base cases were used in the study to analyze the stability impacts of the proposed generation facility. A 2010 summer peak case and a 2009 winter peak case which were both modified to include the prior queued projects shown in Table 1. Fifty-two (52) contingencies were identified and analyzed for this study.

2.0 Purpose

The purpose of this study is to evaluate the impact of the proposed interconnection on the reliability of the Transmission System.

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

3.0 Facilities

3.1 Generating Facility

The generating facility was studied with the assumption that it would be using G.E. 1.5 MW wind turbines. Each wind turbine has a nameplate rating of 1.5 MW with a machine base of 1.67 MVA and has a 34.5kV/0.69kV transformer. The Customer's interconnection facilities will include a 345/34.5kV transformer. Figure 1 shows a simplified one-line of the customer's facility.

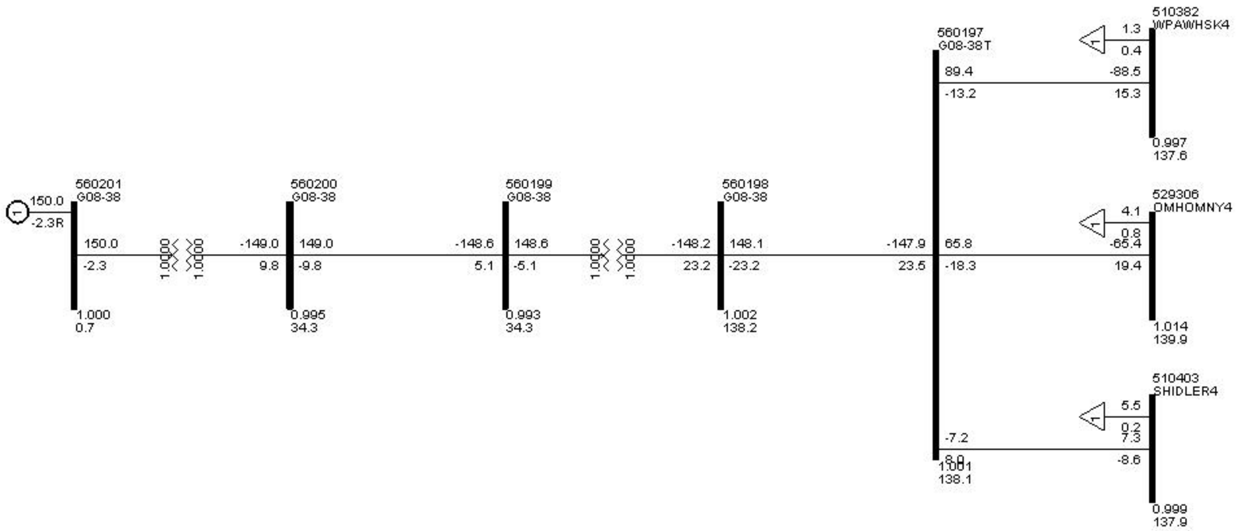


Figure 1 - GEN-2008-038 Facility One Line Diagram

3.2 <u>Interconnection Facilities</u>

The point of interconnection (POI) will be at a new AEPW 138 kV switching station located along the Shidler – North Pawhuska138 kV transmission line. Figure 2 shows a one-line of the proposed POI with proposed upgrades and mitigations. Interconnection facilities will include a 138kV, four breaker ring bus substation.

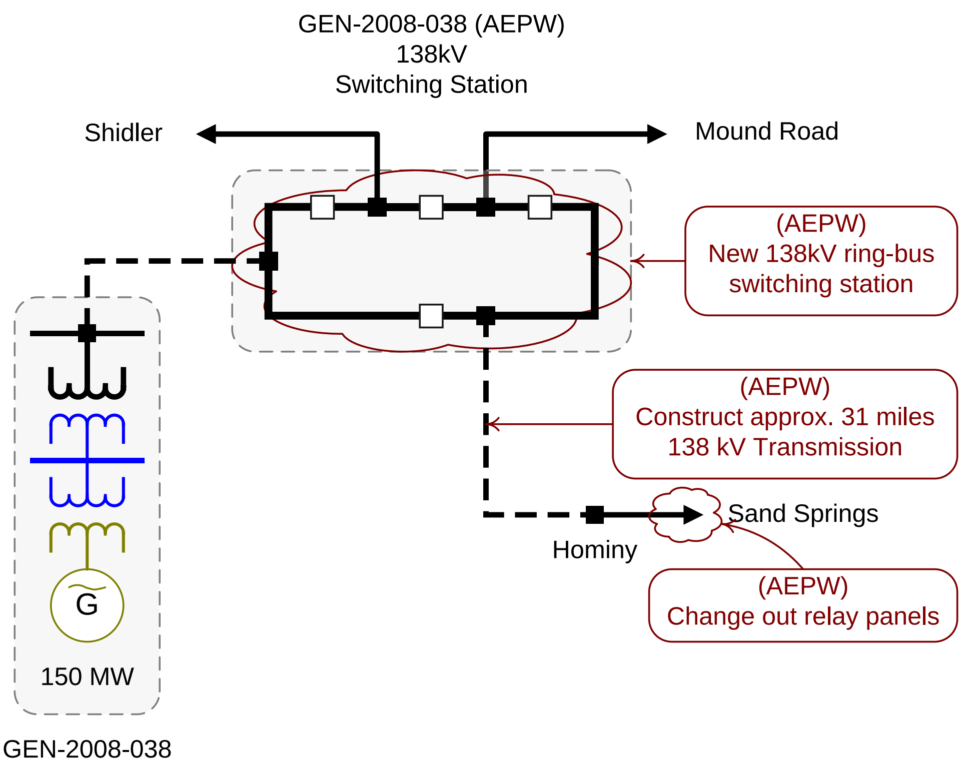


Figure 2: GEN-2008-038 Facility and Proposed Interconnection Configuration

4.0 Stability Study Criteria

FERC Order 661A Low Voltage Ride-Through Provisions (LVRT), which went into effect January 1, 2006, requires that wind generating plants remain in-service during 3-phase faults at the point of interconnection. This order may require a Static VAr Compensator (SVC) or STATCOM device be specified at the Customer facility to keep the wind generator on-line for the fault. Dynamic Stability studies performed as part of the System Impact Study will provide additional guidance as to whether the reactive compensation can be static or a portion must be dynamic (such as a SVC or STATCOM).

5.0 Stability Study Analysis

Fifty-two (52) contingencies were considered for the transient stability simulations. These contingencies included three phase faults and single phase line faults at locations defined by SPP. Single-phase line faults were simulated by applying fault impedance to the positive sequence network at the fault location to represent the effect of the negative and zero sequence networks on the positive sequence network. The fault impedance was computed to give a positive sequence voltage at the specified fault location of approximately 60% of pre-fault voltage. This method is in agreement with SPP current practice.

The faults that were defined and simulated are listed in Table 2 below. The faults were simulated on a summer peak and a winter peak model.

Table 2: Contingency List

Cont. No.	Cont. Name	Description
1	FLT01-3PH	3 phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
2	FLT02-1PH	1 phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3.6 cycles, then trip the line in (b) and remove fault.
3	FLT03-3PH	3 phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line.
4	FLT04-1PH	1 phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek. a. Apply fault at the Wolf Creek 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3.6 cycles, then trip the line in (b) and remove fault.
5	FLT05-3PH	3 phase fault on the AECI-FS-6T (302011) – Fairfax (300139) 138kV line near AECI_FS-6T. a. Apply fault at the AECI-FS-6T 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT06-1PH	Single phase fault and sequence like previous
7	FLT07-3PH	3 phase fault on the AECI-FS-6T (302011) – AECI-FS-7T (302017) 138kV line near AECI_FS-6T. a. Apply fault at the AECI-FS-6T 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.

Cont. No.	Cont. Name	Description
8	FLT08-1PH	Single phase fault and sequence like previous
9	FLT09-3PH	3 phase fault on the Neosho (532793) – Lacygne (542981) 345kV line near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
10	FLT10-1PH	1 phase fault on the Neosho (532793) – Lacygne (542981) 345kV line near Neosho. a. Apply fault at the Neosho 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
11	FLT11-3PH	3 phase fault on the Burbank (300922) – AECI-FS-7T (302017) 138kV line near AECI_FS-7T. a. Apply fault at the AECI-FS-7T 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
12	FLT12-1PH	Single phase fault and sequence like previous
13	FLT13-3PH	3 phase fault on the Shidler (510403) – AECI-FS-7T (302017) 138kV line near AECI_FS-7T. a. Apply fault at the AECI-FS-7T 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
14	FLT14-1PH	Single phase fault and sequence like previous
15	FLT15-3PH	3 phase fault on the Shidler (510403) – Fairfax Tap (510377) 138kV line near Shidler. a. Apply fault at the Shidler 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
16	FLT16-1PH	Single phase fault and sequence like previous
17	FLT17-3PH	3 phase fault on the Sooner (514803) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.
18	FLT18-1PH	1 phase fault on the Sooner (514803) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
19	FLT19-3PH	3 phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line.

Cont. No.	Cont. Name	Description
20	FLT20-1PH	1 phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127. a. Apply fault at the GEN-2008-127 345kV bus. b. Clear fault after 3.6 cycles by tripping the faulted line. c. Wait 300 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3.6 cycles, then trip the line in (b) and remove fault.
21	FLT21-3PH	3 phase fault on the Sooner (514803) to Woodring (514715) 345kV line, near Woodring. a. Apply fault at the Woodring 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
22	FLT22-1PH	Single phase fault and sequence like previous
23	FLT23-3PH	3 phase fault on the Sooner (514803) to Cleveland (512694) 345kV line, near Cleveland. a. Apply fault at the Cleveland 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
24	FLT24-1PH	Single phase fault and sequence like previous
25	FLT25-3PH	3 phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill. a. Apply fault at the Rose Hill 345V bus. b. Clear fault after 3 cycles by tripping the faulted line.
26	FLT26-1PH	1 phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill. a. Apply fault at the Rose Hill 345V bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 30 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
27	FLT27-3PH	3 phase fault on the GEN-2008-038 (560197) to Shidler (510403) 138kV line, near GEN-2008-038. a. Apply fault at the GEN-2008-038 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
28	FLT28-1PH	Single phase fault and sequence like previous
29	FLT29-3PH	3 phase fault on the GEN-2008-038 (560197) to W Pawhuska (510382) 138kV line, near GEN-2008-038. a. Apply fault at the GEN-2008-038 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
30	FLT30-1PH	Single phase fault and sequence like previous
31	FLT31-3PH	3 phase fault on the GEN-2008-038 (560197) to Hominy (529306) 138kV line, near GEN-2008-038. a. Apply fault at the GEN-2008-038 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.
32	FLT32-1PH	Single phase fault and sequence like previous

Cont. No.	Cont. Name	Description
33	FLT33-3PH	3 phase fault on the Webb City Tap (510376) – Fairfax Tap (510377) 138kV line near Fairfax Tap. a. Apply fault at the Fairfax Tap 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
34	FLT34-1PH	Single phase fault and sequence like previous
35	FLT35-3PH	3 phase fault on the Mound Road (510395) to Barnsdall (510388) 138kV line, near Mound Road. a. Apply fault at the Mound Road 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
36	FLT36-1PH	Single phase fault and sequence like previous
37	FLT37-3PH	3 phase fault on the Mound Road (510395) to BV-Comanche (510390) 138kV line, near Mound Road. a. Apply fault at the Mound Road 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 Northeastern (510406) to Delaware (510380) 345kV line, near Delaware. a. Apply fault at the Delaware 345kV bus. b. Clear fault after 3 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 3 cycles, then trip the line in (b) and remove fault.
40	FLT40-1PH	1 phase fault on the Northeastern (510406) to Delaware (510380) 345kV line, near Delaware. a. Apply fault at the Delaware 345kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
41	FLT41-3PH	3 phase fault on the Cleveland Tap (301500) to Fairfax (300139) 138kV line, near Fairfax. a. Apply fault at the Fairfax 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
42	FLT42-1PH	Single phase fault and sequence like previous
43	FLT45-3PH	3 phase fault on the Kildare (514760) to Newkirk (514759) 138kV line, near Kildare. a. Apply fault at the Kildare 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
44	FLT46-1PH	Single phase fault and sequence like previous

Cont. No.	Cont. Name	Description
45	FLT47-3PH	3 phase fault on the Osage (514743) to Webb City Tap (510376) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
46	FLT48-1PH	Single phase fault and sequence like previous
47	FLT49-3PH	3 phase fault on the Sooner (514802) to Sooner Pump Tap (514798) 138kV line, near Sooner. a. Apply fault at the Sooner 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
48	FLT50-1PH	Single phase fault and sequence like previous
49	FLT51-3PH	3 phase fault on the Sooner (514802) to Miller (514704) 138kV line, near Sooner. a. Apply fault at the Sooner 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
50	FLT52-1PH	Single phase fault and sequence like previous
51	FLT53-3PH	3 phase fault on the Osage (514743) to Maryland Tap (514770) 138kV line, near Osage. a. Apply fault at the Osage 138kV bus. b. Clear fault after 5 cycles by tripping the faulted line. c. Wait 20 cycles, and then re-close the line in (b) back into the fault. d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
52	FLT54-1PH	Single phase fault and sequence like previous

6.0 Simulation Results

Table 3: Contingency Results

Cont. No.	Cont. Name	Description	Summer	Winter
1	FLT01-3PH	3 phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek.	OK	OK
2	FLT02-1PH	1 phase fault on the Wolf Creek (532797) – Benton (532791) 345kV line near Wolf Creek.	OK	OK
3	FLT03-3PH	3 phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek.	OK	OK
4	FLT04-1PH	1 phase fault on the Wolf Creek (532797) – Rose Hill (532794) 345kV line near Wolf Creek.	OK	OK
5	FLT05-3PH	3 phase fault on the AECI-FS-6T (302011) – Fairfax (300139) 138kV line near AECI_FS-6T.	OK	OK
6	FLT06-1PH	Single phase fault and sequence like previous	OK	OK
7	FLT07-3PH	3 phase fault on the AECI-FS-6T (302011) – AECI-FS-7T (302017) 138kV line near AECI_FS-6T.	OK	OK
8	FLT08-1PH	Single phase fault and sequence like previous	OK	OK

Cont. No.	Cont. Name	Description	Summer	Winter
9	FLT09-3PH	3 phase fault on the Neosho (532793) – Lacygne (542981) 345kV line near Neosho.	OK	OK
10	FLT10-1PH	1 phase fault on the Neosho (532793) – Lacygne (542981) 345kV line near Neosho.	OK	OK
11	FLT11-3PH	3 phase fault on the Burbank (300922) – AECI-FS-7T (302017) 138kV line near AECI_FS-7T.	OK	OK
12	FLT12-1PH	Single phase fault and sequence like previous	OK	OK
13	FLT13-3PH	3 phase fault on the Shidler (510403) – AECI-FS-7T (302017) 138kV line near AECI_FS-7T.	OK	OK
14	FLT14-1PH	Single phase fault and sequence like previous	OK	OK
15	FLT15-3PH	3 phase fault on the Shidler (510403) – Fairfax Tap (510377) 138kV line near Shidler.	OK	OK
16	FLT16-1PH	Single phase fault and sequence like previous	OK	OK
17	FLT17-3PH	3 phase fault on the Sooner (514803) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127.	OK	OK
18	FLT18-1PH	1 phase fault on the Sooner (514803) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127.	OK	OK
19	FLT19-3PH	3 phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127.	OK	OK
20	FLT20-1PH	1 phase fault on the Rose Hill (532794) to GEN-2008-127 (573039) 345kV line, near GEN-2008-127.	OK	OK
21	FLT21-3PH	3 phase fault on the Sooner (514803) to Woodring (514715) 345kV line, near Woodring.	OK	OK
22	FLT22-1PH	Single phase fault and sequence like previous	OK	OK
23	FLT23-3PH	3 phase fault on the Sooner (514803) to Cleveland (512694) 345kV line, near Cleveland.	OK	OK
24	FLT24-1PH	Single phase fault and sequence like previous	OK	OK
25	FLT25-3PH	3 phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill.	OK	OK
26	FLT26-1PH	1 phase fault on the Rose Hill (532794) to Latham (532800) 345kV line, near Rose Hill.	OK	OK
27	FLT27-3PH	3 phase fault on the GEN-2008-038 (560197) to Shidler (510403) 138kV line, near GEN-2008-038.	OK	OK
28	FLT28-1PH	Single phase fault and sequence like previous	OK	OK
29	FLT29-3PH	3 phase fault on the GEN-2008-038 (560197) to W Pawhuska (510382) 138kV line, near GEN-2008-038.	OK	OK
30	FLT30-1PH	Single phase fault and sequence like previous	OK	OK
31	FLT31-3PH	3 phase fault on the GEN-2008-038 (560197) to Homony (529306) 138kV line, near GEN-2008-038.	OK	OK
32	FLT32-1PH	Single phase fault and sequence like previous	OK	OK
33	FLT33-3PH	3 phase fault on the Webb City Tap (510376) – Fairfax Tap (510377) 138kV line near Fairfax Tap.	OK	OK

Cont. No.	Cont. Name	Description	Summer	Winter
34	FLT34-1PH	Single phase fault and sequence like previous	OK	OK
35	FLT35-3PH	3 phase fault on the Mound Road (510395) to Barnsdall (510388) 138kV line, near Mound Road.	OK	OK
36	FLT36-1PH	Single phase fault and sequence like previous	OK	OK
37	FLT37-3PH	3 phase fault on the Mound Road (510395) to BV-Comanche (510390) 138kV line, near Mound Road.	OK	OK
38	FLT38-1PH	Single phase fault and sequence like previous	OK	OK
39	FLT39-3PH	3 phase fault on the Northeastern (510406) to Delaware (510380) 345kV line, near Delaware.	OK	OK
40	FLT40-1PH	1 phase fault on the Northeastern (510406) to Delaware (510380) 345kV line, near Delaware.	OK	OK
41	FLT41-3PH	3 phase fault on the Cleveland tap (301500) to Fairfax (300139) 138kV line, near Fairfax.	OK	OK
42	FLT42-1PH	Single phase fault and sequence like previous	OK	OK
43	FLT45-3PH	3 phase fault on the Kildare (514760) to Newkirk (514759) 138kV line, near Kildare.	OK	OK
44	FLT46-1PH	Single phase fault and sequence like previous	OK	OK
45	FLT47-3PH	3 phase fault on the Osage (514743) to Webb City Tap (510376) 138kV line, near Osage.	OK	OK
46	FLT48-1PH	Single phase fault and sequence like previous	OK	OK
47	FLT49-3PH	3 phase fault on the Sooner (514802) to Sooner Pump Tap (514798) 138kV line, near Sooner.	OK	OK
48	FLT50-1PH	Single phase fault and sequence like previous	OK	OK
49	FLT51-3PH	3 phase fault on the Sooner (514802) to Miller (514704) 138kV line, near Sooner.	OK	OK
50	FLT52-1PH	Single phase fault and sequence like previous	OK	OK
51	FLT53-3PH	3 phase fault on the Osage (514743) to Maryland Tap (514770) 138kV line, near Osage.	OK	OK
52	FLT54-1PH	Single phase fault and sequence like previous	OK	OK

7.0 Generator Performance

The transmission system and the study generators were found to remain stable during the dynamic stability analysis.

Prior-queued projects AECI FS-6 and AECI FS-7 use G.E. 1.5 MW wind turbines to represent the generation. The project GEN-2008-038 uses G.E. 1.5 MW wind turbines to represent the generation in the study.

Figure 3 shows the output power, terminal voltage, and speed of the projects under contingency FLT27-3PH during the 2009 winter peak case. As shown, the output power, terminal voltage and speed oscillate following the fault and return to system stable levels within 7 seconds of the fault being cleared.

Figure 4 shows the output power, terminal voltage and speed of the projects under contingency FLT47-3PH during the 2010 summer peak case. As shown, the output power, terminal voltage and speed oscillate following the fault and return to system stable levels within 7 seconds of the fault being cleared.

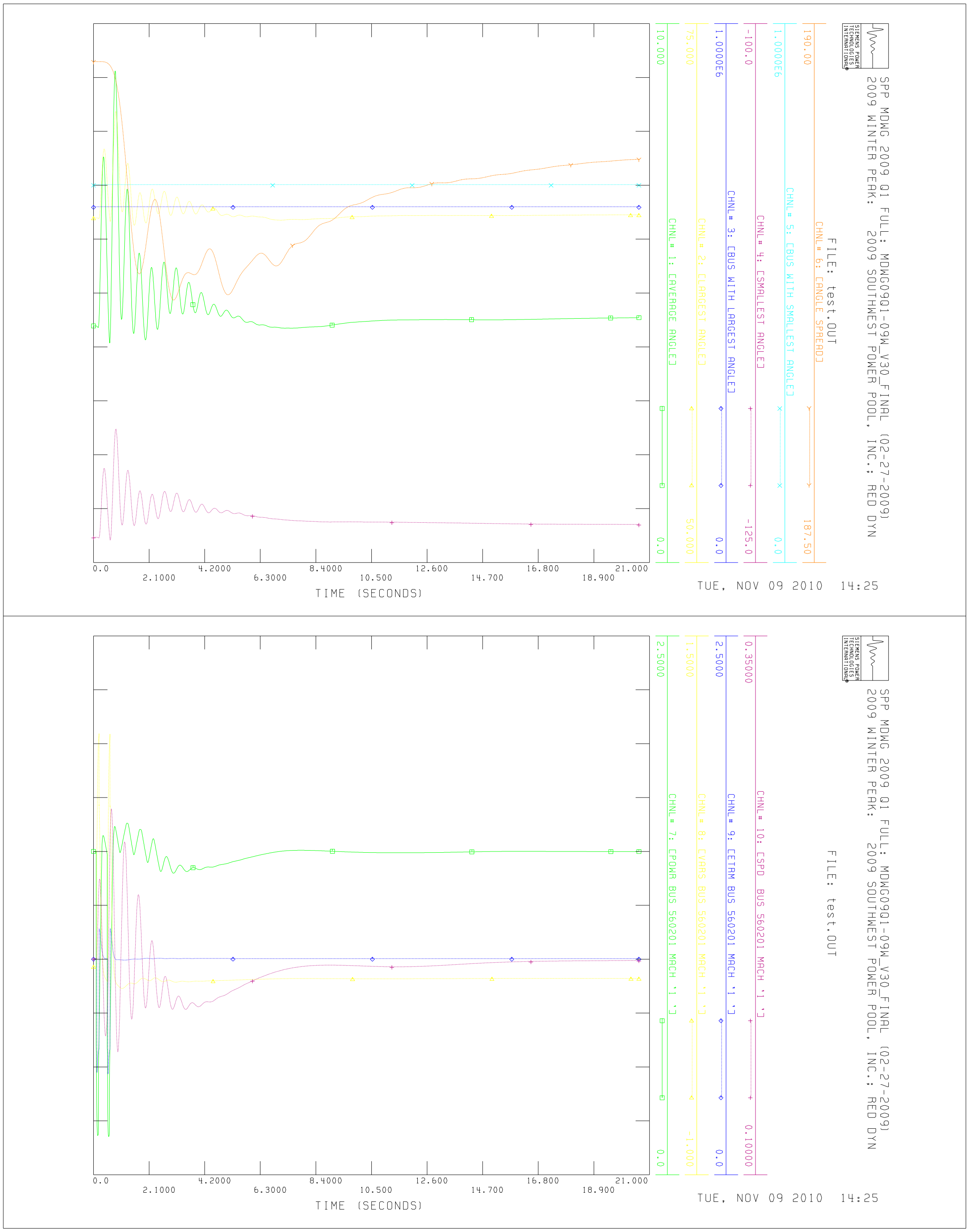


Figure 3: Plot for fault FLT13-3PH

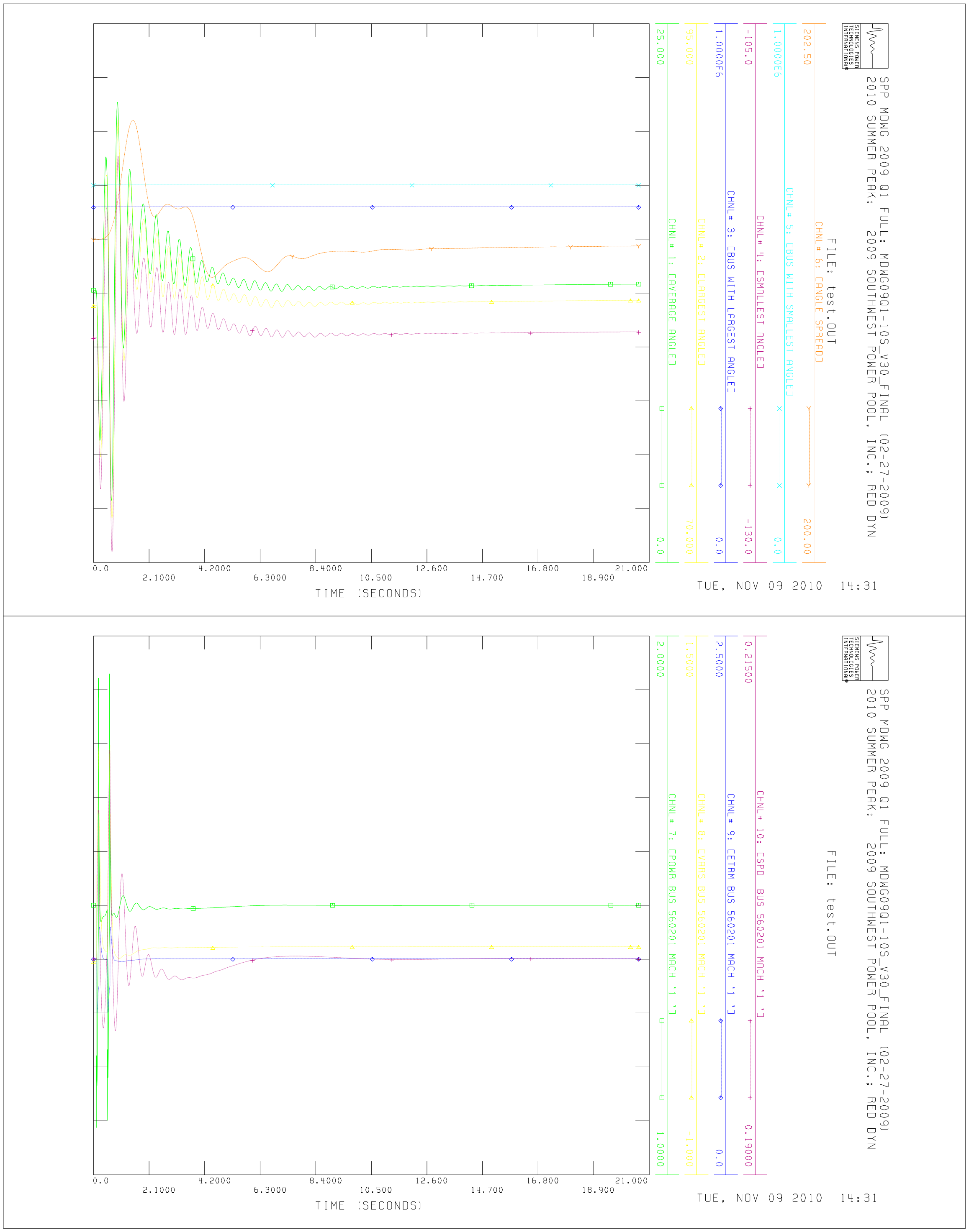


Figure 4: Plot for fault FLT47-3PH

8.0 Power Factor Analysis

A power factor analysis was performed by modeling a VAR generator at the high voltage bus of GEN-2008-038. The VAR generator was set to hold a voltage schedule of 1.000 per unit at the POI (a tap on the Shidler – North Pawhuska 138 kV transmission line) and the contingencies listed in Table 2 were studied.

Table 4 shows the calculated power factors that need to be maintained at the POI for each of the contingencies that were studied. The highest leading power factor that would be required is 0.95 under the FLT13-3PH. The highest lagging power factor that would be required is 1.00 under the FLT47-3PH contingency.

As the analysis has determined that a power factor standard is required, the Customer is required to maintain 95% lagging (providing) and 95% leading (absorbing) power factor at the point of interconnection.

Table 4: Required Power Factor

Voltage 1.000 pu	2010 SUMMER				2009 WINTER			
	MW	MVAR	PF	Type	MW	MVAR	PF	Type
Pre Contingency	-148.0	22.3	0.9888	Leading	-148.0	31.2	0.9785	Leading
Wolk Creek - Benton 345kV	-148.0	21.0	0.9901	Leading	-148.0	31.4	0.9782	Leading
Wolf Creek - Rose Hill 345kV	-148.0	21.0	0.9901	Leading	-148.0	31.4	0.9782	Leading
AECI FS-6 - Fairfax 138kV	-148.0	17.8	0.9928	Leading	-148.0	26.3	0.9846	Leading
AECI FS-6 - AECI FS-7 138kV	-148.0	24.3	0.9868	Leading	-148.0	32.8	0.9763	Leading
Neosho - Lacygne 345kV	-148.0	19.5	0.9914	Leading	-148.0	30.0	0.9801	Leading
AECI FS-7 - Burbank 138kV	-148.0	23.0	0.9881	Leading	-148.0	31.4	0.9782	Leading
AECI FS-7 - Shidler 138kV	-148.0	37.5	0.9694	Leading	-148.0	44.3	0.9580	Leading
GEN-2008-127 - Sooner 345kV	-148.0	20.6	0.9905	Leading	-148.0	31.3	0.9784	Leading
GEN-2008-127 - Rose Hill 345kV	-148.0	20.0	0.9910	Leading	-148.0	30.8	0.9790	Leading
Woodring - Sooner 345kV	-148.0	22.1	0.9890	Leading	-148.0	31.1	0.9786	Leading
Cleveland - Sooner 345kV	-148.0	18.3	0.9924	Leading	-148.0	27.4	0.9833	Leading
Rose Hill - Lathams 345kV	-148.0	21.3	0.9898	Leading	-148.0	31.7	0.9778	Leading
GEN-2008-038 - Shidler 138kV	-148.0	27.7	0.9829	Leading	-148.0	31.4	0.9782	Leading
GEN-2008-038 - Wpawhsk 138kV	-148.0	22.6	0.9885	Leading	-148.0	29.4	0.9808	Leading
GEN-2008-038 - Omhomny 138kV	-148.0	11.0	0.9972	Leading	-148.0	20.6	0.9905	Leading
Fairfax Tap - Webb Tap 138kV	-148.0	1.1	1.0000	Leading	-148.0	9.0	0.9982	Leading
Moundrd - Barnsal 138kV	-148.0	17.3	0.9932	Leading	-148.0	27.6	0.9831	Leading
Moundrd - Bvcom 138kV	-148.0	28.5	0.9820	Leading	-148.0	30.9	0.9789	Leading
Delaware - NES 345kV	-148.0	21.3	0.9898	Leading	-148.0	30.7	0.9792	Leading
Fairfax - Cleveland Tap 138kV	-148.0	21.9	0.9892	Leading	-148.0	27.1	0.9836	Leading
Kildare - Newkirk 138kV	-148.0	20.0	0.9910	Leading	-148.0	30.2	0.9798	Leading
Osage - Webb tap 138kV	-148.0	-0.4	1.0000	Lagging	-148.0	7.8	0.9986	Leading
Sooner - Snrpmpt 138kV	-148.0	17.2	0.9933	Leading	-148.0	28.9	0.9815	Leading
Sooner - Miller 138kV	-148.0	18.6	0.9922	Leading	-148.0	29.9	0.9802	Leading
Osage - Maryland Tap 138kV	-148.0	22.4	0.9887	Leading	-148.0	30.4	0.9795	Leading
Burbank - Fairfax 138kV	-148.0	22.6	0.9885	Leading	-148.0	31.0	0.9788	Leading

9.0 Conclusion

A transient stability analysis was performed to evaluate GEN-2008-038 generation request. The study was conducted for two different scenarios, summer peak and winter peak cases due to the interconnection of wind farm, GEN-2008-038. The analysis did not find any stability issues for the contingencies included in the study.

The power factor analysis indicated that the GEN-2008-038 request will be required to maintain 95% leading and 95% lagging power factor at the point of interconnection.

With the assumptions described in this study, GEN-2008-038 should be able to connect on the SPP transmission system without causing any stability issues.