GEN-2012-032
Impact Restudy for Generator Modification (Turbine Change)

December 2014
Generator Interconnection

SPP Southwest Power Pool

Executive Summary

The GEN-2012-032 interconnection customer has requested a system impact restudy to determine the effects of changing wind turbine generators from the previously studied Vestas V112 3.0 MW (100 generators total) to Siemens SWT-2.3MW wind turbine generators (130 machines total).

In this restudy the project uses one-hundred thirty (130) Siemens SWT-2.3MW wind turbine generators for an aggregate power of 299.0MW. The point of interconnection (POI) for GEN-2012-032 is at the Oklahoma Gas and Electric Company (OG&E) Open Sky 345 kV Substation.

This study was performed to determine whether the request for modification is considered Material. To determine this, study models that included Interconnection Requests through DISIS-2012-002 were used that analyzed the timeframes of 2015 summer, 2015 winter, and 2025 summer models.

The restudy showed that no stability problems were found during the summer and the winter peak conditions as a result of changing to the Siemens SWT-2.3MW wind turbine generators. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and, therefore, will meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

A power factor analysis and a low-wind/no-wind condition analysis were performed for this modification request. The facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VARs) power factor at the POI. Additionally, the project will be required to install approximately 7 Mvar of reactor shunts on its substation 34.5kV bus(es). This is necessary to offset the capacitive effect on the transmission network caused by the project's transmission line and collector system during low-wind/no-wind conditions.

With the assumptions outlined in this report and with all the required network upgrades from the GEN-2012-032 GIA in place, GEN-2012-032 with the Siemens SWT2.3MW wind turbine generators should be able to interconnect reliably to the SPP transmission grid.

It should be noted that this study analyzed the requested modification to change generator technology, manufacturer, and layout. Powerflow analysis was not performed. This study analyzed many of the most probable contingencies, but it is not an all-inclusive list and cannot account for every operational situation. It is likely that the customer may be required to reduce its 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.

Nothing in this study should be construed as a guarantee of transmission service or delivery rights. If the customer wishes to obtain deliverability to final customers, a separate request for transmission service must be requested on Southwest Power Pool's OASIS by the customer.

I. Introduction

GEN-2012-032 Impact Restudy is a generation interconnection study performed to study the impacts of interconnecting the project shown in Table I-1. This restudy is for a change from Vestas to Siemens wind turbines.

Table I-1: Interconnection Request

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2012-032	299	Siemens SWT2.3MW	Open Sky 345kV (515621)

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

Table I-2: Prior Queued Interconnection Requests

Request	Capacity (MW)	Generator Model	Point of Interconnection
ASGI-2010-006	150.0	GE 1.5MW	Remington 138kV (301369)
GEN-2002-004	199.5	GE 1.5MW	Lathams 345kV (532800)
GEN-2005-013	199.8	Vestas V90	Caney River 345kV (532780)
GEN-2007-025	299.2	GE 1.6 MW	Viola 345kV (532798)
GEN2008-013	299.04	GE 1.68 MW	Hunter 345kV (515476)
GEN-2008-098	100.8	Gamesa 2.0 MW	Waverly 345kV (532799)
GEN-2009-025	59.8	Siemens 2.3MW	Nardins 69kV (515528)
GEN-2010-003	100.8	Gamesa 2.0 MW	Waverly 345kV (532799)
GEN-2010-005	299.2	GE 1.6 MW	Viola 345kV (532798)
GEN-2011-057	150.4	GE 1.6 MW	Creswell 138kV (532981)
GEN-2012-027	136.0	GE 1.62 MW	Shidler 138kV (510403)
GEN2012-033	98.8	GE 1.62 MW	Breckinridge 138kV (514815)
GEN-2012-040	76.5	GE 1.7 MW	Chilocco 138kV (521198)
GEN-2014-022*	15MW	Siemens SWT 2.3MW	Open Sky 345kV (515621)

*GEN-2014-022 is an uprate to GEN-2012-032

The study included a stability analysis of the 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. Also, a power factor analysis and a low-wind/no-wind analysis were performed on this project since it is a wind farm. The analyses were performed on three seasonal models, the modified versions of the 2015 summer peak, the 2015 winter peak, and the 2025 summer peak cases.

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

The power factor analysis determines the power factor at the point of interconnection for the wind interconnection project for pre-contingency and post-contingency conditions. The contingencies used in the power factor analysis were a subset of the stability analysis contingencies shown in Table III-1.

The low-wind/no-wind analysis determines the capacitive effect at the POI caused by the project's collector system and transmission line capacitance. A shunt reactor size was determined to offset the capacitive effect and to maintain zero Mvar flow at the POI when the plant generators and capacitors are off-line such as might be seen in low-wind or no-wind conditions.

II. Facilities

A one-line drawing for the GEN-2012-032 generation interconnection request is shown in Figure II-1. The POI is the OG&E Open Sky 345kV substation. The drawing also includes the later queued GEN-2014-022 Interconnection Request.

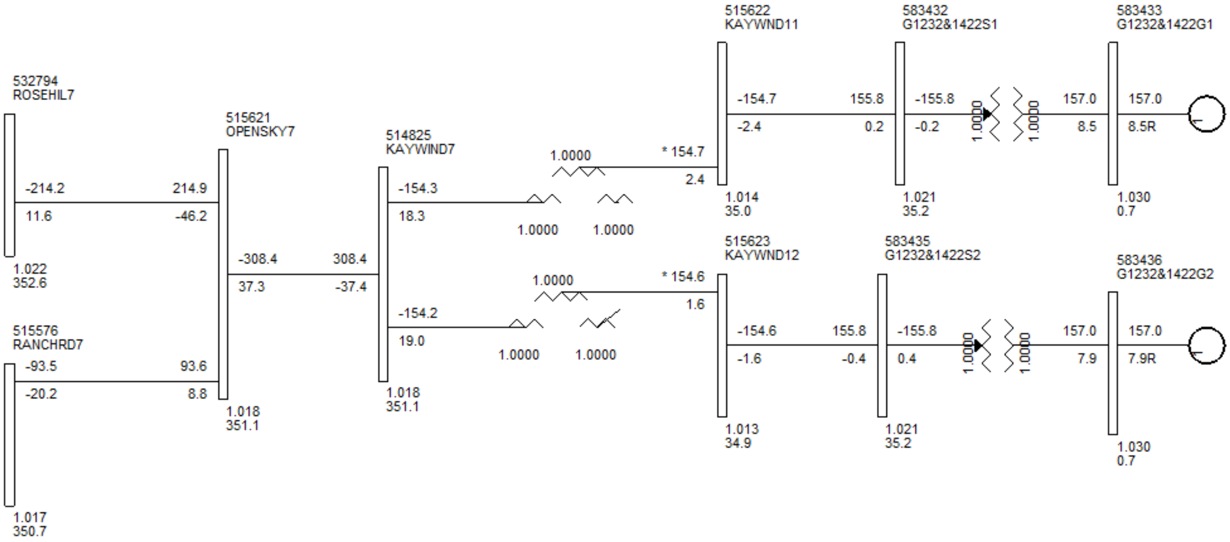

Figure II-1: GEN-2012-032 One-line Diagram

III. Stability Analysis

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

Model Preparation

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

Disturbances

Eleven (11) contingencies were identified for use in this study and are listed in Table III-1. 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.

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

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

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

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

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
1	FLT_01_OpenSky_RanchRoad_345kV	3 phase fault on the Open Sky (515621) to Ranch Road (515576) 345kV line, at Open Sky. a. Apply fault at the Open Sky 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	FLT_02_OpenSky_Rosehill_345kV	3 phase fault on the Open Sky (515621) to Rose Hill (532794) 345kV line, at Open Sky. a. Apply fault at the Open Sky 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.
3	FLT_03_RanchRoad_Sooner_345kV	3 phase fault on the Ranch Road (515576) to Sooner (514803) 345kV line, at Ranch Road. a. Apply fault at the Ranch Road 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	FLT_04_Sooner_Cleveland_345kV	3 phase fault on the Sooner (514803) to Cleveland (512694) 345kV line, at Sooner. a. Apply fault at the Sooner 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.
5	FLT_05_Sooner_Woodring_345kV	3 phase fault on the Sooner (514803) to Woodring (514715) 345kV line, at Sooner. a. Apply fault at the Sooner 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	FLT_06_Sooner_SpringCreek_345kV	3 phase fault on the Sooner (514803) to Spring Creek (514881) 345kV line, at Sooner. a. Apply fault at the Sooner 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.

Table III-1: Contingencies Evaluated

Cont. No.	Contingency Name	Description
7	FLT_07_Sooner_Sooner_345_138kV	3 phase fault on the Sooner (514803) 345/ (514802) 138/ (515760) 13.8kV transformer, near the Sooner 345kV bus. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer
8	FLT_08_Rosehill_Benton_345kV	3 phase fault on the Rose Hill (532794) to Benton (532791) 345kV line, at 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.
9	FLT_09_Rosehill_WolfCreek_345kV	3 phase fault on the Rose Hill (532794) to Wolf Creek (532797) 345kV line, at 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.
10	FLT_10_Rosehill_Lathams_345kV	3 phase fault on the Rose Hill (532794) to Lathams (532800) 345kV line, at 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.
11	FLT_11_Rosehill_Rosehill_345_138kV	3 phase fault on the Rose Hill (532794) 345/ (533062) 138/ (532831) 12.5kV transformer, near the Rose Hill 345kV bus. a. Apply fault at the Sooner 345kV bus. b. Clear fault after 5 cycles by tripping the faulted transformer

Results

The stability analysis was performed and the results are summarized in Table III-2. Based on the stability results and with all network upgrades in service, GEN-2012-032 did not cause any stability problems and remained stable for all faults studied. No generators tripped or went unstable, and voltages recovered to acceptable levels.

Complete sets of plots for the stability analysis are available on request.

Table III-2: Stability Analysis Results

Contingency Number and Name		2015SP	2015WP	2025SP
1	FLT_01_OpenSky_RanchRoad_345kV	Stable	Stable	Stable
2	FLT_02_OpenSky_Rosehill_345kV	Stable	Stable	Stable
3	FLT_03_RanchRoad_Sooner_345kV	Stable	Stable	Stable
4	FLT_04_Sooner_Cleveland_345kV	Stable	Stable	Stable
5	FLT_05_Sooner_Woodring_345kV	Stable	Stable	Stable
6	FLT_06_Sooner_SpringCreek_345kV	Stable	Stable	Stable
7	FLT_07_Sooner_Sooner_345_138kV	Stable	Stable	Stable
8	FLT_08_Rosehill_Benton_345kV	Stable	Stable	Stable
9	FLT_09_Rosehill_WolfCreek_345kV	Stable	Stable	Stable
10	FLT_10_Rosehill_Lathams_345kV	Stable	Stable	Stable
11	FLT_11_Rosehill_Rosehill_345_138kV	Stable	Stable	Stable

NOTE: “- NA -“means the contingency is not applicable

FERC LVRT Compliance

FERC Order #661A places specific requirements on wind farms through its Low Voltage Ride Through (LVRT) provisions. For Interconnection Agreements signed after December 31, 2006, wind farms shall stay on line for faults at the POI that draw the voltage down at the POI to 0.0 pu.

Contingencies 1 and 2 in Table III-2 simulated the LVRT contingencies. GEN-2012-032 met the LVRT requirements by staying on line and the transmission system remaining stable.

IV. Power Factor Analysis

A subset of the stability faults was used as power flow contingencies to determine the power factor requirements for the wind farm to maintain scheduled voltage at the POI. The voltage schedule was set equal to the voltages at the POI before the project is added, with a minimum of 1.0 per unit. A fictitious reactive power source replaced the study project to maintain scheduled voltage during all studied contingencies. The MW and Mvar injections from the study project at the POI 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 project must install before commercial operation.

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 power factor analysis showed a need for reactive capability by the study project at the POI. The final power factor requirement in the Generator Interconnection Agreement (GIA) will be the pro-forma 0.95 lagging to 0.95 leading at the POI, and this requirement is shown in Table IV-1. The detailed power factor analysis tables are in Appendix B.

Table IV-1: Power Factor Requirements [a]

Request	Size (MW)	Generator Model	Point of Interconnection	Final PF Requirement at POI	
				Lagging [b]	Leading [c]
GEN-2012-032	299	Siemens SWT-2.3MW	Open Sky 345kV (515621)	0.95	0.95

Notes:

a. 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.

In a separate test, the effect of low-wind/no-wind conditions at the wind farm is analyzed. The project generators and capacitors (if any) were turned off in the base case (Figure IV-1). The resulting reactive power injection into the transmission network comes from the capacitance of the project’s transmission lines and collector cables.

Shunt reactors were added at the study project substation 34.5 kV buses to bring the Mvar flow into the Open Sky 345kV substation down to approximately zero (Open Sky 345kV in Figure IV-2). Final shunt reactor requirement for this project is approximately 7Mvars. The one-line diagram in Figure IV-2 shows actual Mvar output at the specific voltages in the base case. The results shown are for the 2014WP case. The other two cases (2015SP and 2024SP) were almost identical since the plant design is the same in all cases.

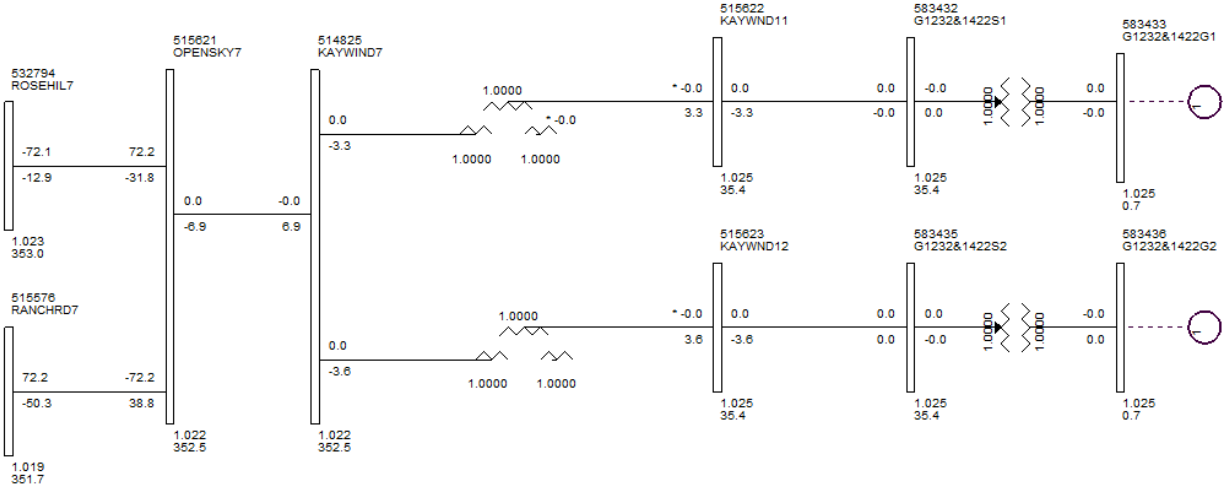

Figure IV-1: GEN-2012-032 with generators off and no shunt reactors

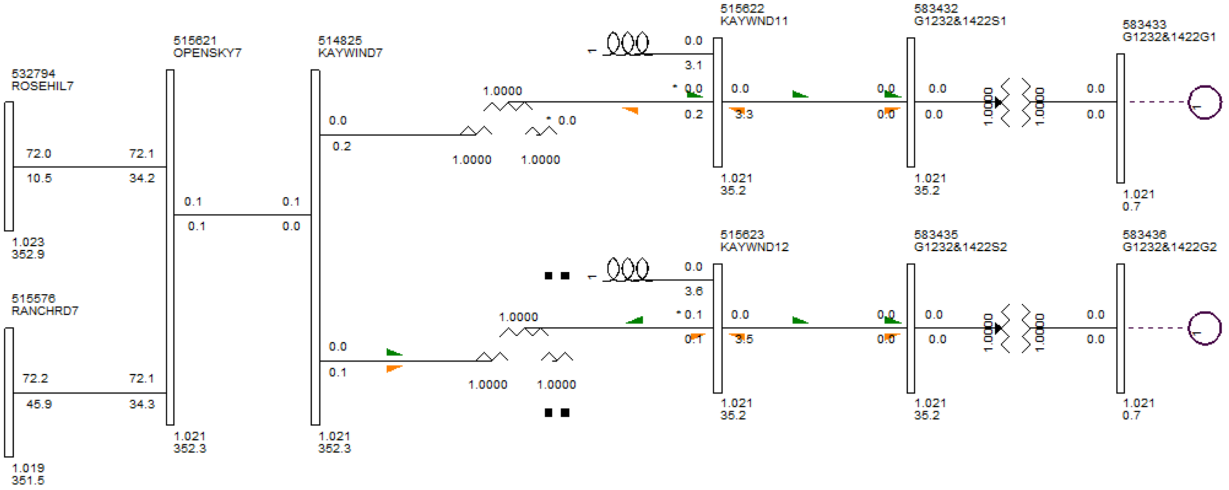

Figure IV-2: GEN-2012-032 with generators turned off and shunt reactors added to the low side of the substation 345/34.5kV transformers

V. Conclusion

The SPP GEN-2012-032 Impact Restudy evaluated the impact of interconnecting the project shown below.

Request	Capacity (MW)	Generator Model	Point of Interconnection
GEN-2012-032	299	Siemens SWT-2.3MW	Open Sky 345kV (515621)

With all Base Case Network Upgrades in service, previously assigned Network Upgrades in service, and required capacitor banks in service, the GEN-2012-032 project was found to remain on line, and the transmission system was found to remain stable for all conditions studied.

A power factor analysis and a low-wind/no-wind condition analysis were performed for this modification request. The facility will be required to maintain a 95% lagging (providing VARs) and 95% leading (absorbing VARs) power factor at the POI. Additionally, the project will be required to install a total of approximately 7Mvar of reactor shunts on its substation 34.5kV buses. This is necessary to offset the capacitive effect on the transmission network cause by the project's transmission line and collector system during low-wind or no-wind conditions.

Low Voltage Ride Through (LVRT) analysis showed the study generators did not trip offline due to low voltage when all Network Upgrades are in service.

All generators in the monitored areas remained stable for all of the modeled disturbances.

Any changes to the assumptions made in this study, for example, one or more of the previously queued requests withdraw, may require a re-study at the expense of the Customer.

Nothing in this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service.

APPENDIX A

PLOTS

Available on request

APPENDIX B

POWER FACTOR ANALYSIS

GEN-2012-032	**2015 Summer Peak**				**2015 Winter Peak**				**2025 Summer Peak**			
POI: Open Sky 345kV (515621)	**MW**	**Mvar**	**PF**		**MW**	**Mvar**	**PF**		**MW**	**Mvar**	**PF**	
POI voltage for all seasons is 1.0PU												
FLT_00_NoFault	313.95	1.702811718	0.999985291	LAG	313.95	2.964011192	0.999955436	LAG	313.9500122	2.307119846	0.999973	LAG
FLT_01_OpenSky_RanchRoad_345kV	313.95	21.74044991	0.997610937	LAG	313.95	76.87796021	0.971302856	LAG	313.9500122	43.63505173	0.990478992	LAG
FLT_02_OpenSky_Rosehill_345kV	313.95	55.66561127	0.984642248	LAG	313.95	-8.27528674	0.999652793	LEAD	313.9500122	29.96191025	0.995476926	LAG
FLT_03_RanchRoad_Sooner_345kV	313.95	19.55751038	0.998065297	LAG	313.95	81.82255554	0.967675552[a]	LAG	313.9500122	39.05141068	0.992352522	LAG
FLT_04_Sooner_Cleveland_345kV	313.95	7.4148283	0.999721215	LAG	313.95	8.482138634	0.999635228	LAG	313.9500122	10.72505665	0.999417	LAG
FLT_05_Sooner_Woodring_345kV	313.95	4.050383568	0.999916788	LAG	313.95	5.207544327	0.999862461	LAG	313.9500122	4.003107548	0.999918719	LAG
FLT_06_Sooner_SpringCreek_345kV	313.95	5.797264576	0.999829555	LAG	313.95	8.583132744	0.999626494	LAG	313.9500122	4.703810692	0.999887779	LAG
FLT_07_Sooner_Sooner_345_138kV	313.95	1.74643302	0.999984528	LAG	313.95	2.734875202	0.99996206	LAG	313.9500122	2.26636982	0.999973945	LAG
FLT_08_Rosehill_Benton_345kV	313.95	-6.37031507	0.999794204	LEAD	313.95	-12.1400098	0.999253207[b]	LEAD	313.9500122	1.259792924	0.999991949	LAG
FLT_09_Rosehill_WolfCreek_345kV	313.95	9.990620613	0.999494054	LAG	313.95	28.73441505	0.995837679	LAG	313.9500122	16.59634209	0.998605673	LAG
FLT_10_Rosehill_Lathams_345kV	313.95	7.108560085	0.999743761	LAG	313.95	19.76827621	0.998023497	LAG	313.9500122	7.89778614	0.999683733	LAG
FLT_11_Rosehill_Rosehill_345_138kV	313.95	5.068910122	0.999869685	LAG	313.95	1.460888028	0.999989174	LAG	313.9500122	4.114156246	0.999914147	LAG

NOTE:

a. Lowest lagging (supplying vars) power factor requirement for all three seasons
b. Lowest leading (absorbing vars) power factor requirement for all three seasons

APPENDIX C

PROJECT MODELS

GEN-2012-032 (Siemens SWT2.3MW)

PSS/E 32 Power Flow Data

```
@! ----------- Add New Buses -----------
BAT_SPLT,515621,514825,'KAYWIND7',345.00,;
BAT_SPLT,515622,583432,'G1232&1422S1', 34.50,;
BAT_SPLT,515623,583435,'G1232&1422S2', 34.50,;
BAT_BUS_DATA_2,514825,1,524, 566,, 345.00,,,'KAYWIND7',;
BAT_BUS_DATA_2,515619,1,524, 566,,  13.80,,,'KAYWNDT1',;
BAT_BUS_DATA_2,515622,1,524, 566,,  34.50,,,'KAYWND11',;
BAT_BUS_DATA_2,583432,1,524, 566,,  34.50,,,'G1232&1422S1',;
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BAT_BUS_DATA_2,515620,1,524, 566,,  13.80,,,'KAYWNDT2',;
BAT_BUS_DATA_2,515623,1,524, 566,,  34.50,,,'KAYWND12',;
BAT_BUS_DATA_2,583435,1,524, 566,,  34.50,,,'G1232&1422S2',;
BAT_BUS_DATA_2,583436,2,524, 566,,   0.65,,,'G1232&1422G2',;
BAT_PURGLOAD,515622,'1'
BAT_PURGLOAD,515623,'1'
@!
@! ----------- Add New Generators -----------
BAT_MOVEMAC,515622,'1',583433,'1',;
BAT_MOVEMAC,515623,'1',583436,'1',;
BAT_PURGMAC,515623,'2'
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BAT_PLANT_DATA,583436,    0, 1.03,,;
@! 100%
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@!
@! ----------- Add New Unit Transformers -----------
@!BAT_TWO_WINDING_DATA_3,514825,515622,'1',1,,,,,,33,,,,1,0,1,2,1, 0.003539,0.08490,100.00,,,,,,167.00,167.00,,,,,,,,,,,,,,;
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BAT_THREE_WND_WINDING_DATA_3,514825,515619,515622,'1',3,33,0,0,1,0, 1.0,0.0,0.0,  55.6,  55.6,0.0, 1.1, 0.9, 1.1,
0.9,0.0,0.0,0.0
BAT_SEQ_3_WIND_GROUNDING_DATA,514825,515619,515622,'1',2,0.0,0.0
BAT_SEQ_3_WIND_WINDING_DATA,514825,515619,515622,'1',1, 0.000872904, 0.111667
BAT_SEQ_3_WIND_WINDING_DATA,514825,515619,515622,'1',2, 0.00115761,-0.0107786
BAT_SEQ_3_WIND_WINDING_DATA,514825,515619,515622,'1',3, 0.00321012, 0.0484047
@!BAT_TWO_WINDING_DATA_3,514825,515623,'1',1,,,,,,33,,,,1,0,1,2,1, 0.003539,0.08490,100.00,,,,,,167.00,167.00,,,,,,,,,,,,,,;
BAT_THREE_WND_IMPEDANCE_DATA,514825,515620,515623,'2',,,,,1,2,1,,,,,,,,,,,,,,,,,,,,,,;
BAT_THREE_WND_IMPEDANCE_DATA,514825,515620,515623,'2',524,0,0,0,1,2,1,1,514825,514825,515623,515620, 0.001786852,
0.08878201, 0.001268388, 0.01092663, 0.001185709, 0.0464849,100.0, 33.33, 33.33,0.0,0.0, 1.0, 1.0, 1.0, 1.0,,,'KAYWINDB1',;
BAT_THREE_WND_WINDING_DATA_3,514825,515620,515623,'2',1,33,0,0,1,0, 1.0,0.0,0.0, 166.7, 166.7,0.0, 1.1, 0.9, 1.1,
0.9,0.0,0.0,0.0
BAT_THREE_WND_WINDING_DATA_3,514825,515620,515623,'2',2,33,0,0,1,0, 1.0,0.0,0.0, 166.7, 166.7,0.0, 1.1, 0.9, 1.1,
0.9,0.0,0.0,0.0
BAT_THREE_WND_WINDING_DATA_3,514825,515620,515623,'2',3,33,0,0,1,0, 1.0,0.0,0.0,  55.6,  55.6,0.0, 1.1, 0.9, 1.1,
0.9,0.0,0.0,0.0
BAT_SEQ_3_WIND_GROUNDING_DATA,514825,515620,515623,'2',2,0.0,0.0
BAT_SEQ_3_WIND_WINDING_DATA,514825,515620,515623,'2',1, 0.000872904, 0.111667
BAT_SEQ_3_WIND_WINDING_DATA,514825,515620,515623,'2',2, 0.00115761,-0.0107786
```

```
BAT_SEQ_3_WIND_WINDING_DATA,514825,515620,515623,'2',3, 0.00321012, 0.0484047
BAT_TWO_WINDING_DATA_3,583432,583433,'1',1,,,,,, 5,,,,1,0,1,2,1, 0.00840, 0.06000,169.00,,,,,,169.00,169.00,,,,,,,,,,,,,,;
BAT_TWO_WINDING_DATA_3,583435,583436,'1',1,,,,,, 5,,,,1,0,1,2,1, 0.00840, 0.06000,169.00,,,,,,169.00,169.00,,,,,,,,,,,,,,;
@!
@! ----------- Add New Collector Cables -----------
BAT_BRANCH_DATA,515622,583432,'1',1,,,,,, 0.00479, 0.00487, 0.03150,,,,,,,    ,,,,,;
BAT_BRANCH_DATA,515623,583435,'1',1,,,,,, 0.00535, 0.00653, 0.03395,,,,,,,    ,,,,,;
@!
@! ----------- Add Transmission Line from Substation to POI -----------
@!BAT_BRANCH_DATA,515621,514825,'1',1,,,,,, 0.00092, 0.01104, 0.20930,,,,,,, 23.00,,,,,;
  BAT_BRANCH_DATA,515621,514825,'1',1,,,,,,0.000004, 0.00004, 0.00066,,,,,,,  0.08,,,,,;
@!
@END
```

PSS/E 32 Dynamics Data

```
/ Siemens 2.3 MW 108m (SWTVS4_Model_PSSE_Ver_32.obj)
/
 / SWTVS4  V1.0, 2.3 MW 101 m;  60 Hz
583433 'USRMDL' 1 'SWTVS4'  1  1    25  154  29  99
  1 1 3 1 1 0 0 1 1 1 1 1 1 1 0 0 0 1 1 0 0 0 1 1 1 54.62 1.0927 15.5910 0.1458 128.61 1.2471 1.1177 1.0969 1.0003 1.1111  1.40 1.10
0.10 1.1 1.1 22
  100000 2.00 100000 1 0.1 1.1 2.0 1.0000 0.9877 1.0225 0.010 0.10 0.40 0.6 0.05 0.090 0.090 0.30 3.0 0.955 0.70 0.002 0.5 3 200
0.25 0.25 0.1 1
  0.9 1.0 0.028 0.10 11.47 22.91 1 1.00 2.93 58.59 0.9 0.020 10 0.00 1.836 0.174 -0.174 0.037 9.98 1.1014 0.05 0.0022 0.1415 0.06
  0.90 0.040 2.10 0.70 1.20 0.70 1.89 2.0 0.82 0.5 0.40 4.0 1.225 15 1.00 2.0 0.055 25.0 0.276 1.0069
  13.05 -101.50 -56.39 0.15 7.0 -8.0 45.0 -2.0 2.0 0.060 0.9655 -4.7283 -0.6755 0.2174 0.2174 1.0 100 0.90 200 0.05 0.85 11.00 0.05
  0.70 2.60 0.05 0.40 1.60 0.05 0.15 0.85 0.05 0.10 1.00 0.05 0.10 1.00 0.05 0.10 1.00 0.05 1.10 1.00 0.05 1.20 0.15 0.05 1.45 1.00
0.05
  1.45 1.00 0.05 1.45 1.00 0.05 0.95 10.00 0.00 0.95 0.20 0.00 1.0333 0.20 0.00 /
/
 / SWTVS4  V1.0, 2.3 MW 101 m;  60 Hz
583436 'USRMDL' 1 'SWTVS4'  1  1    25  154  29  99
  1 1 3 1 1 0 0 1 1 1 1 1 1 1 0 0 0 1 1 0 0 0 1 1 1 54.62 1.0927 15.5910 0.1458 128.61 1.2471 1.1177 1.0969 1.0003 1.1111  1.40 1.10
0.10 1.1 1.1 22
  100000 2.00 100000 1 0.1 1.1 2.0 1.0000 0.9877 1.0225 0.010 0.10 0.40 0.6 0.05 0.090 0.090 0.30 3.0 0.955 0.70 0.002 0.5 3 200
0.25 0.25 0.1 1
  0.9 1.0 0.028 0.10 11.47 22.91 1 1.00 2.93 58.59 0.9 0.020 10 0.00 1.836 0.174 -0.174 0.037 9.98 1.1014 0.05 0.0022 0.1415 0.06
  0.90 0.040 2.10 0.70 1.20 0.70 1.89 2.0 0.82 0.5 0.40 4.0 1.225 15 1.00 2.0 0.055 25.0 0.276 1.0069
  13.05 -101.50 -56.39 0.15 7.0 -8.0 45.0 -2.0 2.0 0.060 0.9655 -4.7283 -0.6755 0.2174 0.2174 1.0 100 0.90 200 0.05 0.85 11.00 0.05
  0.70 2.60 0.05 0.40 1.60 0.05 0.15 0.85 0.05 0.10 1.00 0.05 0.10 1.00 0.05 0.10 1.00 0.05 1.10 1.00 0.05 1.20 0.15 0.05 1.45 1.00
0.05
  1.45 1.00 0.05 1.45 1.00 0.05 0.95 10.00 0.00 0.95 0.20 0.00 1.0333 0.20 0.00 /
/
```