Impact Study for Generation Interconnection Request GEN–2007–006

Addendum

SPP Tariff Studies
(#GEN-2007-006)

May 2008

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), S&C Electric Company (S&C) performed an Impact Study in January, 2008 to satisfy the Impact Study Agreement executed by the requesting customer and SPP for SPP Generation Interconnection request GEN-2007-006.

This analysis is an addendum to the original Impact Study. SPP has run additional simulations assuming that no reclosing will occur on faults at the point of interconnection. SPP has also run subsequent voltage stability analysis to determine the reliability of the transmission system for the loss of the Roman Nose – El Reno 138kV transmission line.

The interconnection of GEN-2007-006 can be accommodated in either of two different methods. One, the Interconnection Customer must reduce the queue position for GEN-2007-006 to 160 MW and install or pay to install the applicable facilities in Tables 1. and 2. The cost for 160 MW interconnection is estimated at $1,050,000 not including the cost of facilities to be determined by the Customer. Two, the Interconnection Customer can interconnect at 200 MW but will need to install or pay to install the applicable facilities in Tables 5. and 6. These facilities include a new 31 mile, 138kV transmission line between Roman Nose and El Reno. The cost for 200 MW interconnection is estimated at $24,050,000 not including the cost of facilities to be determined by the Customer.

The Suzlon S88 wind turbines will meet the LVRT provisions of FERC Order #661A provided all applicable facilities in Table 5 and Table 6 are installed. If the new transmission line from Roman Nose to El Reno is not installed, dynamic compensation will be required for the wind farm to meet the LVRT provisions. These devices have been preliminarily sized at two (2) +/- 8MVA STATCOM devices. The final size of these devices will be determined by the manufacturer using their detailed modeling information. A change in wind turbine manufacturer or type will cause the interconnection request to be restudied.

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

If any previous queued projects withdraw from the queue or suspend their interconnection agreements, the facility requirements for this interconnection request will change. A restudy must be conducted to determine these changes.

Introduction

This analysis is an addendum to the original Impact Study for GEN-2007-006 conducted by S&C Electric Company. SPP has run additional simulations assuming that no reclosing will occur on faults at the point of interconnection. SPP has also run subsequent voltage stability analysis to determine the reliability of the transmission system for the loss of the Roman Nose – El Reno 138kV transmission line. The original Impact Study should be consulted for details of the wind generation facility.

Existing Transmission System

Voltage Stability Analysis

The original Impact Study determined that a number of issues are encountered due to the addition of GEN-2007-006. The problems were encountered for an outage of the Roman Nose – El Reno 138kV transmission line. The original Impact Study determined that to meet FERC Order #661A low voltage ride through (LVRT) requirements, the Customer would have to install STATCOM devices at their facility and in addition would have to pay for the installation of capacitor banks at GEN-2006-046 generation facility and the GEN-2001-014 generation facility.

Considering the difficulty in finding a solution for LVRT requirements and the heavy loading observed on the Roman Nose – El Reno 138kV line in system intact conditions (loaded up to 179% of Rate A ratings with previous queued projects in service), SPP conducted a voltage stability analysis. SPP conducted a P-V analysis at the point of interconnection for the outage of the Roman Nose – El Reno 138kV transmission line. For this analysis the Customer's wind farm was modeled as provided. For reactive compensation of the wind farm, capcitors and a var generator was placed on each of the 34.5kV buses of the wind farm and set to schedule the voltage at 1.02 pu at Roman Nose substation.

Using the P-V analysis tool available in PSS/E, it was found that the maximum transfer available from the point of interconnection under winter peak conditions is approximately 175MW. Mooreland 138kV substation is the where voltage collapse occurs. At voltage collapse, the voltage at Mooreland is approximately 0.94 pu. The fact that there are many thermal transmission line overloads observed at Mooreland for this condition indicated that the addition of reactive compensation at Mooreland was not the proper solution as it would only make these observed loadings worse. The Feasibility Study loadings for selected lines in the Mooreland area are listed in Table 1. Please see the Figure 1 for the P-V analysis graph of the Roman Nose – El Reno outage.

Table 1. Selected Loadings from GEN-20007-006 Feasibility Study

Element	Rate	Loading	Contingency
KNOBHILL - MOORELAND 138KV CKT 1	96	113.2	GLASS MOUNTAIN - MOORELAND 138KV CKT 1
CLEO CORNER - GLASS MOUNTAIN 138KV CKT 1	153	125.1	2002-05T 138.00 - ELK CITY 138KV CKT 1
GLASS MOUNTAIN - MOORELAND 138KV CKT 1	124	157.5	2002-05T 138.00 - ELK CITY 138KV CKT 1
2002-05T 138.00 - ELK CITY 138KV CKT 1	158	168.6	CLEO CORNER - MEN TAP 138KV CKT 1
2002-05T 138.00 - ELK CITY 138KV CKT 1	130	176.2	BASE CASE
TALOGA 138/69KV TRANSFORMER CKT 1	56	207.1	EL RENO - ROMAN NOSE 138KV CKT1
EL RENO - ROMAN NOSE 138KV CKT 1	133	179.3	BASE CASE
DOVER SW - OKEENE 138KV CKT 1	122	128.0	EL RENO - ROMAN NOSE 138KV CKT1
CANTON - TALOGA 69KV CKT 1	61	121.1	EL RENO - ROMAN NOSE 138KV CKT1
DEWEY - TALOGA 138KV CKT1	143	140.5	EL RENO - ROMAN NOSE 138KV CKT1

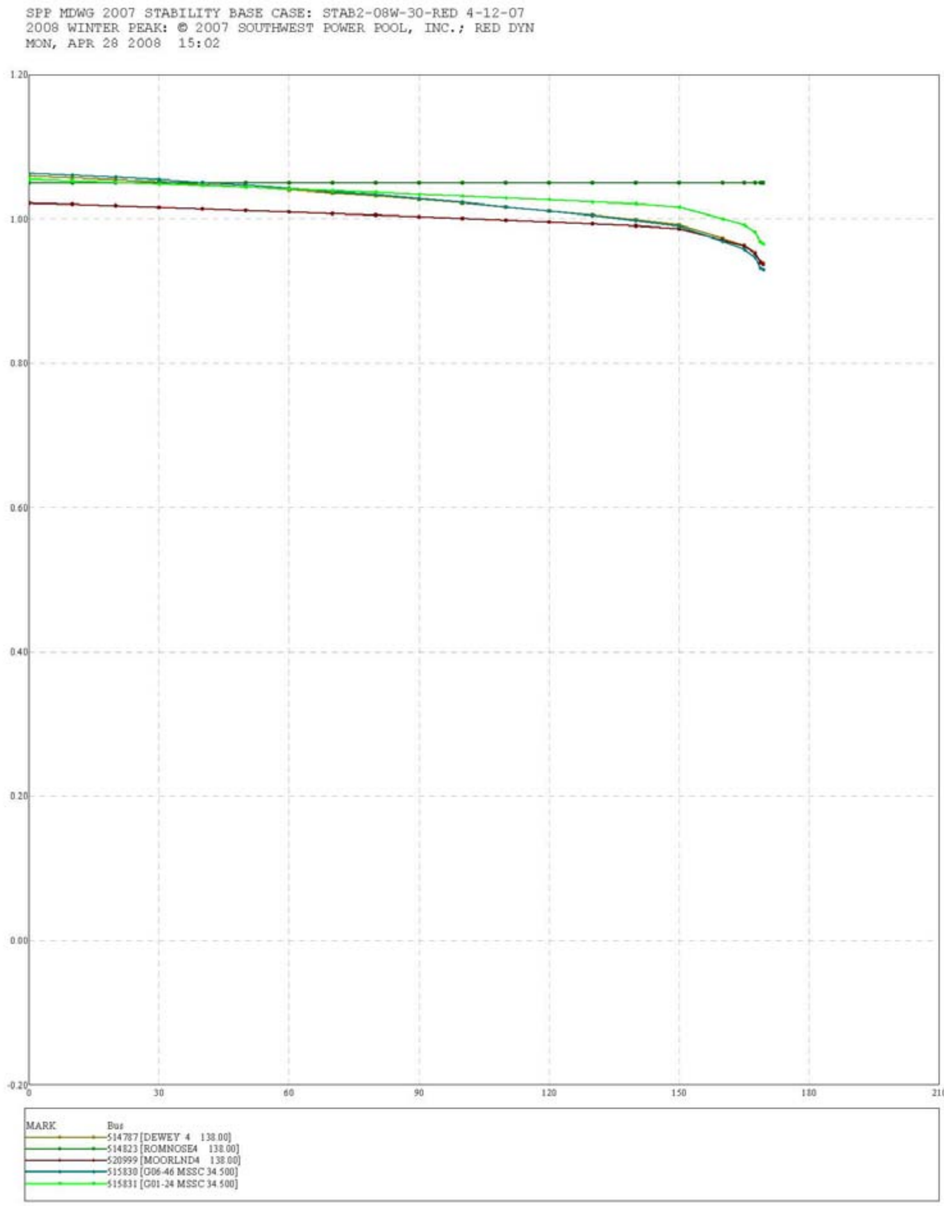

Figure 1. P-V Graph for GEN-2007-006 for outage of the Roman Nose – El Reno 138kV line

Using this result from the P-V analysis and applying an acceptable safety margin, SPP determined that the maximum allowable interconnection at the point of interconnection without the addition of new transmission lines would be 160 MW. The powerflow analysis of this contingency (Roman Nose – El Reno 138kV) determined that the facility would need to operate at unity to avoid voltage collapse at the wind farm. SPP then sized the capacitor banks and ran dynamic stability for all contingencies studied in the original Impact Study.

Facility Configuration

To reduce the wind farm size to 160 MW, the original configuration provided by the Customer was adjusted. One feeder from the #1 transformer wase removed and one feeder from the #2 transformer were removed. This made the transformers collecting the energy from 80 MW each. The transformers were reduced in size to two 48MVA OA units. The original impedances provided by the Customer were used.

Powerflow analysis determined that for the outage of the Roman Nose – El Reno 138kV transmission line, the generation facility would need to maintain unity power factor. To maintain unity power factor for the facility described above, the Customer will need to install two 34.5kV, 14 Mvar capacitor banks.

Dynamic stability analysis determined that the Customer will need to install two (2) 34.5kV, +/- 8 MVA STATCOM devices in order to meet FERC Order #661A LVRT requirements. These devices are needed in addition to the capacitor banks above. The final sizing of these devices will depend upon the manufacturer's modeling information.

Dynamic Stability Analysis

Dynamic stability analysis was conducted on the 160 MW facility. For detail of the modeling of the wind farm collector system and the Suzlon wind turbines in both powerflow and stability, the original Impact Study will need to be consulted. The contingencies from the original Impact Study were used with the exception that the faults at the point of interconnection would not have reclosing applied. Table 2 (from the original S&C study) below lists the contingencies studied. These contingencies were applied to both the 2008 winter peak season model and the 2012 summer peak season model.

Table 2. Contingencies Applied

Cont. No.	*Cont. Name*	*Description*
1	*FLT13PH*	3 phase fault on the Roman Nose (514823) to Southard (514822) 138kV line, near Roman Nose. a. Apply fault at Roman Nose. b. Clear fault after 5 cycles by tripping the line from Roman Nose to Southard.
2	FLT21PH	*Single phase fault and sequence like Cont. No. 1*
3	*FLT33PH*	3 phase fault on the Roman Nose (514823) to El Reno (514819) 138 kV line, near Roman Nose. a. Apply fault at Roman Nose. b. Clear fault after 5 cycles by tripping the line from Roman Nose to El Reno.
4	FLT41PH	*Single phase fault and sequence like Cont. No. 3*
5	*FLT53PH*	3 phase fault on the Dewey (514787) to Taloga (521065) 138 kV line, near Dewey. a. Apply fault at Dewey. b. Clear fault after 5 cycles by tripping the line from Dewey to Taloga. c. Wait 20 cycles, and then re-close the line in (b) back into the fault.

Cont. No.	*Cont. Name*	*Description*
		d. Leave fault on for 5 cycles, then trip the line in (b) and remove fault.
6	FLT61PH	*Single phase fault and sequence like Cont. No. 5*
7	*FLT73PH*	3 phase fault on the Dewey (514787) to Iodine (514796) 138 kV line, near Dewey. a. Apply fault at Dewey. b. Clear fault after 5 cycles by tripping the line from Dewey to Iodine. 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	FLT81PH	*Single phase fault and sequence like Cont. No. 7*
9	FLT93PH	3 phase fault on the Elk City (511458) to Morewood Switch (521001) 138 kV line, near Elk City. a. Apply fault at the Elk City 138kV bus. b. Clear fault after 5 cycles by tripping the line from Elk City – Morewood Switch. 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	FLT101PH	*Single phase fault and sequence like Cont. No.9*
11	FLT113PH	3 phase fault on the Mooreland (520999) – Cedardale (520848) 138 kV line, near Cedardale. a. Apply fault at the Cedardale 138kV bus. b. Clear fault after 5 cycles by tripping the line from Mooreland - Cedardale. 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	FLT121PH	*Single phase fault and sequence like Cont. No.11*
13	FLT133PH	3 phase fault on the Woodward (514785) – Iodine (OG&E) (514796) 138kV line near Woodward. a. Apply fault at the Woodward bus. b. Clear fault after 5 cycles by tripping the line from Woodward-Iodine. 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	FLT141PH	*Single phase fault and sequence like Cont. No.13*
15	FLT153PH	3 phase fault on the Cimarron autotransformer (514898-514901-515715) a. Apply fault at the Cimaron 138kV bus. b. Clear fault after 5 cycles by taking the auto out of service
16	FLT161PH	*Single phase fault and sequence like Cont. No.15*
17	FLT173PH	3 phase fault on the Woodring autotransformer (514715-514714-515770) a. Apply fault at the Woodring 138kV bus. b. Clear fault after 5 cycles by taking the auto out of service
18	FLT181PH	*Single phase fault and sequence like Cont. No.17*
19	FLT193PH	3 phase fault on the Mooreland (520999) – GEN-2001-037 (515785) 138 kV line, near Mooreland. a. Apply fault at the Mooreland 138kV bus. b. Clear fault after 5 cycles by tripping the line from Mooreland – GEN-2001-037. 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	FLT201PH	*Single phase fault and sequence like Cont. No.19*
21	FLT213PH	3 phase fault on the Cimarron (514898) – Jensen Tap (514820) 138kV line near Cimarron.

Cont. No.	Cont. Name	Description
		a. Apply fault at the Cimarron bus. b. Clear fault after 5 cycles by tripping the line from Cimarron – Jensen Tap – Jensen (514821) – El Reno (514819). 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	FLT221PH	*Single phase fault and sequence like Cont. No.21*
23	FLT233PH	3 phase fault on the Cimarron (514898) – El Reno (514819) 138kV line near Cimarron. a. Apply fault at the Cimarron bus. b. Clear fault after 5 cycles by tripping the line from Cimarron – El Reno (514819). 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	FLT241PH	*Single phase fault and sequence like Cont. No.23*

Prior queued projects monitored are:

a. GEN-2001-037; 102MW of GE turbines
b. GEN-2001-014; 94MW of Suzlon turbines
c. GEN-2002-005; 120MW of Acciona turbines
d. GEN-2003-022/GEN-2004-020; 147MW of GE turbines
e. GEN-2005-008; 120MW of GE turbines
f. GEN-2006-024; 20MW of Suzlon turbines
g. GEN-2006-046; 130MW of Suzlon turbines

To meet the low voltage requirements of FERC Order #661A, the Impact Study determined that the Interconnection Customer will be required to install two (2) 34.5kV STATCOM devices within the Interconnection Customer's substation. These STATCOM devices have been sized at +/-8 MVA each for a total of +/-16 MVA. However, exact sizing will need to be performed by the manufacturer of the devices using exact dynamic models provided by the manufacturer. The size of these devices or possibly even the need for the devices may change depending upon a number of factors, including whether prior queued interconnection requests in the local area withdraw or whether new transmission lines are built in the area of the interconnection request as a result of transmission service request studies. The manufacturer may also be able to switch some of the required capacitors for proper operation and reduce the size of the equipment. Please see Figure 2 for turbine reaction to the Roman Nose – El Reno 138kV outage with a +/-6 MVA STATCOM device.

The stability analysis determined that for the loss of the Roman Nose – El Reno 138kV line, the addition of GEN-2007-006 will depress voltages enough in the area to cause two prior queued projects in the area to develop unstable oscillations in power, speed, and voltage. It became apparent after conducting P-V analysis that the area around Mooreland was experiencing voltage collapse. To prevent these oscillations in the

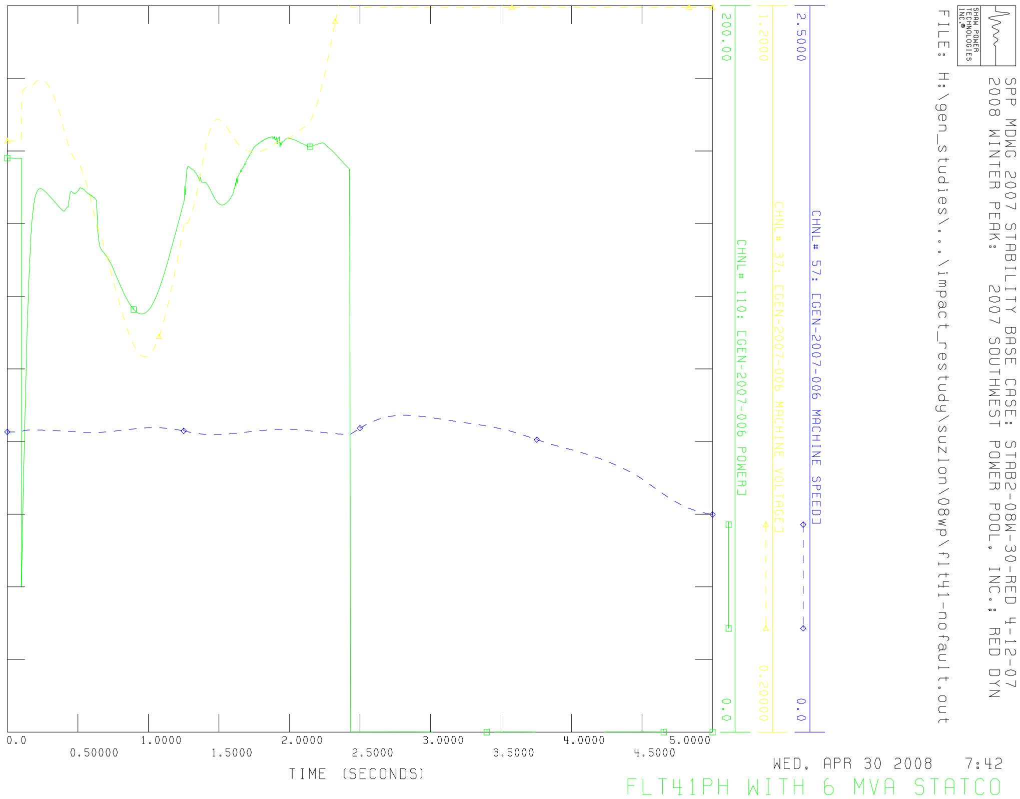

Figure 2. Roman Nose – El Reno outage with +/-6 MVA STATCOM

dynamic simulation by the two previous queued interconnection requests, additional capacitor banks are required to be installed for these two wind farms.

At GEN-2001-014, the additional 12 Mvar of capacitance necessary for stable operation is located at the wind farm. However, it is unknown if proper switching equipment is present at this station to accommodate the necessary switching procedure. This will be evaluated during the Facility Study.

At GEN-2006-046, the capacitance specified is in addition to the capacitance specified in the Impact Study for this request. Therefore, the Interconnection Customer for GEN-2007-006 is responsible for the cost to install additional capacitors at GEN-2006-046. These costs will be further evaluated in the Facility Study. For 160 MW operation at GEN-2007-006, this capacitor bank should be sized at 34.5kV, 10 Mvar.

The need for these capacitor banks and switching devices at GEN-2001-014 and GEN-2006-046 may change depending upon a number of factors, including whether prior queued interconnection requests in the local area withdraw or whether new transmission lines are built in the area of the interconnection request as a result of transmission service request studies.

The results of the stability analysis are included in Table 3.

Table 3. Dynamic Stability Results for 160 MW Interconnection

Cont. Name	Description	Winter Peak 2008				Summer Peak 2012			
		Pre-Project	With GEN-2007-006			Pre-Project	With GEN-2007-06		
			No STATCOM	With STATCOM and No MSSCs (at GEN-2001-14 and GEN-2006-46)	With STATCOM and With MSSCs (at GEN-2001-14 and GEN-2006-46)		No STATCOM	With STATCOM and No MSSCs (at GEN-2001-14 and GEN-2006-46)	With STATCOM and With MSSCs (at GEN-2001-14 and GEN-2006-46)
FLT13PH	3 phase fault on the Roman Nose (514823) to Southard (514822) 138kV line, near Roman Nose.	STABLE	n/a	STABLE	STABLE	STABLE	STABLE	STABLE	STABLE
FLT21PH	*Single phase fault and sequence like Cont. No. 1*	STABLE	n/a	STABLE	STABLE	STABLE	STABLE	STABLE	STABLE
FLT33PH	3 phase fault on the Roman Nose (514823) to El Reno (514819) 138 kV line, near Roman Nose.	STABLE	STABLE GEN-2007-006 Trips off	UNSTABLE	STABLE	STABLE	STABLE GEN-2007-006 Trips off	UNSTABLE	STABLE
FLT41PH	*Single phase fault and sequence like Cont. No. 3*	STABLE	STABLE GEN-2007-006 Trips off	UNSTABLE	STABLE	STABLE	STABLE GEN-2007-006 Trips off	UNSTABLE	STABLE
FLT53PH	3 phase fault on the Dewey (514787) to Taloga (521065) 138 kV line, near Dewey.	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT61PH	*Single phase fault and sequence like Cont. No. 5*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT73PH	3 phase fault on the Dewey (514787) to Iodine (514796) 138 kV line, near Dewey.	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT81PH	*Single phase fault and sequence like Cont. No. 7*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT93PH	3 phase fault on the Elk City (511458) to Morewood Switch (521001) 138 kV line, near Elk City.	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT101PH	*Single phase fault and sequence like Cont. No.9*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT113PH	3 phase fault on the Mooreland (520999) –	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE

	Cedardale (520848) 138 kV line, near Cedardale.								
FLT121PH	*Single phase fault and sequence like Cont. No.11*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT133PH	3 phase fault on the Woodward (514785) – Iodine (OG&E) (514796) 138kV line near Woodward.	STABLE	n/a	n/a	STABLE	STABLE GEN-01-37 Trips off	n/a	n/a	STABLE
FLT141PH	*Single phase fault and sequence like Cont. No.13*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT153PH	3 phase fault on the Cimarron autotransformer (514898-514901-515715)	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT161PH	*Single phase fault and sequence like Cont. No.15*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT173PH	3 phase fault on the Woodring autotransformer (514715-514714-515770)	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT181PH	*Single phase fault and sequence like Cont. No.17*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT193PH	3 phase fault on the Mooreland (520999) – GEN-2001-037 (515785) 138 kV line, near Mooreland.	STABLE GEN-01-37 Trips off	n/a	n/a	STABLE	STABLE GEN-01-37 Trips off	n/a	n/a	STABLE
FLT201PH	*Single phase fault and sequence like Cont. No.19*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT213PH	3 phase fault on the Cimarron (514898) – Jensen Tap (514820) 138kV line	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT221PH	*Single phase fault and sequence like Cont. No.21*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT233PH	3 phase fault on the Cimarron (514898) – El Reno (514819) 138kV line near Cimarron.	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE
FLT241PH	*Single phase fault and sequence like Cont. No.23*	STABLE	n/a	n/a	STABLE	STABLE	n/a	n/a	STABLE

Transmission System Upgrades for 200 MW Operation

In order for the Customer to interconnect their facility at 200 MW as originally proposed, the addition of a new 138kV transmission line in the area will be necessary. As most of the power flow in the area goes in a southeasterly direction to Oklahoma City (the existing Roman Nose – El Reno 138kV line loads to 180% of Rate A), the proposed upgrade is a new 138kV transmission line from Roman Nose to El Reno.

This 138kV transmission line will be constructed along an undetermined route that will approximate a parallel path to the existing Roman Nose – El Reno 138kV line. This line is estimated at 31 miles in length and is tentatively proposed to have 1272 MCM conductor.

Voltage Stability Analysis

Voltage Stability Analysis found no limiting elements at the point of interconnection for interconnection 200MW of wind generation with the addition of the new Roman Nose – El Reno 138kV transmission line.

Dynamic Stability Analysis

Dynamic stability analysis was conducted on the original 200 MW facility configuration provided by the Customer. It was found that the previously assigned 34.5kV, 18 Mvar capacitor banks are necessary for both unity power factor and to prevent unstable oscillations of the Suzlon wind turbines for certain contingencies. Without the capacitors, the wind turbines were found to oscillate for the outage of the Roman Nose – El Reno 138kV transmission line.

The analysis was conducted on the same contingencies as in Table 1. The results are listed below in Table 4. The generation facility and the transmission system were found to be stable for all contingencies with the addition of the capacitor banks. No STATCOM devices were found to be necessary for compliance of FERC Order #661A LVRT requirements.

Table 4. Dynamic Stability Results for 200 MW Interconnection (with new Roman Nose – El Reno 138kV line)

Cont.	Description	2008 WP Pre-Project	2008 WP with GEN-2007-006	2012 SP Pre-Project	2012 SP with GEN-2007-006
FLT13PH	3 phase fault on the Roman Nose (514823) to Southard (514822) 138kV line, near Roman Nose.	STABLE	STABLE	STABLE	STABLE
FLT21PH	*Single phase fault and sequence like Cont. No. 1*	STABLE	STABLE	STABLE	STABLE
FLT33PH	3 phase fault on the Roman Nose (514823) to El Reno (514819) 138 kV line, near Roman Nose.	STABLE	STABLE	STABLE	STABLE
FLT41PH	*Single phase fault and sequence like Cont. No. 3*	STABLE	STABLE	STABLE	STABLE
FLT53PH	3 phase fault on the Dewey (514787) to Taloga (521065) 138 kV line, near Dewey.	STABLE	STABLE	STABLE	STABLE
FLT61PH	*Single phase fault and sequence like Cont. No. 5*	STABLE	STABLE	STABLE	STABLE
FLT73PH	3 phase fault on the Dewey (514787) to Iodine (514796) 138 kV line, near Dewey.	STABLE	STABLE	STABLE	STABLE
FLT81PH	*Single phase fault and sequence like Cont. No. 7*	STABLE	STABLE	STABLE	STABLE
FLT93PH	3 phase fault on the Elk City (511458) to Morewood Switch (521001) 138 kV line, near Elk City.	STABLE	STABLE	STABLE	STABLE
FLT101PH	*Single phase fault and sequence like Cont. No.9*	STABLE	STABLE	STABLE	STABLE
FLT113PH	3 phase fault on the Mooreland (520999) – Cedardale (520848) 138 kV line, near Cedardale.	STABLE	STABLE	STABLE	STABLE
FLT121PH	*Single phase fault and sequence like Cont. No.11*	STABLE	STABLE	STABLE	STABLE
FLT133PH	3 phase fault on the Woodward (514785) – Iodine (OG&E) (514796) 138kV line near Woodward.	STABLE	STABLE	STABLE GEN-01-37 Trips off	STABLE GEN-01-37 Trips off
FLT141PH	*Single phase fault and sequence like Cont. No.13*	STABLE	STABLE	STABLE	STABLE
FLT153PH	3 phase fault on the Cimarron autotransformer (514898-514901-515715)	STABLE	STABLE	STABLE	STABLE
FLT161PH	*Single phase fault and sequence like Cont. No.15*	STABLE	STABLE	STABLE	STABLE
FLT173PH	3 phase fault on the Woodring autotransformer (514715-514714-515770)	STABLE	STABLE	STABLE	STABLE
FLT181PH	*Single phase fault and sequence like Cont. No.17*	STABLE	STABLE	STABLE	STABLE
FLT193PH	3 phase fault on the Mooreland	STABLE	STABLE	STABLE	STABLE

	(520999) – GEN-2001-037 (515785) 138 kV line, near Mooreland.	GEN-01-37 Trips off	GEN-01-37 Trips off	GEN-01-37 Trips off	GEN-01-37 Trips off
FLT201PH	*Single phase fault and sequence like Cont. No.19*	STABLE	STABLE	STABLE	STABLE
FLT213PH	3 phase fault on the Cimarron (514898) – Jensen Tap (514820) 138kV line	STABLE	STABLE	STABLE	STABLE
FLT221PH	*Single phase fault and sequence like Cont. No.21*	STABLE	STABLE	STABLE	STABLE
FLT233PH	3 phase fault on the Cimarron (514898) – El Reno (514819) 138kV line near Cimarron.	STABLE	STABLE	STABLE	STABLE
FLT241PH	*Single phase fault and sequence like Cont. No.23*	STABLE	STABLE	STABLE	STABLE
FLT253PH	3 phase fault on the NEW Roman Nose (514823) to El Reno (514819) 138 kV line, near Roman Nose.	STABLE	STABLE	STABLE	STABLE
FLT261PH	*Single phase fault and sequence like Cont. No. 25*	STABLE	STABLE	STABLE	STABLE

Interconnection Facilities

The interconnection facilities necessary for this generation interconnection request are dependent upon which option the Customer wishes to pursue in regards to their interconnection request. These facilities are listed below in Table 5 and Table 6. When different facilities are required for either 160 MW interconnection or 200 MW interconnection, those are denoted. These cost estimates will be refined during the Facility Study Agreement. These costs do not include costs associated with short circuit analysis. A short circuit study will be performed when during the Facility Study.

If any previous queue projects withdraw from the queue or suspend their Interconnection Agreements, the facility requirements may change. A restudy will need to be conducted in order to determine these changes.

Table 5: Direct Assignment Facilities

FACILITY	ESTIMATED COST (2008 DOLLARS)
Customer – 138/34.5 kV Substation facilities.	*
Customer – 138 kV transmission line facilities between Customer facilities and the Roman Nose Substation.	*
Customer - Right-of-Way for Customer facilities.	*
Customer –Two (2) 34.5 kV, 18 Mvar staged capacitor bank(s) in Customer substation. (For 200 MW interconnection)	*
Customer –Two (2) 34.5 kV, staged capacitor bank(s) in Customer substation. Sized tentatively at 14 Mvar (For 160 MW interconnection)	*
Customer – Two (2) 34.5kV, +/-8 MVA STATCOM devices in Customer substation (For 160 MW interconnection)	*
GEN-2001-014 – Switching devices to properly switch capacitor banks to prevent voltage oscillations of wind turbines (Cost to be borne by GEN-2007-006 Customer)(For 160 MW interconnection)	**
GEN-2006-046 – 34.5kV, 10 Mvar capacitor bank to prevent voltage oscillations of wind turbines (Cost to be borne by GEN-2007-006 Customer)(For 160 MW interconnection)	***
OKGE – Add 138 kV line terminal equipment including revenue metering at Roman Nose Substation (Cost to be borne by GEN-2007-006 Customer)	$350,000
Total	$350,000

* Estimates of cost to be determined by Customer.
** Estimates of cost to be determined by GEN-2001-014 Customer during Facility Study
*** Estimates of cost to be determined by GEN-2006-046 Customer during Facility Study

Table 6: Required Interconnection Network Upgrade Facilities

FACILITY	ESTIMATED COST (2007 DOLLARS)
OKGE – Rebuild Roman Nose Substation into three breaker 138 kV ring bus, disconnect switches, and associated equipment.	$700,000
OKGE – Construct approximately 31 miles of 138kV, 1272 MCM ACSR transmission line from Roman Nose to El Reno including substation work at El Reno and Roman Nose (for 200 MW interconnection)	$23,000,000
Total	**$23,700,000**

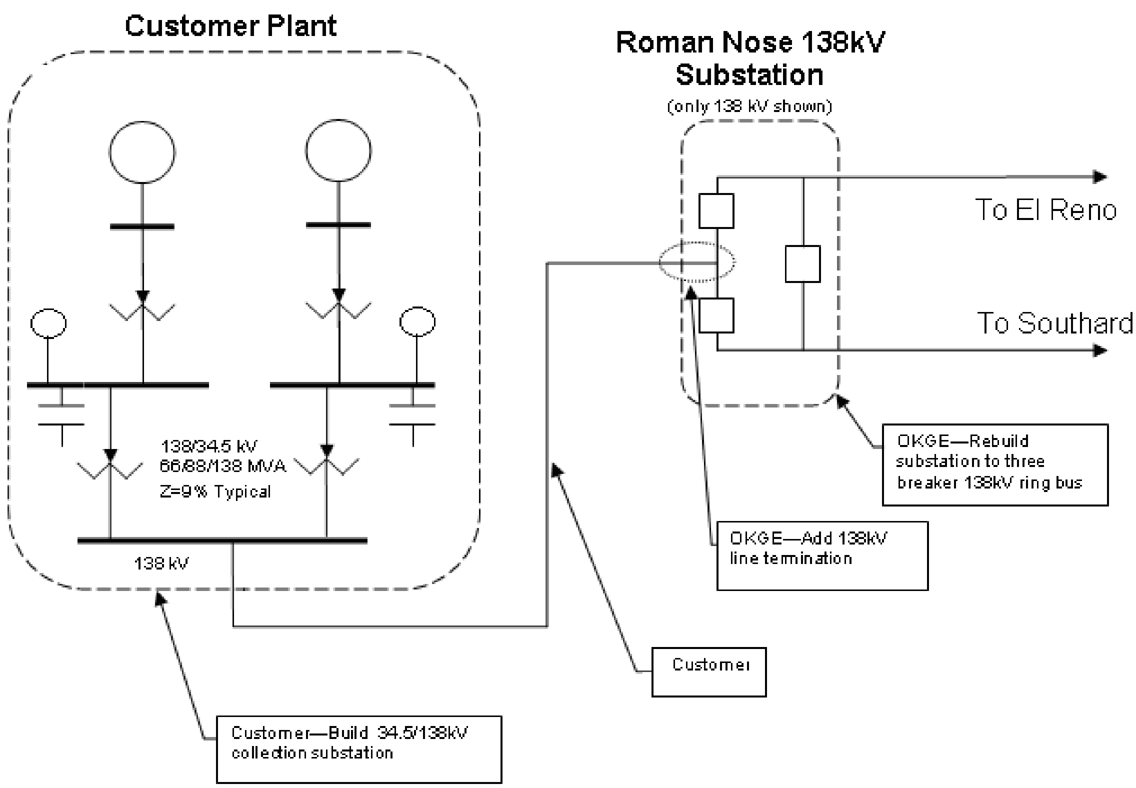

Figure 1: Proposed Interconnection
(Final substation design to be determined)

Conclusion

The interconnection of GEN-2007-006 can be accommodated in either of two different methods. One, the Interconnection Customer must reduce the queue position for GEN-2007-006 to 160 MW and install or pay to install the applicable facilities in Tables 5. and 6. The cost for 160 MW interconnection is estimated at $1,050,000 not including the cost of facilities to be determined by the Customer. Two, the Interconnection Customer can interconnect at 200 MW but will need to install or pay to install the applicable facilities in Tables 5. and 6. These facilities include a new 31 mile, 138kV transmission line between Roman Nose and El Reno. The cost for 200 MW interconnection is estimated at $24,050,000 not including the cost of facilities to be determined by the Customer.

The Suzlon S88 wind turbines will meet the LVRT provisions of FERC Order #661A provided all applicable facilities in Table 5 and Table 6 are installed. A change in wind turbine manufacturer or type will cause the interconnection request to be restudied.

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

If any previous queued projects withdraw from the queue or suspend their interconnection agreements, the facility requirements for this interconnection request will change. A restudy must be conducted to determine these changes.

Appendix A.

Dynamic Simulations

Winter Peak

160 MW Operation
(with 6MVA STATCOM)

Appendix B.

Dynamic Simulations

Winter Peak

160 MW Operation
(with 8MVA STATCOM)

Appendix C.

Dynamic Simulations

Winter Peak

200 MW Operation
(with new Roman Nose – El Reno 138kV)

Appendix D.

Dynamic Simulations

Summer Peak

160 MW Operation
(with 8MVA STATCOM)

Appendix E

Dynamic Simulations

Summer Peak

200 MW Operation
(with new Roman Nose – El Reno 138kV)