SPP Southwest Power Pool

Facility Study For Generation Interconnection Request GEN-2008-022

SPP Generator Interconnection Studies

(#GEN-2008-022)

February 2014

Revision History

Date	Author	Change Description
9/15/2011	SPP	Facility Study Report Issued
2/6/2014	SPP	Account for Updated Facility Upgrades and Costs Estimates

SPP Summary
Xcel Energy Inc (Xcel), a subsidiary of Southwestern Public Service Company (SPS), performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2008-022 (300.0 MW/ Wind). The request for interconnection was placed with SPP in accordance with SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Phases of Interconnection Service
It is not expected that interconnection service will require phases however, interconnection service will not be available until all interconnection facilities and network upgrades can be placed in service.

Interconnection Customer Interconnection Facilities
The Interconnection Customer will be responsible for the 345 kV transmission line from its generator facility substation to the Point of Interconnection (POI), a new 345 kV ring bus switching station on the Eddy County to Tolk 345kV transmission line. This new 345kV switching station, named Crossroads Switching Station, will be approximately fifty-five (55) miles from the Tolk Substation. Additionally, the Interconnection Customer will be responsible for reactive power compensation equipment to maintain 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection. Any capacitor banks installed by the Customer shall not cause voltage or other distortion on the transmission system in accordance with Article 9.7.6 of the Standard GIA, Power Quality.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades
To allow interconnection the Transmission Owner will need to construct a new 345kV three breaker ring bus and associated equipment for acceptance of the Interconnection Customer's Interconnection Facilities. The Transmission Owner will also need to add reactors on the Eddy County – Tolk 345kV transmission circuit. An Electro-magnetic Transient Program (EMTP) Study has determined that a 40MVAr reactor is needed at Crossroads Switching Station for the Crossroads – Tolk 345kV circuit and a 60MVAr reactor is needed at Crossroad Switching Station for the Crossroads – Eddy County 345kV circuit. The Interconnection Customer is responsible for $12,672,014.00 of Transmission Owner Interconnection Facilities and non-shared network upgrades.

Potential Stability Impacts for Reactors
The Crossroad Switching Station reactor additions required a stability analysis to be conducted by SPP. Please refer to Appendix A for more information about this analysis of the stability.

Shared Network Upgrades
The Interconnection Customer was studied within the DISIS-2010-001-8 Impact Restudy (November 2013). At this time, the Interconnection Customer is allocated $0 of shared network upgrades. If higher queued Interconnection Customers withdraw from the queue, suspend or terminate their GIA, restudies will have to be conducted to determine the Interconnection Customers' allocation of shared network upgrades. All studies have been

conducted on the basis of higher queued interconnection requests and the upgrades associated with those higher queued interconnection requests being placed in service.

Additional Required Network Upgrade

Certain Network Upgrades are required for Interconnection. These Network Upgrades include:

1. Hitchland – Woodward 345kV double circuit, scheduled for 6/30/2014 in-service
2. Hitchland 345/230/13kV Autotransformer circuit #2, scheduled for 6/30/2014 in-service
3. TUCO Interchange – Border – Woodward 345kV circuit #1, scheduled for 5/19/2014 in service
4. Woodward 345/138kV transformer circuit #2, scheduled for 5/19/2014 in-service

These network upgrades are scheduled to be in service until December 31, 2014. Depending upon the status of higher or equally queued customers, the Interconnection Customer's in service date may be delayed until the in service date of these Network Upgrades.

Conclusion

Interconnection Service for GEN-2008-022 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for $12,672,014.00 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated $0.00 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 300.0 MW, as requested by GEN-2008-022, can be allowed. At this time the total allocation of costs assigned to GEN-2008-022 for Interconnection Service are estimated at $12,672,014.00.

Updated Facility Study For Southwest Power Pool (SPP)

300 MW [Omitted Text]
Roosevelt County, New Mexico
SPP # GEN-2008-022

January 24, 2014

Transmission Planning
Southwestern Public Service

Executive Summary

[Omitted Text] ("Interconnection Customer") in 2008 was assigned the Generator Interconnection Agreement for GEN-2008-022 (SPP SA#2305R1). Interconnection Customer subsequently requested to modify the interconnection substation location. The wind generation facility will be located in Roosevelt County, New Mexico to the Southwestern Public Service Company (SPS), transmission network. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. This facility has a capacity of 300 MW. The Interconnection Customer's facility will connect to "Crossroads Switching Station", a new SPS Switching Station located in Roosevelt County, New Mexico approximately 22 miles east and 3 miles south of Elida, New Mexico. The Interconnection Customer's desired commercial operation date is December 2015.

This facility study is updated for the request to modify the interconnection substation location. The interconnection request was studied using 120 G.E 2.5MW wind turbines for a total of 300 MW. The Interconnection Customer is required to maintain a Power Factor of 0.95 lagging and 0.95 leading at the Point of Interconnection (POI) on the 345 kV.

SPS requires that all construction for this request be in compliance with the latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Produced-Owned Generation. SPP requires that each Generator shall implement Automatic Under Frequency Load Shedding according to Regional Reliability Standard: PRC-006-SPP-01. To fulfill this requirement, coordination with Xcel Energy is required during the under-frequency relay-setting phase for the generation. The Interconnection Customer is required to report their generation off-nominal frequency tripping relay settings to SPP and SPS. SPS will also require that the Interconnection Customer be in compliance with all applicable criteria, guidelines, standards, requirements, regulations, and procedures issued by the North American Electric Reliability Corporation (NERC), Southwest Power Pool (SPP), and the Federal Energy Regulatory Commission (FERC) or their successor organizations.

The Interconnection Customer is responsible for the cost of the Interconnection Facilities, and any Direct Assigned Interconnection Facilities; inclusive of all construction required for the 345 kV transmission line from the Interconnection Customer's substation to the SPS Crossroads Switching Station. The Interconnection Customer is also responsible for obtaining any permits and/or Certificate of Convenience and Necessity (CCN) for building their 345kV transmission lines from the Public Utility Commission of New Mexico.

An Electro-magnetic Transient Program (EMTP) Study was completed to finalize any 345 kV or higher voltage shunt reactor sizes, cost and delivery. The study determined that a 40 MVAr reactor on the Tolk side of Crossroads was required and 60 MVAr reactor on the Eddy County side of Crossroads was required.

As for this request (GEN-2008-022), it is anticipated that the entire process of building a new 345 kV 3-breaker ring bus at Crossroads Switching Station for the acceptance of the Generation facility output will require approximately 18 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received.

The cost of these upgrades, inclusive of the Interconnection Customer's cost for the interconnection of the Interconnection Customer's facility, is shown below in Table 1, with the detailed description of the cost shown in Table 3.

Table 1, Cost Summary, New Switching Station

SPS Network Upgrades:	**$ 12,334,639**
Interconnection Facilities [1]:	**$ 337,375**
Total:	**$12,672,014**

[1] This is a direct assigned cost to the Interconnection Customer.

General Description of SPS Facilities [2]

1. **Construction of New Line Terminal:** See Appendix A, Figure A-1, for general vicinity location map

   1.1. **Location:** SPS will build a new 345 kV 3-breaker ring bus configuration expandable to breaker and one-half at SPS Crossroads Switching Station. Appendix A, Figure A-2 shows the one-line diagram of the switching station, while Appendix A, Figure 3 shows a typical elevation view of the Point of Interconnection (POI).

   1.2. **Bus Design:** The new 345 kV station will have three breakers (Ring Bus Design configuration) at Crossroads Switching Station to accommodate the output from the 248.4 MW Wind Generator facility. This scheme is shown in the one-line diagram in Appendix A, Figure A-2

   1.3. **Line Terminals:** The 345 kV lines and static wire terminals will be designed to accommodate 14,000 pounds per phase conductor (28,000 per bundle) at maximum tension, with a maximum 15° pull-off angle from normal.

   1.4. **Control House:** The new control house will be utilized to accommodate the new metering, protective relaying and control devices, terminal cabinets, and any fiber-optic cable terminations, etc. for the 345 kV line breaker terminals..

   1.5. **Security Fence:** The new security fence will have a 7-foot chain-link fence with steel posts set in concrete with 1-foot of barbed wire on the top in a "V" configuration. The enclosed area will be approximately 660' by 660' with a rock yard surface.

   1.6. **Ground Grid**: A complete ground grid shall be installed per ANSI/IEEE STD 80-1986, with our standard 4/0 copper ground mesh on 40-foot centers with ground rods and 20-foot centers in corners and loop outside of fence.

   1.7. **Site Grading:** Company contractor, per company specifications, will perform any site grading and erosion control of the new switching station. Soil compaction shall be not less than 95% of laboratory density as determined by ASTM-D-698.

   1.8. Station Power: A 199 kV/120-240 volt transformer tapped off of the 345 kV bus will provide station power. A backup station power source will be taken from local distribution if it is available or a generator will be installed if none is available. A flip-flop to automatically transfer the station power will be installed.

   1.9. **Relay and Protection Scheme:** The new Switching Station will be a 345 kV ring bus with 3-breakers. The primary protection to the interconnection customer's 345 kV transmission line with fiber will use a 311L-P/421-S (with re-close function) Permissive Overreaching Transfer Tripp (POTT). Secondary relaying will use an SEL 421 step-distance relay. No automatic re-closing scheme will be used. The SEL 421 will be used for line/bus SCADA closing conditions for the 345 kV breakers. A SEL 501-0 will be used for breaker failure. Modifications at Tolk and Eddy County.

   An SEL 421 will display the bus voltage, GCB amps, MW, MVAr, and fault location. An SEL 2032 will be installed for relay communications and other functions as required.

[2] All modifications to SPS facilities will be owned, maintained and operated by SPS.

1.10. **Revenue Metering:** The new SPS Crossroads Switching Station is connected to the 345 kV line from Tolk to Eddy County approximately 55 miles from Tolk. On the 345 kV line terminal to the Interconnection Customer's Substation, an individual billing meter will be installed along with a meter per ANSI C12.1 accuracy class 0.2 (3-PT's IEEE C57.13 accuracy class 0.3 and 3 CT's IEEE C57.13 accuracy class 0.15) for full 3-phase 4-wire metering. Pulses out of the billing meter will be sent via SCADA to the Transmission Owner's Control Center in Amarillo, Texas.

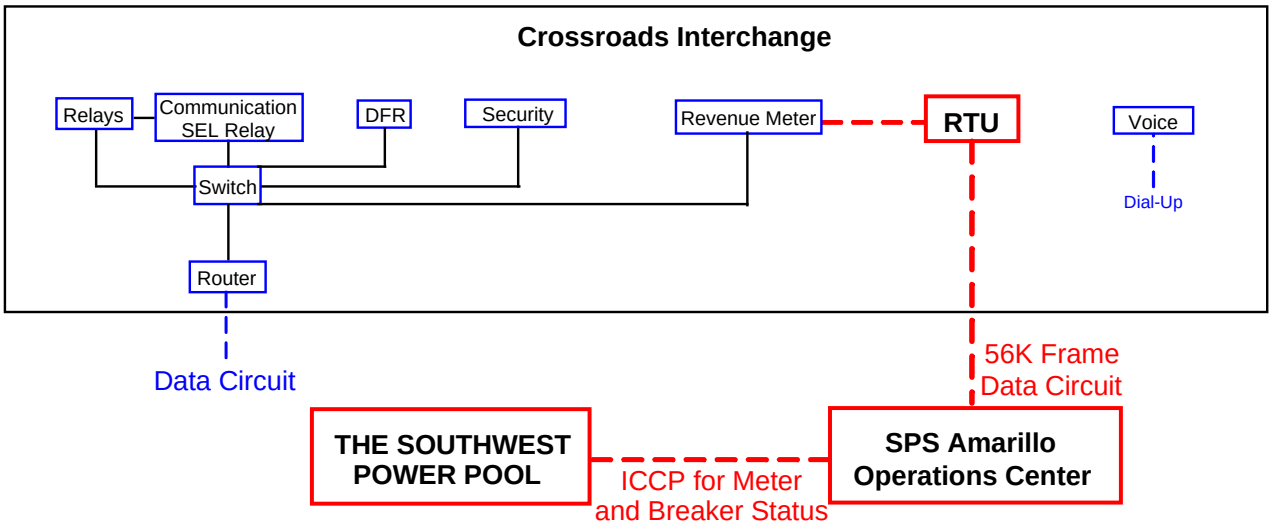
1.11. **Disturbance Monitoring Device:** A Disturbance-Fault Recorder (DFR), capable of recording faults, swings, and long term trending, will be installed to monitor and record conditions in the substation and on the transmission lines. The disturbance equipment shall also be equipped with a GPS time synch clock. System Protection Engineer will specify size and type of DFR. This equipment will have communication capability with a dedicated communication circuit. The disturbance equipment has to have a communications circuit.

1.12. **Remote Terminal Unit (RTU):** A RTU will be installed to accommodate the new 345 kV line terminals at Crossroads Switching Station. SPS will install RTU cards for metering and telemetry as required by the latest Xcel Energy Interconnection Guidelines. The direct cost will be charged to the Interconnection Customer.

1.13. **Communications:** To meet its Communications obligations, the Interconnection Customer shall be responsible for making arrangements with the local phone company to provide telephone circuits as required by the Transmission Owner. Transmission Owner equipment may include, but is not limited to, the following: relay communication equipment, RTU, and disturbance monitoring equipment at Crossroads Switching Station. Prior to any construction, the Interconnection Customer is required to contact the Transmission Owner substation-engineering department for all communication details.

The following communications schematic diagram, which includes communication equipment information for the Interconnection Customer, Transmission Provider (Southwest Power Pool) and Transmission Owner (Southwestern Public Service), is provided to assist the Parties.

A schematic outlining the proposed communications is provided below:



The Interconnection Customer shall be responsible for providing fiber optic communication circuit installed in their overhead transmission line static wire for protective relaying from the customer substation to Crossroads Switching Station indicated in Section 1.9.

2. **Transmission Work:**

2.1. The Interconnection Customer will construct, own, operate, and maintain the 345 kV transmission line from the Interconnection Customer's Substation to the Interconnection Point at SPS Crossroads Switching Station as shown in Appendix A, Figure A-3. ***The SPS transmission design group prior to any construction by the Interconnection Customer or its contractor on any customer 345 kV transmission lines, or doing work in close proximity to any SPS transmission line, will require an engineering review of the customer's design. It is the Interconnection Customer's responsibility to initiate the design review in a timely manner before construction of any transmission line begins. If the review has not been made or the design at any of the aforementioned locations is deemed inadequate, the crossing(s) and or termination into the SPS Crossroads Switching Station will be delayed until the matters are resolved. SPS will not be held responsible for these delays.***

3. **Right-Of-Way and Permits:**

3.1. **Permitting**: The New Mexico Public Utility Commission will not require a permit for the construction of the new 345 kV line terminals to receive output from the Customer's Wind Turbines Generators facility at Crossroads Switching Station, which will be adjacent to the Tolk to Eddy County 345 kV line. The interconnection customer will be responsible for any permitting and right of way of their substation, switching station, and the 345 kV transmission lines from their Substation to the Interconnection Point at Crossroads Interchange.

4. **Construction Power and Distribution Service:** It is the sole responsibility of the Interconnection Customer to make arrangements for both construction and station power, which may be required for the Interconnection Customer's Wind Turbines Generation facility and their substation. **Additionally, if the Interconnection Customer's substation(s) and/or construction site(s) are located outside of the SPS service area, SPS cannot provide station power (retail distribution service) and the Interconnection Customer needs to make arrangements for distribution service from the local retail provider.**

5. **Project and Operating Concerns:**

5.1 Close work between the Transmission group, the Interconnection Customer's personnel and local operating groups will be imperative in order to meet any in-service date that has been established.

5.2 The Interconnection customer will be required to maintain a Power Factor of 0.95 lagging and 0.95 leading at the Point of Interconnection (POI). This is required to maintain acceptable dynamic voltage rise as per latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Producer-Owned Generation Greater than 20 MW:

6. **Fault Current Study:** The available fault current at the new Crossroads Interchange located 55 from Tolk Station on J-02, which is the interconnection location for GEN-2008-022, without any contribution from the Generation facility, is shown in Table 2 below.

Table 2, - Available fault current at Point of Interconnection Location

Short Circuit Current Availability at Crossroads Switching Station without contribution from GEN 2008-022				
	Fault Current (Amps)		Impedance (Ω)	
Fault Location	Line-to-Ground	3–Phase	Z^+	Z^0
345 kV Bus	3,180	3,981	3.54+j49.91	19.96+j86.18

Estimated Construction Costs

The projects required for the interconnection of this Roosevelt Wind Ranch which is 120 G.E. 2.5MW wind turbines for a total of 300.0 MW facilities are summarized in the table below.

Table 3, Required Interconnection Projects[3]

Project	Description	Estimate
	SPS Network Upgrades	
1	Disturbance Monitoring Device (DFR) and Remote Terminal Unit (RTU) and Communication Equipment	$ 532,334
2	ROW[4] for Crossroads Interchange	$ 101,158
3	Transmission Line Work J-02 (In and Out)	$ 1,569,098
4	Build new 345 kV 3-Breaker Ring Bus expandable to breaker and one-half GEN-2008-022. Install 40 MVAr line reactor on the Tolk side of Crossroads and a 60 MVAr line reactor on the Eddy County side of Crossroads. An Electro-magnetic Transient Program (EMTP) Study was completed in January 2014.	$ 10,132,049
	Subtotal:	**$ 12,334,639**
	Interconnection Facilities (Interconnection Customer's Expense)	
5	Communications[5]	*$ See footnote*
6	Revenue metering	$ 280,000
7	345 kV Line arrestors	$ 57,375
	Subtotal:	**$ 337,375**

Total Cost:	**$ 12,672,014**

An Electro-magnetic Transient Program (EMTP) Study was completed in January 2014 to finalize any 345 kV or higher voltage shunt reactor sizes, cost and delivery.

Engineering and Construction:

An engineering and construction schedule for the installation of the 345 kV line Ring Bus and the Shared Network Upgrades is estimated at approximately 18 months. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. The schedule is applicable after all required agreements are signed, and internal approvals are granted.

All additional cost for work not identified in this study is the sole responsibility of the Interconnection Customer unless other arrangements are made.

[3] The cost estimates are 2014 dollars with an accuracy level of ±20% except it does not include AFUDC.

[4] Transmission work cost estimate has an accuracy level of ±20% because of unknown Right of Way (ROW) information.

[5] It is the Requester's responsibility to provide both the data circuit and dial-up telephone circuits, see Section 1.13

Appendix A

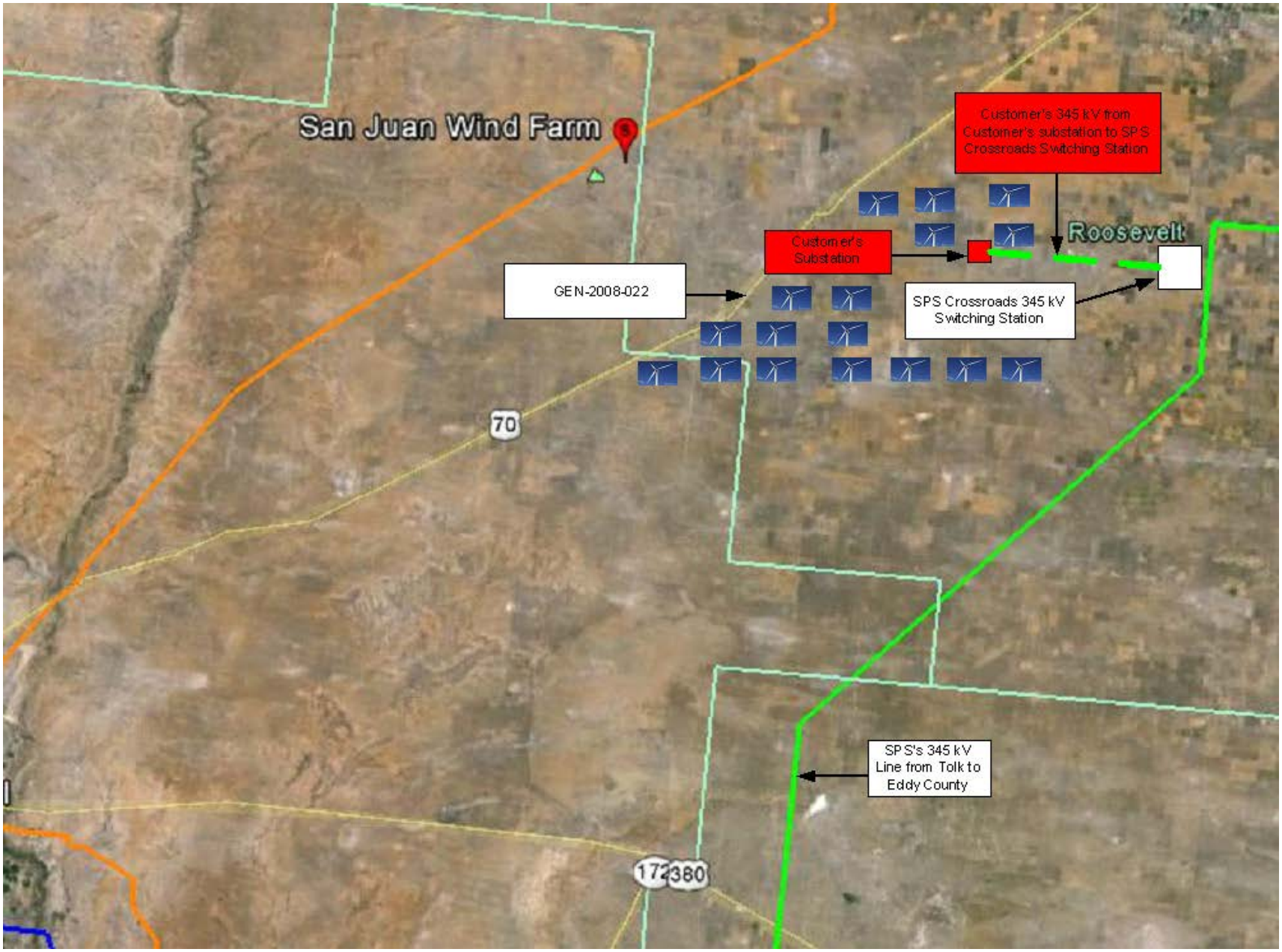


Figure A- 1 Approximate location of proposed Roosevelt Wind Ranch

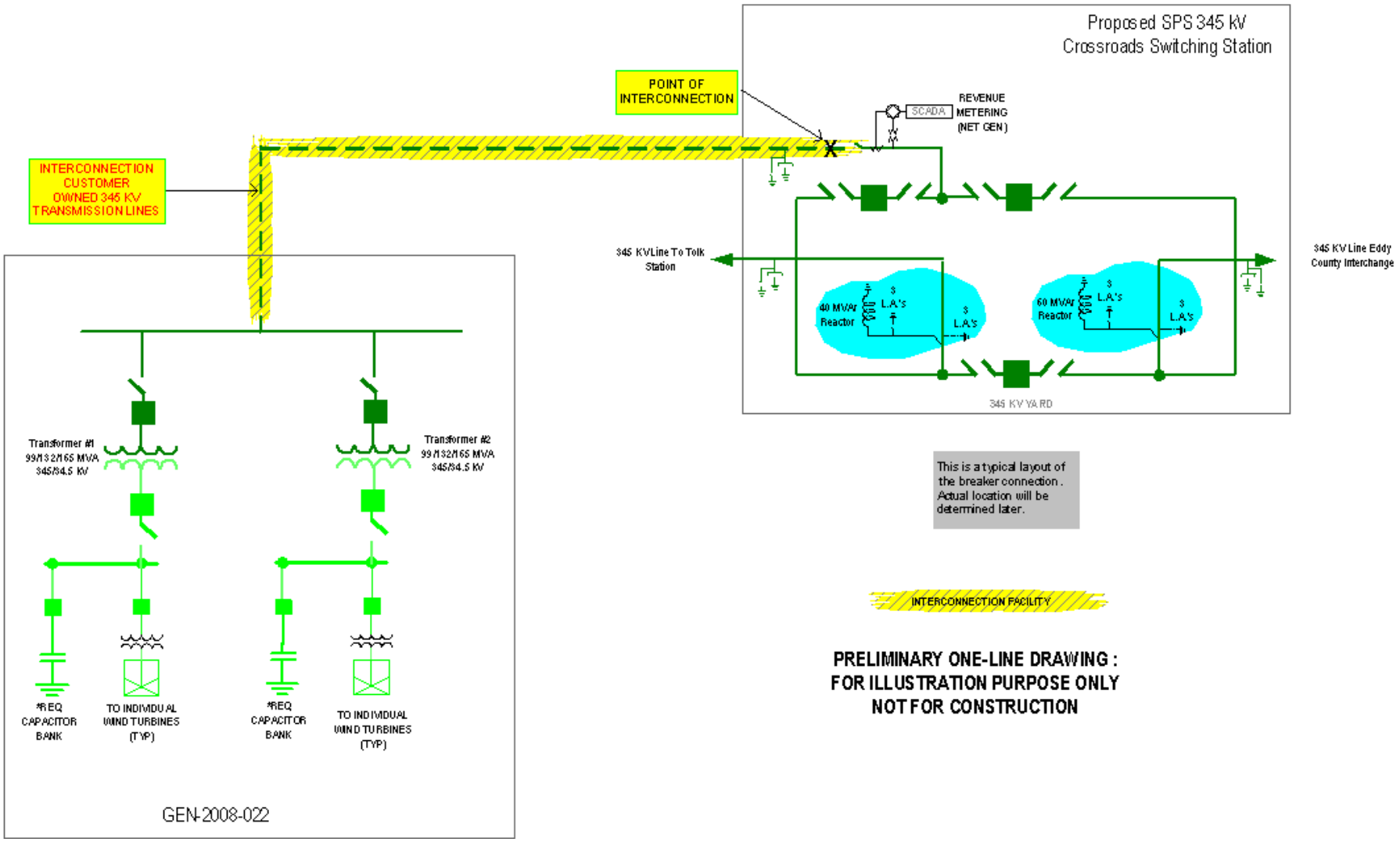


Figure A- 2 One-line Diagram of Crossroads Interchange to Customer Interconnection Facility

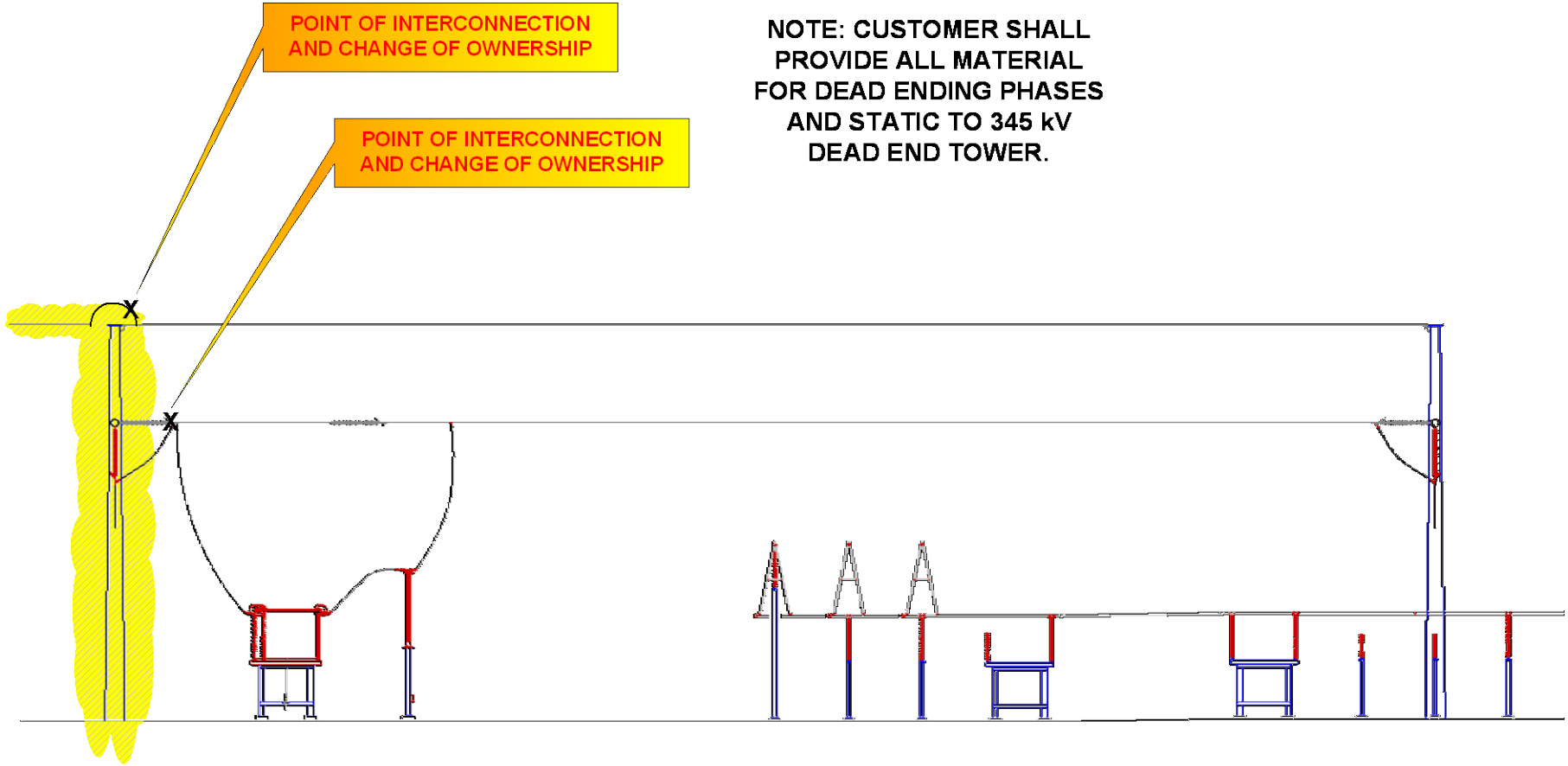


Figure A- 3 Point of Interconnection & Change of Ownership (Typical)

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Appendix A

Modification Request Impact Study for Generator Interconnection Request

GEN-2008-022

February 2014
Generator Interconnection

SPP Southwest Power Pool

Executive Summary

<OMITTED TEXT> (Customer) has requested a modification to its Generator Interconnection Request, GEN-2008-022, in accordance with Section 4.4 of the Generator Interconnection Procedures (GIP) of the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2008-022 is a request for interconnection of 300MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of the Southwestern Public Service Company (SPS) on the Tolk – Eddy County 345kV line. SPP has undertaken this Modification Request Impact Study (MRIS) to determine the impacts to the transmission system of accommodating the modification request.

For this MRIS, a transient stability analysis was performed. The MRIS assumes that all Generator Interconnection queued projects and assigned system upgrades will go into service to determine adverse impacts from the modification request. The modification being analyzed is a request to move the interconnection substation for GEN-2008-022 northeast along the Tolk – Eddy County 345kV line closer to the Tolk 345kV substation.

Transient Stability analysis has determined that the transmission system will remain stable for the four (4) selected faults for the interconnection of GEN-2008-022 with one-hundred-twenty (120) 2.5 MW wind turbine generators and associated facilities into a new tap on the Eddy – Tolk 345kV line.

Per the original Impact Studies, the Generating Facility will be required to maintain a 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection.

The request of the Customer to move the interconnection substation closer to the Tolk 345kV substation is not considered a Material Modification under GIP 4.4.

It should be noted that this MRIS did not evaluate powerflow analysis. It is likely that the Customer may be required to reduce their generation output to 0 MW under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing within this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service rights. Should the Customer require transmission service, those rights should be requested through SPP's Open Access Same-Time Information System (OASIS).

This study fulfills SPP's requirements in accordance with GIP 4.4.3 to evaluate the Customer's modification. In accordance, with GIP 4.4.2, the Customer may choose to withdraw its request for modification.

Table of Contents

Introduction

<OMITTED TEXT> (Customer) has requested a modification to its Generator Interconnection Request, GEN-2008-022, in accordance with Section 4.4 of the Generator Interconnection Procedures (GIP) of the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2008-022 is a request for interconnection of 300MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of the Southwestern Public Service Company (SPS) on the Tolk – Eddy County 345kV line. SPP has undertaken this Modification Request Impact Study (MRIS) to determine the impacts to the transmission system of accommodating the modification request.

Purpose

The purpose of this Modification Request Impact Study (MRIS) is to evaluate the impact of the proposed interconnection, GEN-2008-022, on the reliability of the Transmission System. For this MRIS, both a transient stability and reactive compensation analysis are conducted. The MRIS assumes that all Generator Interconnection queued projects and assigned system upgrades will go into service to determine adverse impacts from the modification request. Modification Request Impact Studies are conducted under GIP 4.4 “Modifications”.

The MRIS considers the Base Case as well as all Generating Facilities (and with respect to (b) below, any identified Network Upgrades associated with such queued interconnection) that, on the date the MRIS is commenced:

a) are directly interconnected to the Transmission System;
b) are interconnected to Affected Systems and may have an impact on the Interconnection Request;
c) have a pending queued Interconnection Request to interconnect to the Transmission System listed; or
d) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Nothing within this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service rights. Should the Customer require transmission service, those rights should be requested through SPP’s Open Access Same-Time Information System (OASIS).

Facilities

Generating Facility

The Customer has requested its interconnection project, GEN-2008-022, to be studied with a total of 300MW comprised of one-hundred-twenty (120) General Electric 2.5 MW wind turbine generators, and associated facilities interconnecting at a new substation that will tap the Eddy – Tolk 345kV line. The wind turbines are connected to equivalent 0.69/34.5KV generator step units (GSU). The high side of each GSU is connected to a 34.5/345kV substation transformer. A 345kV transmission line connects the Customer's substation transformer to the POI.

Interconnection Facilities

The POI for GEN-2008-022 Interconnection Customer is a new tap on the Eddy – Tolk 345kV line in Roosevelt County, New Mexico. Figure 1 depicts the one-line diagram of the local transmission system including the POI as well as the power flow model representing the request.

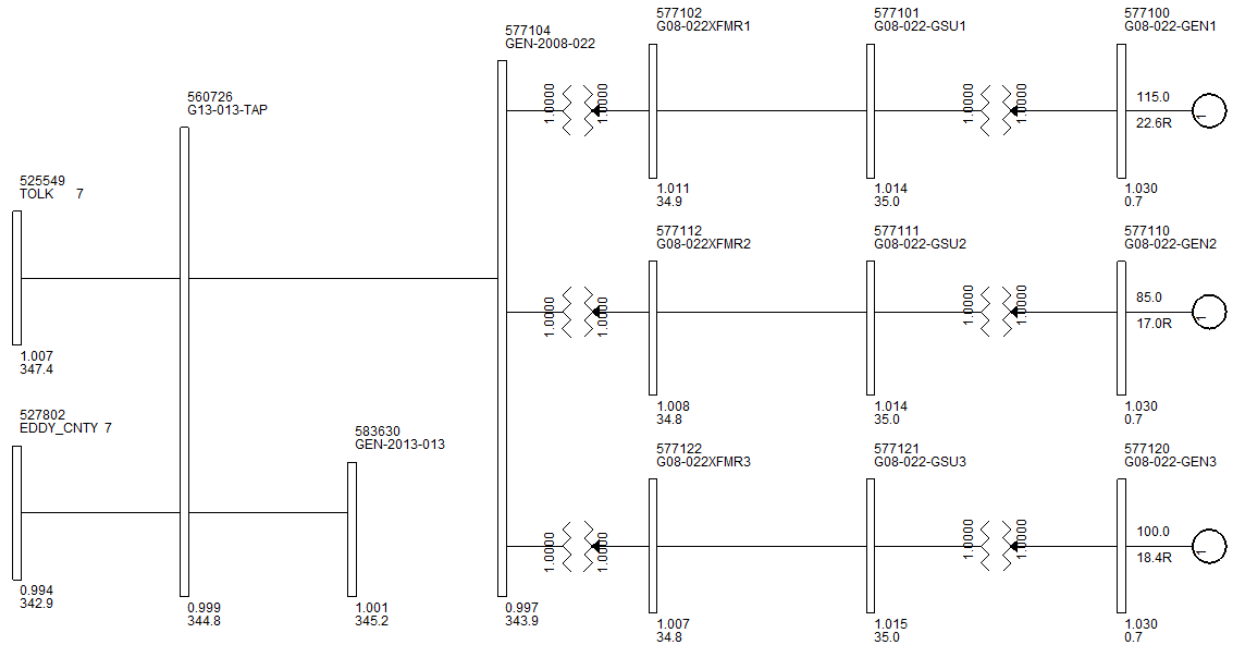

Figure 1: Proposed POI Configuration and Request Power Flow Model

Base Case Network Upgrades

The models for this study used the latest up to date models for Generator Interconnection Cluster studies. The Network Upgrades included within the cases used for this MRIS are those facilities that are listed in the Impact Study; "Definitive Interconnection System Impact Study for Generation Interconnection Requests", DISIS-2013-001-1. That study, posted to SPP OASIS on March 31, 2013, can be found at the following web address:

http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2013_Generation_Studies/DISIS-2013-001-1_8-30-13_Final_Report.pdf

This list includes facilities that have an approved Notification to Construct (NTC) or are in construction stages that are part of the SPP Transmission Expansion Plan, the Balanced Portfolio, or Priority Projects. Additionally, facilities have been included that do not yet have approval but have been assigned to Generator Interconnection Customers of higher and lower queued projects. No other upgrades were included for this MRIS. If for any reason, construction on these projects is delayed or discontinued, a restudy may be needed to determine the interconnection service availability of the Customers.

Stability Analysis

Transient stability analysis is used to determine if the transmission system can maintain angular stability and ensure bulk electric system 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 2013 series of Model Development Working Group (MDWG) dynamic study models representing the Southwest Texas Panhandle and New Mexico geographical study areas or Group 6 within the SPP footprint.

The Group 6 scenario contains the 2014 (winter) 2015 (summer) and 2023 (summer) seasonal models or cases. The cases are then adapted to resemble the power flow study cases with regards to queued generation requests and topology. Finally the queued and study generation is 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.

The software tool, Siemens PSS/E Version 32.2, was used to perform the impact restudy. For simulation purposes, the Customer's facility was simplified by using an equivalent model of the wind farm as shown in Figure 1. The data used to develop the equivalent wind farm model were supplied by the Customer. The Customer also supplied the PSS/E Version 32.1 stability models for the GE 2.5MW wind turbine generators. The GE's reactive power capability provided is +/- 0.90.

Disturbances

The four (4) contingencies were considered for the transient stability simulations used in this study. These faults are listed within Table 4. 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.

With exception to transformers, the typical sequence of events for a three-phase and 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 only performed for three-phase faults, unless otherwise noted. Additionally the sequence of events for a transformer is to 1) apply a three-phase fault for five (5)

cycles and 2) clear the fault by tripping the affected transformer facility. Unless otherwise noted there will be no re-closing into a transformer fault.

Table 1: Contingencies Evaluated

Contingency Number and Name		Description
1	FLT_01_G0822T_TOLK7_345kV_3PH	*3-Phase fault on the GEN 2008-022 tap – Tolk 345kV near the GEN 2008-022 tap 345kV bus.*
2	FLT_02_G0822T_TOLK7_345kV_1PH	*Single-phase fault similar to previous fault.*
3	FLT_03_G0822T_EDDY_345kV_3PH	*3-Phase fault on the GEN 2008-022 tap – Eddy 345kV near the GEN 2008-022 tap 345kV bus.*
4	FLT_04_G0822T_EDDY_345kV_1PH	*Single-phase fault similar to previous fault.*

Results

Results of the stability analysis are summarized in Table 5. These results are valid for GEN-2008-022 interconnecting with a generation amount up to 300.0 MW. The results indicate that the transmission system remains stable for all contingencies studied. All faults were run for both summer and winter cases, and no tripping occurred in this study. Complete sets of plots for summer and winter cases will be available upon request.

Table 2: Fault Analysis Results

Contingency Number and Name		2014WP	2015SP	2023SP
1	FLT_01_G0822T_TOLK7_345kV_3PH	Stable	Stable	Stable
2	FLT_02_G0822T_TOLK7_345kV_1PH	Stable	Stable	Stable
3	FLT_03_G0822T_EDDY_345kV_3PH	Stable	Stable	Stable
4	FLT_04_G0822T_EDDY_345kV_1PH	Stable	Stable	Stable

FERC LVRT Compliance

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

Fault contingencies were developed to verify that wind farms remain on line when the POI voltage is drawn down to 0.0 pu. These contingencies are shown in Table 6.

Table 3: LVRT Contingencies

Contingency Number and Name		Description
1	FLT_01_G0822T_TOLK7_345kV_3PH	*3-Phase fault on the GEN 2008-022 tap – Tolk 345kV near the GEN 2008-022 tap 345kV bus.*
2	FLT_03_G0822T_EDDY_345kV_3PH	*3-Phase fault on the GEN 2008-022 tap – Eddy 345kV near the GEN 2008-022 tap 345kV bus.*

Based on the dynamic results and with all network upgrades in service, GEN-2008-022 did not cause any stability problems and remained stable for all faults studied. Additionally, the project wind farm was found to stay connected during the contingencies that were studied and therefore, meet the Low Voltage Ride Through (LVRT) requirements of FERC Order #661A.

Conclusion

<OMITTED TEXT> (Customer) has requested a modification to its Generator Interconnection Request, GEN-2008-022, in accordance with Section 4.4 of the Generator Interconnection Procedures (GIP) of the Southwest Power Pool Open Access Transmission Tariff (OATT). GEN-2008-022 is a request for interconnection of 300MW of wind generation to be interconnected as an Energy Resource (ER) into a transmission facility of the Southwestern Public Service Company (SPS) on the Tolk – Eddy County 345kV line. SPP has undertaken this Modification Request Impact Study (MRIS) to determine the impacts to the transmission system of accommodating the modification request.

A transient stability analysis has determined that the transmission system will remain stable for the four (4) selected faults for the interconnection of GEN-2008-022 with one-hundred twenty (120) General Electric 2.5 MW wind turbine generators and associated facilities.

The Generating Facility will be required to maintain a 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection.

The request of the Customer to move location of the interconnection substation closer to the Tolk substation is not considered a Material Modification under GIP 4.4.

It should be noted that this MRIS did not evaluate powerflow analysis. It is likely that the Customer may be required to reduce their generation output to 0 MW under certain system conditions to allow system operators to maintain the reliability of the transmission network.

Nothing within this System Impact Study constitutes a request for transmission service or confers upon the Interconnection Customer any right to receive transmission service rights. Should the Customer require transmission service, those rights should be requested through SPP's Open Access Same-Time Information System (OASIS).

This study fulfills SPP's requirements in accordance with GIP 4.4.3 to evaluate the Customer's modification. In accordance, with GIP 4.4.2, the Customer may choose to withdraw its request for modification.