



**Facility Study  
For  
Generator Interconnection  
Request  
GEN-2013-013**

***SPP Generator  
Interconnection Studies***

***(#GEN-2013-013)***

**August 2014**

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## Revision History

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Date	Author	Change Description
8/5/2014	SPP	Facility Study Report Issued

## **Summary**

Southwestern Public Service (SPS) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2013-013 (248.4 MW, Wind) located in Roosevelt County, New Mexico. SPP has proposed an in-service date that will be after the assigned Transmission Owner Interconnection Facilities, Non-Shared Network Upgrades, and Shared Network Upgrades are completed. Full Interconnection Service will also require the Network Upgrades listed in the "Other Network Upgrades" section. 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 all of the transmission facilities connecting the customer owned substation to the Point of Interconnection (POI), at a new Southwestern Public Service (SPS) 345 kV substation tapping the Tolk – Eddy County 345kV transmission line. This new 345kV substation is called Crossroad Switching Station and is currently the cost responsibility of GEN-2008-022. The Interconnection Customer will also be responsible for any equipment located at the Customer substation necessary to maintain a power factor of 0.95 lagging to 0.95 leading at the POI.

## **Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades**

To accommodate the interconnection of the Generating Facility, the Transmission Owner will expand the three breaker ring bus configuration for Crossroads Switching Station, which is assigned to GEN-2008-022, to a four breaker ring bus and install any associated terminal equipment that is acceptable for the addition of the Interconnection Customer's Interconnection Facilities. Additionally, the Interconnection Customer will be responsible for the communications, metering, and line arrestor upgrades required receiving the Generator Interconnection Facilities. SPS has proposed a lead time of 18 months after a fully executed Generation Interconnection Agreement (GIA) for the completion of the Interconnection Facilities and Non-Shared Network Upgrades required at the Crossroads Substation. At this time, GEN-2013-013 is responsible for approximately \$3,495,026 of Interconnection Facilities. If GEN-2008-022 withdraws or terminates its GIA, GEN-2013-013 will be responsible for the 3 breaker ring bus and associated terminal equipment needed for Crossroads Switching Station.

The Electro-magnetic Transient Program (EMTP) Study for GEN-2008-022 determined that a 40 MVAR reactor on the Tolk side of Crossroads was required and 60 MVAR reactors on the Eddy County side of Crossroads were required. Another study may be required with the addition of GEN-2013-013 at the Interconnection Customer's expense including any additional equipment.

The following Non-Shared Network Upgrades were required in the DISIS-2013-001-2 Impact Restudy for mitigation of Network Resource Interconnection Service (NRIS) injection constraints:

Non-Shared Network Upgrade Description	Allocated Cost	Allocated Percent (%)	Total Cost
Plant X Station 230/115/13kV Transformer circuit #2 – Build a second 230/115/13kV 250MVA Transformer at Plant X Substation and any associated terminal equipment.	\$8,000,000	100%	\$8,000,000
<b>Total</b>	<b>\$8,000,000</b>	<b>100%</b>	<b>\$8,000,000</b>

GEN-2013-013 is responsible for approximately \$11,495,026 of Interconnection Facilities and Non-Shared Network Upgrades. More information regarding the Interconnection Facilities and Non-Shared Network Upgrades can be found in the attached SPS Facility Study.

### Shared Network Upgrades

The Interconnection Customer was studied within the DISIS-2013-001-2 Impact Restudy. At this time, the Interconnection Customer is allocated approximately \$28,506,422 for 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. At this time, the Interconnection Customer is allocated the following cost for Shared Network Upgrade:

Shared Network Upgrade Description	Allocated Cost	Allocated Percent (%)	Total Cost
Deaf Smith – Plant X 230kV Circuit #1 Terminal Equipment Upgrades – Replace line traps at both terminals of Deaf Smith – Plant X 230kV circuit #1 to achieve atleast a Rate B ampacity of 840 amps (502MVA) in Summer Peak and 932 amps (557MVA) in Winter Peak.	\$911,531	91.2%	\$1,000,000
Tolk – Plant X 230kV Circuit #3 Build – Construct a third 230kV circuit between Tolk – Plant X to achieve atleast a Rate B ampacity of 840 amps (502MVA) in Summer Peak and 932 amps (557MVA) in Winter Peak.	\$17,954,355	89.8%	\$20,000,000
Oklaunion 345 kV Reactive Power Support – Build an additional 60MVAR of Capacitor Banks at the existing Oklaunion 345kV Capacitor Banks	\$9,640,536	48.2%	\$20,000,000
<b>Total</b>	<b>\$28,506,422</b>	<b>69.5%</b>	<b>\$41,000,000</b>

## **Other Network Upgrades**

Certain Other Network Upgrades are currently not the cost responsibility of the Customer but will be required for full Interconnection Service. Currently, no Other Network Upgrades are required.

1. Border – TUCO Interchange 345kV circuit #1, Scheduled for 9/30/2014 in-service
2. NRIS required only, TUCO Interchange – New Deal – Stanton 345/115kV Project, assigned to DISIS-2011-001 NRIS Customer
  - Build TUCO Interchange – New Deal 345kV circuit #1
  - Build New Deal – Stanton 115kV circuit #1
  - Build New Deal 345/115/13kV Transformer #1

Depending upon the status of higher or equally queued customers, the Interconnection Customer's in-service date is at risk of being delayed or their Interconnection Service is at risk of being reduced until the in-service date of these Other Network Upgrades.

## **Conclusion**

Interconnection Service for GEN-2013-013 will be delayed until the Transmission Owner Interconnection Facilities, Non-Shared Network Upgrades, and Shared Network Upgrades are constructed. The Interconnection Customer is responsible for approximately \$11,495,026 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated approximately \$28,506,422 for Shared Network Upgrades. After all Interconnection Facilities, Non-Shared Network Upgrades, and Shared Network Upgrades have been placed into service, Interconnection Service for 248.4 MW of Wind, as requested by GEN-2013-013, can be allowed. At this time the total allocation of costs assigned to GEN-2013-013 for Interconnection Service are estimated at \$40,001,448.



**Updated Facility Study For  
Southwest Power Pool (SPP)**  
248.4 MW Generation Facility  
Roosevelt County, New Mexico  
SPP # GEN-2013-013

July 10, 2014

Transmission Planning  
Southwestern Public Service

## Executive Summary

("Interconnection Customer") in 2013 requested the interconnection of a wind generation facility 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 248.4 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.

The Southwest Power Pool (SPP) originally evaluated the request to interconnect the generator facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS)-2013-001-1 for GEN-2013-013, which was completed in August 2013. GEN-2013-013 interconnection request was studied using 108 Siemens 2.3 MW wind turbines for a total of 248.4 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.

SPP requires that each generator shall implement Automatic Under Frequency Load Shedding (UFLS) according to the SPP UFLS Plan at the following link: [http://www.spp.org/publications/SPP%20UFLS%20Plan\\_Final.pdf](http://www.spp.org/publications/SPP%20UFLS%20Plan_Final.pdf). 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. SPP specifies that generators shall not trip at frequencies above 58.5 Hz unless exceptions in the Transmission Provider Criteria are met. The Interconnection Customer agrees that the energy generating units installed at this interconnection will not be tripped for under-frequency conditions above 58.5 Hz in compliance with Transmission Provider criteria. This means that the generation subject to this Interconnection Agreement may not trip for under-frequency conditions on the transmission system until all under-frequency load shedding relays have operated. 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), 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 EMTP Study for GEN-2008-022 determined that a 40 MVAR reactor on the Tolk side of Crossroads was required and 60 MVAR reactors on the Eddy County side of Crossroads were required. Another study may be required with the addition of this wind farm at the customer's expense including any additional equipment.

As for this request (GEN-2013-013), it is anticipated that the entire process of adding a new 345 kV breaker to an existing 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 Generation 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:	<b>\$ 3,157,651</b>
Interconnection Facilities <sup>1</sup> :	<b>\$ 337,375</b>
Total:	<b>\$ 3,495,026</b>

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<sup>1</sup> This is a direct assigned cost to the Interconnection Customer.



## General Description of SPS Facilities<sup>2</sup>

1. **Construction of New Line Terminal:** See Appendix A, Figure A-1, for general vicinity location map
  - 1.1. **Location:** SPS will add a new 345 kV breaker at a 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 terminal will be added to a three breaker (Ring Bus Design configuration) at Crossroads Switching Station to accommodate the output from the 248.4 MW Wind Generator facilities. 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 18,000 pounds per phase conductor (36,000 per bundle) at maximum tension, with a maximum 15° pull-off angle from normal.
  - 1.4. **Control House:** The existing 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 existing 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 Crossroads Switching Station will be a 345 kV ring bus with 4-breakers when the new terminal for GEN-2013-013 is added (GEN-2008-022 is the first connection, which is a 3-breaker ring). The primary protection to the interconnection customer’s 345 kV transmission line with fiber will use a SEL 411L. Secondary relaying will use a SEL 311C. No automatic re-closing scheme will be used. The SEL 411L and 311C-1 will be used for line/bus SCADA closing conditions for the 345 kV breakers. A SEL 351S will be used for breaker failure. Modifications at Tolk and Eddy County.

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<sup>2</sup> All modifications to SPS facilities will be owned, maintained and operated by SPS.

An SEL 411L 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.

- 1.10. **Revenue Metering:** On the proposed SPS new 345 kV Switching Station line terminal to the Interconnection Customer's substation, a billing meter will be installed, 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. Also installed will be 3-PT's and 3-CT's for full 3-phase 4-wire metering. There will be two meters per line terminal: one will be primary, and the other will be backup. Each will have full 4 quadrant metering. Pulses out of the primary billing meter will be sent via SCADA to the Transmission Owner's Control Center in Amarillo, Texas. The Interconnection Customer may install a meter at the SPS 345 kV Switching Station that will utilize the same billing PT's and CT's. The physical location of Interconnection Customer's meter will be outside the SPS Switching Station fence at a mutually-agreed location. SPS will work with Interconnection Customer for communication specifications for transmittal of Interconnection Customer's meter data back to the Interconnection Customer's Substation.

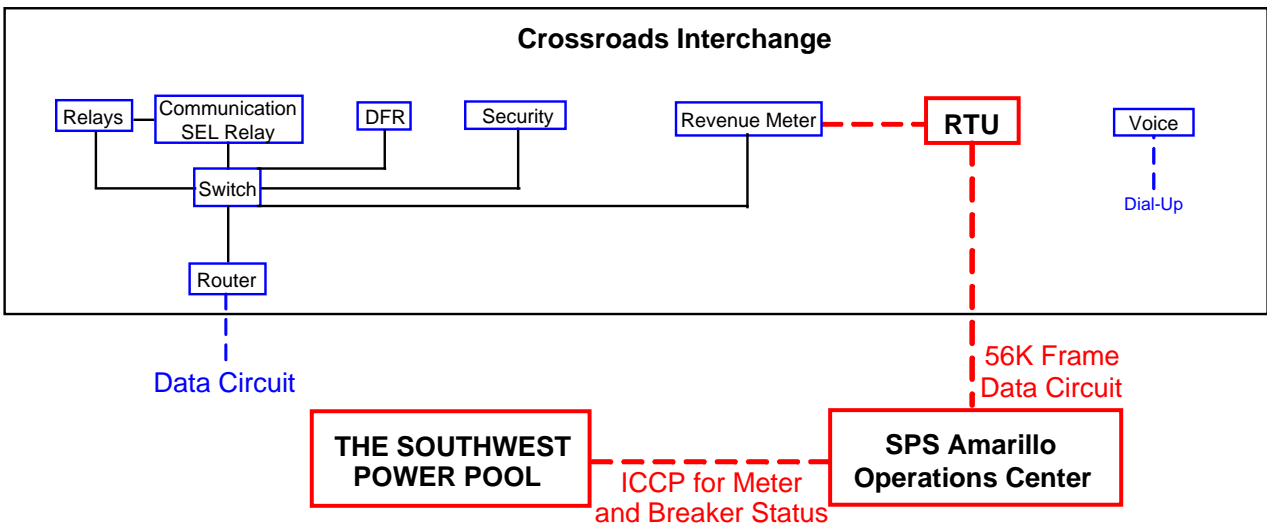
For more than one generating facility attached to the same Interconnection Customer's Interconnection Facilities and the SPS Switching Station, the generating facility owners will install metering equipment at physical locations beyond the Interconnection Point that will record and differentiate any metering energy values for both consumption and generation that may be used for billing or generation settlements. The metered energy values must be adjusted as applicable to agree with the single SPS 345 kV Switching Station meter values so that transmission line losses are split appropriately to the Interconnection Customers and generating facility owners on a 15-minute, hourly, or other mutually-agreed time interval basis. The metered energy values must include full four-quadrant for VAR energy measurements. Interval data from the generating facility owner's meters must be made available to SPS upon request within 30 days or reasonable time period, and the generating facility owner(s) must allow SPS to witness any meter accuracy tests, upon request.

- 1.11. **Disturbance Monitoring Device:** An existing Disturbance-Fault Recorder (DFR), capable of recording faults, swings, and long term trending, will 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):** An existing RTU will 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 adding a new 345 kV line terminals to receive output from the Customer's Wind Turbines Generators facility at Crossroads Switching Station, which is adjacent to the Tolk to Eddy County 345 kV line (Circuit J-2). 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 Crossroads Interchange located 52 miles from Tolk Station on J-02, which is the interconnection location for GEN-2008-022 and GEN-2013-013, without any contribution from the Generation facilities, 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 2013-013				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	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 GEN-2013-013 which is 108 Siemens 2.3 MW wind turbines for a total of 248.4 MW facilities are summarized in the table below.

• **Table 3, Required Interconnection Projects<sup>3</sup>**

Project	Description	Estimate
<b>SPS Network Upgrades</b>		
1	Disturbance Monitoring Device (DFR) and Remote Terminal Unit (RTU) and Communication Equipment (Installed on GEN-2008-022)	\$ 0
2	ROW <sup>4</sup> for Crossroads Interchange (Installed on GEN-2008-022)	\$ 0
3	Transmission Line Work J-02 (In and Out) (Installed on GEN-2008-022)	\$ 0
4	Add a new 345 kV breaker to an existing 3-Breaker Ring Bus expandable to breaker and one-half.	\$ 3,157,651
<b>Subtotal:</b>		<b>\$ 3,157,651</b>
<b>Interconnection Facilities (Interconnection Customer's Expense)</b>		
5	Communications <sup>5</sup>	\$ See footnote
6	Revenue metering	\$ 280,000
7	345 kV Line arrestors	\$ 57,375
<b>Subtotal:</b>		<b>\$ 337,375</b>
<b>Total Cost:</b>		<b>\$ 3,495,026</b>

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 a new 345 kV terminal to an existing Ring Bus and 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.

<sup>3</sup> The cost estimates are 2014 dollars with an accuracy level of  $\pm 20\%$  except it does not include AFUDC.

<sup>4</sup> Transmission work cost estimate has an accuracy level of  $\pm 20\%$  because of unknown Right of Way (ROW) information.

<sup>5</sup> It is the Requester's responsibility to provide both the data circuit and dial-up telephone circuits, see Section 1.13

## Appendix A

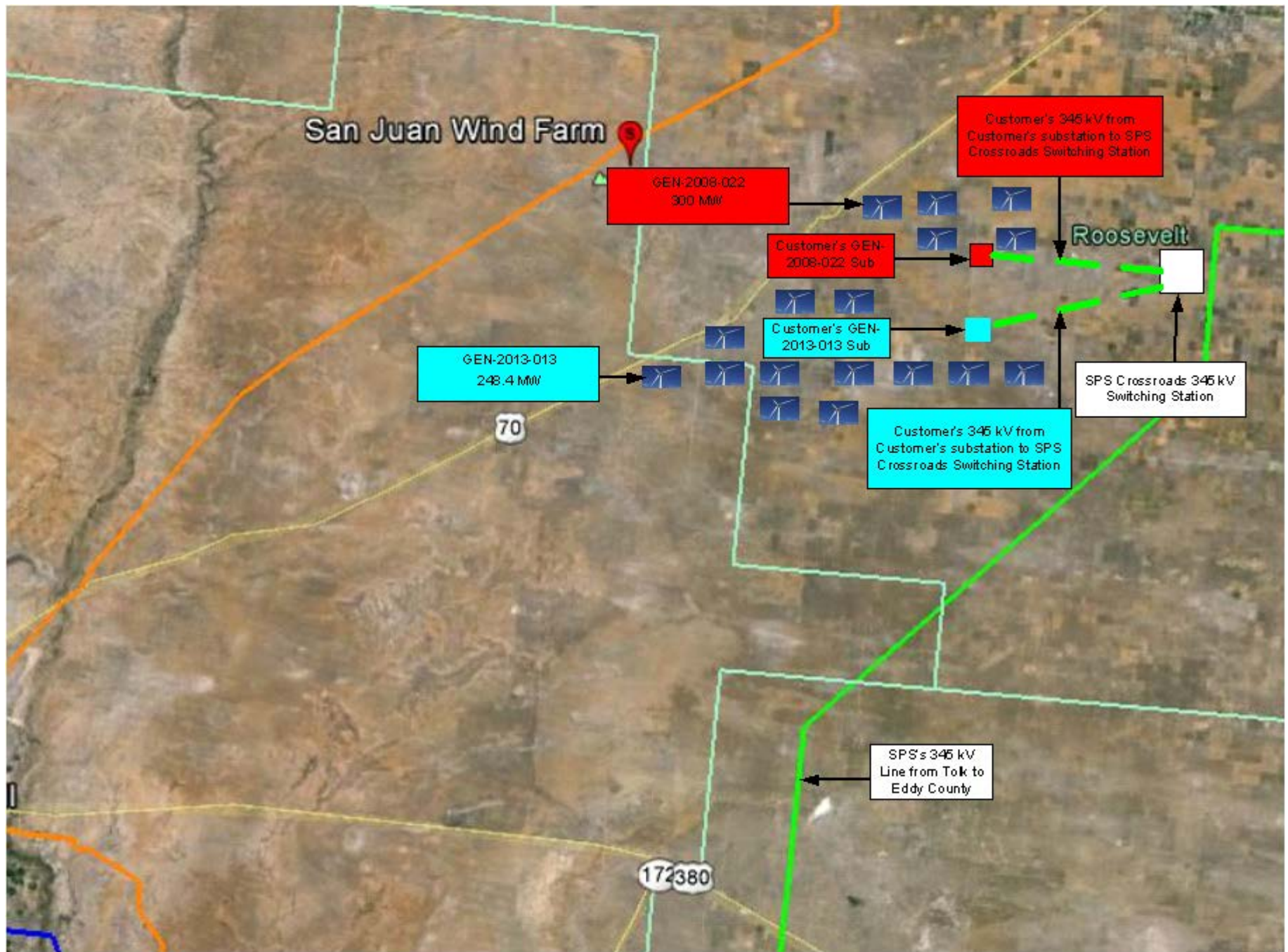


Figure A- 1 Approximate location of proposed GEN-2008-022 and GEN-2013-013



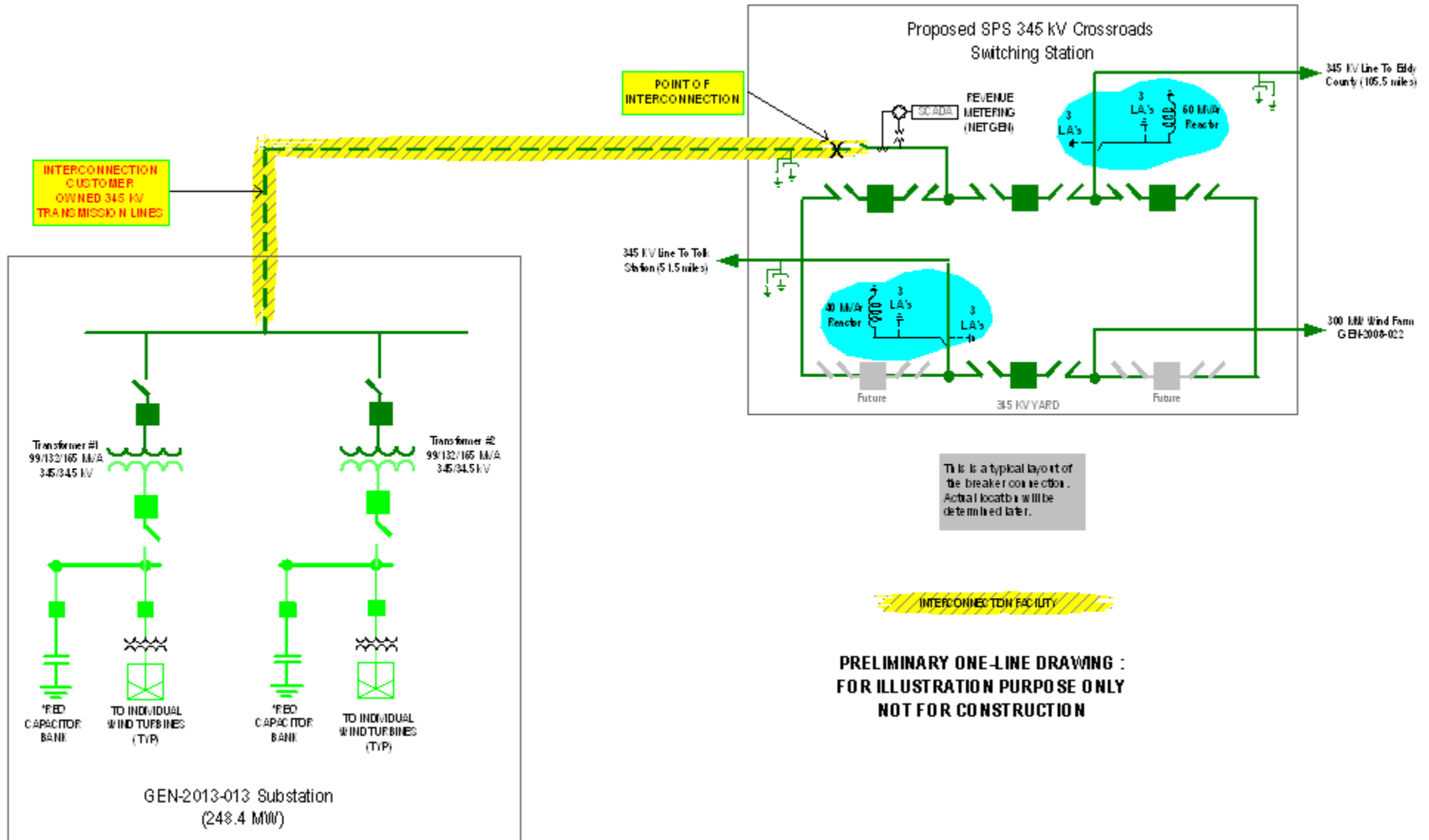
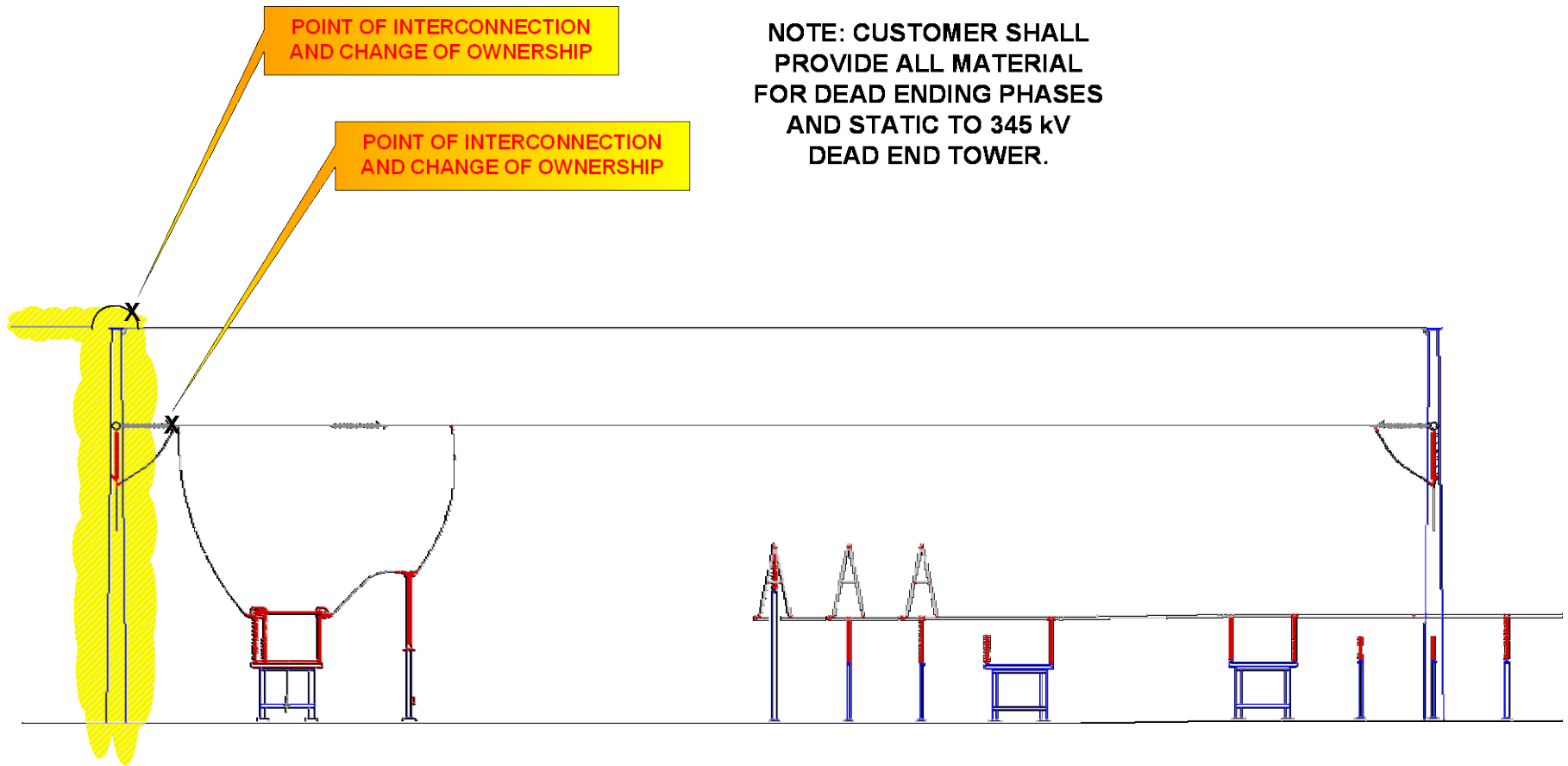


Figure A- 2 One-line Diagram of Crossroads Interchange to Customer Interconnection Facility



**NOTE: CUSTOMER SHALL PROVIDE ALL MATERIAL FOR DEAD ENDING PHASES AND STATIC TO 345 kV DEAD END TOWER.**

**THIS DRAWING ILLUSTRATES ONLY THE POINT OF INTERCONNECTION AND THE BOUNDARIES OF CUSTOMERS RESPONSIBILITY. IT MAY NOT BE USED FOR CONSTRUCTION**

Customer's Responsibility

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

*– END OF REPORT –*