



**Interconnection Facilities Study  
For  
Generator Interconnection  
Request  
GEN-2014-047  
(IFS-2014-002-16)**

***SPP Generator  
Interconnection Studies***

***(#GEN-2014-047)  
(#IFS-2014-002-16)***

**February 2016**

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## Revision History

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Date	Author	Change Description
9/16/2015	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued
10/20/2015	SPP	Final Interconnection Facilities Study Report Revision 0 Issued
2/2/2016	SPP	Facilities Study Report Revised for changes in Shared Network Upgrades

## **Summary**

Southwestern Public Service Company (SPS), an operating company subsidiary of Xcel Energy Inc., performed a detailed Interconnection Facilities Study (IFS) at the request of Southwest Power Pool (SPP) for Generator Interconnection request GEN-2014-047/IFS-2014-002-16 (40.00 MW/Solar) located in Roosevelt County, New Mexico. The Interconnection Customer's originally proposed in-service date for GEN-2014-047/IFS-2014-002-16 is December 1, 2016. SPP has proposed the full interconnection service in-service date will be after the assigned Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) are completed. Full Interconnection Service will require the Network Upgrade(s) 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's generation facility consists of eighty (80) Advanced Energy (A.E.) 500NX 0.5MW solar inverters for a total nameplate rating of 40.00 MW. The 34.5kV collector system for this solar facility is planned to be connected to one (1) 345/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. An approximate nine (9) mile overhead 345kV transmission circuit will connect GEN-2014-047/IFS-2014-002-16 to the Point of Interconnection (POI) at the planned 345kV bus at the SPS owned Crossroads Substation. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the POI.

The Interconnection Customer will 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. The Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

### Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s)

To facilitate interconnection the Transmission Owner will construct a new 345kV terminal at the Crossroads 345kV substation. In order to add another 345kV terminal, SPS will need to expanding the planned three (3) breaker ring configuration to breaker-and-half configuration, add three (3) 3000A continuous ampacity 345kV circuit breakers and associated terminal equipment for acceptance of the Interconnection Customer's Interconnection Facilities. Currently, SPS estimates an Engineering and Construction (E&C) lead time of approximately eighteen (18) months after a fully executed Generator Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, GEN-2014-047/IFS-2014-002-16 is responsible for \$3,164,380 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s). **Table 1** displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s).

**Table 1: GEN-2014-047/IFS-2014-002-16 TOIF and Non-Shared Network Upgrade(s)**

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
<b>Interconnection Substation - Transmission Owner Interconnection Facilities</b> 345kV Substation work for a new line terminal position, line switch, dead end structure, communications, revenue metering, and line arrestors	\$337,375	100%	\$337,375
<b>Interconnection Substation - Network Upgrade(s)</b> 345kV Substation work for substation expansion, new terminal position, build three (3) 3000A continuous ampacity 345kV breakers and associated switches, structures, other terminal equipment.	\$2,827,005	100%	\$2,827,005
Total	\$3,164,380	100%	\$3,164,380

### Shared Network Upgrade(s)

The Interconnection Customer was studied within the DISIS-2014-002 Impact Study, and its subsequent restudies, the latest iteration being DISIS-2014-002-5, with Energy Resource Interconnection Service (ERIS) only . At this time, the Interconnection Customer is allocated \$1,299,846 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 Upgrades:

**Table 2: GEN-2014-047/IFS-2014-002-16 Shared Network Upgrade(s)**

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
<b>Tolk – Plant X 230kV Circuit #1 &amp; #2:</b> Rebuild Tolk – Plant X circuits #1 and #2	\$972,809	9.59	\$9,921,693
<b>TUCO Substation 345/230kV Transformer replacement:</b> Replace existing 345/230kV 560MVA transformer with unit with emergency ratings of 644MVA(summer)/700MVA(winter)	\$327,037	8.7	\$3,374,036
<b>Total</b>	<b>\$1,299,846</b>		<b>\$13,295,729</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, the following Other Network Upgrades are assigned to GEN-2014-047/IFS-2014-002-16:

- China Draw 115kV Reactive Power Support build assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- Livingston Ridge – Sage Brush – Lagarto – Cardinal 115kV circuit #1 assigned in the High Priority Increment Load Study (HPILs) per SPP-NTC-200309 with current on schedule 6/1/2018 in-service
- Ochoa 115kV Reactive Power Support assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- Potash Junction Project 230/115kV assigned in High Priority Increment Load Study (HPILs) per SPP-NTC-200282 with current on schedule 12/1/2015 in-service
- Potash Junction 230kV Reactive Power Support assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- Road Runner 115kV Reactive Power Support assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324

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-2014-047/IFS-2014-002-16 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$3,164,380 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$1,299,846 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service,

Interconnection Service for 40.00 MW, as requested by GEN-2014-047/IFS-2014-002-16, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-047/IFS-2014-002-16 for interconnection Service are estimated at \$4,464,226.



**Facility Study For  
Southwest Power Pool (SPP)**  
40 MW Solar Facility  
Roosevelt County, New Mexico  
SPP # GEN-2014-047

April 30, 2015

Transmission Planning South  
Xcel Energy Services

**Executive Summary**

("Interconnection Customer") in 2015 requested the interconnection of a solar (yes solar) generation facility located in Roosevelt County, New Mexico to the Southwestern Public Service Company (SPS), 345 kV transmission network. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. This facility has a capacity of 40 MW. The Interconnection Customer's facility will connect to an existing Crossroads 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 12/1/2016.

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)-2014-002 for GEN-2014-047, which was completed in January 2015. The interconnection request was studied for 40 MW of solar panels. 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.xcelenergy.com/Energy\\_Partners/Generation\\_Owners/Interconnections\\_for\\_Transmission](http://www.xcelenergy.com/Energy_Partners/Generation_Owners/Interconnections_for_Transmission). 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 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.

The network upgrades for the Interconnection at Crossroads Switching Station is \$2,827,005.

As for this request (GEN-2014-047), it is anticipated that the entire process of adding one new 345 kV breaker terminal 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 GEN-2014-047 facility, is shown below in Table 1, with the detailed description of the cost shown in Table 3.

**Table 1, Cost Summary, Crossroads Switching Station**

**\$ 2,827,005**



<b>SPS Network Upgrades:</b>	
<b>Interconnection Facilities <sup>1</sup>:</b>	<b>\$ 337,375</b>
<b>Total:</b>	<b>\$ 3,164,380</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 build a new 345 kV terminal for the interconnection of GEN-2014-047 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 345 kV station has three breakers (Ring Bus Design configuration) at Crossroads Switching Station and is adding one new 345 kV breaker terminal to accommodate the output from the 40 MW Solar 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 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 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 has 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 was built 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 existing 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 provides 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 primary protection to the interconnection customer’s 345 kV transmission line with fiber will use a 311L (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 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.

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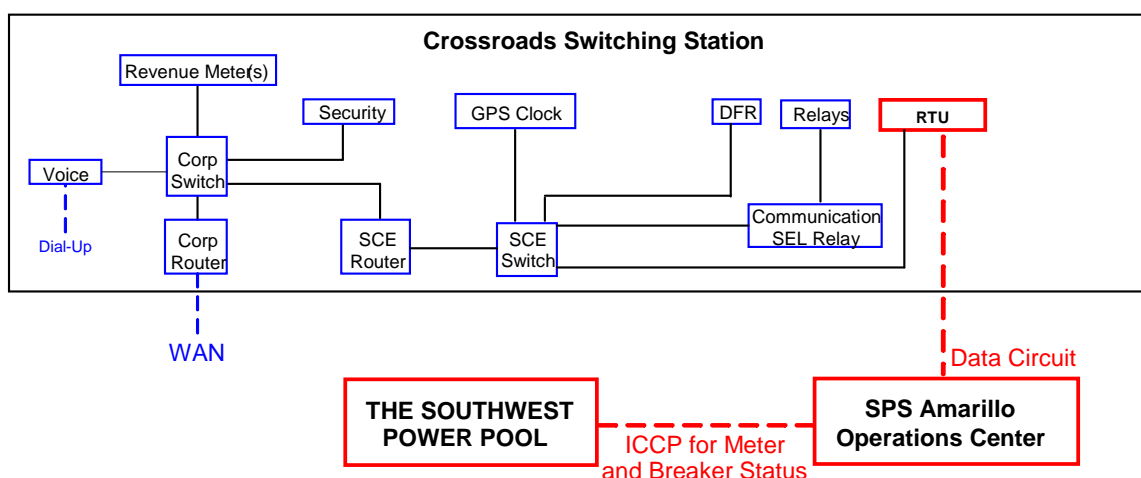
<sup>2</sup> All modifications to SPS facilities will be owned, maintained and operated by SPS.

- 1.10. **Revenue Metering:** The existing 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:** An existing Disturbance-Fault Recorder (DFR), capable of recording faults, swings, and long term trending, will 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):** 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:



Interconnection Customer shall be responsible for providing fiber optic communication circuit installed in the overhead transmission line static wire from the customer substation to Chaves County Interchange for protective relaying and for transmitting metering and status data to SPS.

## 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 Solar 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 Switching Station.

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 Solar Panels 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 Switching Station located 55 from Tolk Station on J-15, which is the interconnection location for GEN-2014-047, 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 w/o contribution from GEN 2014-047				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
345 kV Bus	3,406	4,095	$5.64+j48.12$	$21.25+j75.51$

## Estimated Construction Costs

The projects required for the Interconnection Customer's 40 MW Solar Energy facility are summarized in the table below.

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

Project	Description	Estimate
	<b>SPS Network Upgrades</b>	
2	Add a new 345 kV terminal.	\$ 2,827,005
	<b>Subtotal:</b>	<b>\$ 2,827,005</b>
	<b>Interconnection Facilities (Interconnection Customer's Expense)</b>	
3	Communications <sup>4</sup>	\$ See footnote
4	Revenue metering	\$ 280,000
5	345 kV Line arrestors	\$ 57,375
	<b>Subtotal:</b>	<b>\$ 337,375</b>
<b>Total Cost:</b>		<b>\$ 3,164,380</b>

<sup>3</sup> The cost estimates are 2015 dollars with an accuracy level of  $\pm 20\%$  except it does not include AFUDC.

<sup>4</sup> It is the Requester's responsibility to provide both the data circuit and dial-up telephone circuits, see Section 1.13

**Engineering and Construction:**

An engineering and construction schedule for the installation of the 345 kV terminals is 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.



**Appendix A**

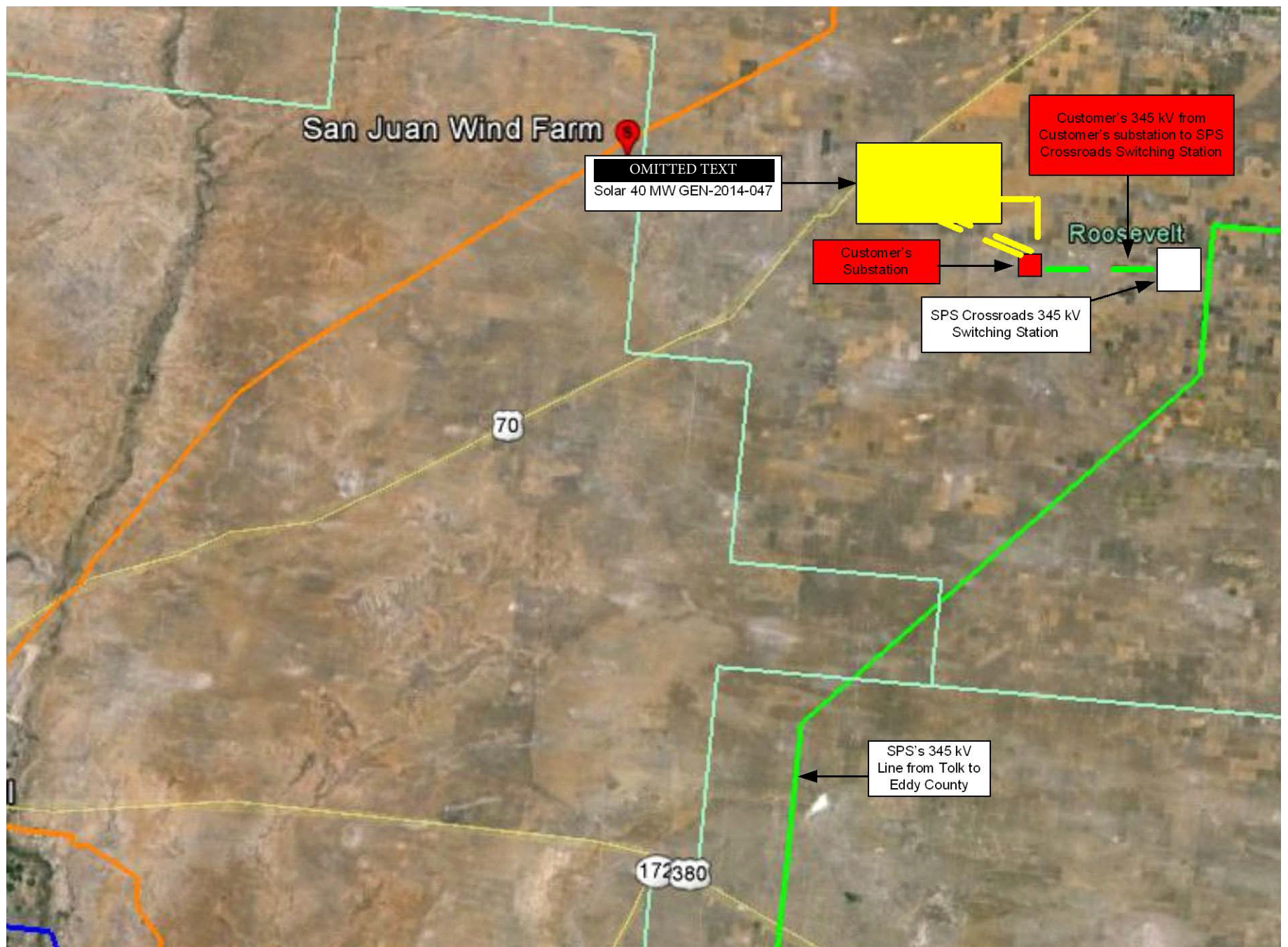
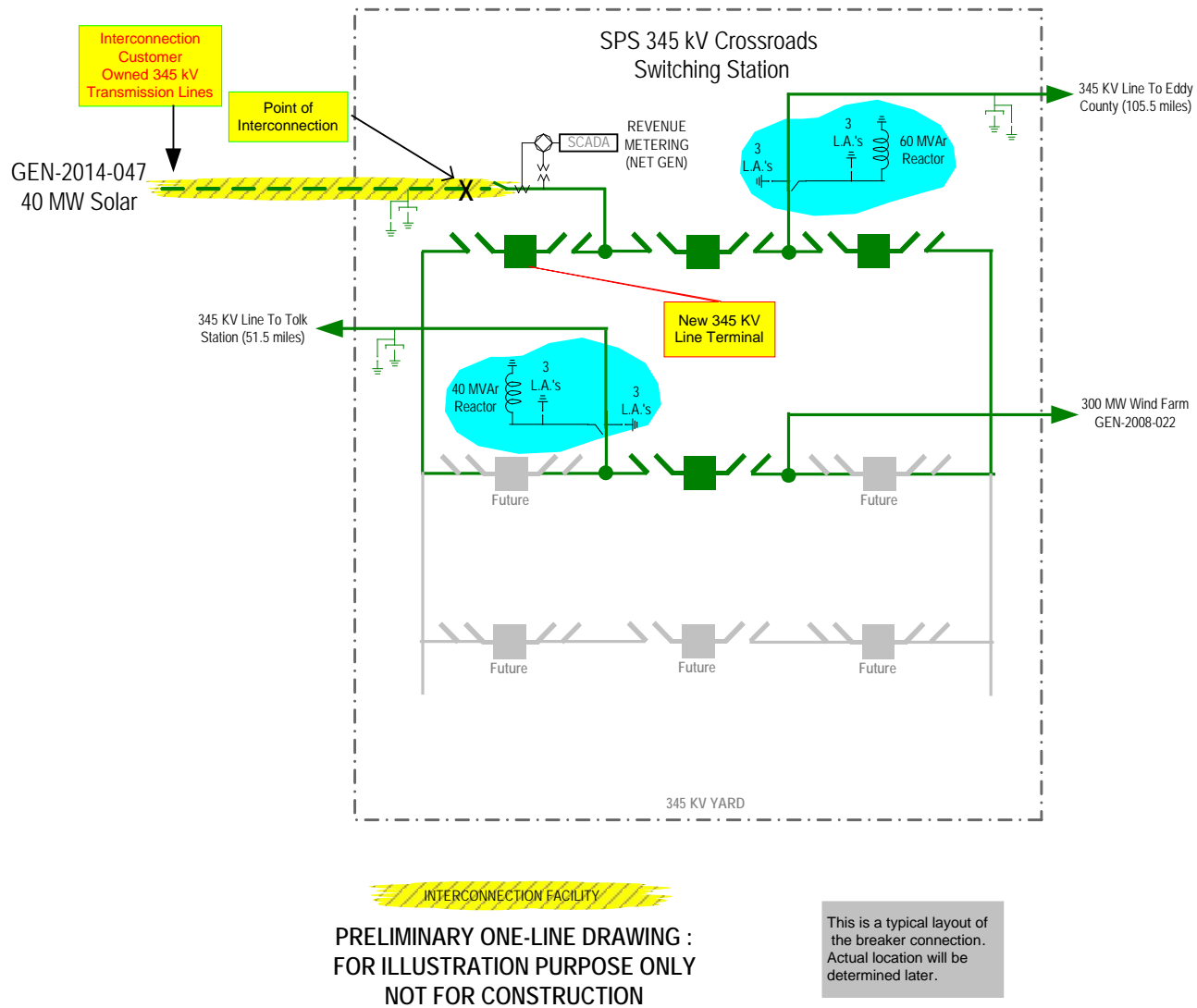
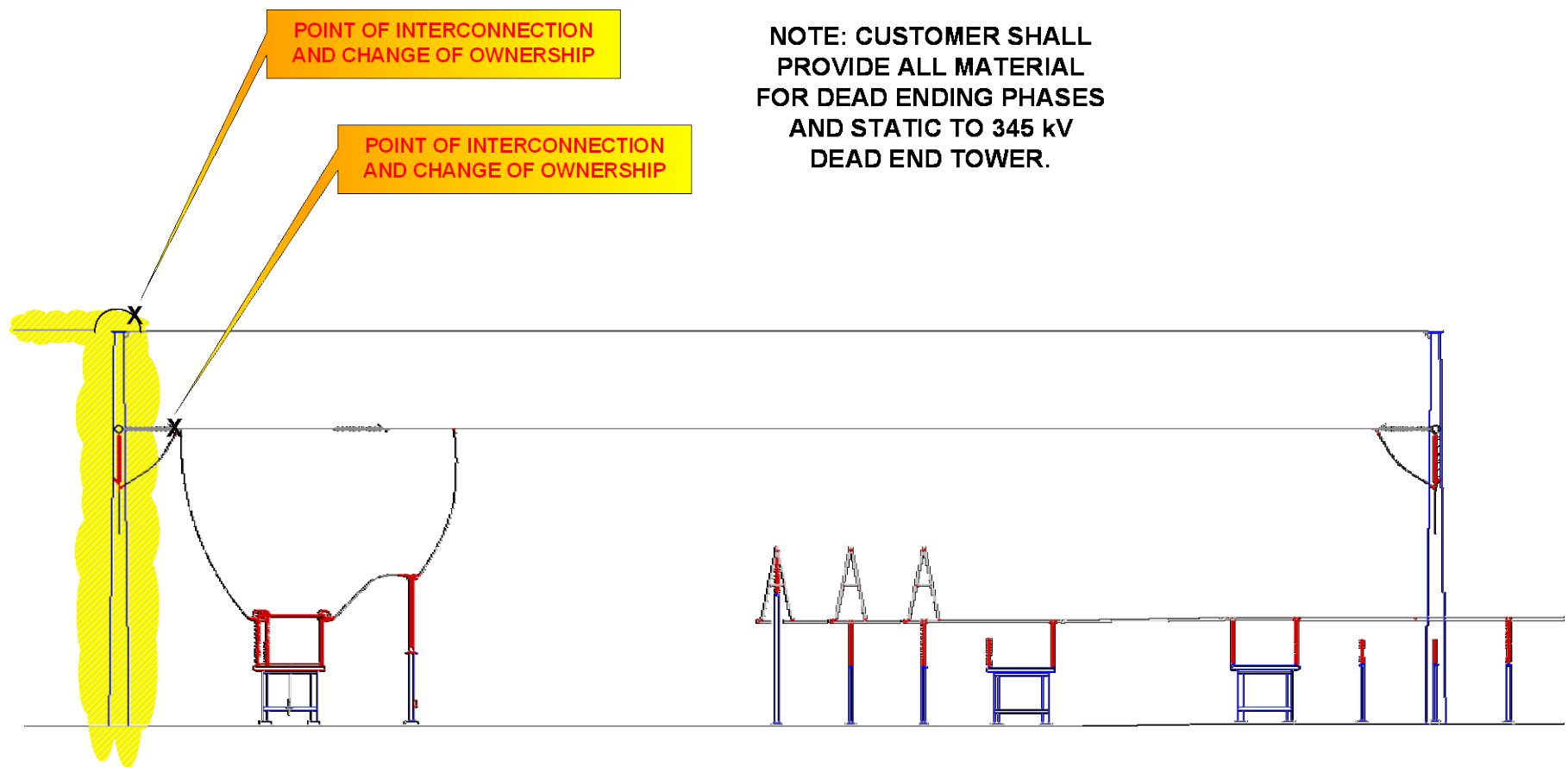


Figure A- 1 Approximate location of proposed GEN-2014-047



**Figure A- 2 One-line Diagram of Crossroads Switching Station and Customer's POI**



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 –*