Facility Study For Generation Interconnection Request GEN-2008-014

SPP Tariff Studies

(#GEN-2008-014)

March 2010

Summary

Southwestern Public Service Company (SPS) performed the following Study at the request of the Southwest Power Pool (SPP) for Generation Interconnection request Gen-2008-014. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Pursuant to the tariff, Southwestern Public Service Company was asked to perform a detailed Facility Study of the generation interconnection request to satisfy the Facility Study Agreement executed by the requesting customer and SPP.

Interconnection Customer Interconnection Facilities

The Interconnection Customer will be responsible for the 345kV transmission line from the point of interconnection to its 345/34.5kV substation that will contain its 345/34.5kV transformer(s) and wind turbine collector feeders. In addition, the Customer will be required to maintain a +/- 95% power factor at the point of interconnection (GEN-2005-015 345kV substation). Using the studied Vestas wind turbines, additional capacitors will be necessary.

Transmission Owner Interconnection Facilities and Non Shared Network Upgrades

Per the following Facility Study, the Interconnection Customer is responsible for $517,750 of Transmission Owner Interconnection Facilities and $1,355,168 of non shared Network Upgrades. In the event GEN-2005-015 withdraws from the SPP Generation Interconnection queue, the Interconnection Customer will be responsible for $11,773,193 of non shared Network Upgrades in addition to $517,750 Transmission Owner Interconnection Facilities.

Shared Network Upgrades

The GEN-2008-014 Interconnection Customer is included in the 1st Cluster Study approved in FERC Docket #ER09-262. The Interconnection Customer's shared upgrade costs are $9,552,208. This cost is subject to change depending upon the Facility Study for the shared network upgrades. This cost is also subject to change for restudies conducted by the Transmission Provider in response to the higher queued customers or other customers in the 1st Cluster that withdraw their interconnection request or suspend, terminate, or request unexecuted filings of their LGIAs.

The in service date for the interconnection request may also be delayed depending upon the in service date of the shared network upgrades.

Facilities Study For
Southwest Power Pool (SPP)

150 MW Wind-Generated Energy Facility
Floyd County, Texas
SPP #GEN-2008-014

March 5, 2010

Xcel Energy Services, Inc.
Transmission Planning

Executive Summary

The Interconnection Customer in 2008 requested the interconnection of a wind energy facility located in Floyd County, Texas 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 net capacity of 150 MW. The Interconnection Customer GEN 2008-014 will connect to the proposed switching station previously requested by GEN 2005-015 located approximately fourteen (14) miles southeast of Floydada, Texas. The Interconnection Customer's expected commercial operation date and back feed date is December 1, 2010 and August 1, 2010, respectively.

The Southwest Power Pool (SPP) originally evaluated the request to interconnect the wind farm facility to the SPS transmission system in a System Impact Re-Study (SIRS) GEN-2008-014 completed in January 2010. The original interconnection request was studied using eighty-three (83) Vestas V90 wind turbines at 1.8 MW each for a total output of 150 MW. The Interconnection Customer is required to maintain a Power Factor of 0.95 lagging at the Point of Interconnection (POI), and be able to provide 54 MVAr of capacitance (at the point of interconnection) through the use of capacitor bank on the 34.5 kV side of their collector's 345/34.5 kV bus based on SPP's Cluster #1 SIRS Table 4-3.

This request will consist of adding one (1) 345 kV line terminal at the Point of Interconnection (POI), to the proposed three-breaker ring bus switching station previously requested by GEN 2005-015, Scenario One. If GEN-2005-015 withdraws or suspends, then the requirements at the POI will consist of a three-breaker ring bus switching station covered in Scenario Two.

SPS requires that all construction for this request be in compliance with the latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Producer-Owned Generation Greater than 20 MW, Version 3.0 dated Dec 31, 2006, and is available at (http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_16699_24407-1428-0_0_0-0,00.html). This document describes the requirements for connecting new generation to the Xcel Energy transmission systems including technical, protection, commissioning, operation, and maintenance. 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, installation of the cap banks 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 proposed SPS Switching Station.

As for this request (GEN-2008-014), it is anticipated that Scenario One will require approximately 12 months and Scenario Two require approximately 24 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 this wind farm facility, is shown below in Table 1, with the detailed description of the cost shown in Table 3.

Table 1, Cost Summary

	Scenario One[1]	Scenario Two[2]
Stand Alone Network Upgrades:		$ 6,749,829
Network Upgrades:	$ 1,355,168	$ 5,023,364
Interconnection Facilities[3]:	$ 517,750	$ 517,750
Total:	**$ 1,872,918**	**$ 12,290,943**

[1] Scenario 1: GEN 2005-015 "staying" in the queue. Add a new 345 kV line terminal to the proposed (3) terminal/ring switch station.
[2] Scenario 2: GEN 2005-015 "withdrawing" from the queue. Construct a (3) terminal/ring switch station.
[3] This is a direct assigned cost to the Interconnection Customer.

General Description of SPS Facilities [4]

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

    1.1. **Location:** SPS will add a new 345 kV line terminal for GEN 2008-014 at the proposed SPS Switching Station for GEN 2005-015. Appendix A, Figure A- 2, shows the preliminary one-line of the new switching station and new 345 kV terminals referred to as Scenario One. Appendix A, Figure A-3 shows the preliminary one-line of the new 345 kV three (3) breaker ring bus at the new switching station referred to as Scenario Two. Figure A- 4 shows a typical elevation view of the Point of Interconnection (POI).

    1.2. **Bus Design:** The proposed three (3) terminal ring bus design for GEN 2005-015 will be expanded to four (4) breaker ring as shown in the preliminary one-line in Figure A-2, Scenario One of Appendix A. If GEN 2005-015 withdraws or suspends, a new 345 kV three-breaker ring-bus switching station will be built to accommodate the output from the wind energy facility GEN 2008-014 shown in the one-line in Figure A-3, Scenario Two of Appendix A.

    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 from normal.

    1.4. **Control House:** The control house for the proposed for GEN 2005-015 will be utilized to accommodate the new metering, protective relaying and control devices, terminal cabinets, and any fiber-optic cable terminations, etc. for the new 345 kV line breaker terminals for GEN 2008-014.

    1.5. **Security Fence:** The switching station 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 430' × 400', with a rock yard surface.

    1.6. **Ground Grid**: A complete ground-grid will be installed for the proposed switching station for 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 initial site grading and erosion control for the proposed new switching station and the new line terminal. Soil compaction shall be not less that 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.

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

1.9. **Relay and Protection Scheme:** The new 345 kV breaker line terminals primary protection to the interconnection customer 345 kV transmission line will use line current differential relaying over optical fiber installed in the static on the new transmission line. Secondary relaying will use mirrored bit, Permissive Overreaching Transfer Trip (POTT) over the optical fiber. An SEL 311L and a 421 will be used as primary and secondary relays, respectively. A SEL 501-0 will be used for breaker failure. Significant modifications will be required at remote terminals.

An SEL DTA-2 will display the bus voltage, GCB amps, MW, MVAr, and fault location.

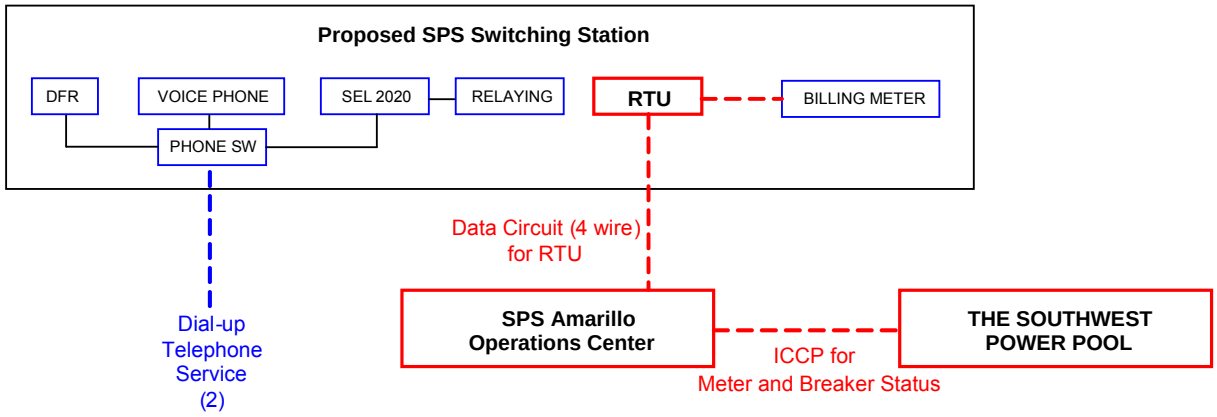
1.10. **Revenue Metering:** On the SPS new 345 kV switching station at the Customer's Point of Interconnection from their substation, an individual billing meter will be installed along with an ION 8400 meter unit, ANSI C12.1 accuracy class 0.2 (3-PT's IEEE C57.13 accuracy class 0.3 and 3 CT's IEEE C57.13 accuracy class 0.15) for full 3 phase 4-wire metering. Also installed for the metering units will be optical 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 back up, 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.

1.11. **Disturbance Monitoring Device:** Disturbance-monitoring equipment (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. This equipment will have communication capability with a dedicated communication circuit. The disturbance equipment will have its own dedicated dial-up communications telephone circuit.

1.12. **Remote Terminal Unit (RTU):** A new RTU will be installed to accommodate the new 345 kV line terminals at the proposed switching station. An SEL 2020 will be installed for relay communications and other function as required. SPS will provide and install an RTU for metering and telemetry at the Interconnection Customer's facility as required by the latest Xcel Energy Interconnection Guidelines. The direct cost will be charged to the Interconnection Customer.

1.13. **Communications:** Communications from the new switching station to the Amarillo Control Center will consist of a telephone and data circuit. ***It is the Interconnection Customer's responsibility to make arrangements with the local phone company to provide telephone circuits to the relay communication equipment and disturbance-monitoring equipment at proposed switching station and to their wind farm facility. Prior to any construction the Interconnection Customer is required to contact the SPS substation-engineering department for all details.***

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 the new switching station indicated in Section 1.9.

2. **Transmission Work:**

2.1. The Interconnection Customer will construct, own, operate, and maintain any customer owned 345 kV transmission line from the Interconnection Customer's substation to the Interconnection Point at the new SPS switching station as shown in Appendix A, Fig. A-1.

2.2. ***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 new 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. **Switching Station Real Estate**: SPS will provide Interconnection Customer with easement detailing the metes and bounds description for the required switching station real estate. The Interconnection Customer will obtain all necessary signatures from landowner(s) for the easement needed on the land where the new SPS switching station will be built.

3.2. **Permitting**: Permitting for the construction of a new 345 kV line terminal at the switching station is not required from the Public Utility Commission in the State of Texas. The interconnection customer will be responsible for any permitting and right of way of their substation and the 345 kV transmission line from their substation to the Interconnection Point.

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 farm facility. **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. It is understood that the Capacitor Banks will be installed at the Interconnection Customer's substation on the 34.5 kV bus side to avoid voltage spikes on the 345 kV that adversely affects the Xcel Energy transmission system. The Interconnection customer will be required to maintain a Power Factor of 0.95 lagging at the Point of Interconnection (POI), which is based on SPP's Impact Cluster #1 Restudy Table 4-3 and switch the capacitor banks in stages of 20 MVAr or less. 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, Version 3.0 dated December 31, 2006, and is available at (http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_16699_24407-1428-000-0,00.html)

6. **Fault Current Study:** The available fault current at the interconnection location, without any contribution from the wind farm facilities, is shown in Table 2 below.

Table 2, - Available Fault Current at Point of Interconnection Location

Short Circuit Information without contribution from Wind Farm Facilities **GEN 2008-014 or GEN 2005-015**				
	Fault Current (Amps)		Impedance (Ω)	
Fault Location	Line-to-Ground	3–Phase	Z^+	Z^0
345 kV Bus	1033	3943	4.6568+j50.3046	18.6187+j90.1056

Estimated Construction Costs

The projects required for the interconnection of this 150 MW Wind Farm facility consist of the projects summarized in the table below.

Table 3, Required Interconnection Projects[5]

Project	Description	Estimated Cost	Estimated Cost
	Stand Alone Network Upgrades	**Scenario 1[6]**	**Scenario 2[7]**
1	New Switching Station (3-Breaker Ring Bus) Facility		$ 6,484,204
2	Control House		$ 265,625
	Subtotal	**$0**	**$ 6,749,829**
	Network Upgrades		
3	Transmission Line Work		$ 580,335
4	Right-of-Way		$ 45,000
5	Relay Upgrades at remote terminals		$ 150,000
6	Disturbance Monitoring Device		$ 51,376
7	Reactors		$ 4,196,653
8	New 345 kV breaker added to 3-breaker ring bus	$1,355,168	
	Subtotal:	**$1,355,168**	**$ 5,023,364**
	Interconnection Facilities (at the Interconnection Customer's expense)		
9	Communications [8]	*$ See footnote*	
10	345 kV Disconnect Switch	$ 210,375	$ 210,375
11	Revenue metering	$ 250,000	$ 250,000
12	345 kV Line arrestors	$ 57,375	$ 57,375
	Subtotal:	**$ 517,750**	**$ 517,750**
	Total Cost:	**$1,872,918**	**$12,290,943**

Engineering and Construction:

An engineering and construction schedule to build the new switching station at 345 kV line is estimated at approximately 24 months. The construction schedule to add a 345 kV line terminal is 12 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.

[5] The cost estimates are 2009 dollars with an accuracy level of ±20% except as noted, without AFUDC.

[6] Scenario 1 (GEN 2005-015 "staying" in the queue): includes cost to build only a 345 kV line terminal to existing breaker ring switch station.

[7] Scenario 2 (GEN 2005-015"withdrawing" from the queue): includes cost to build a three (3)-breaker/terminal ring switch station.

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

Appendix A

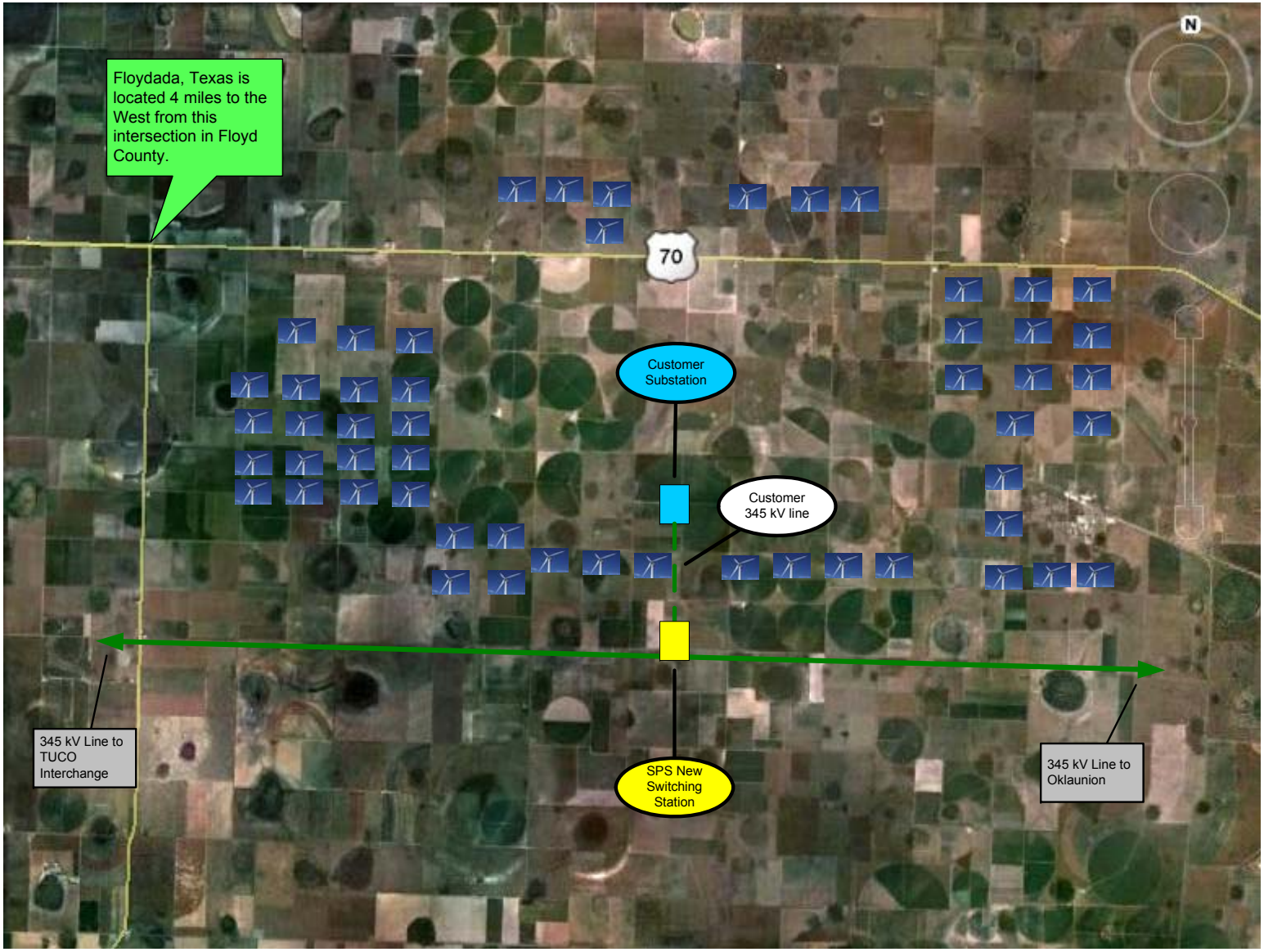


Figure A- 1 Approximate location of proposed SPS Switching Station and Wind Farm Facility

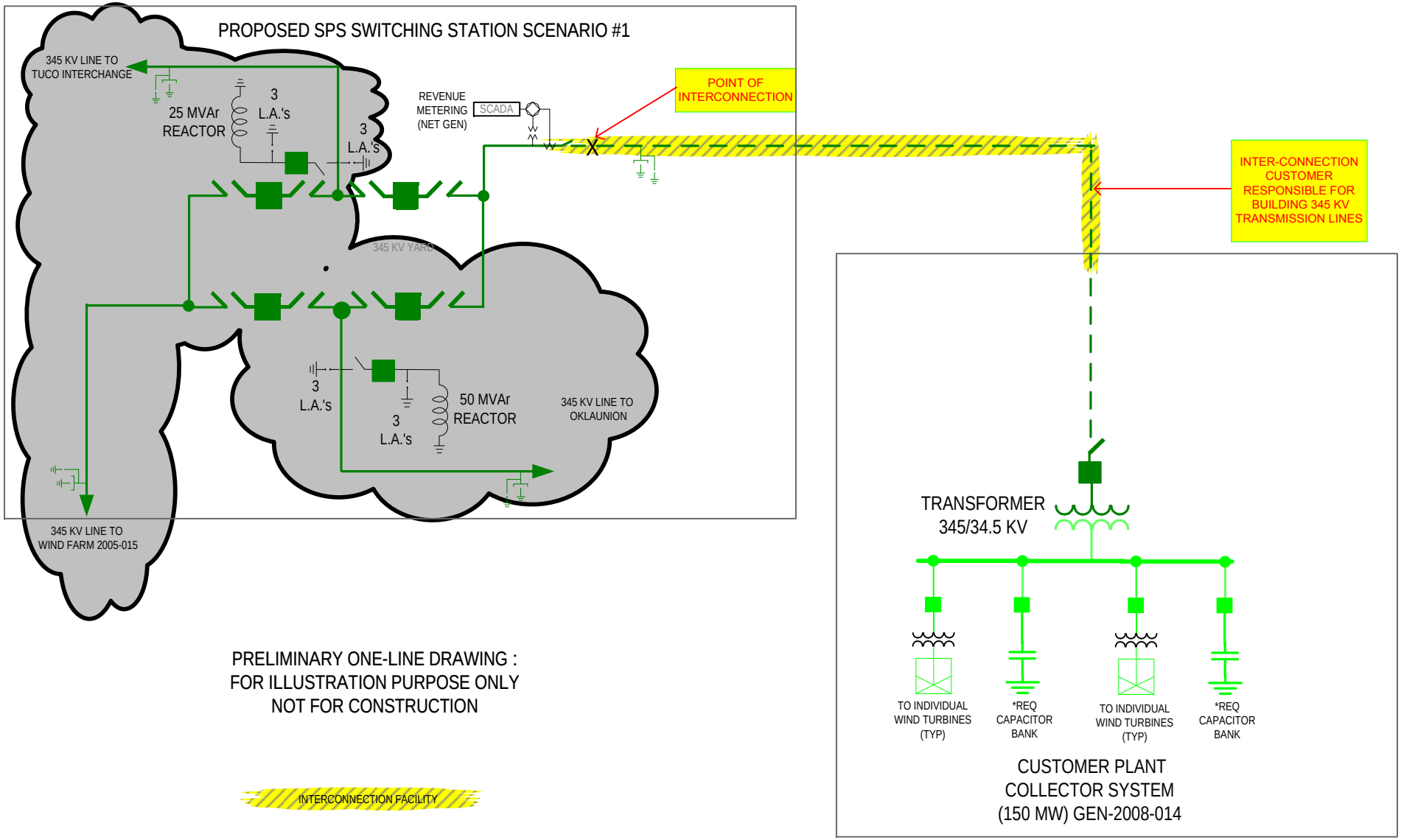


Figure A- 2 One-line Diagram of Proposed SPS Switching Station to Customer Interconnection Facility, Scenario One.

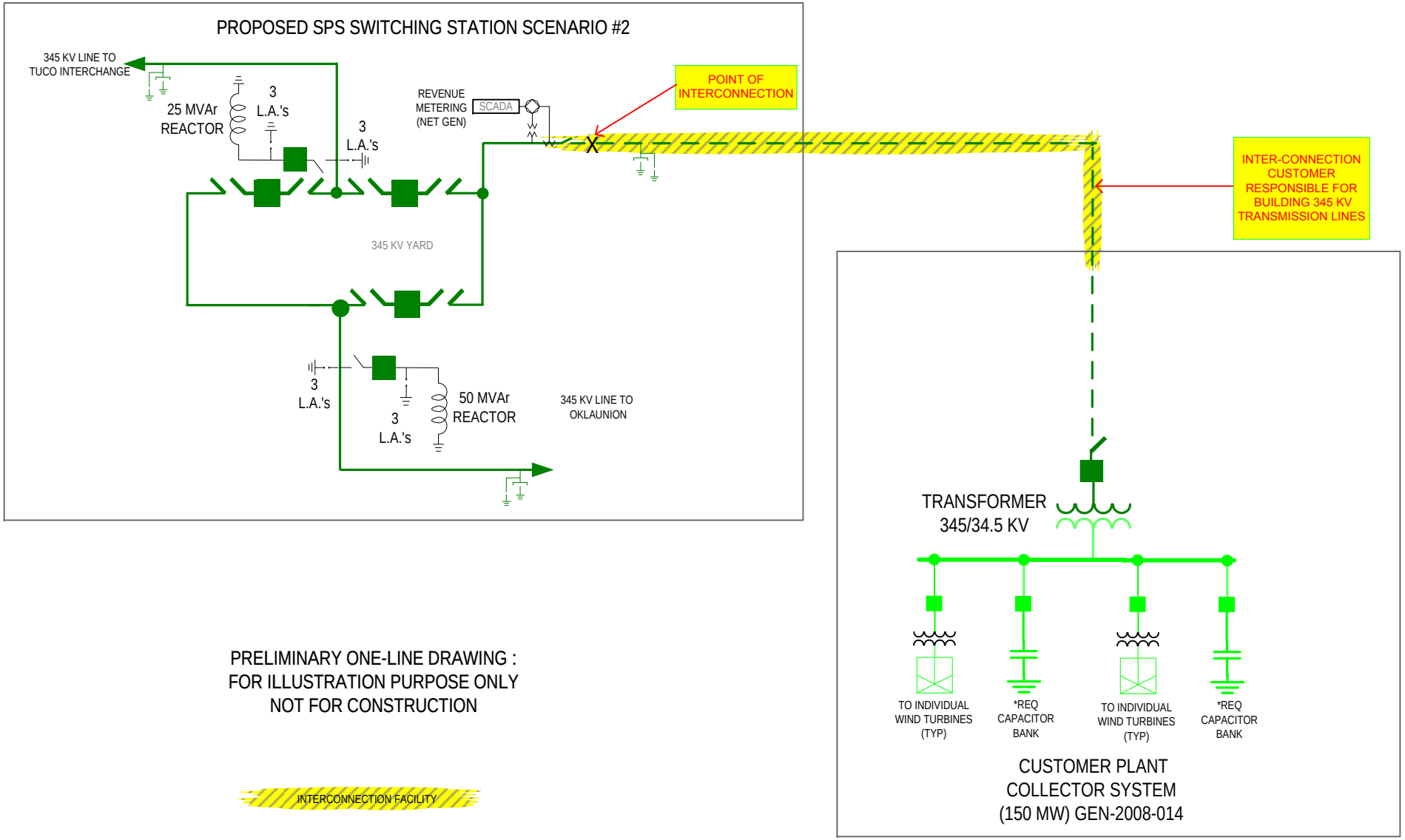


Figure A- 3. One-line Diagram of Proposed SPS Switching Station to Customer Interconnection Facility, Scenario Two.

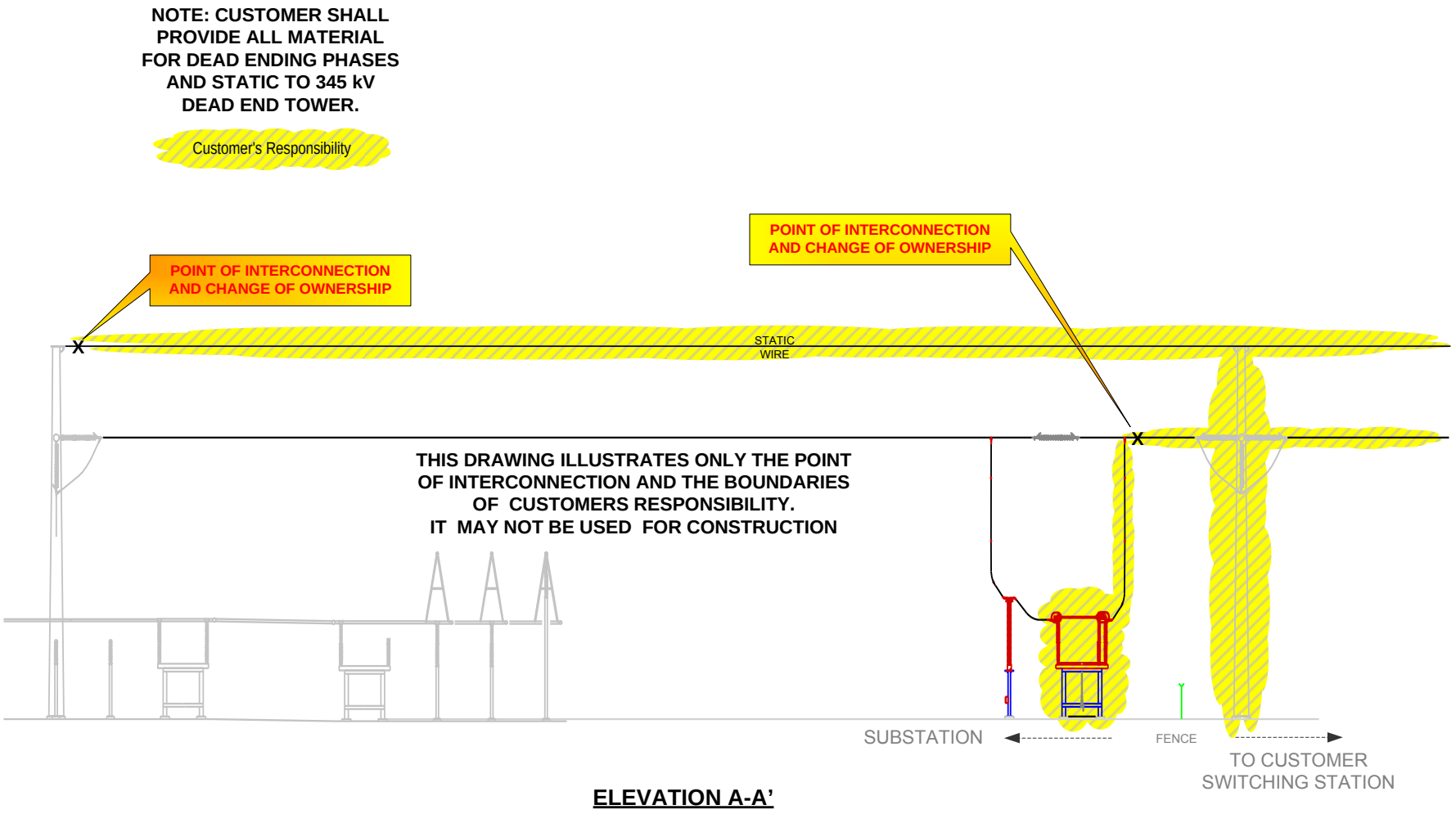


Figure A- 4 New Switching Station Interconnection Facility Preliminary Elevation View

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