



***Facility Study
For
Generation Interconnection
Request
GEN-2007-048***

***SPP Tariff Studies
(#GEN-2007-048)***

February 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-2007-048. 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 230kV transmission line from the point of interconnection to its 230/34.5kV substation that will contain its 230/34.5kV transformer(s) and wind turbine collector feeders. In addition, the Customer will be required to maintain a +/- 99% power factor at the point of interconnection (Amarillo South Interchange – Swisher Interchange 230kV line). Using the studied Fuhrlaender wind turbines, additional capacitors may not be necessary.

Transmission Owner Interconnection Facilities and Non Shared Network Upgrades

Per the following Facility Study, the Interconnection Customer is responsible for \$283,469 of Transmission Owner Interconnection Facilities and \$3,335,421 of non shared Network Upgrades. In addition, the Customer is responsible for the following non-shared network upgrade -

<u>Amarillo South 230kV substation</u> –	Replace 230kV Wave Trap	\$27,144
	Replace 230kV Disconnect Switch	<u>\$11,588</u>
Subtotal		\$38,732
<u>Swisher 230kV substation</u> -	Replace 230kV Wave Trap	\$27,144
	Replace 230kV Disconnect Switch	<u>\$11,588</u>
Subtotal		\$38,732

Shared Network Upgrades

The GEN-2007-048 Interconnection Customer is included in the 1st Cluster Study approved in FERC Docket #ER09-262. The Interconnection Customer's shared upgrade costs are \$65,120,627. 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)**
400 MW Wind-Generated Energy Facility
Randall County, Texas
SPP #GEN-2007-048

February 1, 2010

Xcel Energy Services, Inc.
Transmission Planning

Executive Summary

The Interconnection Customer in 2007 requested the interconnection of a wind energy facility located in Randall 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 400 MW. The Interconnection Customer's facility will connect to a new SPS 230 kV switching station located approximately 9 miles southeast of Canyon, Texas and located adjacent to SPS's 230kV transmission line circuit from Amarillo South Interchange to Swisher County Interchange. The Interconnection Customer's expected commercial operation date is December 16, 2011 and the requested back-feed date is September 16, 2011.

The Southwest Power Pool (SPP) evaluated the request to interconnect the wind farm facility to the SPS transmission system in a System Impact Study (SIS) GEN-2007-048 completed in January, 2010. The interconnection request was studied using one hundred sixty (160) Fuhrlaender Wind Turbines at 2.5 MW each for a total output of 400 MW. The Interconnection Customer will be required to maintain a Power Factor of 0.997 lagging and a 0.998 leading at the Point of Interconnection (POI), based on SPP's Impact Cluster #1, Group #5 Restudy Table 4-2.

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 capacitor banks and any Direct Assigned Interconnection Facilities; inclusive of all construction required for the 230 kV transmission line from the Interconnection Customer's substation to the new SPS switching station.

As for this request (GEN-2007-048), it is anticipated that the entire process of adding the new 230 kV switching station for the acceptance of the wind farm facility output, will require approximately 16 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^a

Stand Alone Network Upgrades	\$ 2,792,657
Network Upgrades:	\$ 542,764
	542,764
Interconnection Facilities ^b :	\$ 283,469
Total:	\$ 3,558,890

^a The cost estimates are 2009 dollars with an accuracy level of $\pm 20\%$.

^b This is a direct assigned cost to the Interconnection Customer.

General Description of SPS^c Facilities

1. **Construction of new Switching Station:** See Appendix A, Figure A- 1 for general vicinity location map.
 - 1.1. **Location:** SPS will construct a new 230 kV three (3) breaker ring bus at the new switching station. Appendix A, Figure A- 2, shows a preliminary one-line of the new switching station, while Figure A- 3 shows a typical elevation view of the Point of Interconnection (POI).
 - 1.2. **Bus Design:** The new 230 kV three-breaker ring-bus switching station will be built to accommodate the output from the wind energy facility.
 - 1.3. **Line Terminals:** The 230kV lines and static wire terminals will be designed to accommodate 2,000 pounds per phase conductor at maximum tension, with a maximum 15-degree pull off from normal.
 - 1.4. **Control House:** The control house for the proposed switching station will be utilized to house the new metering, protective relaying and control devices, terminal cabinets, and any fiber-optic cable terminations, etc. for the new 230kV line breaker terminals.
 - 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 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 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 133 kV/120-240 volt transformer tapped off of the 230 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 230 kV three (3) breaker ring-bus line terminals primary protections to the interconnection customer 230 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 an SEL 321-1 will be used as primary and secondary relays, respectively. An SEL 279H-2 relay will be installed; however no automatic re-closing scheme will be used. The SEL 279H-2 will be used for line/bus SCADA closing conditions for the 230 kV breakers. Also, a SEL 501-0 will be used for breaker failure. Modifications will be required at remote terminals.

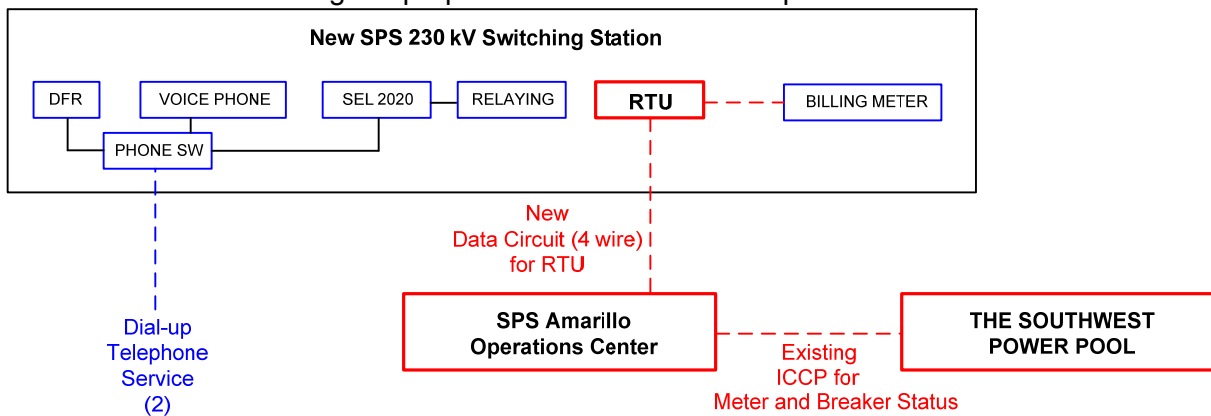
An SEL DTA-2 will display the bus voltage, GCB amps, MW, MVAR, and fault location.
 - 1.10. **Revenue Metering:** On the SPS new switching station 230 kV line terminal to the Interconnection Customer's substation, an individual billing meter will be installed along

^c All modifications to SPS facilities will be owned, maintained and operated by SPS.

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 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 utilized with communications for the new switching station. An SEL 2020 will be installed for relay communications and other functions 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 both the four-wire data circuit and both telephone circuits to the new switching station and the new 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 230 kV transmission line from the Interconnection Customer's substation to the Interconnection Point at the new SPS switching station as shown in Appendix A, Figure A-1. ***The SPS transmission design group prior to any construction by the Interconnection Customer or its contractor on any customer 230 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:

- 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 230 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 230 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 230 kV that adversely affects the Xcel Energy transmission system. The Interconnection customer will be required to maintain a Power Factor of 0.997 lagging and a 0.998 leading at the Point of Interconnection (POI), which is based on SPP's Impact Cluster #1 Restudy Table 4-2 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.

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

Short Circuit Information without contribution from Wind Farm Facilities (GEN-2007-048)				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3-Phase	Z^+	Z^0
230 kV Bus	1,412	5,545	3.145 + j23.739	9.688 + j45.216

Estimated Construction Costs

The projects required for the interconnection of this 400 MW Wind Farm facility consist of the projects summarized in the table below.

Table 3, Required Interconnection Projects^d

Project	Description	Estimated Cost
	Stand Alone Network Upgrades	
1	230 kV Breaker Line Terminal (3-terminal)	\$ 2,541,045
2	Control House	\$ 191,612
	Subtotal	\$ 2,732,657
	Network Upgrades	
3	Relay Upgrades at remote terminals	\$ 85,973
4	Disturbance Monitoring Device	\$ 51,376
5	Transmission Line Work	\$ 370,415
6	Right-Of-Way ^e	\$ 35,000
	Subtotal:	\$ 542,764
	Interconnection Facilities (at the Interconnection Customer's expense)	
7	Communications ^f	\$ See footnote
8	Remote Terminal Unit (RTU)	\$ 25,000
9	Revenue metering	\$ 225,000
10	230 kV Line arrestors	\$ 33,469
	Subtotal:	\$ 283,469
	Total Cost:	\$ 3,558,890

Engineering and Construction:

An engineering and construction schedule for the installation of the 230 kV line terminals is estimated at approximately 16 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.

^d The cost estimates are 2009 dollars with an accuracy level of $\pm 20\%$.

^e Surveying cost; Interconnection Customer will acquire the SPS easement needed for the land upon which the new switching station will be built, see Section 3.1.

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

Appendix A

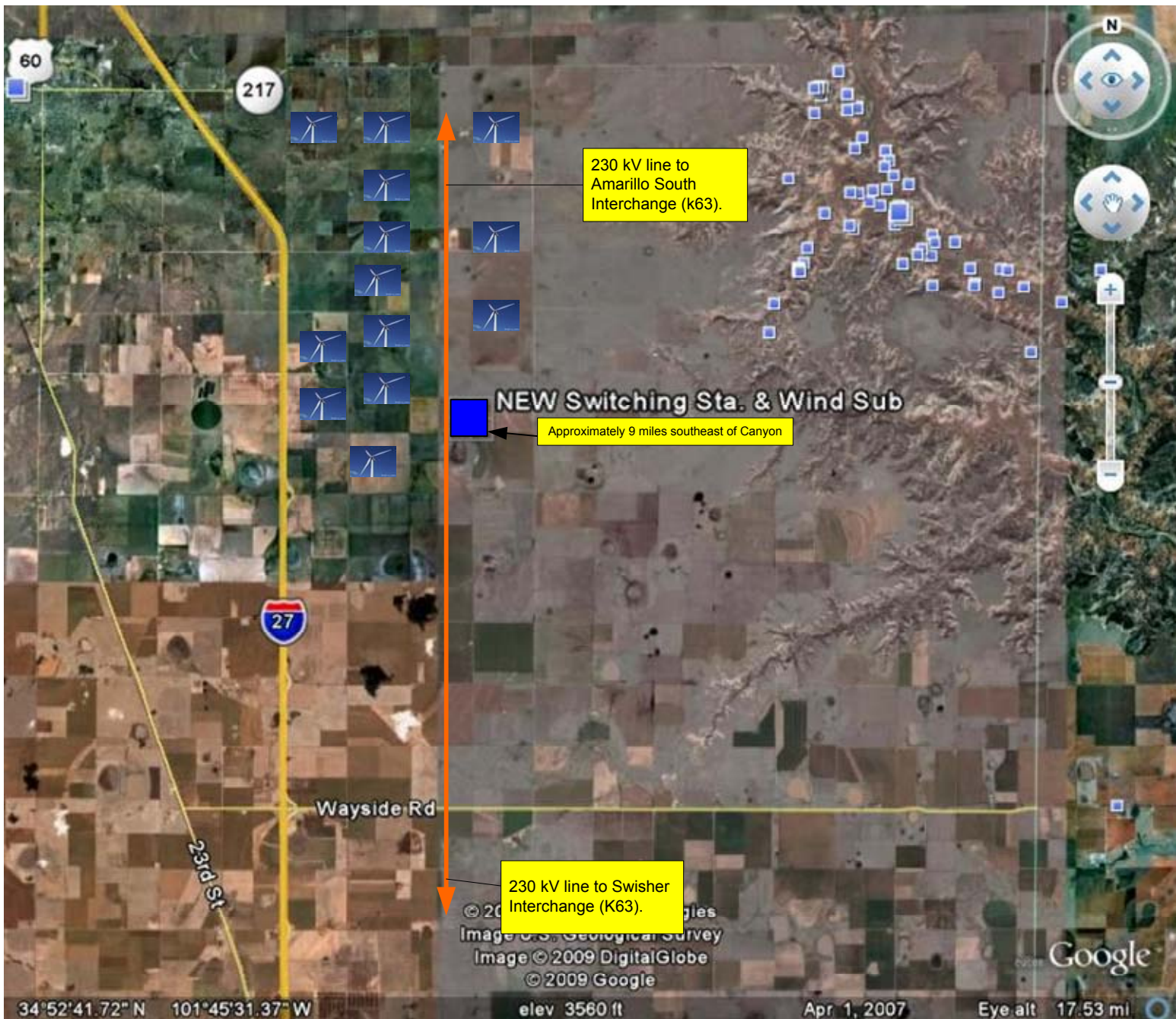


Figure A- 1 Approximate location of proposed switching station

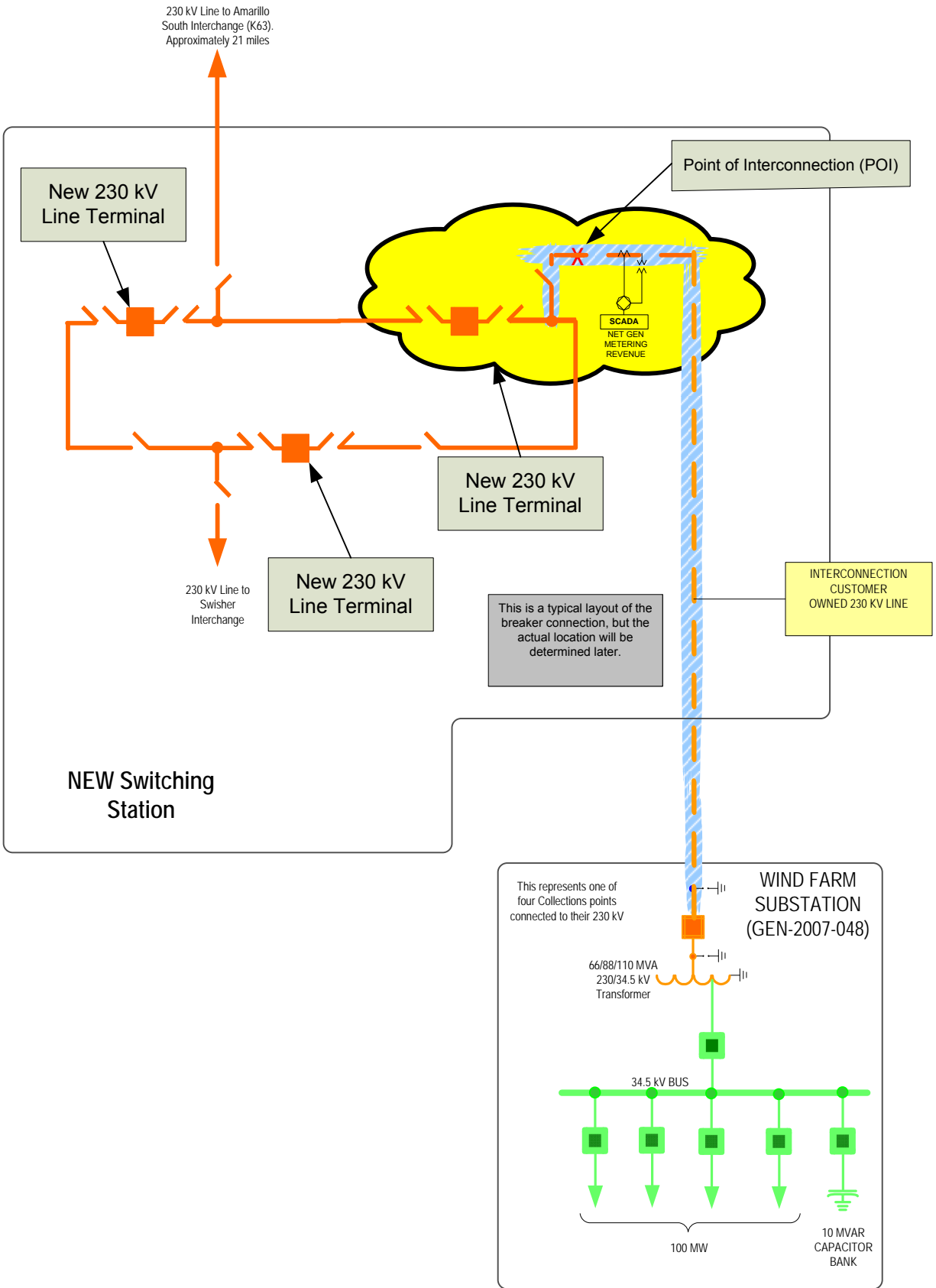


Figure A- 2 One-line Diagram of New Switching Station GEN-2007-048

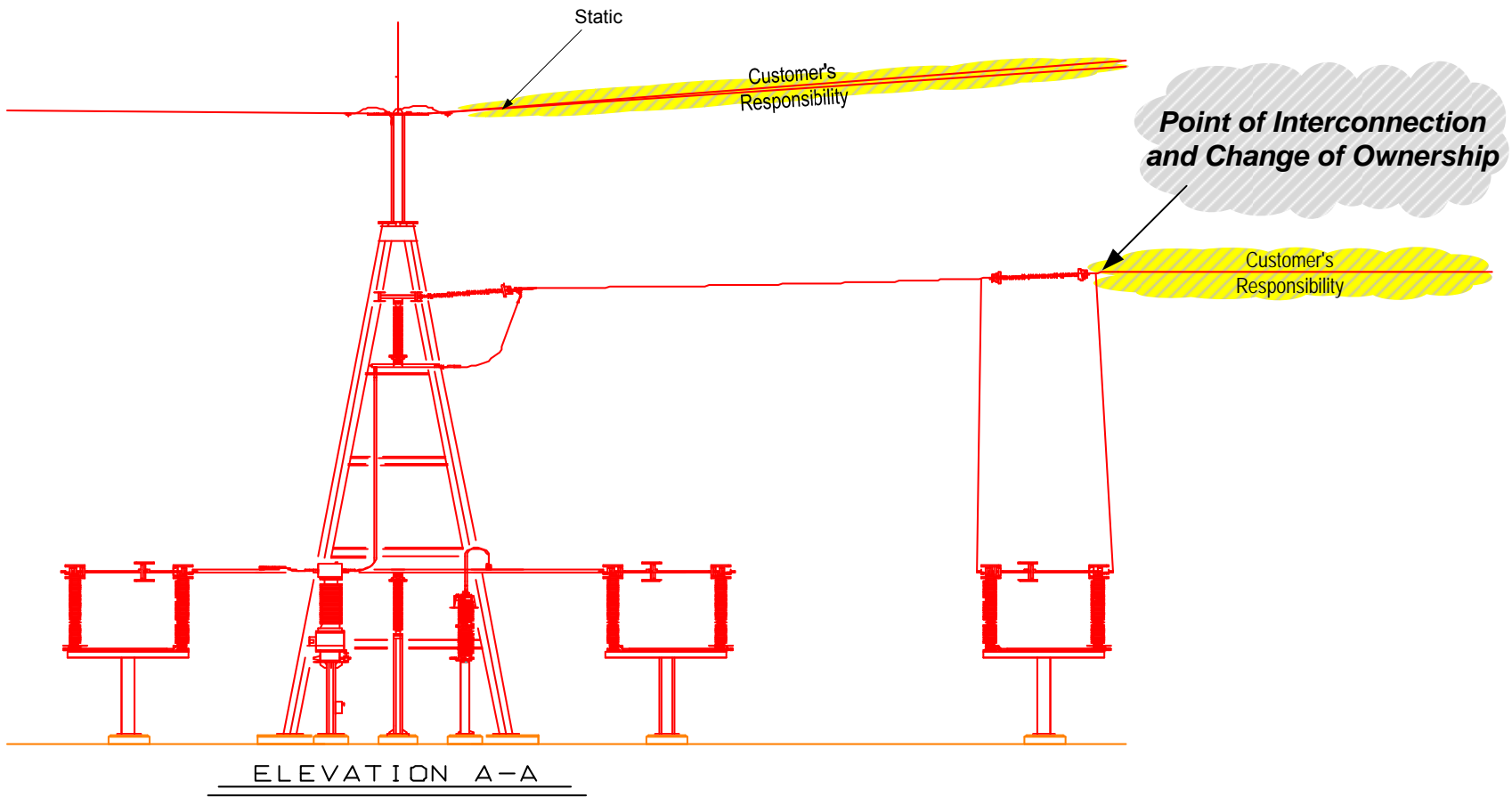


Figure A- 3 Point of Interconnection & Change of Ownership (Typical)

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