



**Facility Study
For
Generation Interconnection
Request
GEN-2014-040
(IFS-2014-002-14)**

***SPP Generator
Interconnection Studies***

***(#GEN-2014-040)
(#IFS-2014-002-14)***

June 2015

Revision History

Date	Author	Change Description
6/12/2015	SPP	Draft Facility Study Report Revision 0 Issued
6/19/2015	SPP	Final Facility Study Report Revision 0 Issued

Summary

Southwestern Public Service Company (SPS), an operating company subsidiary of Xcel Energy Inc., performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2014-040/IFS-2014-002-14 (320.00 MW/Wind) located in Castro County, Texas. The Interconnection Customer's originally proposed in-service date for GEN-2014-040/IFS-2014-002-14 is September 1, 2016. SPP has proposed the full interconnection service in-service date will be after the assigned Interconnection Facilities and Non-Shared Network upgrades are completed. Full Interconnection Service will 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^{1,2}

The Interconnection Customer's generation facility consists of one hundred sixty (160) Vestas V110 2.0 MW wind turbines for a total generation nameplate capacity of 320.00 MW. The 34.5kV collector system for this wind facility is planned to be connect to two (2) 115/34.5kV Interconnection Customer owned and maintained transformers at the Interconnection Customer owned substation. An approximate four (4) mile 115kV transmission circuit will connect GEN-2014-040/IFS-2014-002-14 to the Point of Interconnection (POI) at the existing SPS owned 115kV bus at the Castro County Substation. The Interconnection Customer will be responsible for all of the transmission facilities connecting the Interconnection Customer owned substation to the Point of Interconnection (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 and 0.95 leading at the POI, including approximately 15.0 Mvar³ of reactors to compensate for injection of reactive power into the transmission system under reduced generating conditions. Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

¹ Based on the information provided within the original DISIS and IFS Application

² Since the DISIS-2014-002-1 study, the Interconnection Customer has requested a modification study to change the wind generators to Vesta V110 VCSS 2.0 MW wind turbines. The evaluation results from this modification study can be seen in the posted study:

http://sppoasis.spp.org/documents/swpp/transmission/studies/files/2014_Generation_Studies/GEN-2014-040%20Turbine%20Restudy.pdf

³ This approximate amount of reactors is based on results of modification study discussed above.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades

To allow interconnection the Transmission Owner will construct a new 115kV terminal 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 thirty (30) months after a fully executed Generation Interconnection Agreement (GIA) for the completion of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, GEN-2014-040/IFS-2014-002-14 is responsible for \$1,510,017 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. Table 1 displays the estimated costs for Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

Table 1: GEN-2014-040/IFS-2014-002-14 TOIF and Non-Shared Network Upgrades

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
Interconnection Substation - Transmission Owner Interconnection Facilities 115kV Substation work for communication, revenue metering, and line arrestors	\$260,000	100%	\$260,000
Interconnection Substation - Network Upgrades 115kV Substation work for the addition of the a new terminal position	\$1,250,017	100%	\$1,250,017
Total	\$1,510,017	100%	\$1,510,017

Shared Network Upgrades

The Interconnection Customer was studied within the DISIS-2014-002 Impact Study as Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). Per SPP Generation Interconnection Procedures, an Interconnection Customer is allowed to change their NRIS interconnection service request without risk prior to an executed Interconnection Facility Study Agreement. GEN-2014-040 notified SPP of its intent to withdraw the NRIS interconnection service request and continue on with only ERIS. Therefore, GEN-2014-040 was studied within the DISIS-2014-002-1 Impact Restudy with Energy Resource Interconnection Service (ERIS) only. At this time, the Interconnection Customer is allocated \$0 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:

Table 2: GEN-2014-040/IFS-2014-002-14 Shared Network Upgrades

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
<u>Currently, GEN-2014-040 is not allocated any Shared Network Upgrades</u>	\$0	n/a	\$0

Total	\$0	n/a	\$0
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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 assigned to GEN-2014-040/IFS-2014-002-14.

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-2014-040/IFS-2014-002-14 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$1,510,017 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$0 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 320.00 MW, as requested by GEN-2014-040/IFS-2014-002-14, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-040/IFS-2014-002-14 for interconnection Service are estimated at \$1,510,017.



**Facilities Study For
Southwest Power Pool (SPP)**

Castro County, Texas

GEN-2014-040/IFS-2014-002-14

Total Output is 320 MW

Generation Facilities

March 26, 2015

Transmission Planning South
Xcel Energy Services

Executive Summary

("Interconnection Customer") in 2015 requested an interconnection of a wind energy facility located in Castro 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 320 MW. The Interconnection Customer's facility will connect to SPS's existing Castro County Substation on the 115 kV systems. The Interconnection Customer's requested commercial operation date is September 1, 2016.

The Southwest Power Pool (SPP) evaluated the request (GEN-2014-040) to interconnect the wind generation facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS-2014-002), which was completed in January 2015. The interconnection request was studied using 160 turbines, which are Vestas 2.0 MW units for a total of 320 MW. The Interconnection Customer is required to build 115 kV transmission line from their substation wind farm facility to SPS's Castro Substation. The Interconnection Customer will be required to maintain a Power Factor between 0.95 lagging and 0.95 leading at the Point of Interconnection (POI).

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. 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 all the cost of the Interconnection Facilities, installation of the Direct Assigned Interconnection Facilities; inclusive of all construction required for the 115 kV to interconnect at SPS's Castro Substation.

It is anticipated that the entire process of building a new terminal at an existing breaker and half on the 115 kV at Castro Substation for the acceptance of the Wind Farm facility output and the network upgrades allocated to this project will require approximately 30 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

		Network Upgrades:	\$ 1,250,017
Transmission Owner Interconnection Facilities:			\$ 260,000
Total:			\$ 1,510,017

^a The cost estimates are 2015 dollars with an accuracy level of ±20%.

General Description of SPS^b Facilities

1. Construction at Castro County Substation:

- 1.1. **Location:** Customer will build a new 115 kV line from their substation to SPS's 115 kV Castro County Substation which is a breaker and half scheme. Appendix A, Figure A-1, shows a preliminary one-line of Castro County Substation, while Figure A-2 shows a typical elevation view of the normal Point of Interconnection (POI).
- 1.2. **Bus Design:** The 115 kV breaker and half scheme will accommodate the output from the wind energy facility. This is shown in Appendix A, Figure A-1.
- 1.3. **Line Terminals:** The 115 kV lines and static wire terminals will be designed to accommodate 14,000 pounds per phase conductor (28,000 Bundle) at maximum tension, with a maximum 15-degree pull off from normal.
- 1.4. **Control House:** The existing control house will accommodate the new metering, protective relaying and control devices, terminal cabinets, and any fiber-optic cable terminations, etc. for the 115 kV line breaker terminals.
- 1.5. **Security Fence:** The existing substation 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 330' x 480', with a rock yard surface.
- 1.6. **Ground Grid:** An existing ground grid is 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:** No additional work required.
- 1.8. **Station Power:** Existing station power will be used.
- 1.9. **Relay and Protection Scheme:** The 115 kV breaker line terminal primary protection to the interconnection customer 115 kV transmission line will use line current differential relaying over optical fiber installed in the static of the customer's 115 kV transmission line. Secondary relaying will use mirrored bit, Permissive Overreaching Transfer Trip (POTT) over the optical fiber. An SEL 311L and an SEL 421 will be used as primary and secondary relays, respectively. The SEL 421 will be used for line/bus SCADA closing conditions for the 115 kV breakers. Also, a SEL 351S will be used for breaker failure.

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

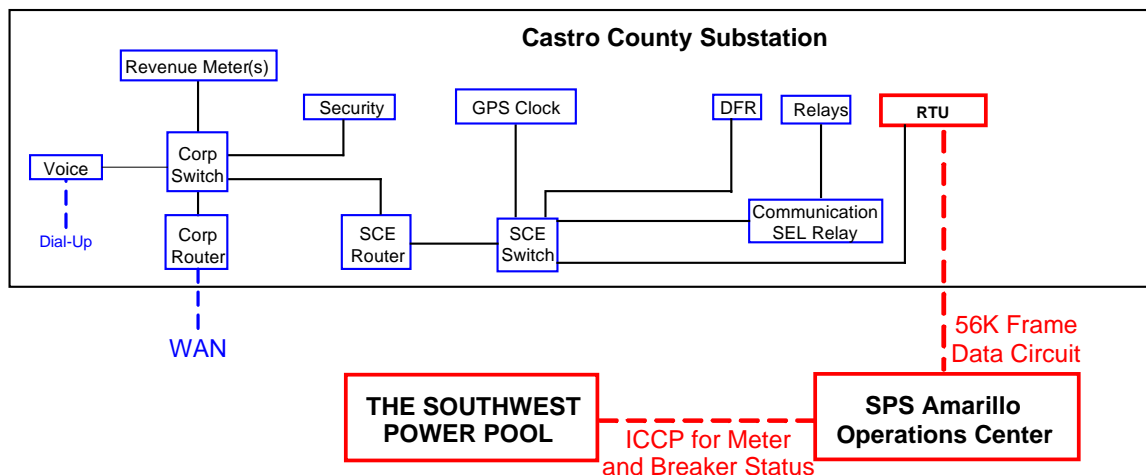
^b All modifications to SPS facilities will be owned, maintained and operated by SPS.

- 1.10. Revenue Metering:** An individual billing meter will be installed at Castro County Substation on the 115 kV line terminal from the Interconnection Customer's substation, which meets the standards: 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. 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:** 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 is equipped with a GPS time synching clock. This equipment has communication capability with a dedicated communication circuit. The disturbance equipment has its own dedicated communications circuit.
- 1.12. Remote Terminal Unit (RTU):** An existing RTU will be utilized for communications at Castro County Substation. A Communication SEL Relay will be installed for relay communications and other functions as required. The RTU will be used 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:** 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. 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 for protective relaying from the customer substation to Castro County Substation.

2. Transmission Work:

- 2.13. The Interconnection Customer will construct, own, operate, and maintain any customer owned 115 kV transmission line from the Interconnection Customer's substation to the Interconnection Point at SPS's Castro County Substation on the 115 kV. This line is shown in Appendix A, Figure A-1 and is approximately 4 miles from customer's substation POI. **The SPS transmission design group prior to any construction by the Interconnection Customer or its contractor on any customer 115 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 interchange will be delayed until the matters are resolved. SPS will not be held responsible for these delays.**

3. Right-Of-Way:

- 3.1 **Permitting:** Permitting for the construction of a new 115 kV line terminal at Castro County Substation 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 115 kV transmission line from their substation to the POI.

4. **Construction Power and Retail 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 service) and the Interconnection Customer needs to make arrangements for retail service from the local retail provider. Retail provider and Customer will be responsible for making any necessary transmission service arrangements as required under the SPP OATT.**

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 between 0.95 lagging and a 0.95 leading at the Point of Interconnection (POI). All capacitors required will be installed on the 34.5 kV at customer's substation. 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. The capacitor banks need to be switched in stages where the voltage rise is less than 3%.

- 6 **Fault Current Study:** The available fault current at the interconnection location on the 115 kV at Castro County Substation without any contribution from the new generator facilities, is shown in Table 2.

Table 2, - Available fault current at interconnection location

Short Circuit Information without contribution from new Generator Facilities (GEN 2014-040)				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3-Phase	Z^+	Z^0
115 kV Bus	6,493	8,044	$2.71 + j7.68$	$2.22 + j13.90$

Estimated Construction Costs

The projects required for the interconnection of 320 MW Wind Generation facilities consist of the projects summarized in the table below.

Table 3, Required Interconnection Projects^c

Project	Description	Estimated Cost
	Shared Network Upgrades:	
1	At this current time, the current estimated shared network upgrades allocation cost for the GEN-2014-040 as calculated by SPP total \$0.0	\$ 0
	Subtotal:	\$ 0
	Network Upgrades (at the Interconnection Customer's expense)	
2	Install new 115 kV line terminal for 320 MW Wind Farm, includes all main bus conductor to be 4" aluminum tubing.	\$ 1,250,017
	Subtotal:	\$ 1,250,017
	Transmission Owner Interconnection Facilities (at the Interconnection Customer's expense)	
3	Communications ^d	\$ See footnote
4	Revenue metering	\$ 230,000
5	115 kV Line arrestors	\$ 30,000
	Subtotal:	\$ 260,000
	Total Cost	\$ 1,510,017

Engineering and Construction:

An engineering and construction schedule for this project is estimated at approximately 30 months. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. This 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.

^c The cost estimates are 2015 dollars with an accuracy level of ±20%.

^d It is the Requester's responsibility to provide both the data circuit and communication circuits, see Section 1.13.

Appendix A

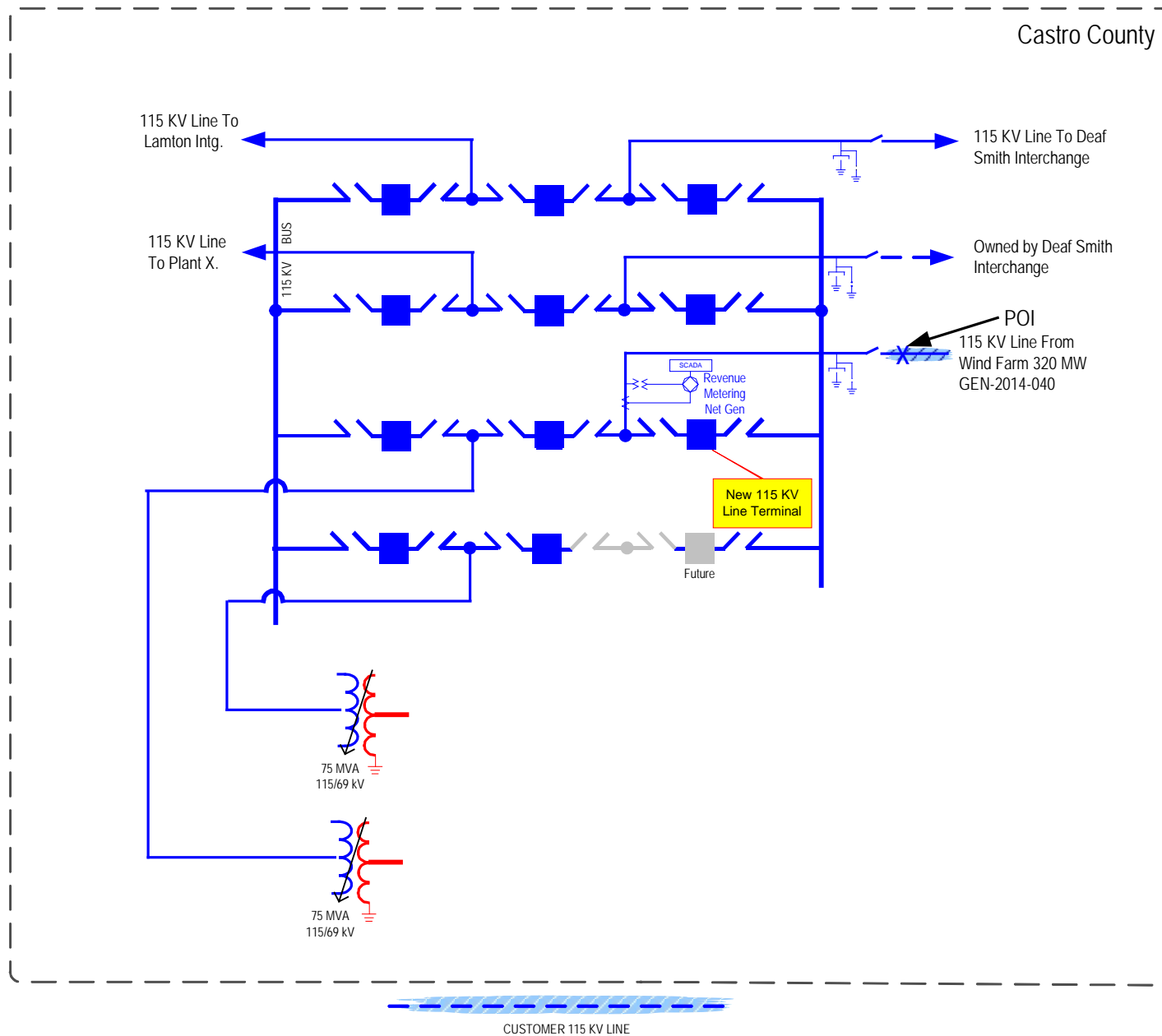
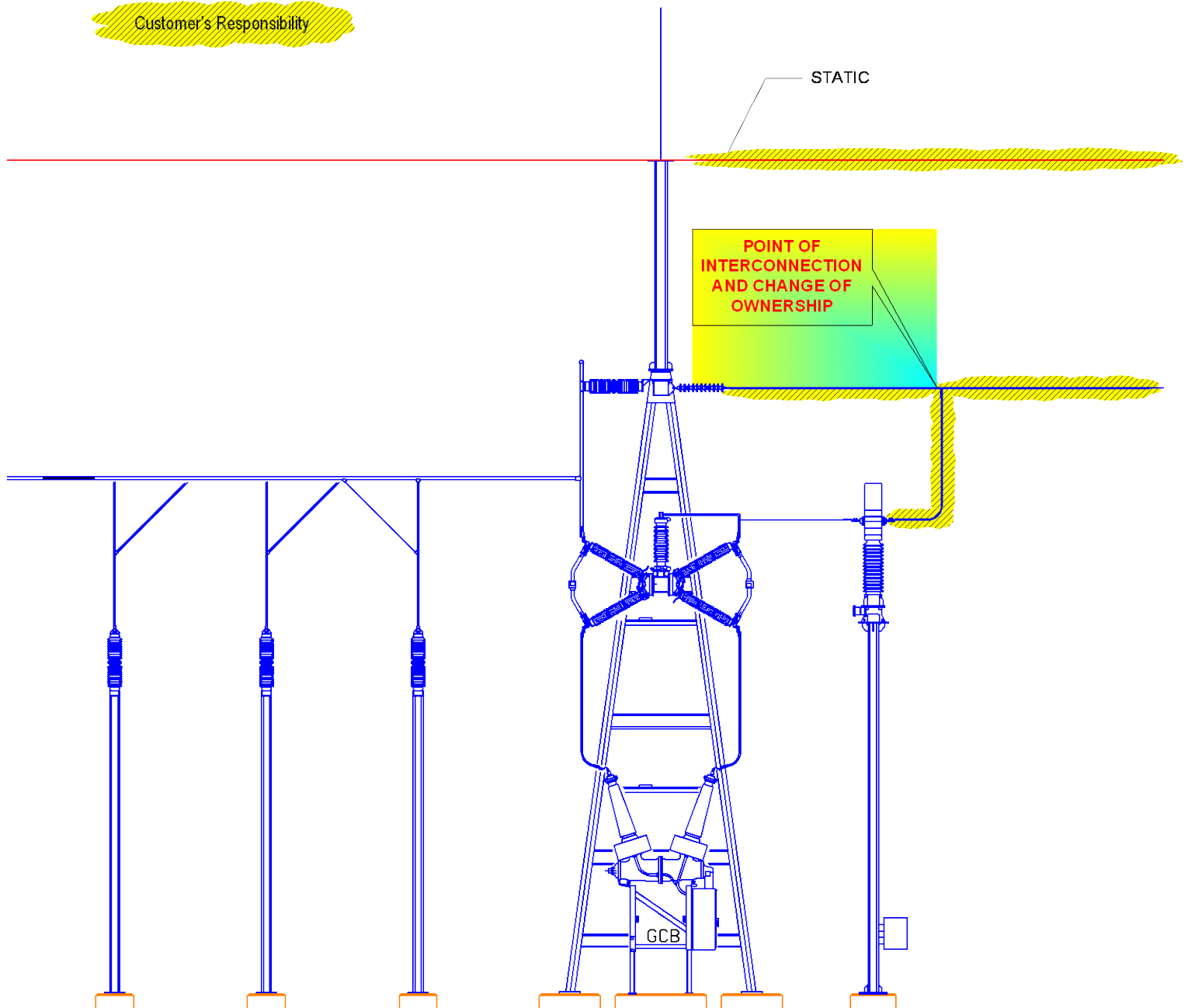


Figure A-1. One-line Diagram of Castro County Substation

**CUSTOMER SHALL PROVIDE
ALL MATERIAL FOR DEAD
ENDING PHASES AND STATIC
TO 115 kV DEAD END TOWER.**

Customer's Responsibility



ELEVATION A-A'

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

– *END OF REPORT* –