



**Interconnection Facilities Study  
For  
Generator Interconnection  
Request  
GEN-2014-033  
(IFS-2014-002-10)**

***SPP Generator  
Interconnection Studies***

***(#GEN-2014-033)  
(#IFS-2014-002-10)***

**October 2015**

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## Revision History

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Date	Author	Change Description
9/15/2015	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued
10/19/2015	SPP	Final Interconnection Facilities Study Report Revision 0 Issued

## **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-2014-033/IFS-2014-002-10 (70.00 MW/Solar) located in Chaves County, New Mexico. The Interconnection Customer's originally proposed in-service date for GEN-2014-033/IFS-2014-002-10 is December 31, 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<sup>1,2</sup>**

The Interconnection Customer's generation facility consists of seventy pairs (70) of SMA Sunny Central SC 500HE/CP 0.5MVA/0.5MW @ 1.0 power factor Inverters for a total inverter nameplate rating of 70.00 MW. The 34.5kV collector system for this solar facility is planned to be connect to one (1) 115/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. An approximate one-tenth (1/10) mile overhead 115kV transmission circuit will connect GEN-2014-033/IFS-2014-002-10 to the Point of Interconnection (POI) at the existing 115kV bus at the SPS owned Chaves County 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. Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

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<sup>1</sup> Based on the information provided within the original DISIS and IFS application

<sup>2</sup> The Interconnection Customer has requested a modification study to change the SMA solar inverters to General Electric (G.E) solar inverters. The evaluation of this material modification is in progress and will not be included within this Interconnection Facilities Study

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

To facilitate interconnection the Transmission Owner will construct a new 115kV terminal position to the Chaves County Interchange. In order to add another 115kV terminal, SPS will need to add a new rung, two (2) 3000A, 115kV circuit breakers, and associated terminal equipment for acceptance of the Interconnection Customer's Interconnection Facilities. Additional Network Upgrade work will be needed to relocate the existing capacitor bank (s) and existing reactor bank(s) to a more suitable location on the 115kv bus configuration to accommodate the addition of the new rung. Currently, SPS estimates an Engineering and Construction (E&C) lead time of approximately twenty-four (24) 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-2014-033/IFS-2014-002-10 is responsible for \$2,090,343 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-2014-033/IFS-2014-002-10 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> 115kV Substation work for a new line terminal position, line switch, dead end structure, communications, revenue metering, and line arrestors	\$260,000	100%	\$260,000
<b>Interconnection Substation - Network Upgrade(s)</b> 115kV Substation work for a new terminal position, build new rung, two (2) 3000A breakers and associated 3000A switches, structures, other terminal equipment. Capacitor Bank(s) & Reactor Bank(s) relocation work and equipment.	\$1,830,343	100%	\$1,830,343
<b>Total</b>	<b>\$2,090,343</b>	<b>100%</b>	<b>\$2,090,343</b>

If GEN-2014-034/IFS-2014-002-11 or GEN-2014-035/IFS-2014-002-12 withdraw or terminate their Generator Interconnection Requests (GIRs), Transmission Owner Interconnection Facilities and Non-Shared Network Upgrade(s) and cost requirements for GEN-2014-034/IFS-2014-002-11 or GEN-2014-035/IFS-2014-002-12 could be assigned to GEN-2014-033/IFS-2014-002-10.

### **Shared Network Upgrade(s)**

The Interconnection Customer was studied within the DISIS-2014-002 Impact Study, DISIS-2014-002-1 Impact Restudy, and DISIS-2014-002-2 Impact Restudy with Energy Resource Interconnection Service (ERIS) only. Cost Allocation was updated in DISIS-2014-002-3 Impact Restudy. At this time, the Interconnection Customer is allocated \$7,664,924 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-2014-033/IFS-2014-002-10 Shared Network Upgrade(s)**

Shared Network Upgrades Description	Allocated Cost (\$)	Allocated Percent (%)	Total Cost (\$)
<b>Oklaunion 345kV Capacitive Reactive Support:</b> Two (2) 150Mvars Static Var Compensator (SVC).	\$3,874,036	9.69	\$40,000,000
<b>Tolk – Plant X 230kV Circuit #1 &amp; #2:</b> Rebuild Tolk – Plant X circuits #1 and #2	\$1,311,591	13.22	\$9,921,693
<b>TUCO 2 Substation (Crawfish Draw) and 345/230kV Transformer:</b> Build new 345/230kV substation and transformer approximately 4 miles from TUCO substation. Tap and re-terminate TUCO – Border 345kV and TUCO – Swisher into new station.	\$2,479,297	10.01	\$24,764,205
<b>Total</b>	<b>\$7,664,924</b>	<b>10.26</b>	<b>\$74,685,898</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-2014-033/IFS-2014-002-10:

- Agave Hill 115kV Reactive Power Support build assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- Amoco Wasson – Oxy Tap 230kV circuit #1 replace terminal equipment assigned to DISIS-2012-002 Interconnection Customer(s)
- 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 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-2014-033/IFS-2014-002-10 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for \$2,090,343 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated \$7,664,924 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 70.00 MW, as requested by GEN-2014-033/IFS-2014-002-10, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-033/IFS-2014-002-10 for interconnection Service are estimated at \$9,755,267.



**Facilities Study For  
Southwest Power Pool (SPP)**  
Chaves County, New Mexico  
GEN-2014-033  
70MW Solar Facility  
Generation Facilities

April 15, 2015

Transmission Planning South  
Xcel Energy Services

## Executive Summary

("Interconnection Customer") in 2015 requested an interconnection of a Solar energy facility located in Chaves 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 net capacity of 70 MW. The Interconnection Customer's facility will connect to SPS's existing Chaves County Interchange on the 115 kV. The Interconnection Customer's requested commercial operation date is August 15, 2016.

The Southwest Power Pool (SPP) evaluated the request (GEN-2014-033) to interconnect the Solar generation facility to the SPS's 115 kV system in a Definitive Interconnection System Impact Study (DISIS-2014-002), which was completed in January 2015. The interconnection request was studied using PV Inverters for a total 70 MW. The Interconnection Customer is required to build 115 kV transmission line from their substation Solar Farm facility to the SPS's Chaves Interchange. 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](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 Chaves Interchange.

The network upgrades for the Interconnection at Chaves is \$ 1,830,343.

As for this request (GEN-2014-033), it is anticipated that the entire process of building a new 115 kV terminal at Chaves Interchange for the acceptance of the Generation facility output is approximately 24 months.

The cost of these upgrades, inclusive of the Interconnection Customer's cost for the interconnection of this Solar Farm facility, is shown below in Table 1, with the detailed description of the cost shown in Table 3.



**Table 1, Cost Summary<sup>a</sup>**

Network Upgrades:	<b>\$ 1,830,343</b>
Transmission Owner Interconnection Facilities:	<b>\$ 260,000</b>
Total:	<b>\$ 2,090,343</b>

<sup>a</sup> The cost estimates are 2015 dollars with an accuracy level of ±20%.

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

### 1. Construction of New Line Terminal:

- 1.1. **Location:** SPS will build a new 115 kV terminal at Chaves County Interchange. Appendix A, Figure A-1 shows the one-line diagram of the Interchange, while Appendix A, Figure 2 shows a typical elevation view of the Point of Interconnection (POI).
- 1.2. **Bus Design:** The existing 115 kV at Chaves County Interchange is a breaker and half configuration and is designed to accommodate the output from the Solar Generation facility. This scheme is shown in the one-line diagram in Appendix A, Figure A-2
- 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 per bundle) at maximum tension, with a maximum 15° pull-off angle 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 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 for the 230/115/69 kV yard is approximately 560’ by 670’ with a rock yard surface.
- 1.6. **Ground Grid:** The existing ground grid shall be extended to accommodate the additional bay required for the new line terminal 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 to accommodate the new line terminal. Soil compaction shall be not less than 95% of laboratory density as determined by ASTM-D-698.
- 1.8. **Station Power:** The existing station power, provided from the local distribution system, will be utilized.
- 1.9. **Relay and Protection Scheme:** The new 115 kV breaker line terminal primary protection to the interconnection customer’s 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 a 421 will be used as primary and secondary relays, respectively. 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 351S will be used for breaker failure. Other relay modifications at Chaves County Interchange may also be required.

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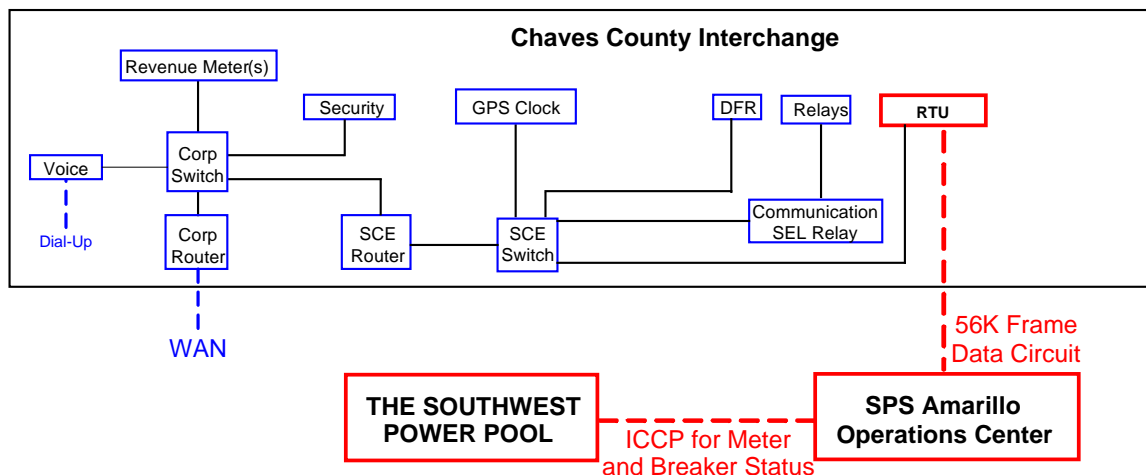
<sup>b</sup> All modifications to SPS facilities will be owned, maintained and operated by SPS.

- 1.10. Revenue Metering:** An individual billing meter will be installed at Chaves County Interchange 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:** A Disturbance Fault Recorder (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 synching clock. This equipment will have communication capability with a dedicated communication circuit. The disturbance equipment will have its own dedicated communications circuit.
- 1.12. Remote Terminal Unit (RTU):** A RTU will be utilized with communications for the new 115 kV terminal. A Communication SEL Relay 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:** 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 from the customer substation to Chaves County Interchange for protective relaying and for transmitting metering and status data to SPS.

## 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 115 kV at Chaves County Interchange. This line is shown in Appendix A, Figure A-1 and is approximately 1400' 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 115 kV line terminal at Chaves County Interchange is not required from the Public Utility Commission in the State of New Mexico. 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 Interconnection Point at 115 kV Chaves County Interchange.

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 solar 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 Chaves County Interchange, 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 2014-033)				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
115 kV Bus	4,086	5,991	$3.32 + j10.88$	$6.64 + j26.48$

## Estimated Construction Costs

The projects required for the interconnection of 70 MW Solar Generation facilities consist of the projects summarized in the table below.

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

<b>Project</b>	<b>Description</b>	<b>Estimated Cost</b>
	<b>Network Upgrades (at the Interconnection Customer's expense)</b>	
2	Build new 115 kV terminal at Chaves County Interchange.	\$ 1,830,343
	<b>Subtotal:</b>	<b>\$ 1,830,343</b>
	<b>Transmission Owner Interconnection Facilities (at the Interconnection Customer's expense)</b>	
3	Communications <sup>d</sup>	\$ See footnote
4	Revenue metering	\$ 230,000
5	115 kV Line arrestors	\$ 30,000
	<b>Subtotal:</b>	<b>\$ 260,000</b>
	<b>Total Cost</b>	<b>\$ 2,090,343</b>

<sup>c</sup> The cost estimates are 2015 dollars with an accuracy level of ±20%.

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

**Engineering and Construction:**

An engineering and construction schedule for this project is estimated at approximately 24 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.



## Appendix A

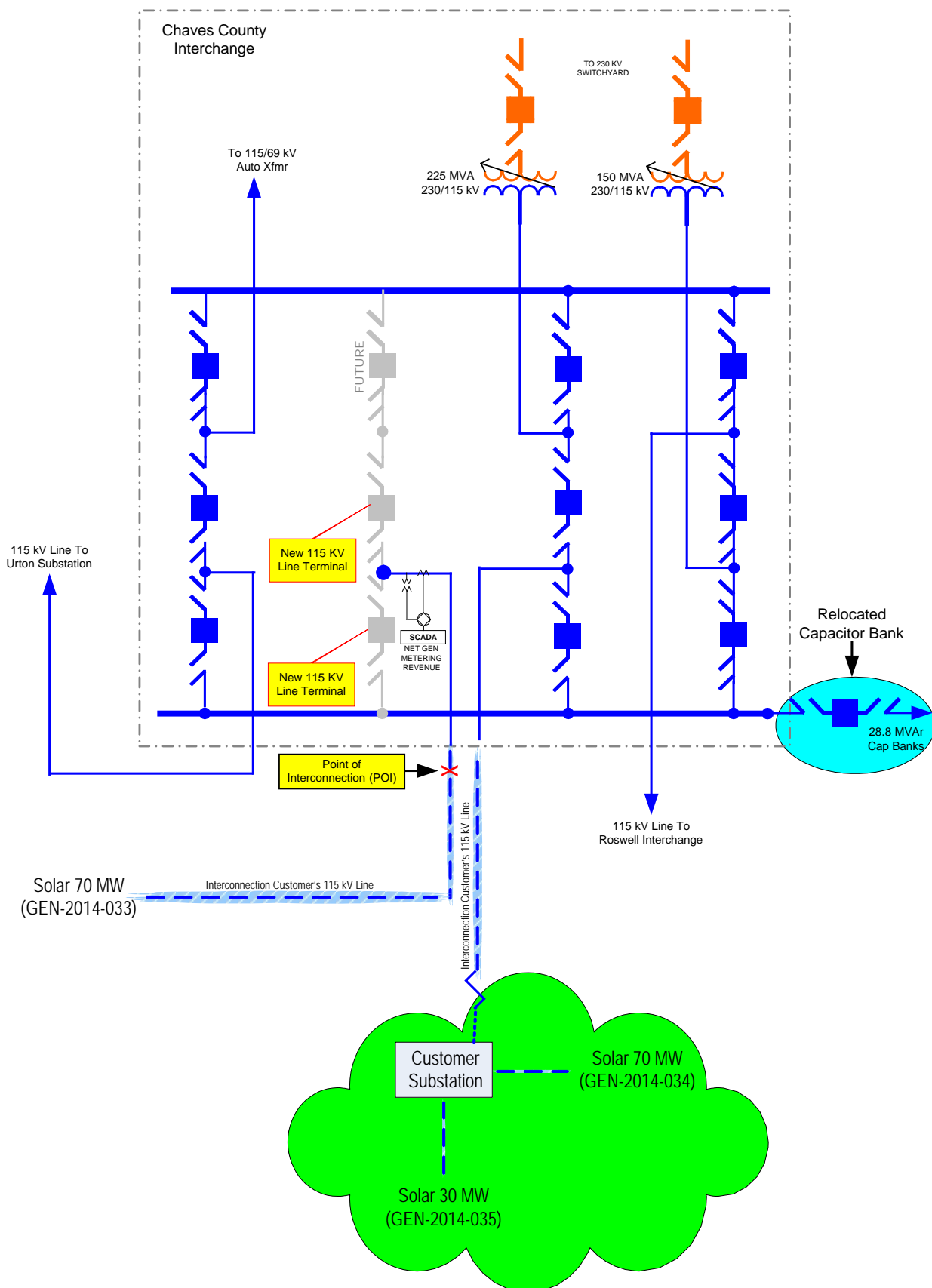
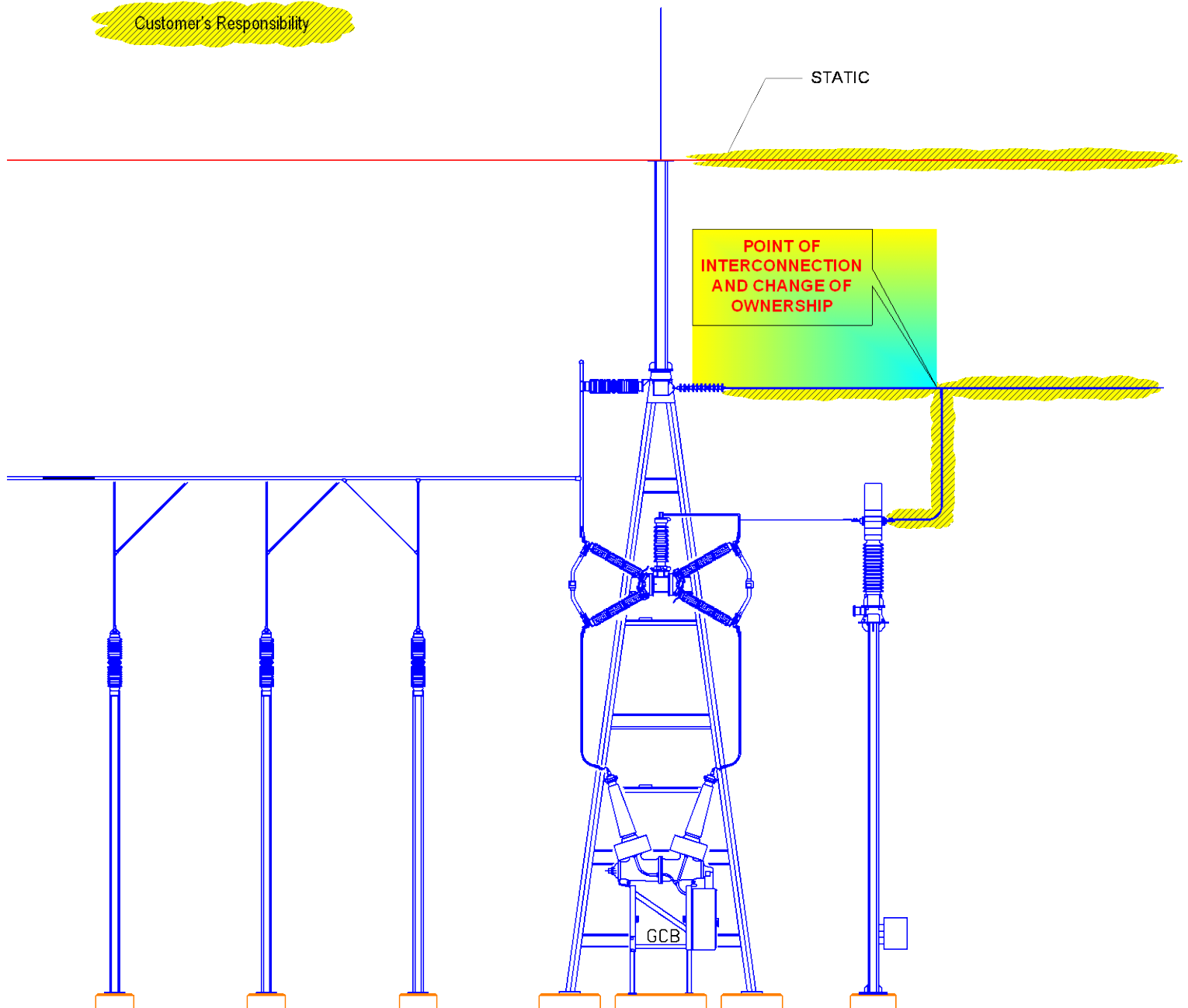


Figure A-1. One-line Diagram of Chaves County Interchange

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-2 Point of Interconnection & Change of Ownership (Typical)

*– END OF REPORT –*