INTERCONNECTION FACILITIES STUDY REPORT

GEN-2015-079

(IFS-2015-002-28)

Published October 2018

By SPP Generator Interconnections Dept.

REVISION HISTORY

DATE OR VERSION NUMBER	AUTHOR	CHANGE DESCRIPTION
4/05/2017	SPP	Initial draft report issued.
8/09/2018	SPP	Revised draft report issued due to DISIS-2015-002-4.
10/29/2018	SPP	Final report issued. Updated cost estimates, removed completed Previous Network Upgrade.

CONTENTS

SUMMARY

INTRODUCTION

This Interconnection Facilities Study (IFS) for Interconnection Request GEN-2015-079/IFS-2015-002-28 is for a 129.20 MW generating facility located in Lea County, New Mexico. The Interconnection Request was studied in the DISIS-2015-002 Impact Study for Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS). Prior to an executed IFS agreement, the Interconnection Customer requested to withdraw NRIS per Section 4.4.1 of the Southwest Power Pool (SPP) Generator Interconnection Procedures (GIP), therefore ERIS-only was analyzed for this request in the DISIS-2015-002-1 Impact Restudy, DISIS-2015-002-2 Impact Restudy, and DISIS-2015-002-4 Impact Restudy. The Interconnection Customer's requested in-service date is October 1, 2018.

The interconnecting Transmission Owner, Southwestern Public Service Company (SPS), performed a detailed IFS at the request of SPP. The full report is included in Appendix A. SPP has determined that full Interconnection Service will be available after the assigned Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) are completed.

The primary objective of the IFS is to identify necessary Transmission Owner Interconnection Facilities, Network Upgrades, other direct assigned upgrades, cost estimates, and associated upgrade lead times needed to grant the requested Interconnection Service.

PHASE(S) OF INTERCONNECTION SERVICE

It is not expected that Interconnection Service will occur in phases. However, Interconnection Service will not be available until all Interconnection Facilities and Network Upgrade(s) can be placed in service.

CREDITS/COMPENSATION FOR AMOUNTS ADVANCED FOR NETWORK UPGRADE(S)

Interconnection Customer shall be entitled to compensation in accordance with Attachment Z2 of the SPP OATT for the cost of SPP creditable-type Network Upgrades, including any tax gross-up or any other tax-related payments associated with the Network Upgrades, that are not otherwise refunded to the Interconnection Customer. Compensation shall be in the form of either revenue credits or incremental Long Term Congestion Rights (iLTCR).

INTERCONNECTION CUSTOMER INTERCONNECTION FACILITIES

The Generating Facility is proposed to consist of thirty-four (34) 3.8 MW General Electric (G.E.) solar inverters for a total generating nameplate capacity of 129.20 MW.

The Interconnection Customer's Interconnection Facilities to be designed, procured, constructed, installed, maintained, and owned by the Interconnection Customer at its sole expense include:

- 34.5 kV underground cable collection circuits;
- 34.5 kV to 230 kV transformation substation with associated 34.5 kV and 230 kV switchgear;
- One (1) 230/34.5 kV 84/112/140 MVA (ONAN/ONAF/ONAF) step-up transformer to be owned and maintained by the Interconnection Customer at the Interconnection Customer's substation;
- A less than one (<1) mile overhead 230 kV line to connect the Interconnection Customer's substation to the Point of Interconnection ("POI") at the 230 kV bus at a new SPS substation ("Stateline Switching") to be owned and maintained by SPS. Stateline Switching will be located approximately twenty-eight (28) miles from Yoakum 230 kV on the Yoakum – Hobbs Interchange 230 kV transmission circuit;
- All transmission facilities required to connect the Interconnection Customer's substation to the POI;
- Equipment at the Interconnection Customer's substation necessary to maintain a power factor at the POI between 95% lagging and 95% leading, including approximately 1.0 Mvars[1] of reactors to compensate for injection of reactive power into the transmission system under no/reduced generating conditions. The Interconnection Customer may use wind turbine manufacturing options for providing reactive power under no/reduced generation conditions. The Interconnection Customer will be required to provide documentation and design specifications demonstrating how the requirements are met.

The Interconnection Customer shall coordinate relay, protection, control, and communication system configurations and schemes with the Transmission Owner.

[1] This approximate minimum reactor amount is needed for the current configuration of the solar farm as studied in the DISIS-2015-002 Study and restudies.

TRANSMISSION OWNER INTERCONNECTION FACILITIES AND NON-SHARED NETWORK UPGRADE(S)

To facilitate interconnection, the interconnecting Transmission Owner will perform work as shown below necessary for the acceptance of the Interconnection Customer's Interconnection Facilities.

Table 1 lists the Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities (TOIF) and Non-Shared Network Upgrade(s) and provides an estimated lead time for completion of construction. The estimated lead time begins when the Generator Interconnection Agreement has been fully executed.

Table 1: Interconnection Customer TOIF and Non-Shared Network Upgrade(s)

TOIF and Non-Shared Network Upgrades Description	Z2 Type[2]	Allocated Cost Estimate ($)	Allocated Percent (%)	Total Cost Estimate ($)	Estimated Lead Time
SPS Stateline Switching Interconnection Substation - Transmission Owner Interconnection Facilities: Construct one (1) 230 kV line terminal, line switches, dead end structure, line relaying, communications, revenue metering, line arrestor and all associated equipment and facilities necessary to accept transmission line from Interconnection Customer's Generating Facility.	N/A	$333,294	100%	$333,294	36 Months
SPS Stateline Switching Interconnection Substation - Non-Shared Network Upgrades: Construct three (3) 230 kV 3000 continuous ampacity breakers, cut in transmission line and re-terminate, acquire 20 acres of land, control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials.	Non-Creditable	$6,049,426	100%	$6,049,426	
Total		**$6,382,720**		**$6,382,720**	

[2] Indicates the method used for calculating credit impacts under Attachment Z2 of the Tariff.

SHARED NETWORK UPGRADE(S)

The Interconnection Customer's share of costs for Shared Network Upgrades is estimated in **Table 2** below.

Table 2: Interconnection Customer Shared Network Upgrades

Shared Network Upgrades Description	Z2 Type	Allocated Cost Estimate ($)	Allocated Percent (%)	Total Cost Estimate ($)
Border – Chisholm 345kV Circuit #1 and #2: Build twenty-four (24) miles of double 345kV circuit from Border (OKGE) – Chisholm (AEP), convert Border 345kV bus to breaker-and-a-half configuration for acceptance of the new line terminal and install seven (7) 345kV 5000 continuous ampacity breakers, and expand Chisholm 345kV bus for acceptance of the new line terminal by installing three (3) 345kV 3000 continuous ampacity breakers. Border and Chisholm substations will require upgrades including: control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. **Estimated Lead Time:** 36 Months	Creditable	$10,653,475	14.60	$72,945,000 (AEP: $42,945,000 OKGE: $30,000,000)
Crawfish Draw – Border 345kV circuit #2: Build one-hundred-ninety-four (194) miles of second 345kV circuit from Crawfish Draw (SPS) – Border (OKGE), expand Crawfish Draw substation for acceptance of the new line terminal by installing one (1) 345kV 3000 continuous ampacity breakers, and expand Crawfish Draw substation for acceptance of the new line terminal by installing one (1) 345kV 5000 continuous ampacity breakers. Crawfish Draw and Border substations will require upgrades including: control panels, line relaying, disconnect switches, structures, foundations, conductors, insulators, and all other associated work and materials. **Estimated Lead Time:** TBD	Creditable	$36,186,222	14.59	$247,951,345 (SPS: $243,551,345 OKGE: $4,400,000)
Crawfish Draw 345/230 kV Substation Upgrade and 345/230 Transformer: Tap Border – TUCO and Tap TUCO – Oklaunion approximately three (3) miles from TUCO, build Crawfish Draw 345 kV substation, add 345/230/13.2 kV transformer, and tie on TUCO – Swisher 230 kV.	Creditable	$3,467,351	14.00	$24,764,205

Total		**$50,307,048**		**$345,660,550**

All studies have been conducted assuming that higher-queued Interconnection Request(s) and the associated Network Upgrade(s) will be placed into service. If higher-queued Interconnection Request(s) withdraw from the queue, suspend or terminate service, the Interconnection Customer's share of costs may be revised. Restudies, conducted at the customer's expense, will determine the Interconnection Customer's revised allocation of Shared Network Upgrades.

PREVIOUS NETWORK UPGRADE(S)

Certain Previous Network Upgrades are currently not the cost responsibility of the Interconnection Customer but will be required for full Interconnection Service.

- None

Depending upon the status of higher- or equally-queued customers, the Interconnection Request's in-service date is at risk of being delayed or Interconnection Service is at risk of being reduced until the in-service date of these Previous Network Upgrades.

CONCLUSION

After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 129.20 MW can be granted. Interconnection Service will be delayed until the Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) are completed. The Interconnection Customer's estimated cost responsibility for Transmission Owner Interconnection Facilities, Non-Shared Network Upgrade(s), and Shared Network Upgrade(s) is summarized in the table below.

Table 3: Cost Summary

Description	Allocated Cost Estimate
Transmission Owner Interconnection Facilities	$333,294
Network Upgrades	$56,356,474
Total	**$56,689,768**

A draft Generator Interconnection Agreement will be provided to the Interconnection Customer consistent with the final results of this IFS report. The Transmission Owner and Interconnection Customer will have 60 days to negotiate the terms of the GIA consistent with the SPP Open Access Transmission Tariff (OATT).

APPENDICES

A: TRANSMISSION OWNER'S INTERCONNECTION FACILITIES STUDY REPORT

See next page for the Transmission Owner's Interconnection Facilities Study Report.

Facilities Study For
Southwest Power Pool (SPP)
Lea County, New Mexico
GEN-2015-079
Total Output is 129.2 MW
Generation Facilities

Transmission Planning South
Xcel Energy Services

November 14, 2016

Executive Summary

An Interconnection Customer (IC) in 2015 requested an interconnection of a solar energy facility located in Lea County, New Mexico to the Southwestern Public Service Company (SPS) transmission network. This facility has a net capacity of 129.2 MW. To interconnect the IC's generating facility to the SPS transmission system, SPS will construct a new 230 kV substation (Stateline substation) on the existing Yoakum to Hobbs Generating 230 kV transmission line (K93) approximately twenty-eight (28) miles from Yoakum towards Hobbs Station. The Interconnection Customer's requested commercial operation date is 10/01/2018.

The Southwest Power Pool (SPP) evaluated the request (GEN-2015-079) to interconnect the solar generation facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS-2015-002). The interconnection request was studied using one-hundred twenty-nine (129) MW of solar generation. The Interconnection Customer is required to build 230 kV transmission line from their solar farm substation to the SPS's new State Line Switching Station. The IC 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 for SPS found in the Xcel Energy Interconnection Guidelines For Transmission Interconnected Producer-Owned Generation Greater Than 20 MW at the following link:

http://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Files/PDF/Interconnection/Interconnections-POL-TransmissionInterconnectionGuidelineGreat20MW.pdf.

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 230 kV to interconnect at SPS's Stateline Switching Station.

The shared network upgrades will be determined at a later date by SPP and may impact the total overall costs for interconnection for the Interconnection Customer.

It is anticipated that the entire process of building a new 230 kV 3-breaker ring at Stateline Switching Station for the acceptance of the First Solar Development's Solar Farm facility output and the network upgrades allocated to this project will require approximately 36 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 Solar Farm facility, is shown below in Table 1, with the detailed description of the cost shown in Table 3.

Table 1, Cost Summary[a]

Description	Cost
Shared Network Upgrades:	**$ TBD**
Network Upgrades:	**$6,049,426**
Transmission Owner Interconnection Facilities:	**$333,294**
Total:	**$6,382,720**

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

General Description of SPS[b] Facilities

1. **Construction of New Stateline Switching Station:** See Appendix A, Figure A- 1 for general vicinity location map.

   1.1. **Location**: Customer will build a new 230 kV line from their substation to SPS's new 230 kV Stateline Switching Station which includes three (3) 230 kV breakers. Appendix A, Figure A- 2, shows a preliminary one-line of Stateline Switching Station.

   1.2. **Bus Design**: The new 230 kV three-breaker ring-bus switching station will be built to accommodate the output from the solar energy facility. This is shown in Appendix A, Figure A- 2.

   1.3. **Line Terminals**: The 230 kV line and static wire breaker terminal, maximum per phase tension, shall be verified by the IC prior to termination of any IC line to the Point of Interconnection (POI). The SPS substation engineering department can provide guidance on the design tension for this breaker terminal and any specifics required of the IC.

   1.4. **Relay and Protection Scheme**: The new 230 kV breaker line terminal primary protection to the Interconnection Customer 230 kV transmission line will use line current differential relaying over optical fiber installed in the static of the customer's 230 kV transmission line. Secondary relaying will use mirrored bit, Permissive Overreaching Transfer Trip (POTT) over the optical fiber. An SEL 411L and an SEL 311C will be used as primary and secondary relays, respectively. The SEL 411L will be used for line/bus SCADA closing conditions for the 230 kV breakers. Also, a SEL 351S will be used for breaker failure.

   An SEL 411L will display the bus voltage, GCB amps, MW, MVAR, and fault location. A communication relay will be installed and for other functions as required.

   1.5. **Revenue Metering**: An individual billing meter will be installed at Stateline Switching Station on the 230 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 one meter per line terminal: the meter 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.

   1.6. **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.

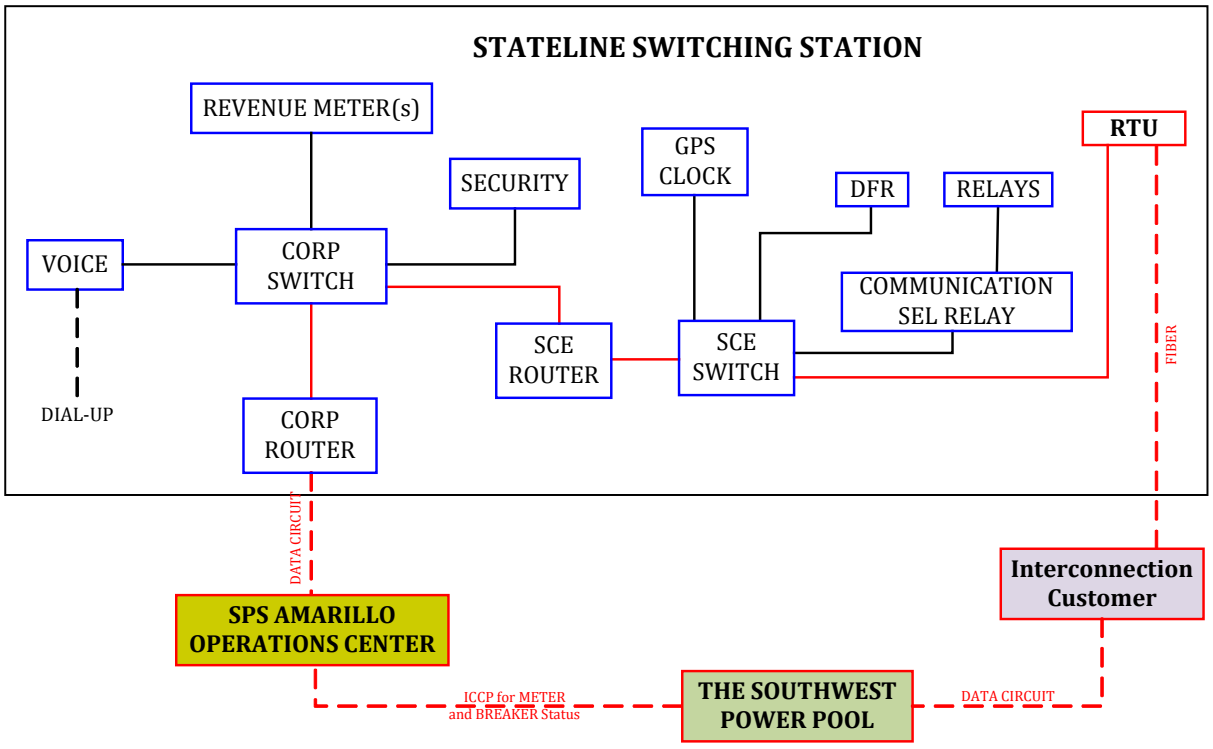
   1.7. **Remote Terminal Unit (RTU)**: A new RTU will be utilized with communications for the new 230 kV breakers. A Communication SEL Relay will be installed for relay communications and other functions as required; these costs will be directly assigned to the IC. The IC will provide and install an RTU for metering and telemetry at the IC's facility as required by the latest Xcel Energy Interconnection Guidelines.

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

1.8. **Communications**: To meet its Communications obligations, the Interconnection Customer shall be responsible for making arrangements with the local phone company to provide a communication circuit 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 Dougherty Switching Station. Prior to any construction, the IC is required to contact the Transmission Owner substation-engineering department for all communication details and provide detail of the method to be used in communication**.**

The following communications schematic diagram, which includes communication equipment information for the IC, Transmission Provider (Southwest Power Pool) and Transmission Owner (Southwestern Public Service), is provided to assist the Parties as a template.

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 Stateline Switching Station for protective relaying and for transmitting metering and status data to SPS. Utilizing this fiber optic connection, SPS will establish a direct connection to the IC's RTU.

SPS will not serve as a proxy for communication from the IC to SPP.

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 SPS's new 230 kV Switching Station. This line is shown in Appendix A, Figure A- 2 and is approximately 0.25 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 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 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**: A CCN may be required for the construction of the new 230 kV Stateline Switching Station from the Public Utility Commission in the State of New Mexico. A 440 Notice will be prepared and submitted to the PUC of New Mexico by the Project Manager (PM) assigned to the construction of the 230kV Stateline Switching Station. 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 at new 230 kV Switching Station.

4. Construction Power and Retail Service:

4.1. **Responsibilities:** 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. **Collaboration of Work**: 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. **Reactive Power Requirements**: 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 using the 2015 MDWG[c] 2020S with MMWG[d] 2019S on the 230 kV at Stateline Switching Station located approximately 1.0 miles west of the TX/NM State Line on circuit K-93, 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 2015-079)				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3–Phase	Z^+	Z^0
230 kV Bus	6,450	9,076	2.38 + j14.44	7.64 + j31.87

7. Estimated Construction Costs

The projects required for the interconnection of 129 MW Solar Generation facilities consist of the projects summarized in the table below.

Table 3, Required Interconnection Projects[e]

Project	Description	Estimated Cost
	Shared Network Upgrades:	
1	Shared Network Upgrades	TBD
	Subtotal:	**$ TBD**
	Network Upgrades (Funded by the IC)	
2	Communication Equipment (DFR, RTU and other related items)	$ 379,293
3	Land Approximately 20 acre	$ 99,650
4	New 3-Breaker Ring Bus (Stateline Switching Station)	$ 4,419,652
5	Tap Hobbs Generating to Yoakum 230 kV Circuit K93 “In and Out”.	$ 1,150,831
	Subtotal Network Upgrades	**$6,049,426**
	Transmission Owner Interconnection Facilities (direct assigned to the IC)	
6	Communications[f]	$ See footnote
7	Line Arrestors, Metering and Other Related Items	$ 333,294
	Subtotal:	**$333,294**
	Total Cost	**$6,382,720**

[c] Model Development Working Group
[d] Multi-Region Model Working Group
[e] The cost estimates are 2015 dollars with an accuracy level of ±20%.
[f] It is the Requester’s responsibility to provide both the data circuit and communication circuits, see Section 1.8.

8. Engineering and Construction:

An engineering and construction schedule for this project is estimated at approximately 36 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

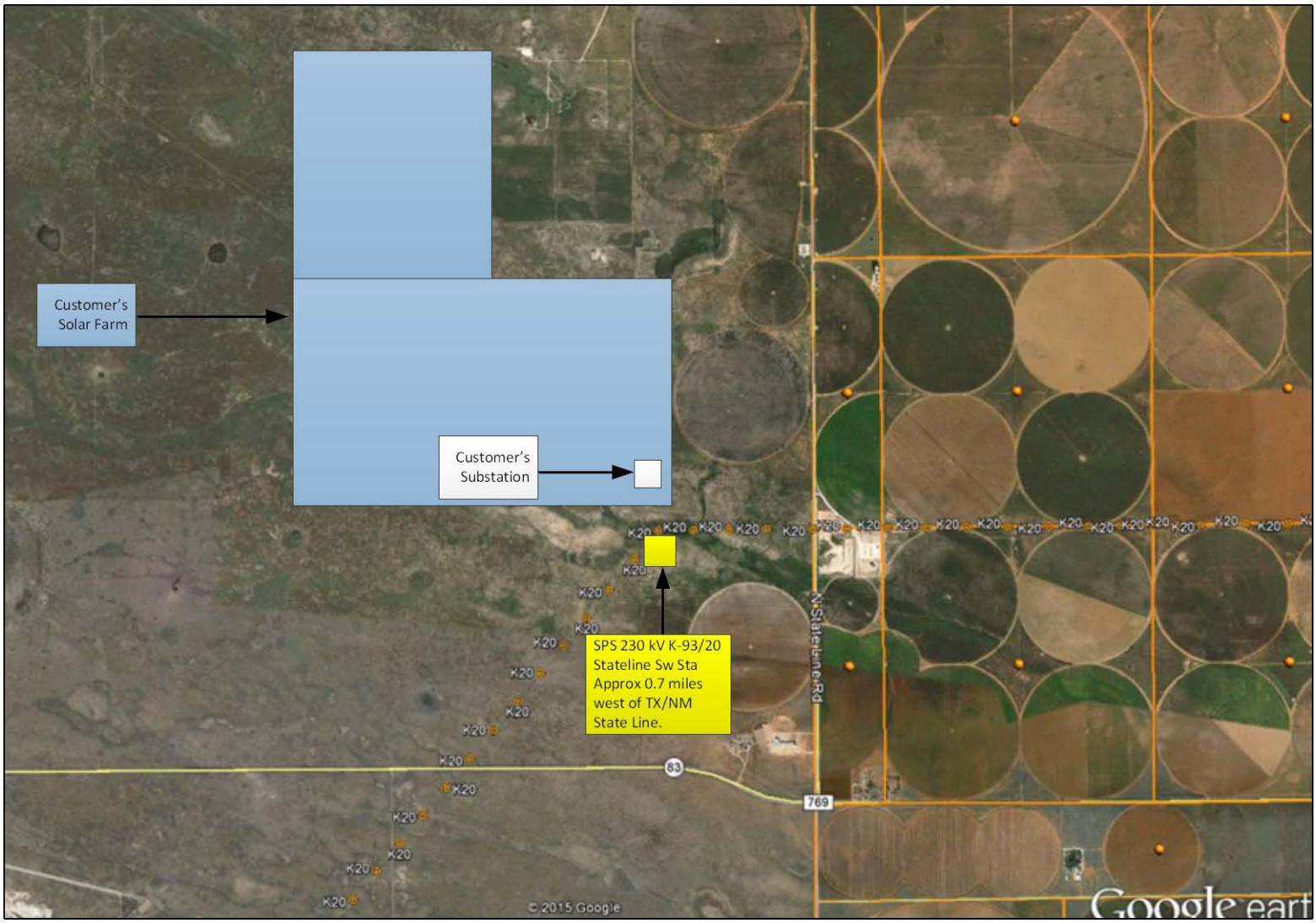


Figure A- 1, Approximate location of Stateline Switching Station and Solar Farm

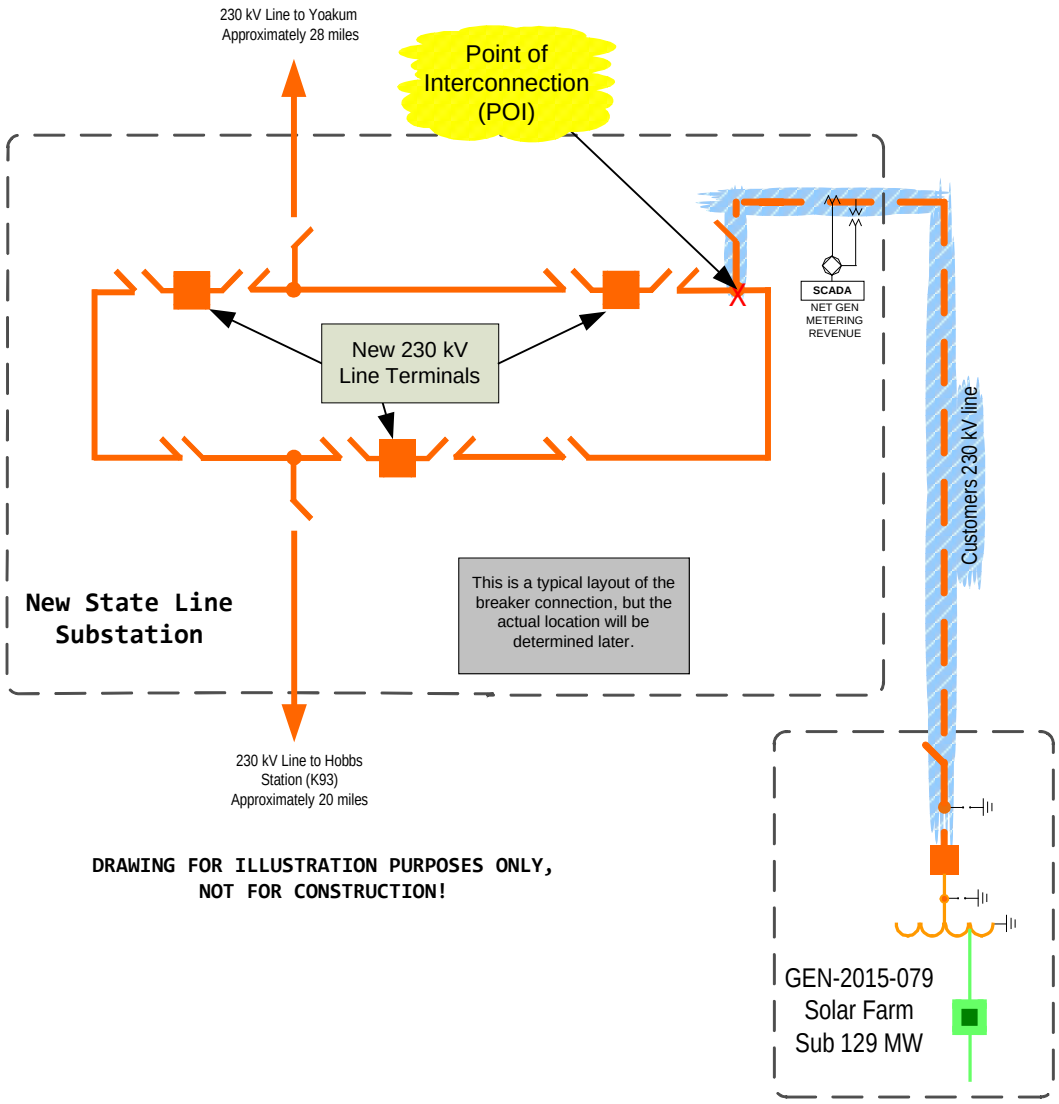


Figure A- 2, One-line Diagram of New Stateline Switching Station

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