Southwest Power Pool

Facility Study
For
Generation Interconnection Request
GEN-2012-020

SPP Generation Interconnection Studies

(#GEN-2012-020)

August 2013

Revision History

Date	Author	Change Description
8/20/2013	SPP	Facility Study Report Issued

Summary
Xcel Energy Inc (Xcel), a subsidiary of Southwestern Public Service Company (SPS), performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2012-020 (478.0 MW/Wind) located in Hale County, Texas. The originally proposed in-service date for GEN-2012-020 was September 30, 2015. SPP has proposed the in-service date will be after the assigned Interconnection Facilities, Non-Shared Network Upgrades, and Shared Network Upgrades are completed. 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
The Interconnection Customer will be responsible for all of the transmission facilities connecting the customer owned substation to the Point of Interconnection (POI), at the Southwestern Public Service Company (SPS) owned 230kV bus at the TUCO Interchange Substation. The Interconnection Customer will also 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.

An additional analysis for reactor sizing was performed as part of this study. In order to perform this analysis, the Customer transmission lines and collectors systems were modeled using specifications provided by the Customer. The facility was such that the generation and capacitor banks are switched out of service but the wind farm's collector subsystem (230kV and 34.5kV) remains in-service. The charging from these open-ended transmission facilities is then monitored for worst case reactive power injections into the POI under differing system conditions. Analysis shows that the approximate amount of charging provided by the GEN-2012-020 subsystem is 15.0 Mvars. It is recommended that the Customer install at least 15.0 Mvars of Reactors to compensate for this injection into the transmission system.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades
To allow interconnection the Transmission Owner will need to construct a new 230kV breaker and associated terminal equipment for acceptance of the Interconnection Customer's Interconnection Facilities. SPS has identified the TUCO Interchange Substation to be near full capacity, so SPS and the Interconnection Customer will need to further refine how the Interconnection Customer is interconnected into TUCO Interchange. At this time GEN-2012-020 is responsible for $1,760,377.00 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

Shared Network Upgrades
The Interconnection Customer was studied within the DISIS-2012-002 Impact Study. At this time, the Interconnection Customer is allocated $6,637,560.72 for Shared Network Upgrades (Xcel Energy costs of shared network upgrades within the body of the report were based on an earlier iteration of DISIS-2012-002). 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:

Shared Network Upgrade Description	Allocated Cost	Total Cost
TUCO 345/230/13.2kV Autotransformer CKT 3, Build and install a third TUCO 345/230/13.2kV autotransformer, install breakers, and associated terminal equipment.	$6,637,560.72	$9,274,171.00
Total	$6,637,560.72	

Previous Network Upgrades

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

1. Tuco-Woodward 345kV line, scheduled for 5/19/2014 in service
2. Hitchland – Woodward 345kV double circuit, scheduled for 6/30/2014 in-service
3. Beaver County – Buckner 345kV circuit 1, assigned to DISIS-2011-001 Customers
4. Beaver County Expansion – Tap and Tie Hitchland 345kV circuit #2, assigned to DISIS-2011-001 Customers
5. Matthewson – Tap and Tie on Tatonga – Northwest 345kV circuit #1 and Cimarron – Woodring 345kV circuit #1, assigned to DISIS-2011-001 Customers
6. Tatonga – Matthewson – Cimarron 345kV circuit #2, assigned to DISIS-2011-001 Customers
7. Woodward 345/138kV transformer circuit #2, scheduled for 5/19/2014 in-service

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-2012-020 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for $1,760,377.00 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated $6,637,560.72 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 478.0 MW, as requested by GEN-2012-020, can be allowed. At this time the total allocation of costs assigned to GEN-2012-020 for Interconnection Service are estimated at $8,397,937.72.

Facilities Study For
Southwest Power Pool (SPP)

GEN-2012-020
Total Output is 478 MW
Generation Facilities
Hale County, Texas

June 28, 2013

Transmission Asset Management
Southwestern Public Service

Executive Summary

[Omitted Text] ("Interconnection Customer") in 2013 requested an interconnection of a wind energy facility located in Hale County, Texas to the Southwestern Public Service Company (SPS) transmission network at TUCO Interchange. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. This facility has a net capacity of 478 MW. The Interconnection Customer's facility will connect to SPS's existing TUCO Interchange on the 230 kV which is located approximately eighteen (18) miles south of the customer's substation. The Interconnection Customer's requested back-feed date is 7/30/2015 and commercial operation date is 9/30/2015.

The Southwest Power Pool (SPP) evaluated the request (GEN-2012-020) to interconnect the generator facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS-2012-002), which was completed in February 2013. An updated DISIS-2012-002-1 was completed in May 2013. The interconnection request was studied using two hundred eighty-four (284) turbines, which are GE 1.68 MW XLE units for a total of 478 MW. The Interconnection Customer is required to build 230 kV transmission line from their substation wind farm facility to the SPS's TUCO Interchange, which requires the customer to enter TUCO Interchange from the West. There is no space available to interconnect TUCO from the East to interconnect to the 230 kV. 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).

SPS requires that all construction for this request be in compliance with the latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Produced-Owned Generation. SPP requires that each Generator shall implement Automatic Under Frequency Load Shedding according to Regional Reliability Standard: PRC-006-SPP-01. To fulfill this requirement, coordination with Xcel Energy is required during the under-frequency relay-setting phase for the generator plant. The Interconnection Customer is required to report their generator off-nominal frequency tripping relay settings to SPP and SPS. 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 all the cost of the Interconnection Facilities, installation of the Direct Assigned Interconnection Facilities; inclusive of all construction required for the 230 kV transmission line from the Interconnection Customer's substation to the SPS's TUCO Interchange.

The current estimated shared network upgrades allocation cost (from DISIS-2012-002-1) for the Interconnection Customer Generating Facility (GEN-2012-020) total $171,733,096, as calculated by SPP and includes the following: Muncy-Sweetwater (Chisholm) 345 kV line $66,476,665; TUCO 345/230/13.2 kV Autotransformer Circuit #3 $13,984,628; Sweetwater (Chisholm) -Gracemont 345 kV line $85,144,135; Sweetwater (Chisholm) Substation $6,127,668.. Muncy is located 35 miles east of TUCO Interchange and is tapping the TUCO to Border 345 kV line. The allocation cost of these network upgrades may change as the content of the GI Cluster group changes. The network upgrades for the Interconnection at TUCO are estimated at $1,500,377.

It is anticipated that the entire process of providing a 230 kV bay at TUCO for the acceptance of the Interconnection Customer facility output will require approximately 24 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. It is anticipated that the shared network upgrades allocated to this project will require approximately 66 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. These network upgrades will need to be built before the customer is allowed to go in-service at 100% name plate. 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]

Shared Network Upgrades Total ($350,504,679): Shared cost (49%)	**$ 171,733,096**
Network Upgrades:	**$ 1,500,377**
Transmission Owner Interconnection Facilities:	**$ 260,000**
Total:	**$ 173,493,473**

Since the Interconnect Customer will be required to enter TUCO Interchange from the west, and must cross at least five (5) existing transmission lines (two 230 kV lines, two 115 kV lines and one 69 kV line) that exit TUCO Interchange SPS, the customer and SPS will need to review and agree to the method of connecting the Customer's 230 kV line to the 230 kV TUCO bus. There are three currently defined methods of accessing the 230 kV bus from the west.

a. Crossing structures would need to be installed on the 5 existing transmission lines to allow customer's line to pass under SPS lines.
b. Customer's 230 kV line to TUCO would be underground to the entrance of the 230 KV TUCO station to minimize any disruption to SPS's existing circuits.
c. Customer and SPS to agree on an SPS line being underground to provide Customer an overhead access that doesn't require crossing of multiple overhead transmission circuits. This is effectively re-arranging the terminal position(s) of one or more existing lines on the TUCO 230 KV bus or other buses.

The Interconnection Customer will need to meet with SPS's engineers to determine what alterative are available and the cost to the interconnect customer.

These costs will be categorized as Transmission Owners Interconnection Facilities in the facility Study.

[a] The cost estimates are 2013 dollars with an accuracy level of ±20%.

General Description of SPS[b] Facilities

1. **Construction of New 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 TUCO Interchange and interconnect on the west side of SPS's interchange. There is not any room to interconnect a 230 kV transmission line to TUCO Interchange from the East. A 230 kV terminal exist. Customer needs to interconnect their 230 kV transmission line to the north terminal that is available. Appendix A, Figure A-2, shows a preliminary one-line of TUCO Interchange, while Figure A-3 shows a typical elevation view of the normal Point of Interconnection (POI).

   1.2. **Bus Design:** The interconnection shall be to the existing breaker and half bus design at TUCO Interchange to accommodate the outputs from the Customers wind farm facility. This is shown in Appendix A, Figure A-2.

   1.3. **Line Terminals:** The 230 kV lines and static wire terminals (operated at 230 kV) 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 new 230 kV line breaker terminals.

   1.5. **Security Fence**: The existing security fence shall be extended if required when the new 230 kV line terminal is installed.

   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 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 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 230 kV breakers. Also, a SEL 501-0 will be used for breaker failure.

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

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.

1.10. Revenue Metering: An individual billing meter will be installed at TUCO Interchange 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 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.

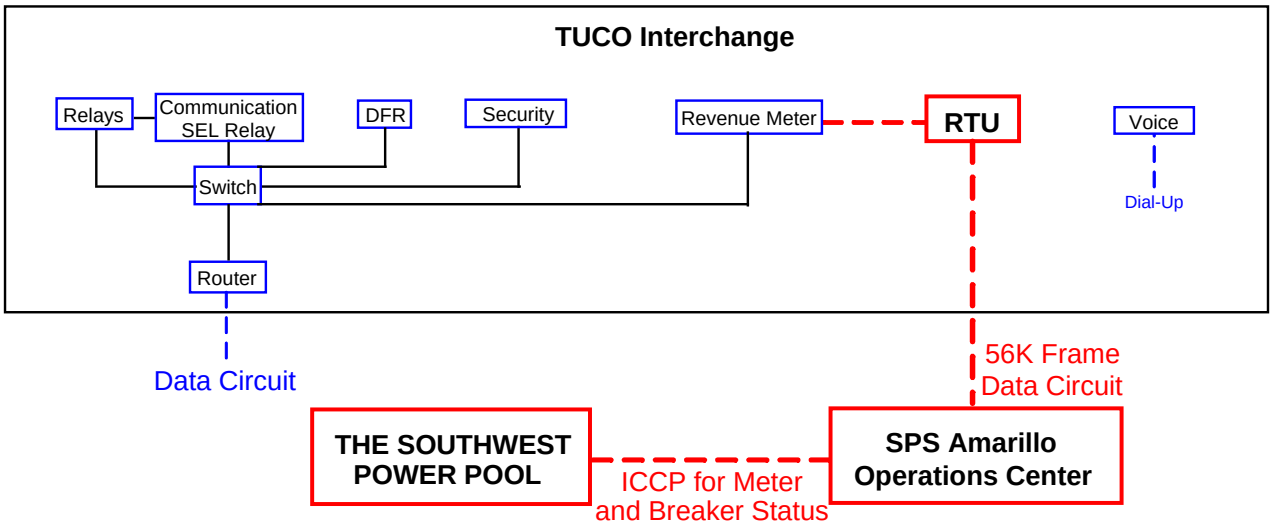
1.11. Disturbance Monitoring Device: An existing Disturbance Fault Recorder (DFR), capable of recording faults, swings, and long term trending, has been installed to monitor and record conditions in the TUCO Interchange and on the transmission lines. The disturbance equipment shall also be equipped with 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): An existing RTU will be utilized to accommodate for the new 230 kV line terminal at TUCO Interchange. SPS will provide and install if needed additional RTU cards for metering and telemetry 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 TUCO Interchange.

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 230 kV terminal at TUCO. **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**: Permitting for the construction at the 230 kV terminals at TUCO 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 Point of Interconnection. **The customer will be responsible for obtaining any easements for SPS if any relocation of transmissions is required**.

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 230 kV at TUCO 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 2012-020)				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3–Phase	Z^+	Z^0
230 kV Bus	15,757	14,031	1.016 + j9.409	0.49 + j6.238

Estimated Construction Costs

The projects required for the interconnection of 478 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	Sweetwater(Chisholm)-Gracemont 345 kV CKT #1 107 miles; Sweetwater(Chisholm) Substation; TUCO-Sweetwater (Chisholm) 345 kV 163 miles; TUCO 345/230/13.2 kV autotransformer CKT #3 Total Cost $350,504,679. Shared Cost (49%). (at the Interconnection Customer's expense)	$171,733,096
	Subtotal:	**$171,733,096**
	Network Upgrades (at the Interconnection Customer's expense)	
2	Disturbance Monitoring Device (DFR)	$ 0
3	Right-Of-Way (Surveying)	$ 0
4	Remote Terminal Unit (RTU)	$ 0
5	Add new 230 kV breaker and replace one 230 kV breaker. Replace 5 230 kV switches and add dead end structure.	$ 1,500,377
	Subtotal:	**$ 1,500,377**
	Transmission Owner Interconnection Facilities (at the Interconnection Customer's expense)	
6	Communications [d]	*$ See footnote*
7	Revenue metering	$ 230,000
8	230 kV Line arrestors	$ 30,000
9	Transmission Line Work, Required for customer crossings. See paragraph at bottom of this table. (Cost to be determined prior to construction)	**TBD**
	Subtotal:	**$ 260,000**
	Total Cost	**$ 173,493,473**

Since the Interconnect Customer will be required to enter TUCO Interchange from the west, and must cross at least five (5) existing transmission lines (two 230 kV lines, two 115 kV lines and one 69 kV line) that exit TUCO Interchange SPS, the customer and SPS will need to review and agree to the method of connecting the Customer's 230 kV line to the 230 kV TUCO bus. There are three currently defined methods of accessing the 230 kV bus from the west.

a. Crossing structures would need to be installed on the 5 existing transmission lines to allow customer's line to pass under SPS lines.
b. Customer's 230 kV line to TUCO would be underground to the entrance of the 230 KV TUCO station to minimize any disruption to SPS's existing circuits.

[c] The cost estimates are 2013 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.

c. Customer and SPS to agree on an SPS line being underground to provide Customer an overhead access that doesn't require crossing of multiple overhead transmission circuits. This is effectively re-arranging the terminal position(s) of one or more existing lines on the TUCO 230 KV bus or other buses.

The Interconnection Customer will need to meet with SPS's engineers to determine what alterative are available and the cost to the interconnect customer.

These costs will be categorized as Transmission Owners Interconnection Facilities in the facility Study.

Engineering and Construction:

It is anticipated that the entire process of providing a 230 kV bay at TUCO for the acceptance of the Interconnection Customer facility output will require approximately 24 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. It is anticipated that the shared network upgrades allocated to this project will require approximately 66 months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. These network upgrades will need to be built before the customer is allowed to go in-service at 100% name plate. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. The 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

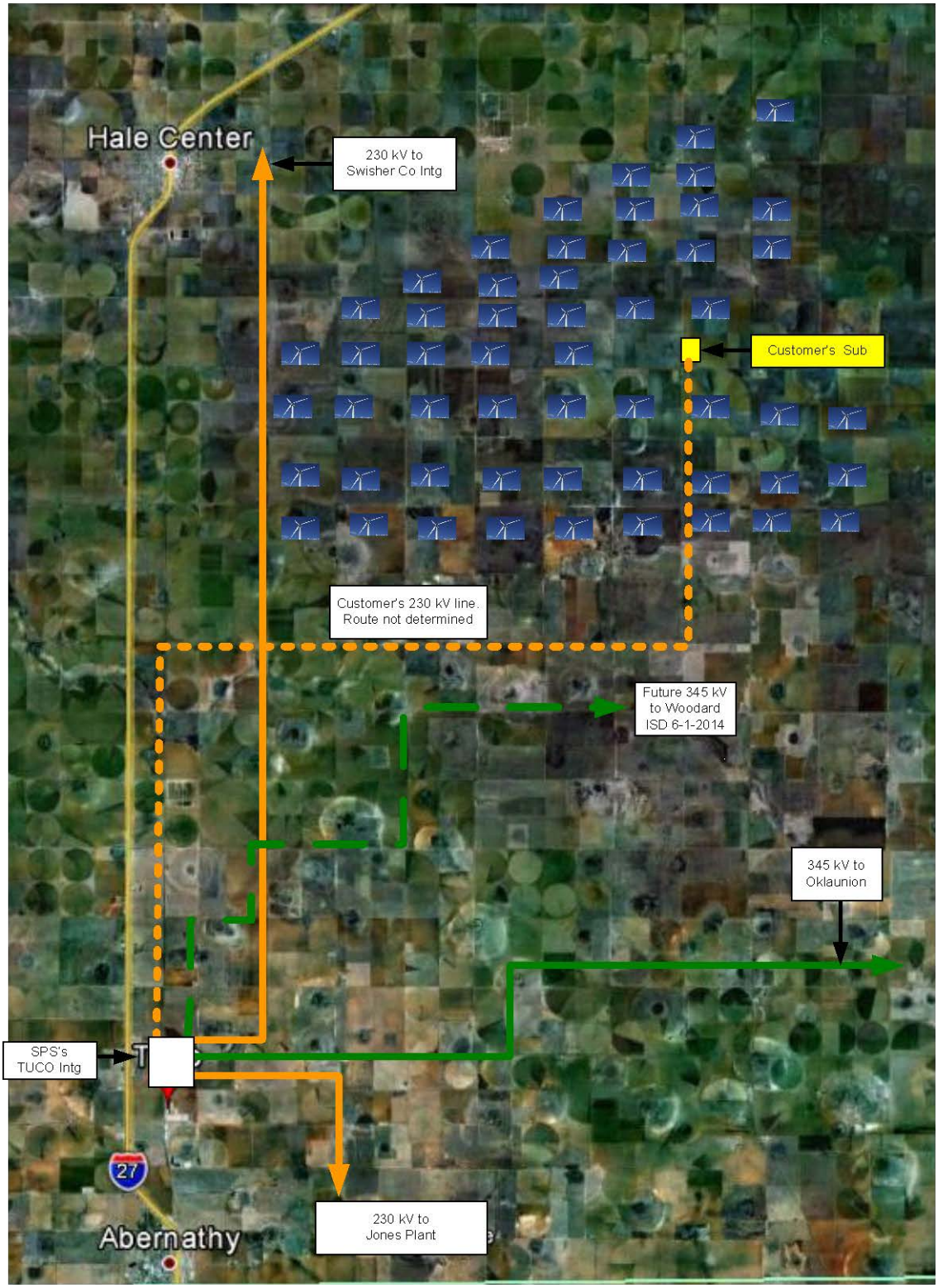


Figure A-1. Approximate location of TUCO Interchange and Wind Farm

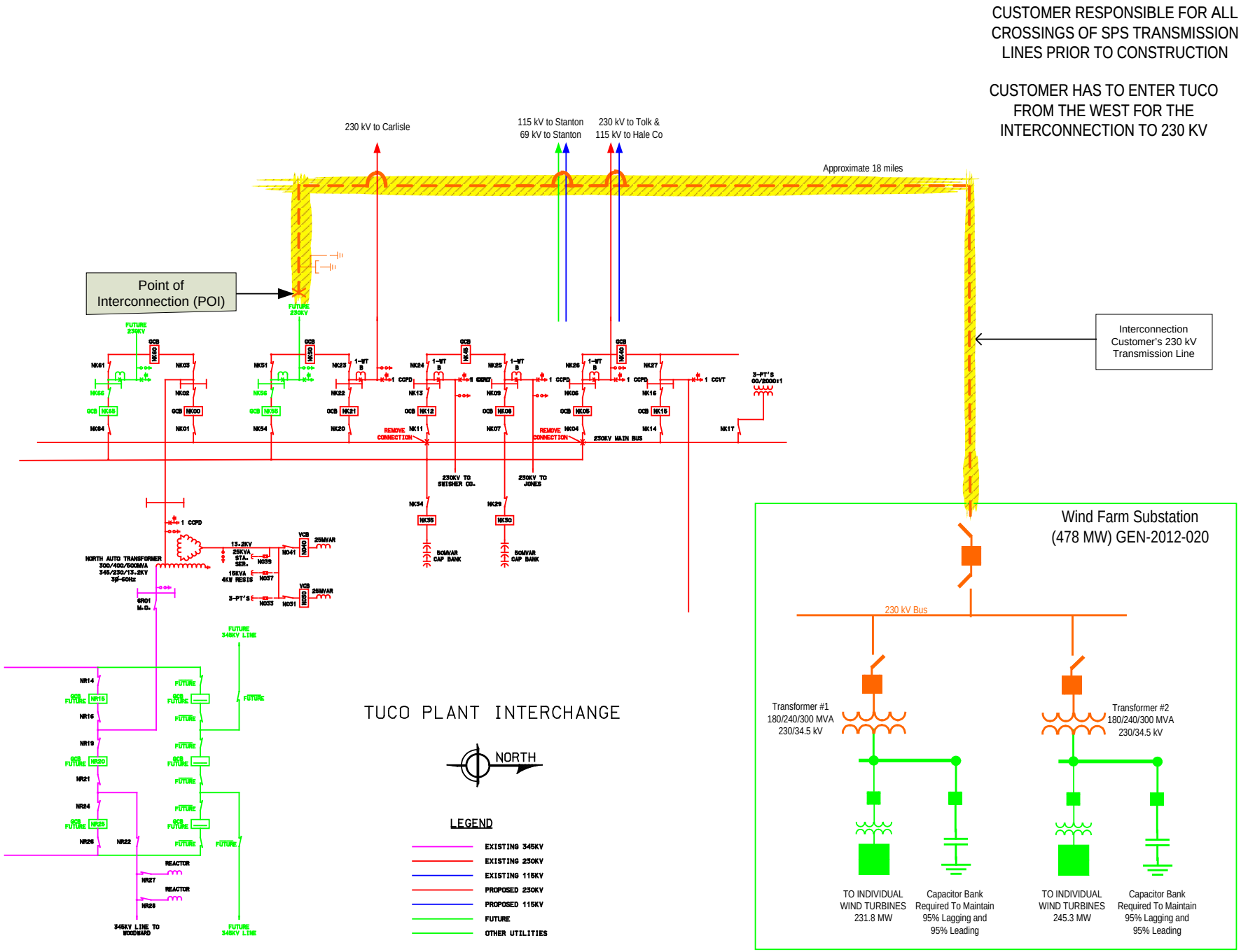


Figure A-2. One-line Diagram of New Switching Station

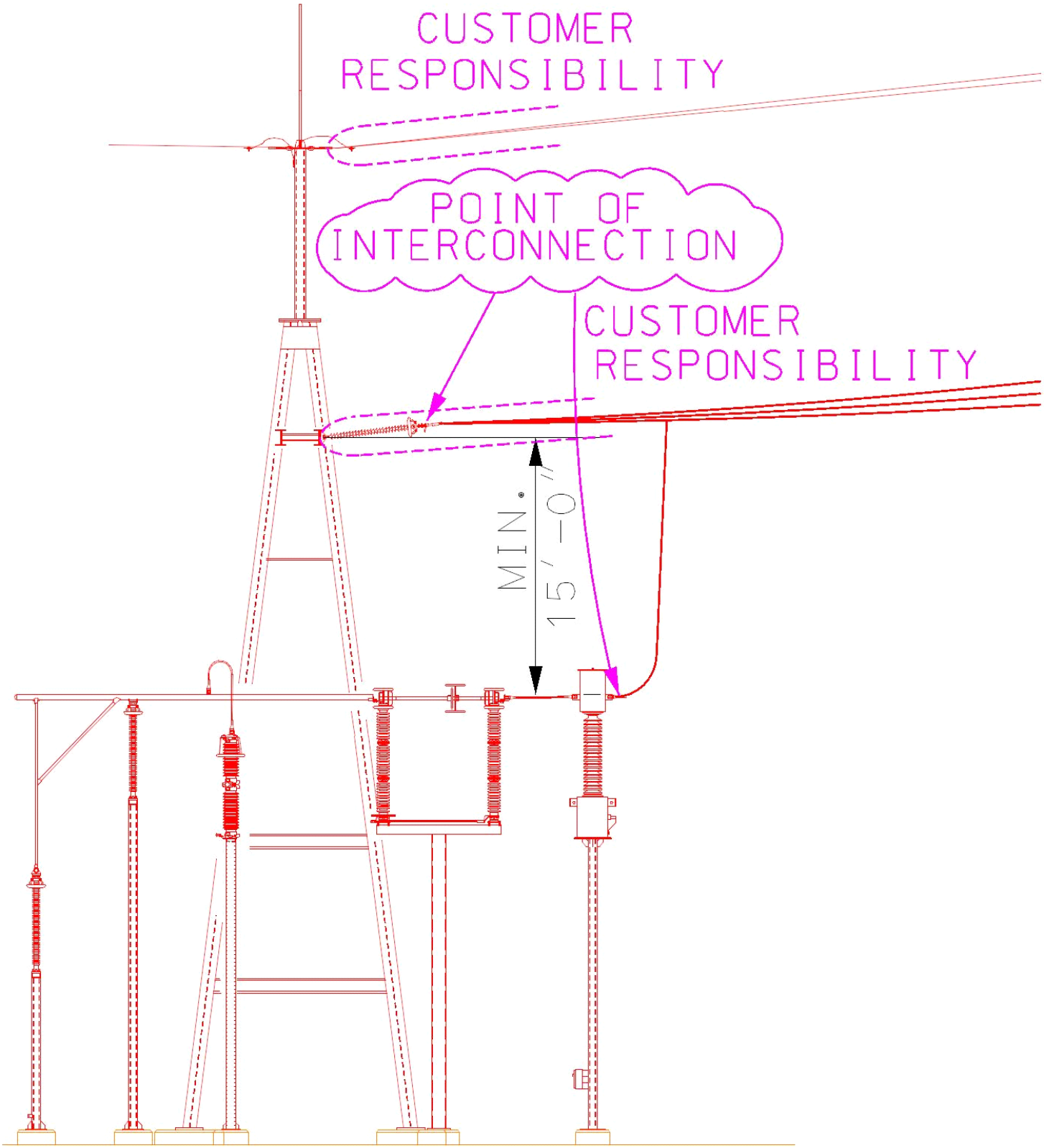


Figure A-3 Point of Interconnection & Change of Ownership (Typical)

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