SPP Southwest Power Pool

Interconnection Facilities Study For Generator Interconnection Request GEN-2014-053 (IFS-2014-002-19)

SPP Generator Interconnection Studies

(#GEN-2014-053)
(#IFS-2014-002-19)

October 2015

Revision History

Date	Author	Change Description
9/17/2015	SPP	Draft Interconnection Facilities Study Report Revision 0 Issued
10/23/2015	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-2014-053/IFS-2014-002-19 (80.00 MW/Wind) located in Hockley County, Texas. The Interconnection Customer's originally proposed in-service date for GEN-2014-053/IFS-2014-002-19 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

The Interconnection Customer's generation facility consists of forty (40) General Electric (G.E.) 2.0MW wind turbines for a total nameplate rating of 80.00 MW. The 34.5kV collector system for this wind facility is planned to be connected to one (1) 230/34.5kV Interconnection Customer owned and maintained transformer at the Interconnection Customer owned substation. An approximate nine (9) mile overhead 230kV transmission circuit will connect GEN-2014-053/IFS-2014-002-19 to the Point of Interconnection (POI) at the existing 230kV bus at the SPS owned Carlisle 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, including approximately 5.8 Mvar[1] of reactors to compensate for injection of reactive power from GEN-2014-053/IFS-2014-002-19 and GEN-2014-054/IFS-2014-002-20 Interconnection Customer Facilities into the transmission system under reduced generating conditions. Reduced generating conditions could be required to be revised and restudy if GEN-2014-053/IFS-2014-002-19 or GEN-2014-054/IFS-2014-002-20 withdraw or terminate their Generator Interconnection Request (GIR). Also, the Interconnection Customer will need to coordinate with the Transmission Owner for relay, protection, control, and communication system configurations.

[1] This approximate amount of reactors is an approximate minimum amount needed for the configuration of the wind farm studied in DISIS-2014-002 Group 06 reduced generation analysis.

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

To facilitate interconnection the Transmission Owner will construct a new 230kV terminal position to the existing breaker-and-half configuration at the Carlisle 230kV substation. In order to add another 230kV terminal, SPS will need to add two (2) 3000A continuous ampacity 230kV circuit breakers 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 eighteen (18) 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-2014-053/IFS-2014-002-19 is responsible for $2,740,324 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-2014-053/IFS-2014-002-19 TOIF and Non-Shared Network Upgrade(s)

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades Description	Allocated Cost ($)	Allocated Percent (%)	Total Cost ($)
Interconnection Substation - Transmission Owner Interconnection Facilities 230kV Substation work for a new line terminal position, line switch, dead end structure, communications, revenue metering, and line arrestors	$260,000	100%	$260,000
Interconnection Substation - Network Upgrade(s) 230kV Substation work for a new terminal position, build two (2) 3000A breakers and associated switches, structures, other terminal equipment.	$2,480,324	100%	$2,480,324
Total	$2,740,324	100%	$2,740,324

A Shared Facilities Usage Agreement for the shared facilities with GEN-2014-054/IFS-2014-002-20 shall be required for Generator Interconnection Service. Shared Facilities Usage Agreement details will be determined during the negotiation phase of the GIA.

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 $9,840,870 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-2014-053/IFS-2014-002-19 Shared Network Upgrade(s)

Shared Network Upgrades Description	Allocated Cost ($)	Allocated Percent (%)	Total Cost ($)
Carlisle 230/115/13kV Transformer Replacement: Replace the existing Carlisle 230/115/13kV Transformer and associated terminal equipment for acceptance	$1,677,165	40.00	$4,192,913
Oklaunion 345kV Capacitive Reactive Support: Two (2) 150Mvars Static Var Compensator (SVC).	$5,192,000	12.98	$40,000,000
TUCO 2 Substation (Crawfish Draw) and 345/230kV Transformer: 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.	$2,971,705	12.00	$24,764,205
Total	$9,840,870		$68,957,118

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-2014-053/IFS-2014-002-19:

- Agave Hill 115kV Reactive Power Support build assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- China Draw 115kV Reactive Power Support build assigned in 2015 Integrated Transmission Plan Near Term Assessment (ITPNT) per SPP-NTC-C-200324
- Hobbs Interchange - Kiowa 345kV Transmission circuit #1 assigned in the High Priority Increment Load Study (HPILs) per SPP-NTC-200309 with current on schedule 6/1/2018 in-service
- Kiowa – North Loving – China Draw 345/115kV Project assigned in the High Priority Increment Load Study (HPILs) per SPP-NTC-200309 with current on schedule 6/1/2018 in-service
- Kiowa – Road Runner 345/230kV Project 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-2014-053/IFS-2014-002-19 will be delayed until the Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades are constructed. The Interconnection Customer is responsible for $2,740,324 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated $9,840,870 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 80.00 MW, as requested by GEN-2014-053/IFS-2014-002-19, can be allowed.

At this time the total allocation of costs assigned to GEN-2014-053/IFS-2014-002-19 for interconnection Service are estimated at $12,851,194.

Facilities Study For
Southwest Power Pool (SPP)

GEN-2014-053
80MW Wind Farm
Wind Generation Facility
Lubbock County, Texas

April 23, 2015

Transmission Planning South
Xcel Energy Services

Executive Summary

("Interconnection Customer") in 2015 requested an interconnection of a wind energy facility located in Lubbock County, Texas to the Southwestern Public Service Company (SPS) transmission network at Carlisle Interchange. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. This facility has a net capacity of 80 MW. The Interconnection Customer's facility will connect to SPS's existing Carlisle Interchange on the 230 kV. The Interconnection Customer's requested commercial operation date is 12/31/2016.

The Southwest Power Pool (SPP) evaluated the request (GEN-2014-053) to interconnect the generator 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 forty (40) turbines, which are GE 2.0 MW for a total of 80 MW. The Interconnection Customer is required to build 230 kV transmission line from their substation wind farm facility to the SPS's Carlisle 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. 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 transmission line from the Interconnection Customer's substation to the SPS's Carlisle Interchange.

The network upgrades for the Interconnection at Carlisle $2,740,324.

It is anticipated that the entire process of providing a 230 kV bay at Carlisle for the acceptance of the GEN-2014-053 facility output will require approximately 18 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]

Network Upgrades:	**$**	**2,480,324**

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

Transmission Owner Interconnection Facilities:	**$**	**260,000**
Total:	**$**	**2,740,324**

General Description of SPS[b] Facilities

1. **Construction adding new 230 kV Terminal at Carlisle Interchange:**

1.1. **Location:** Customer will build a new 230 kV line from their substation to Carlisle Interchange. Appendix A, Figure A-1, shows a preliminary one-line of Carlisle Interchange, while Figure A-2 shows a typical elevation view of the normal Point of Interconnection (POI).

1.2. **Bus Design:** The interconnection shall be to the existing straight bus configuration at Carlisle 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 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 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 Carlisle 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.

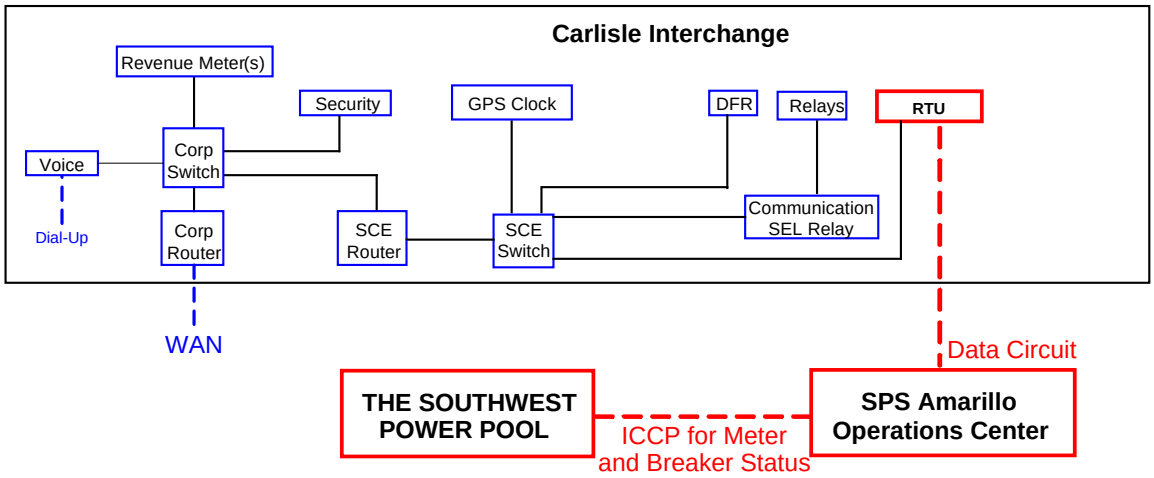
1.11. Disturbance Monitoring Device: An existing Disturbance Fault Recorder (DFR), capable of recording faults, swings, and long term trending, has been installed to monitor and record conditions in the Carlisle Interchange and on the transmission lines. The disturbance equipment shall also be equipped 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 Carlisle 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 from the customer substation to Carlisle Interchange for protective relaying and for transmitting metering and status data to SPS.

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 Carlisle Interchange. **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 Carlisle 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 Carlisle 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 2014-053)				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3–Phase	Z^+	Z^0
230 kV Bus	5,524	6,231	3.57 + j21.14	3.70 + j29.42

Estimated Construction Costs

The projects required for the interconnection of 80 MW Wind Generation facilities consist of the projects summarized in the table below.

Table 3, Required Interconnection Projects[c]

Project	Description	Estimated Cost
	Network Upgrades (at the Interconnection Customer's expense)	
1	Disturbance Monitoring Device (DFR) (existing)	$ 0
2	Right-Of-Way (Surveying) (No purchase)	$ 0
3	Remote Terminal Unit (RTU) (existing)	$ 0
4	Add new 230 kV breaker.	$ 2,480,324
	Subtotal:	**$ 2,480,324**
	Transmission Owner Interconnection Facilities (at the Interconnection Customer's expense)	
5	Communications [d]	*$ See footnote*
6	Revenue metering	$ 230,000
7	230 kV Line arrestors	$ 30,000
	Subtotal:	**$ 260,000**
	Total Cost	**$ 2,740,324**

[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.

Engineering and Construction:

An engineering and construction schedule for this project is estimated at approximately 18 months. 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. 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.

Carlisle Interchange is being converted to breaker and half and is scheduled for completion in June 2017. When this is competed the interconnection customer will be responsible for cost for the relocation of their equipment.

Appendix A

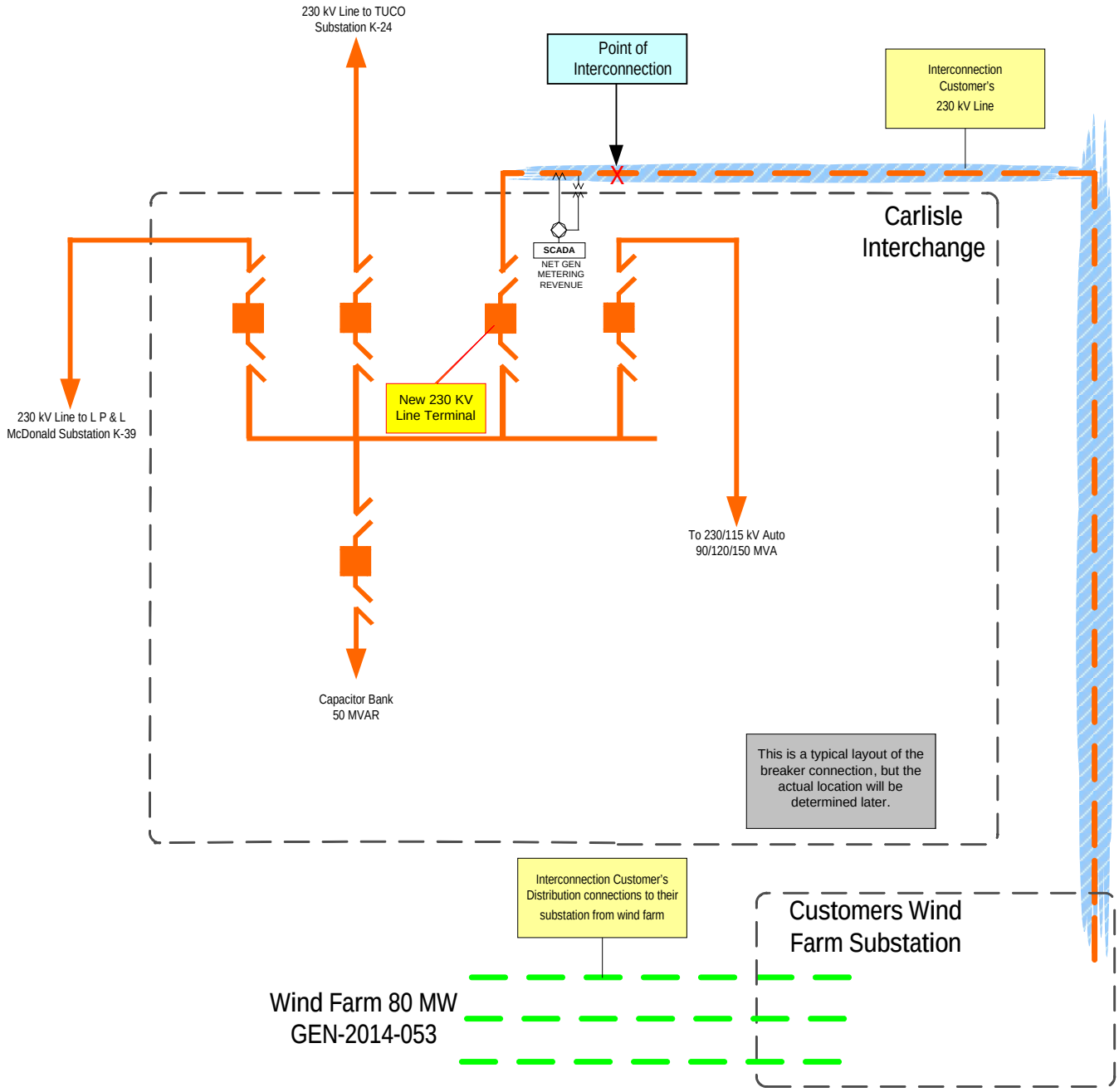


Figure A-1. One-line Diagram of Carlisle Interchange

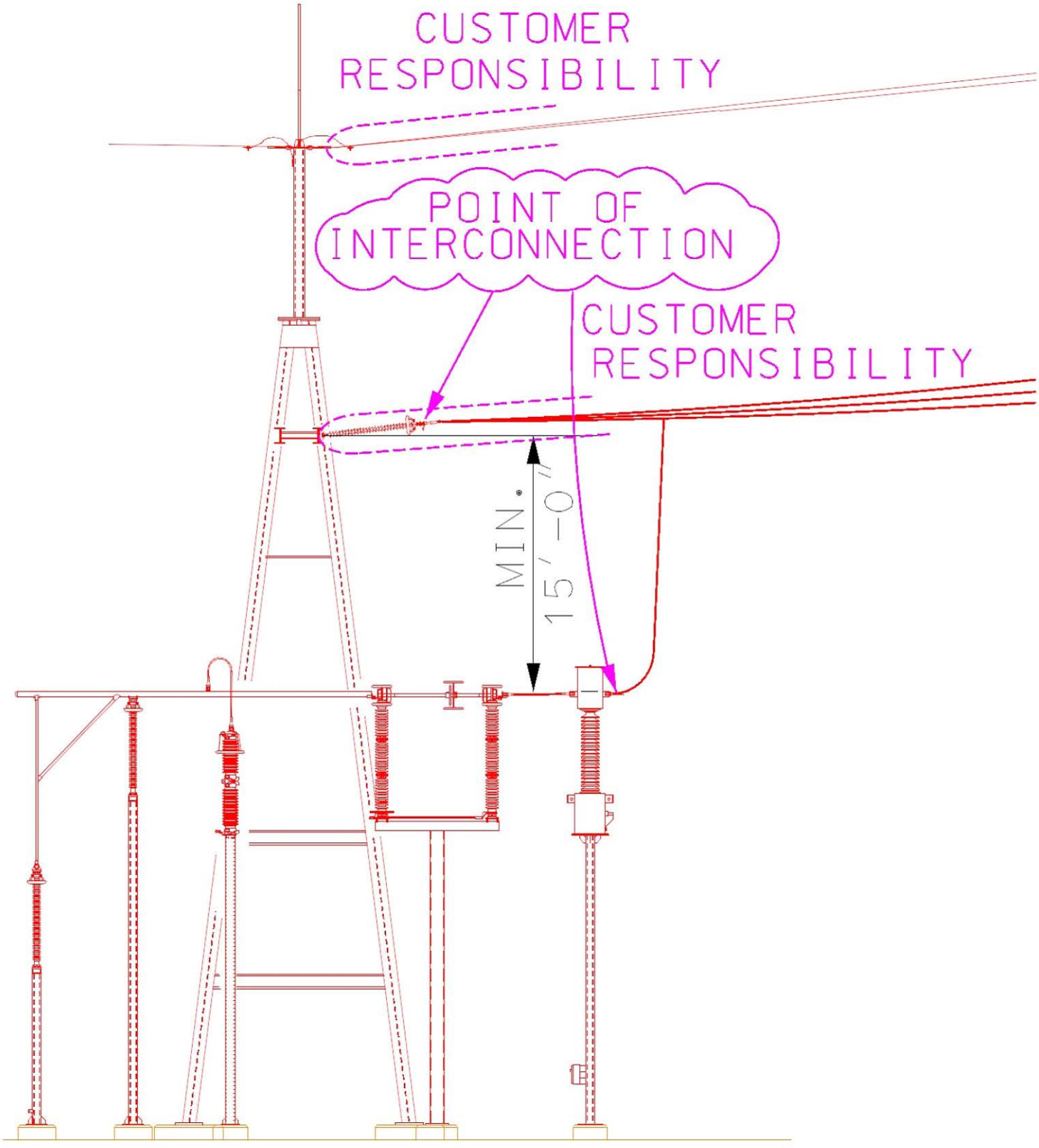


Figure A-2 Point of Interconnection & Change of Ownership (Typical)

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