Southwest Power Pool

Facility Study For Generation Interconnection Request GEN-2011-022

SPP Generation Interconnection

(#GEN-2011-022)

October 2021

Revision History

Date	Author	Change Description
09/07/2012	SPP	Facility Study Report Issued
04/02/2013	SPP	Account for Definitive Interconnection System Impact Restudy Results (DISIS-2011-001-3)
10/13/2021	SPP	Updaed to Reflect Modification Impact Study and DISIS-2018-001-8 ReStudy Results

Summary

Xcel Energy Inc. (Xcel) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2011-022. GEN-2011-022 is comprised of 133 X Siemens 2.3 MW wind turbing generation systems for a total nameplate capacity of 305.9 MW with PPC limiting POI injection to 299 MW. This request is sharing a generator lead line into the POI at Hitchland 345kV with GEN-2010-014, which is comprised of 159 X Siemens 2.3 MW wind turbine generation systems for a total nameplate capacity of 365.7 MW with PPC limiting POI injection to 358.5 MW.

Interconnection Customer Interconnection Facilities

The Interconnection Customer will be responsible for the 345 kV transmission line from its wind farm Substation to the Point of Interconnection (POI), the Hitchland Interchange 345kV substation. In addition, the customer will be responsible for reactive power compensation equipment to maintain 95% lagging (providing vars) and 95% leading (absorbing vars) power factor at the point of interconnection.

Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades

Per the following Facility Study, the Interconnection Customer is responsible for **$3,165,365** of Transmission Owner Interconnection Facilities and non-shared network upgrades.

Shared Network Upgrades

The interconnection customer was studied within the DISIS-2011-001-8 Impact ReStudy (December 2015). The Interconnection Customer is allocated the costs in the table below for shared network upgrades.

Upgrade Description	Allocated Cost	Total Cost
Woodward EHV Phase Shifting Transformer: NRIS install one phase shifting transformer at Woodward	$834,925	$7,100,000
Total	$834,925	

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.

Additional Required Network Upgrades
Certain Network Upgrades that are not the cost responsibility of the Customer are required for Interconnection. These Network Upgrades include:

1. Hitchland – Woodward 345kV double circuit, scheduled for 6/30/2014 in-service
2. Spearville - Clark – Thistle - Wichita double circuit, scheduled for 12/31/2014 in-service
3. Woodward – Border - TUCO 345kV, scheduled for 5/19/2014 in-service
4. Hitchland 345/230kV transformer circuit 2, scheduled for 6/30/2014 in-service
5. Thistle - Woodward 345kV double circuit, scheduled for 12/31/2014 in-service
6. Thistle – Flat Ridge 138kV circuit #1, scheduled for 12/31/2014 in-service
7. Thistle 345/138kV transformer, scheduled for 12/31/2014 in-service
8. Woodward Transformer 345/138/13.8kV circuit #2 and 50 MVAR Reactor, 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-2011-022 will be delayed until the Transmission Owner Interconnection Facilities and Network Upgrades are constructed. The Customer is responsible for $3,165,365 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is also allocated $834,925 for Shared Network Upgrades. After all Interconnection Facilities and Network Upgrades have been placed into service, Interconnection Service for 299 MW, as requested by GEN-2011-022, can be allowed. At this time the total allocation of costs of Interconnection Service for GEN-2011-022 are estimated at $4,000,290.

Facilities Study For Southwest Power Pool (SPP)

Combination: GEN-2010-014 and GEN-2011-022
Total Output: 657 MW
Hansford County, Texas

Xcel Energy Services, Inc.
Transmission Planning South
Updated 9/23/2021

Executive Summary

The Southwest Power Pool (SPP or Transmission Provider) evaluated to combine requests GEN-2010-014 and GEN-2011-022 into a single point of interconnection to interconnect the generation facilities to the SPS transmission system in the "GEN-2010-014 and GEN-2011-022 Modification Request Impact Study", which was completed in May 2021. Both of these generators were previously studied in the Definitive Interconnection System Impact Study (DISIS).

GEN-2010-014 and GEN-2011-022 requested the interconnection of a combined 657 MW wind energy generation facility (358 MW for GEN-2010-014 and 299 MW for GEN-2011-022), located in Hansford County, Texas, to the Southwestern Public Service Company (SPS or Transmission Owner) transmission network. To accommodate the Interconnection Customer's (IC) request, SPS has already installed the appropriate breakers and terminal equipment at the SPS Hitchland Substation. All that remains are the final connections of the IC to the SPS 345 kV bus. The IC is required to build a 345 kV transmission line from their substation facility to the SPS's Hitchland Substation. 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 document for "Large Generation Interconnection Guidelines (>20MW)" found at the following link: https://www.transmission.xcelenergy.com/Interconnections

To fulfill this requirement, coordination with Xcel Energy is required during the under-frequency relay-setting phase for the generation. The IC 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 IC 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 IC 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 IC is responsible for all the cost of the Interconnection Facilities, installation of the direct assigned Transmission Owner Interconnection Facilities (TOIF) which are facilities paid for by the IC but are owned, operated and maintained by SPS; inclusive of all construction required for the IC to interconnect at SPS's Hitchland Substation.

The shared network upgrades, if necessary, had been previously determined by SPP and were included in the original Generation Interconnection Agreements for GEN-2010-014 and GEN-2011-022. The "GEN-2010-014 and GEN-2011-022 Modification Request Impact Study" did not identify any new shared network upgrades required.

It is anticipated that the entire process to do the final interconnection at Hitchland for the acceptance of the IC facility output will require less than two months to complete after an Interconnection Agreement is signed and an authorization to proceed is received. The IC's cost for the interconnection of this generation facility is shown below in Table 1, with the detailed description of the cost shown in Table 3.

Table 1: Cost Summary[1]

Shared Network Upgrades Total:	**$ See DISIS Report**
Network Upgrades:	**$ No Additional funds necessary**
Transmission Owner Interconnection Facilities:	**$ No Additional funds necessary**
Total:	**$ 0**

[1] The cost estimates are 2021 dollars with an accuracy level of ±20%.

General Description of SPS[2] Facilities

1. **Construction at the SPS Hitchland Substation**: See Appendix A, Figure A-1 for general vicinity location map of the SPS facility.

    a. **Location**: IC will build a new 345 kV line from their substation to SPS's 345 kV Hitchland Substation, in Hansford County, TX.

    b. **Bus Design**: The necessary 345 kV breakers, terminal structures, and other associated equipment has already been built to accommodate the output from the wind energy facilities. All that remains is the final connection by the IC and any associated work around those activities. Appendix A, Figure A-2, shows a preliminary one-line of the new 345 kV at Hitchland Substation. Figure A-3 shows the conceptual one-line diagram showing the combined GEN-2010-014 and GEN-2011-022 connection to a single POI at Hitchland. Figure A-4 shows a typical elevation view of the normal Point of Interconnection (POI).

    c. **Revenue Metering**: An individual billing meter will be installed at the SPS substation on the line terminal from the IC'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. Pulses out of the billing meter will be sent via SCADA to the Transmission Owner's Control Center in Amarillo, Texas.
        i. Wind Interconnections: two meters per line terminal will be installed
            1. One will be primary and the other will be a back up
        ii. Solar Interconnections: a single meter per line terminal will be installed
        iii. Coal, Natural Gas, hydro, other: a single meter per line terminal will be installed unless otherwise specified

    d. **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.

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

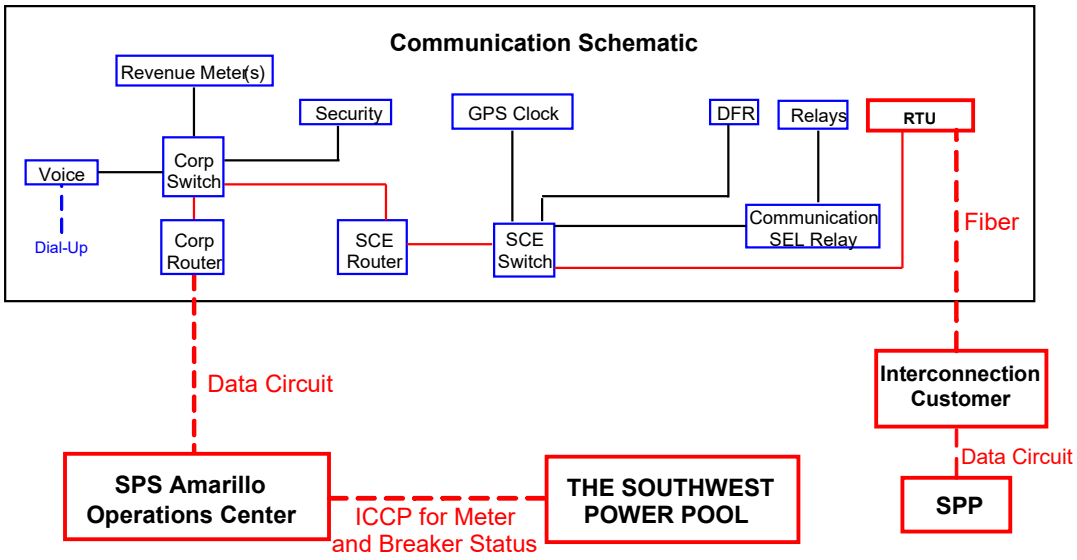
    f. **Communications**: To meet its Communications obligations, the IC shall be responsible for making arrangements with the local phone company to provide a communication circuit as required by the Transmission Owner. Transmission Owner equipment may include, but is not limited to the following: relay communication equipment, RTU, and disturbance monitoring equipment. Prior to any construction, the IC is required to contact the Transmission Owner

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

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:



IC shall be responsible for providing the fiber optic communication circuit installed in the overhead transmission line static wire from the customer substation to the SPS substation 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 – Engineering and Construction**

   a. **Coordination**: The Xcel Energy Transmission Engineering and Design groups require an engineering review of the customer's design prior to any construction by the IC or its contractor on any customer transmission lines, the proposed termination to the SPS substation, or doing work in close proximity to any SPS transmission line. It is the IC'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

   b. Fault or Short Circuit Study: The IC will coordinate with the System Protection Engineering department at SPS on the available fault current at the interconnection location following the acceptance of the Generator Interconnection Agreement (GIA) and prior to final design on the IC's facilities. The table below shows the approximate available fault current at the

interconnection location. The fault data does not contain fault current contribution from the IC's facility.

Table 1: Available fault current at interconnection location

Short Circuit Information without contribution from new Generator Facilities				
Fault Location	Fault Current (Amps)		Impedance (Ω)	
	Line-to-Ground	3–Phase	Z^+	Z^0
345 kV Bus	**	**	**	**

** Values are currently being shared with the customer from the SPS System Protection Engineering dept.

c. **Relaying**: SPS has already installed relaying at the POI per the previously signed GIA's associated with GEN-2010-014 and GEN-2011-022. Any changes in the relaying or communication could result in costs assigned to the IC to remove and install different equipment.

3. **Right-Of-Way**

a. Permitting: The IC will be responsible for any permitting and right of way of their substation and their transmission line from their substation to the Point of Interconnection (POI).

4. **Construction Power and Retail Service**

a. **Responsibility**: It is the sole responsibility of the IC to make arrangements for both construction and station power. The IC 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:**

a. **Collaboration**: Close work between the Transmission group, the IC's personnel and local operating groups will be imperative in order to meet any in-service date that has been established.

b. **Reactive Power Requirements**: The IC 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 lower voltage bus at IC'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. If switched reactive devices are used on the IC's system, they need to be switched in stages where the voltage rise is less than 3%.

6. **Estimated Construction Costs and Schedule**

a. The projects required for the combined interconnections of GEN-2010-014 and GEN-2011-022 at a single POI consist of the projects summarized in the table below:

Table 3: Required Interconnection Projects[3]

Project	Description	Estimated Cost
	Shared Network Upgrades:	
1	The current estimated shared network upgrades to be determined (TBD)	**See DISIS Report**
	Network Upgrades (at the IC's expense)	
2	Final connection by the IC and any associated work around those activities	$ **No Additional funds necessary**
	Subtotal:	**$ 0**
	Transmission Owner Interconnection Facilities (at the IC's expense)	
3	Communications [4]	*$ See footnote*
4	TOIF	$ **No Additional funds necessary**
	Subtotal:	**$ 0**
	Total Cost	**$ 0**

b. **Previous Funds**: SPS has received funds previously for the separate projects GEN-2010-014 and GEN-2011-022. Those remaining funds will be applied to the combined interconnections of GEN-2010-014 and GEN-2011-022 at the single POI at SPS' Hitchland Substation.

c. **Schedule**: An engineering and construction schedule for this project is estimated at less than two 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

d. All additional cost for work not identified in this study is the sole responsibility of the IC unless other arrangements are made.

[3] The cost estimates are 2021 dollars with an accuracy level of ±20%.

[4] It is the Requester's responsibility to provide both the data circuit and communication circuits, see Section 1.f

Appendix A

Figure A-1: General vicinity location map of the SPS facility

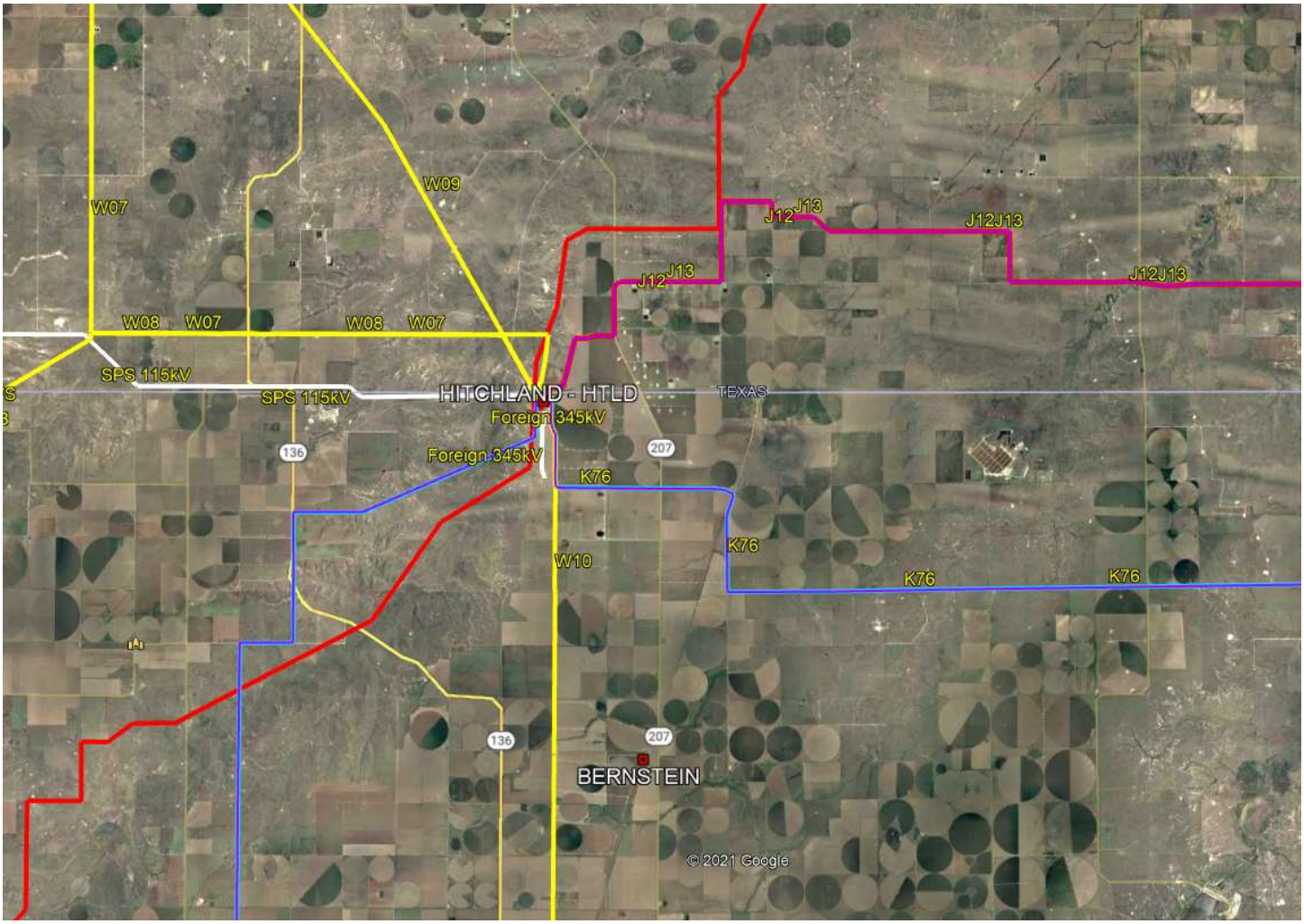


Figure A-2: One-line Diagram at Hitchland Substation

DIAGRAMS ARE NOT FOR CONSTRUCTION PURPOSES

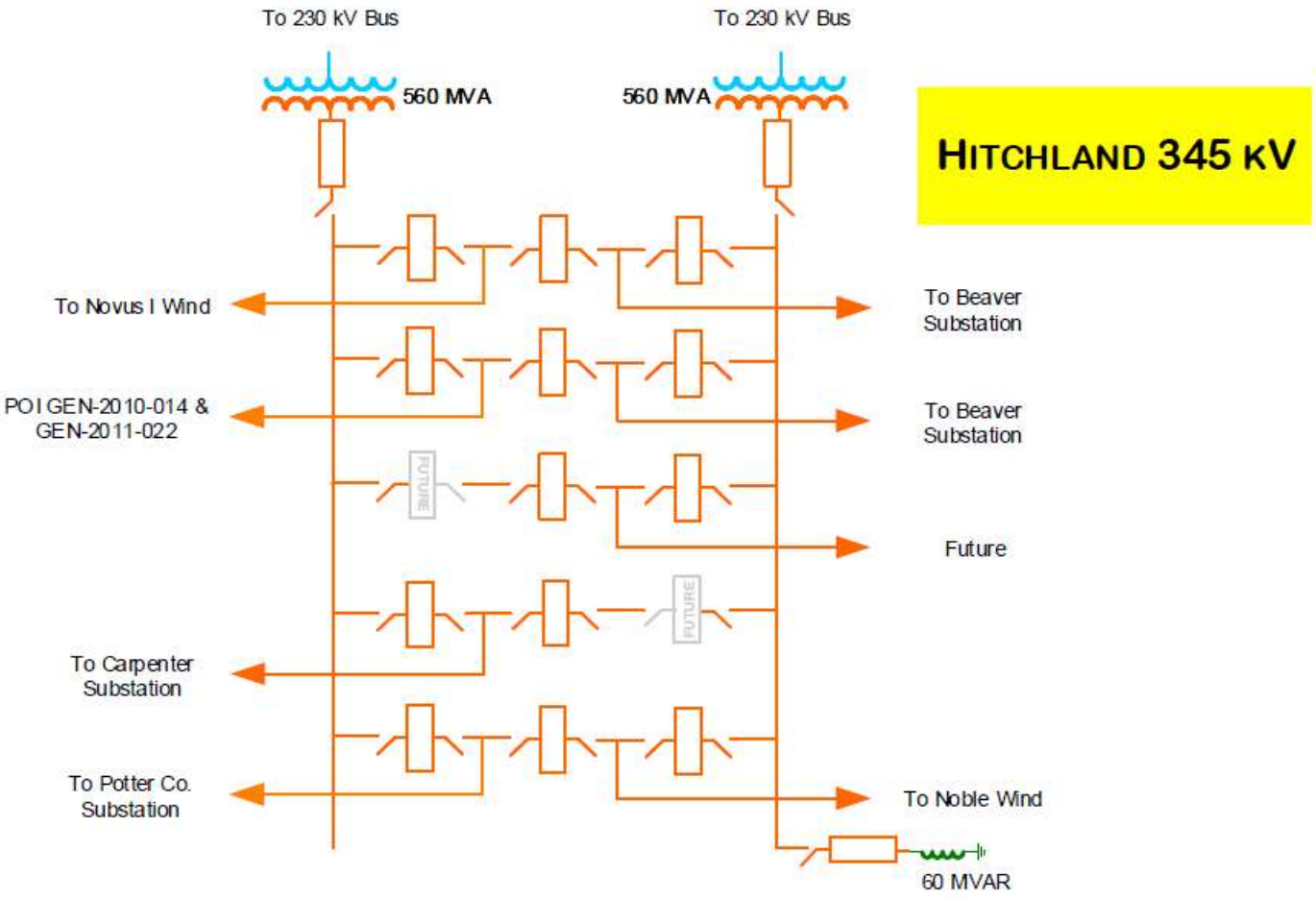


Figure A-3: One-line Diagram Showing the Combined
GEN-2010-014 and GEN-2011-022 Connection to Hitchland

DIAGRAMS ARE NOT FOR CONSTRUCTION PURPOSES

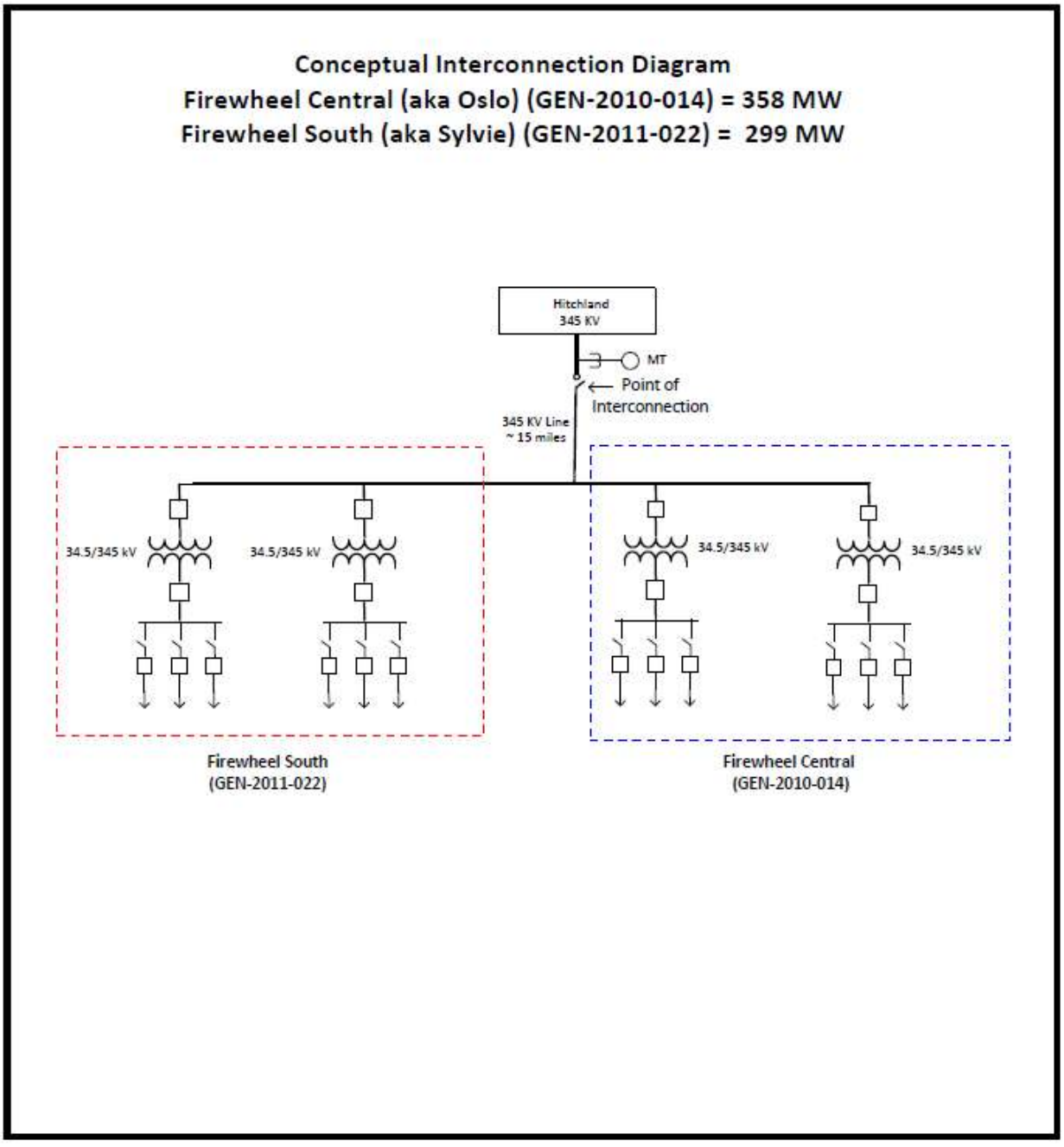
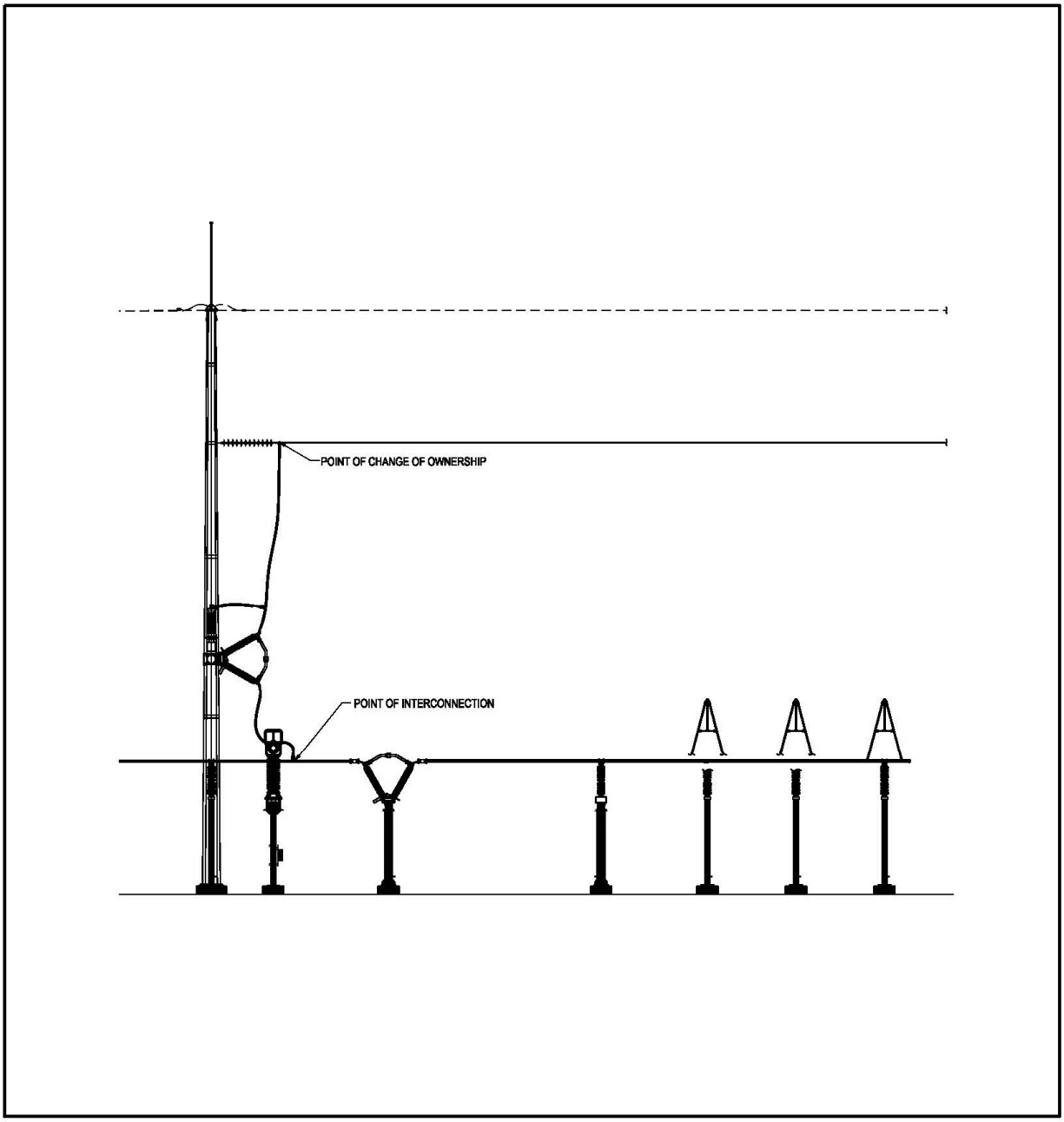


Figure A-4: Point of Interconnection & Change of Ownership Elevation (Typical)

DIAGRAMS ARE NOT FOR CONSTRUCTION PURPOSES



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