



***Facility Study  
For  
Generation Interconnection  
Request  
GEN-2008-016***

***SPP Generation Interconnection Studies  
(#GEN-2008-016)***

**Revised April 2012**

## **Summary**

Xcel Energy Inc. (SPS) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2008-016 (248 MW). The originally proposed in-service date was May 1, 2011. 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**

Due to transmission constraints the original amount of requested interconnection service for 248 MW will be limited until Transmission Owner Interconnection Facilities and Network Upgrades can be constructed. Interconnection Service will be available but limited to 100 MW after construction of the Transmission Owner Interconnection Facilities can be completed, currently estimated for completion June 30, 2014. The service will remain capped at 100 MW until the remainder of the Network Upgrades can be completed, currently estimated for completion March 1, 2018.

## **Interconnection Customer Interconnection Facilities**

The Interconnection Customer will be responsible for the transmission facilities connecting the customer owned substation to the Point of Interconnection (POI), Grassland North which will be a new SPS 230 kV substation to be located on the Jones – Grassland 230 kV transmission line. The 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.

## **Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades**

To allow interconnection the Transmission Owner will need to construct a new 230 kV four-breaker ring-bus substation and associated equipment for acceptance of the Interconnection Customer's Interconnection Facilities. The estimated in-service date for these Interconnection Facilities is June 30, 2014. At this time the Customer is responsible for **\$2,518,914** of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades.

## **Shared Network Upgrades**

The interconnection customer was studied within the ICS-2008-001 Impact Study. At this time, the Interconnection Customer is allocated **\$0** 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.

## **Other Network Upgrades**

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

1. TUCO – Border – Woodward 345kV transmission line, scheduled for May 19, 2014 in-service
2. Hitchland-Woodward double circuit 345kV transmission line scheduled for June 30, 2014.
3. Grassland 230/115kV 150MVA Transformer replacement, scheduled for June 1, 2015 in-service
4. Wolfforth – Grassland North 230kV, scheduled for March 1, 2018 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-2008-016 will be delayed until the Transmission Owner Interconnection Facilities are constructed, estimated at June 30, 2014. The Customer is responsible for **\$2,518,914** of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is allocated **\$0** for Shared Network Upgrades. Interconnection Service will be capped at 100 MW until the ALL of the Other Network Upgrades, specifically Wolfforth - Grassland North 230 kV is placed into service approximately March 1, 2018. After all Network Upgrades previously noted have been placed into service, Interconnection Service for 248 MW, as requested by GEN-2008-016, can be allowed. At this time the total allocation of costs of Interconnection Service for GEN-2008-016 are estimated at **\$2,518,914**.



**Facilities Study For  
Southwest Power Pool (SPP)  
Revised October 2011**  
248 MW Wind-Generated Energy Facility  
100 MW (Stage I)  
248 MW (Stage II)  
Lynn County, Texas  
SPP #GEN-2008-016 (Revised)

April 16, 2012

Xcel Energy Services, Inc.  
Transmission Planning

## Executive Summary

“Interconnection Customer” in 2008 requested the interconnection of a wind energy facility located in Lynn County, Texas to the Southwestern Public Service Company (SPS) transmission network. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. This facility has a net capacity of 248 MW. Stage I will be limited to 100 MW and Stage II will be for 248 MW. The Point of Interconnection is at the new 230 kV Switching Station (Grassland North) located north of Grassland Interchange located approximately 7 miles east of Tahoka, Texas. The Interconnection Customer’s original requested commercial operation date was May 1, 2011 and back-feed date of January 10, 2011.

The Southwest Power Pool (SPP) evaluated the request to interconnect the wind farm facility to the SPS transmission system in a Definitive Interconnection System Impact Re-Study (DISIR) GEN-2008-016, completed in October 2011. The interconnection request was studied using one hundred eight (108) Siemens SWT2.3-100 Wind Turbines at 2.3 MW each for a total output of 248.4 MW. The Interconnection Customer is required to maintain a Power Factor of 0.95 lagging and 0.95 leading at the Point of Interconnection (POI), and is required to build capacitor banks on the 34.5 kV side of their collector’s 230/34.5 kV transformer per FERC and SPP Tariff requirements.

In order to interconnect the requested generation of 248 MW, the system upgrades identified by SPP in DISIR report, require a new 230 kV transmission line be built from SPS’ Wolfforth Interchange to Grassland North Switching Station. Until the 230 kV transmission line is built from Wolfforth Interchange to Grassland North Switching Station, which has an in-service date of 3-1-2018 the capacity of the wind farm is limited to 100 MW. This 100 MW of interconnection service will be available after June 30, 2014.

SPS requires that all construction for this request be in compliance with the latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Producer-Owned Generation Greater Than 20 MW available at:

[http://www.xcelenergy.com/Energy\\_Partners/Generation\\_Owners/Interconnection\\_Guidelines/Interconnections\\_for\\_Transmission](http://www.xcelenergy.com/Energy_Partners/Generation_Owners/Interconnection_Guidelines/Interconnections_for_Transmission)). This document describes the requirements for connecting new generation to the Xcel Energy transmission systems including technical, protection, commissioning, operation, and maintenance. Also, this document has a section on Frequency and Frequency Control for the SPP Region in Section II.H.3, which allows SPS under SPP criteria, to open tie lines at 58.5 Hz and automatically trip generators. Due to the structure of the under-frequency load-shedding plan, it is necessary that generators be able to sustain frequencies to at least 58.5 Hz. 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 the cost of the Interconnection Facilities, installation of their capacitor banks and any Direct Assigned Interconnection Facilities; inclusive of all construction required for the 230 kV transmission line from the Interconnection Customer’s substation to the SPS Grassland Interchange.

As for this request (GEN-2008-016), it is anticipated that the entire process of building a new 230 kV Switching Station at Grassland North for the acceptance of the wind farm facility output will require approximately 18 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 wind farm facility, is shown below in Table 1.

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

Transmission Owner Network Upgrades:	<b>\$ 2,281,842</b>
Transmission Owner Interconnection Facilities:	<b>\$ 237,152</b>
<b>Total:</b>	<b>\$ 2,518,994</b>

<sup>a</sup> The cost estimates are 2012 dollars with an accuracy level of ±20%.

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

1. **Construction of New Switching Station:** See Appendix A, Figure A-1 for general vicinity location map.
  - 1.1. **Location:** SPS will build a new 230 kV switching station (Grassland North) north of the existing SPS Grassland Interchange. Appendix A, Figure A-2 shows a one-line of the new breaker configuration at Grassland North. Figure A-3 shows a typical elevation view of the Point of Interconnection (POI).
  - 1.2. **Bus Design:** The interconnection shall be to the new Grassland North Switching Station, which is a 4-ring breaker configuration with the future to become breaker and half. This station will accommodate the outputs from the wind energy 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 2,000 pounds per phase conductor at maximum tension, with a maximum 15-degree pull off from normal.
  - 1.4. **Control House:** The new control house for the proposed switching station will be utilized to house 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 switching station will have a 7 foot chain-link fence with steel posts set in concrete with 1-foot of barbed wire on the top in a “V” configuration. The enclosed area will be approximately 400’ x 400’, with a rock yard surface.
  - 1.6. **Ground Grid:** A complete ground grid will be installed 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:** A 133 kV/120-240volt transformer tapped off of the 230 kV bus will provide station power. A backup station power source will be taken from local distribution if it is available or a generator will be installed if none is available. A flip-flop to automatically transfer the station power will be installed.
  - 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 421-1 will be used as primary and secondary relays, respectively. The SEL 421-1 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. Modifications at Jones Station and Grassland Interchange will be required.

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

An SEL DTA-2 will display the bus voltage, GCB amps, MW, MVAR, and fault location. An SEL 2032 will be installed for relay communications and other functions as required.

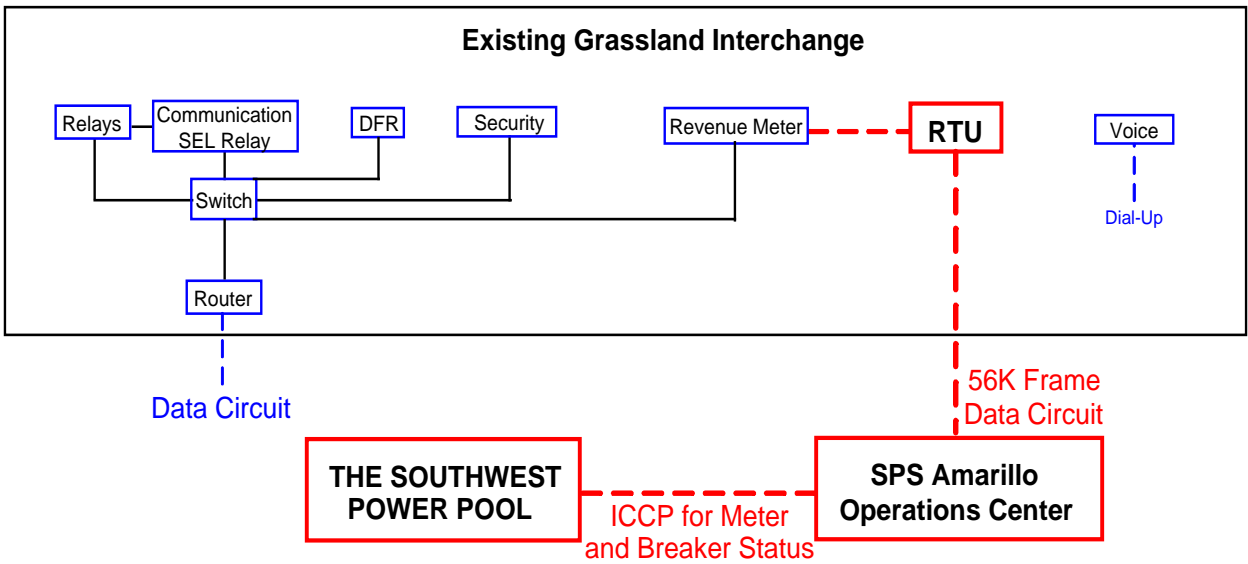
- 1.10. **Revenue Metering:** On the proposed SPS new Grassland North Switching Station on the 230 kV line terminal to the Interconnection Customer's substation, an individual billing meter will be installed along with a meter per ANSI C12.1 accuracy class 0.2 (3-PT's IEEE C57.13 accuracy class 0.3 and 3-CT's IEEE C57.13 accuracy class 0.15) for full 3-phase 4-wire metering. Also installed for the metering units will be 3-PT's and 3-CT's 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:** 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 dial-up communications telephone circuit.
- 1.12. **Remote Terminal Unit (RTU):** A new RTU will be utilized for communications for the new 230 kV switching station at Grassland North. SPS will provide and install 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 at the new Switching Station. 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:



The Interconnection Customer shall be responsible for providing fiber optic communication circuit installed in their overhead transmission line static wire for protective relaying from the customer substation to the new 230 kV Switching Station.

## 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 Grassland North Switching Station. This line is shown in Appendix A, Figure A-1 and is estimated to be 2 miles. **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 Grassland North Switching Station will be delayed until the matters are resolved. SPS will not be held responsible for these delays.**

## 3. Right-Of-Way:

3.1. **Permitting:** Permitting for the construction of a new 230 kV line terminal at Grassland North Switching Station 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 Interconnection Point at Grassland Interchange.

4. **Construction Power and Distribution 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 distribution service) and the Interconnection Customer needs to make arrangements for distribution service from the local retail provider.**

## 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 of 0.95 lagging and a 0.95 leading at the Point of Interconnection (POI). 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.

6. **Fault Current Study:** The available fault current at the new Grassland North Switching Station at the interconnection location, without any contribution from the wind farm facilities, is shown in Table 2.

**Table 2, - Available fault current at interconnection location**

Short Circuit Information without contribution from Wind Farm Facilities (GEN 2008-016)				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
230 kV Bus	1,531	5,510	$2.410 + j23.981$	$7.457 + j37.941$

## Estimated Construction Costs

The projects required for the interconnection of this 100 MW Wind Farm facility consist of the projects summarized in the table 3 below.

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

Project	Description	Estimated Cost
	<b>Transmission Owner Network Upgrades</b>	
1	Disturbance Fault Recorder	\$ 51,346
2	Transmission Line Work (In and Out)	\$ 614,652
3	Land, 40 Acres	\$ 113,608
4	230 kV bus for new 230 kV connection point to wind farm. (Reliability Issue is to build new 4-breaker ring 230 kV station expandable to breaker and half at total cost of \$ 4,737,505, Interconnection Customer's allocation shown.)	\$ 1,502,236
	<b>Subtotal:</b>	<b>\$2,281,842</b>
	<b>Transmission Owner Interconnection Facilities (at the Interconnection Customer's expense)</b>	
5	Communications <sup>d</sup>	\$ See footnote
6	Remote Terminal Unit (RTU)	\$ 4,500
7	Revenue metering	\$ 225,000
8	230 kV Line arrestors	\$ 7,652
	<b>Subtotal:</b>	<b>\$ 237,152</b>
	<b>Total Cost</b>	<b>\$ 2,518,994</b>

There is a network upgrade to build a 230 kV line from Wolfforth to Grassland North scheduled to be in-service in 2018, which would allow the wind farm to increase their interconnection request to 248 MW at Grassland North. No schedule is provided for the projects noted as network upgrades for the interconnection.

### Engineering and Construction:

An engineering and construction schedule is estimated at approximately 18 months based on the new purchase. 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.

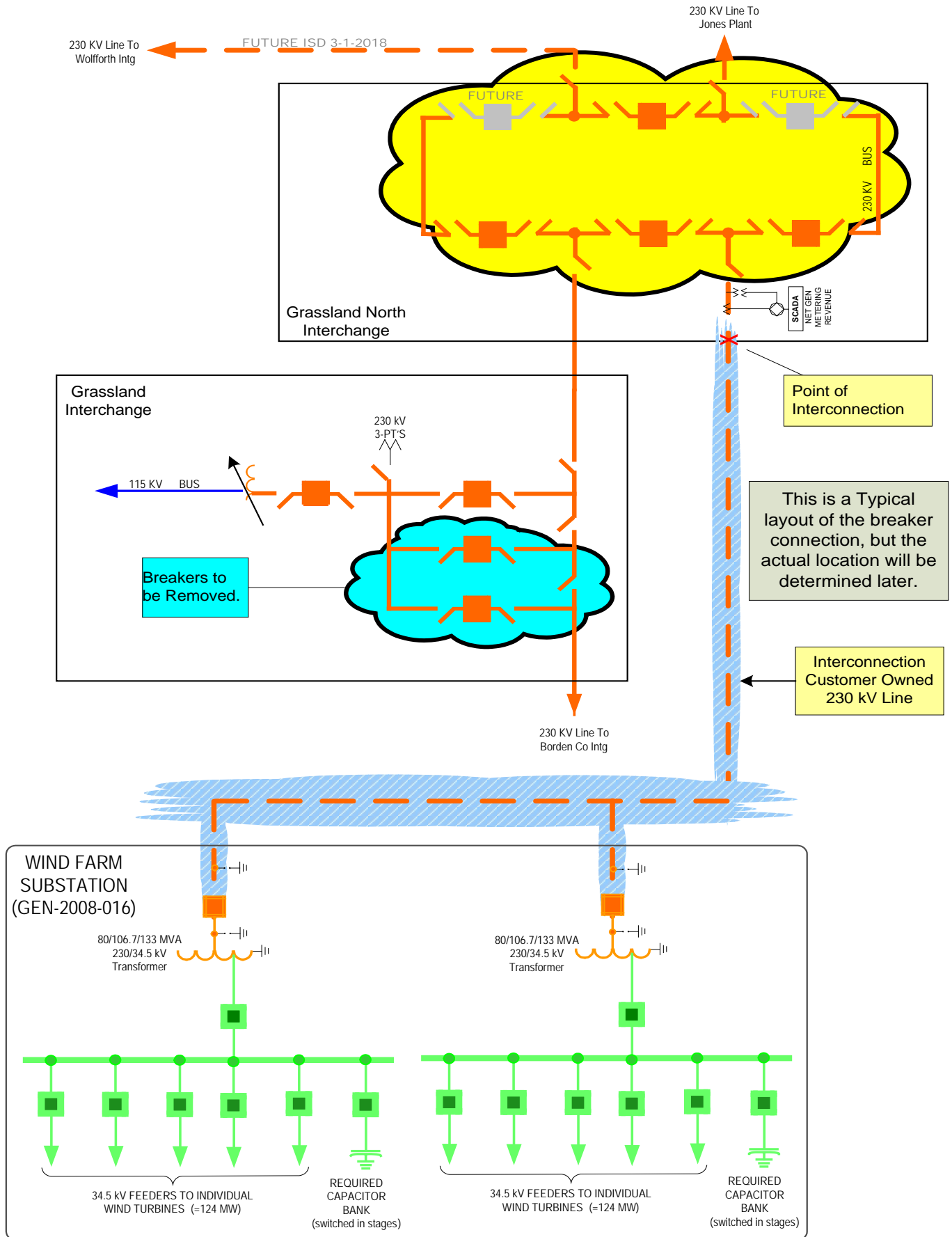
<sup>c</sup> The cost estimates are 2012 dollars with an accuracy level of ±20%.

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

## Appendix A



Figure A-1 Approximate location of Grassland North Switching Station

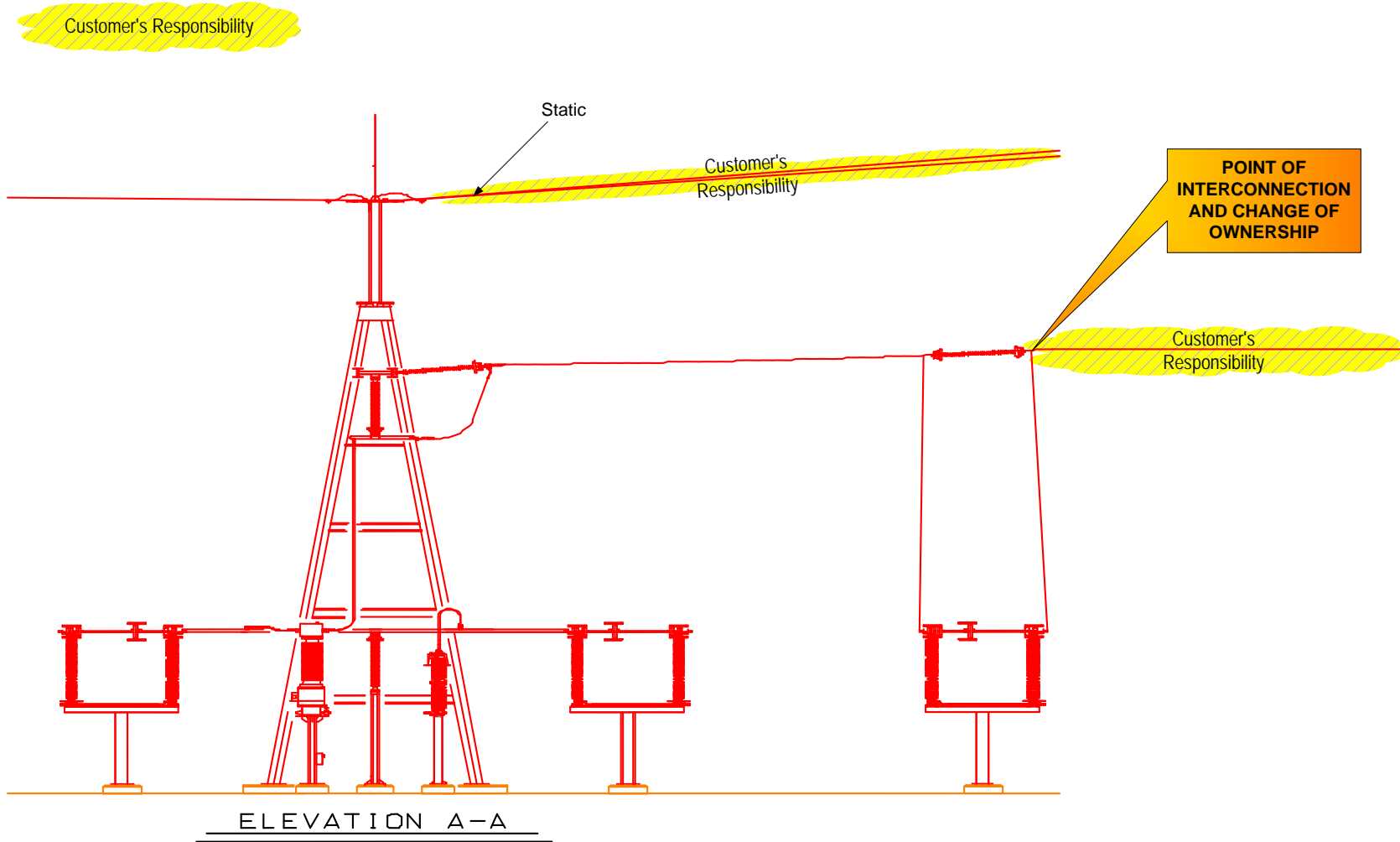


Interconnection is limited to 100 MW until the Wolforth to Grassland North 230 kV transmission line is installed, then 248 MW can be interconnected from the Wind Farm.

**Figure A-2 One-line Diagram of Grassland North Switching Station**



**CUSTOMER SHALL PROVIDE  
ALL MATERIAL FOR DEAD  
ENDING PHASES AND STATIC  
TO 230 kV DEAD END TOWER.**



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

*– END OF REPORT –*