



***Facility Study  
For  
Generation Interconnection  
Request  
GEN-2008-110***

***SPP Generation  
Interconnection***

***(#GEN-2008-110)***

**April 2011**

## **SPP Summary**

Xcel Energy Inc. (Xcel) performed a detailed Facility Study at the request of Southwest Power Pool (SPP) for Generation Interconnection request GEN-2008-110. The interconnection of the 300 MW generation facility located in Texas County, Oklahoma is in the control area of the Southwestern Public Service Company (SPS) transmission network. SPS is a New Mexico Corporation and wholly owned subsidiary of Xcel Energy Inc. 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.

## **Interconnection Customer Interconnection Facilities**

The Interconnection Customer will be responsible for the 345 kV transmission line from its generator facility substation to the Point of Interconnection (POI), the existing Hitchland 345 kV Interchange. Additionally, 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. Any capacitor banks installed by the Customer shall not cause voltage or other distortion on the transmission system in accordance with Article 9.7.6 of the Standard GIA, Power Quality.

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

Per the following Facility Study, the Interconnection Customer is responsible for **\$3,307,387** of Transmission Owner Interconnection Facilities and non-shared network upgrades.

## **Shared Network Upgrades**

The interconnection customer was studied within the DISIS-2010-001-1 Impact Restudy (January 2011). At this time, the Interconnection Customer is allocated the following costs for shared network upgrades:

<b>Upgrade Type</b>	<b>Allocated Costs</b>
Build 105 miles of double circuit 345 kV transmission line from Hitchland to mid-point of TUCO to Woodward 345 kV line. Includes substation work at Hitchland and Border	\$72,910,076
Add -50/+100MVAR SVC at Hitchland 230kV substation	\$3,975,265
<b>Shared Network Upgrade Costs - TOTAL</b>	<b>\$76,885,340</b>

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 transmission line,
2. Tuco – Woodward 345kV transmission line,
3. Medicine Lodge – Woodward 345kV double circuit transmission line, and
4. Medicine Lodge – Wichita double circuit 345kV transmission line.

These network upgrades are not schedule to be in service until December 31, 2014. Depending upon the status of higher or equally queued customers, the Interconnection Customer's in service date may be delayed until the in service date of these Network Upgrades.



**Facilities Study For  
Southwest Power Pool (SPP)**  
300 MW Wind-Generated Energy Facility  
Texas Co., Oklahoma  
SPP #GEN-2008-110

February 8, 2011

Transmission Asset Management  
Southwestern Public Service

<Omitted text> in November 2008 (“Interconnection Customer”) requested the interconnection of a wind energy facility located in Texas Co., Oklahoma 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 300 MW. The Interconnection Customer’s facility will connect to the SPS Hitchland Interchange located in Hansford Co., Texas approximately fourteen (14) miles south of Guymon, Oklahoma. The Interconnection Customer’s expected commercial operation date and back feed date is 7/31/2011 and 5/31/2011 (estimated date) respectively.

The Southwest Power Pool (SPP) originally evaluated the request to interconnect the wind farm facility to the SPS transmission system in a System Impact Study (SIS) (GEN-2008-110) completed in July 2010. The original interconnection request was studied using two-hundred-(200) General Electric wind turbines at 1.5 MW each for a total output of 300 MW. The Interconnection customer is required to provide necessary capacitor banks to provide 145 MVAR of reactive capability at the point of interconnection and to maintain a Power Factor of 0.95 lagging and 0.95 leading at the Point of Interconnection (POI), based on SPP SIS for Cluster Group 2. See Table 2-1.

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, is available at ([http://www.xcelenergy.com/Texas/Company/Transmission/Pages/Transmission\\_Services\\_Interconnection\\_Guidelines.aspx](http://www.xcelenergy.com/Texas/Company/Transmission/Pages/Transmission_Services_Interconnection_Guidelines.aspx)). This document describes the requirements for connecting new generation to the Xcel Energy transmission systems including technical, protection, commissioning, operation, and maintenance. 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, and any Direct Assigned Interconnection Facilities; inclusive of all construction required for the 345 kV transmission line from the Interconnection Customer’s substation to the SPS Hitchland Interchange. The Interconnection Customer is also responsible for obtaining any permits and/or Certificate of Convenience and Necessity (CCN) for building their 345kV transmission lines from the Public Utility Commission of Oklahoma and/or Texas.

As for this request (GEN-2008-110), it is anticipated that the entire process of adding the new 345 kV line terminal at Hitchland Interchange for the acceptance of the wind farm facility output will require approximately 15 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, with the detailed description of the cost shown in Table 3.

**Table 1, Cost Summary, Hitchland Interchange**

SPS Network Upgrades:	\$3,000,012
Interconnection Facilities <sup>1</sup> :	\$ 307,375
Total:	\$3,307,387

<sup>1</sup> This is a direct assigned cost to the Interconnection Customer.

1. **Construction of New Line Terminal:** See Figure A- 1 Appendix A, for general vicinity location map.
  - 1.1. **Location:** SPS will add a new 345 kV line terminal at the existing SPS Hitchland Interchange. Appendix A, Figure A-2 shows the one-line diagram of the Interchange, while Appendix A, Figure 3 shows a typical elevation view of the Point of Interconnection (POI).
  - 1.2. **Bus Design:** The new 345 kV line terminal will be added to the existing 345 kV bus at Hitchland Interchange to accommodate the output from the wind energy facility. The existing bus design at Hitchland Interchange is breaker and a half scheme as shown in the one-line diagram in Figure A-2, Appendix A.
  - 1.3. **Line Terminals:** The 345 kV lines and static wire terminals will be designed to accommodate 14,000 pounds per phase conductor (28,000 per bundle) at maximum tension, with a maximum 15° pull-off angle from normal.
  - 1.4. **Control House:** The existing control house will be utilized to accommodate the new metering, protective relaying and control devices, terminal cabinets, and any fiber-optic cable terminations, etc. for the new 345 kV line breaker terminal.
  - 1.5. **Security Fence:** The existing security fence shall be extended if required when the new branch is added for the new 345 kV line terminal.
  - 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.

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<sup>2</sup> All modifications to SPS facilities will be owned, maintained and operated by SPS.

- 1.8. **Station Power:** The existing station power, provided from the local distribution system, and a pad mounted transformer fed from tertiary winding of the 345/115 kV transformer, will be utilized.
- 1.9. **Relay and Protection Scheme:** The new 345 kV breaker line terminal primary protections to the interconnection customer's 345 kV transmission line will use line current differential relaying over optical fiber installed in the static of the customer's 345 kV transmission line. Secondary relaying will use mirrored bit, Permissive Overreaching Transfer Trip (POTT) over the optical fiber. AN SEL 311L and a 421 will be used as primary and secondary relays, respectively. No automatic re-closing scheme will be used. The SEL 421 will be used for line/bus SCADA closing conditions for the 345 kV breakers. A SEL 501-0 will be used for breaker failure.

AN SEL DTA-2 will display the bus voltage, GCB amps, MW, MVAR, and fault location.

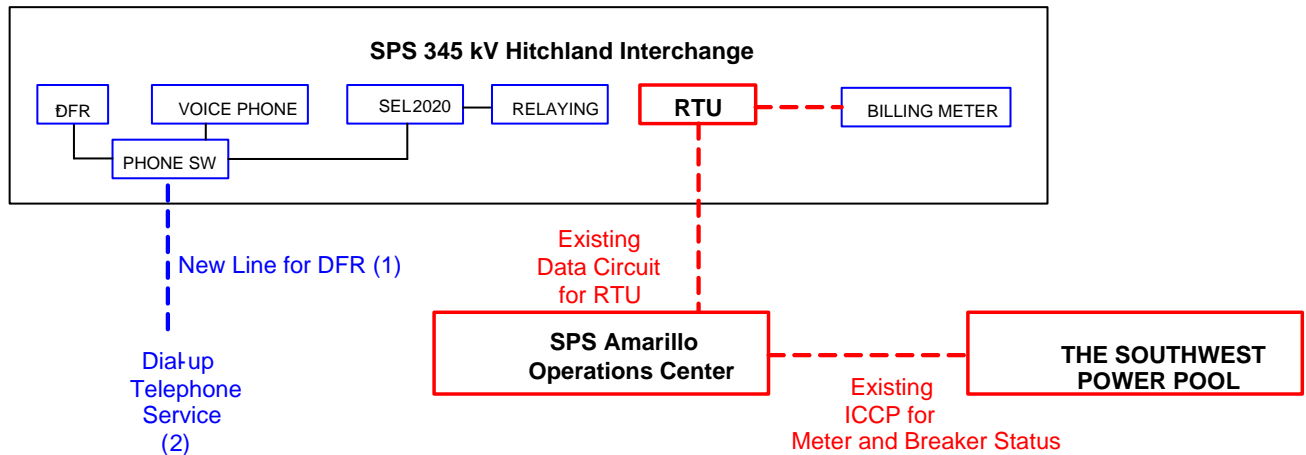
- 1.10. **Revenue Metering:** On the existing SPS Hitchland Interchange 345 kV line terminal at the Customer's Point of Interconnection to the Interconnection Customer's switching station, an individual billing meter will be installed along with a meter per ANSI C12.1 accuracy class 0.2 (3-PT's IEEE 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 optical 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-monitoring equipment (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 synch 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):** The existing RTU will be utilized to accommodate the new 345 kV line terminals at Hitchland 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 under Article 8 of the GIA, 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 Hitchland Interchange. Prior to any construction, the Interconnection Customer is required to contact the Transmission Owner substation-engineering department for all communication details.

A schematic outlining the proposed communications is provided below:



To facilitate its compliance with Appendix D of the GIA, 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’s substation to Hitchland Interchange.

## 2. Transmission Work:

- 2.1. The Interconnection Customer will construct, own, operate, and maintain the 345 kV transmission line from the Interconnection Customer’s switching station to the Interconnection Point at SPS Hitchland Interchange as shown in Appendix A, Figure A- 3. ***The SPS transmission design group prior to any construction by the***

***Interconnection Customer or its contractor on any customer 345 or 115 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 SPS Hitchland Interchange will be delayed until the matters are resolved. SPS will not be held responsible for these delays.***

3. Right-Of-Way and Permits:

3.1. **Permitting:** The Texas Public Utility Commission will not require a permit for the construction of a new 345 kV line terminal to receive output from the Customer's wind farm facility at Hitchland Interchange. The interconnection customer will be responsible for any permitting and right of way of their substation, switching station, and the 345 kV transmission lines from their Switching Station to the Interconnection Point at Hitchland 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 and switching station. **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 It is understood that the Capacitor Banks will be installed at the Interconnection Customer's substation on the 34.5 kV bus side to avoid voltage spikes on the 345 kV that adversely affects the Xcel Energy transmission system. The Interconnection customer will be required to maintain a Power Factor of 0.95 lagging and 0.95 leading at the Point

of Interconnection (POI) by using switched capacitor banks, which is based on SPP's Impact Cluster Study under Group 2 on page 15. The capacitor banks need to be switched in stages of 20 MVAR or less. 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:

[http://www.xcelenergy.com/Texas/Company/Transmission/Pages/Transmission\\_Services\\_Interconnection\\_Guidelines.aspx](http://www.xcelenergy.com/Texas/Company/Transmission/Pages/Transmission_Services_Interconnection_Guidelines.aspx).

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

**Table 2, - Available fault current at Point of Interconnection Location**

<b>Short Circuit Current Availability at Hitchland Interchange without contribution from GEN 2008-110</b>				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
345 kV Bus	4,408	4,233	4.193+j46.867	3.3+j41.322

<b>Short Circuit Current Availability at Hitchland Interchange without contribution from GEN 2008-110 But with the addition of all the Proposed Infrastructure Transmission Lines by SPP.</b>				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
345 kV Bus	Not Available	8,289 @-116°	Not Available	Not Available

Estimated Construction Costs

The projects required for the interconnection of this 300 MW Wind Farm facility consist of the projects summarized in the table below.

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

Project	Description	Estimate
	SPS Network Upgrades	
1	Transmission Line Work and ROW <sup>4</sup> :	\$ 0
2	345 kV Line Terminal for Wind Farm Facility GEN 2008-110	\$ 3,000,012
	Subtotal:	\$ 3,000,012
	Interconnection Facilities (at the Interconnection Customer's expense)	
3	Communications <sup>5</sup>	\$ See footnote
4	Revenue metering	\$ 250,000
5	345 kV Line arrestors	\$ 57,375
	Subtotal:	\$ 307,375
	Total Cost:	\$3,307,387

Engineering and Construction:

An engineering and construction schedule for the installation of the 345 kV line terminals is estimated at approximately 15 months. Other factors associated with clearances, equipment delays and work schedules could cause additional delays. The schedule is applicable after all required agreements are signed, and internal approvals are granted.

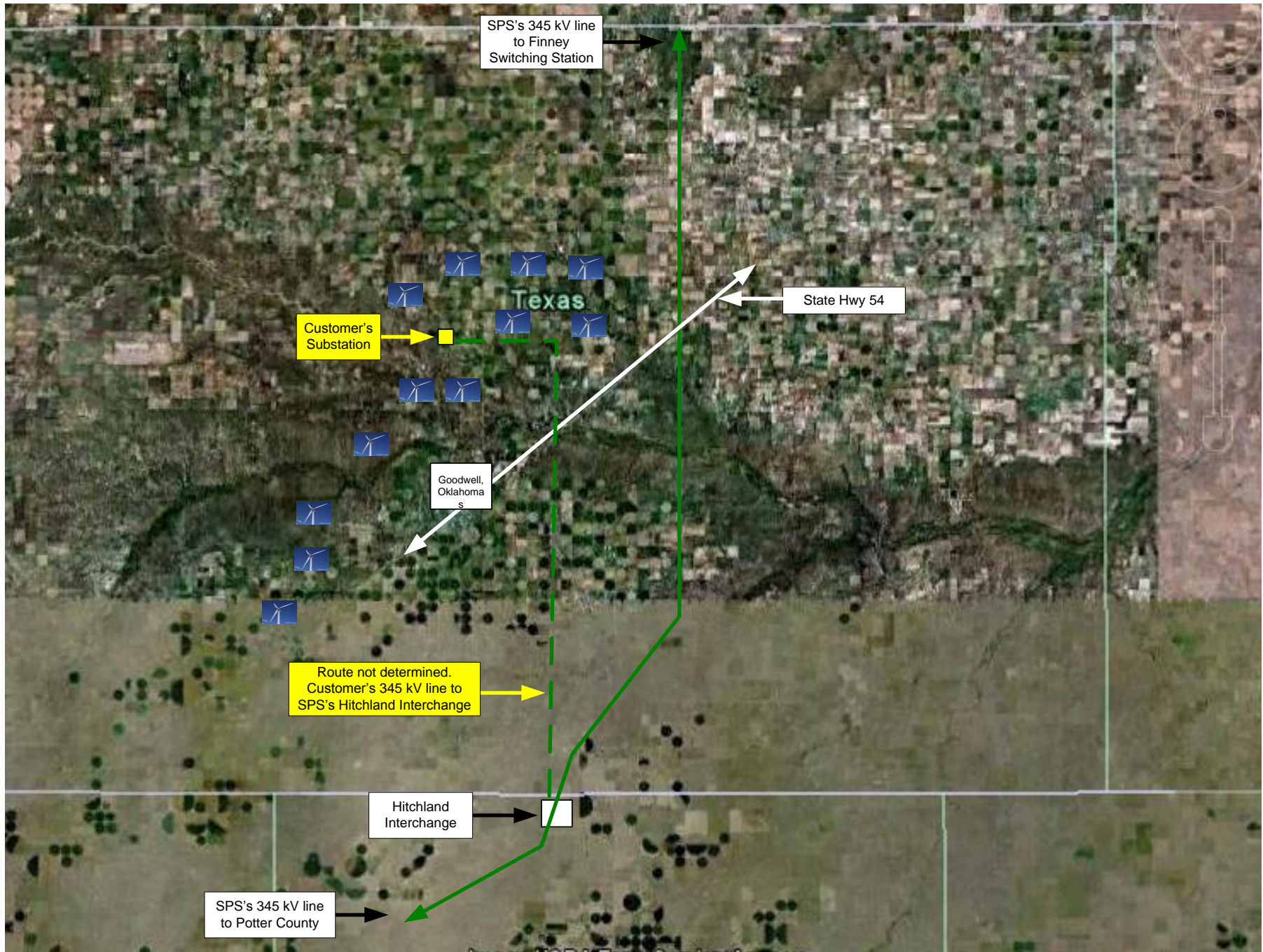
<sup>3</sup> The cost estimates are 2010 dollars with an accuracy level of ±20% except as noted, with AFUDC added.

<sup>4</sup> Transmission work cost estimate has an accuracy level of ±20% because of unknown Right of Way (ROW) information.

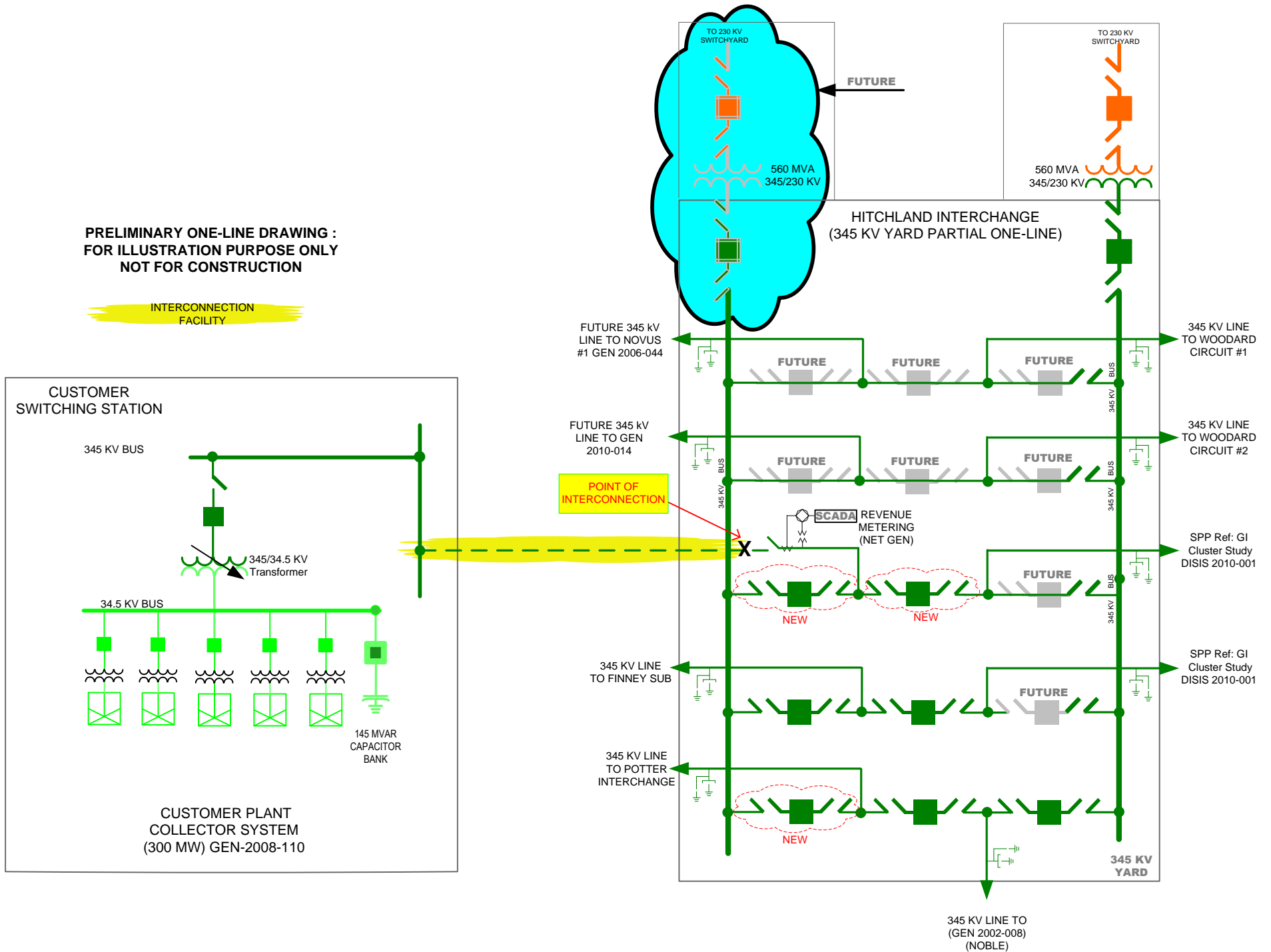
<sup>5</sup> It is the Requester's responsibility to provide both the data circuit and both dial-up telephone circuits, see Section 1.13.

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



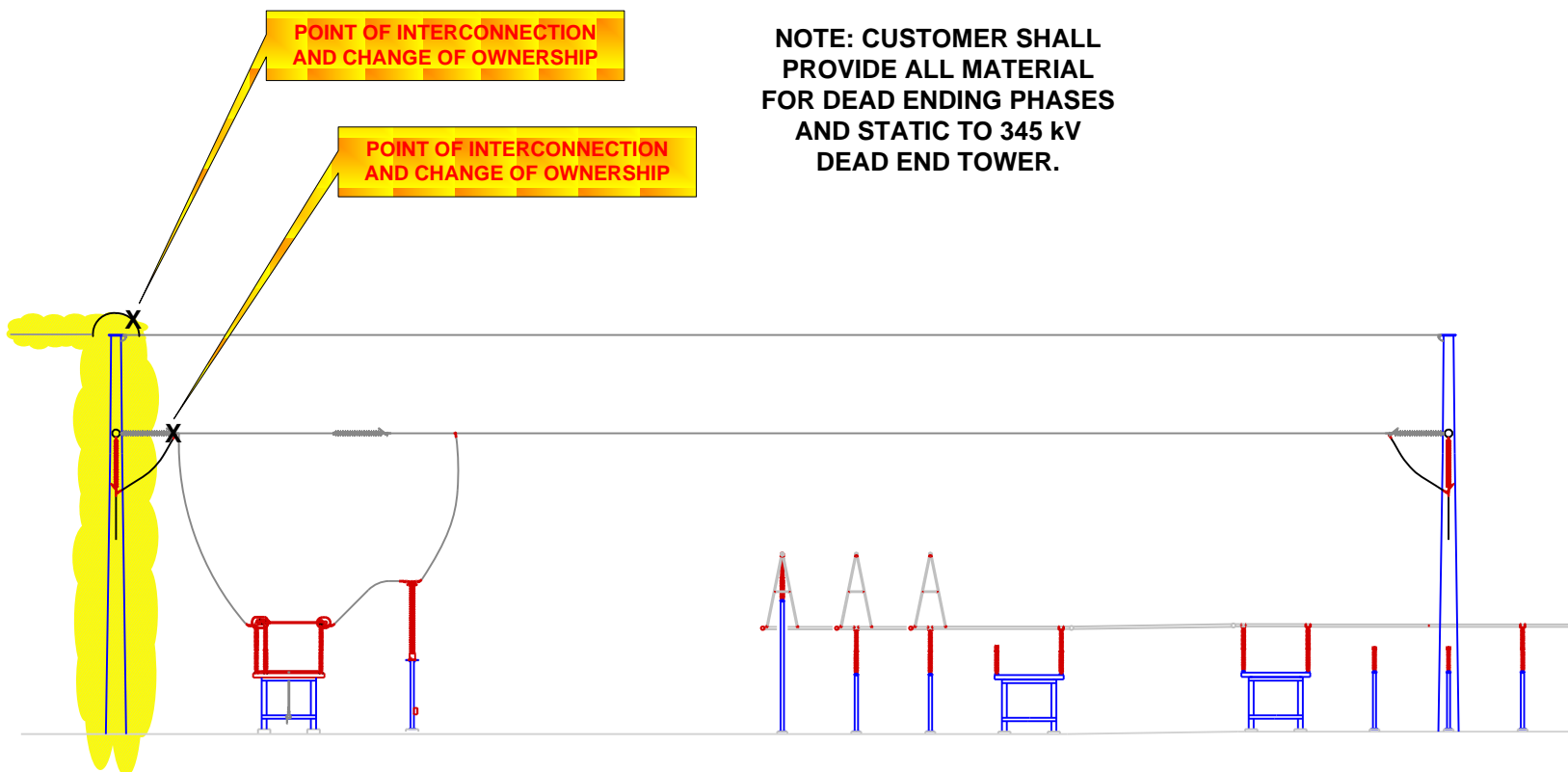


**Figure A- 1 Approximate location of proposed Wind Farm Facility**



**Figure A- 2 One-line Diagram of Hitchland Interchange to Customer Interconnection Facility**





**NOTE: CUSTOMER SHALL PROVIDE ALL MATERIAL FOR DEAD ENDING PHASES AND STATIC TO 345 kV DEAD END TOWER.**

**THIS DRAWING ILLUSTRATES ONLY THE POINT OF INTERCONNECTION AND THE BOUNDARIES OF CUSTOMERS RESPONSIBILITY. IT MAY NOT BE USED FOR CONSTRUCTION**

Customer's Responsibility

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

*– END OF REPORT –*