



***Facility Study  
For  
Generation Interconnection  
Request  
GEN-2011-022***

***SPP Generation  
Interconnection***

***(#GEN-2011-022)***

**April 2013**

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## Revision History

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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)

## 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 (299 MW). 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 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 \$3,281,972 of Transmission Owner Interconnection Facilities and non-shared network upgrades.

## Shared Network Upgrades

The interconnection customer was studied within the DISIS-2011-001 Impact Study. At this time, the Interconnection Customer is allocated \$57,826,554.50 for shared network upgrades.

Upgrade Description	Allocated Cost	Total Cost
Beaver County - Buckner 345kV Build approximately 90 miles of 345kV from Beaver County - Buckner (construction by OKGE)	\$9,517,505.86	\$105,609,050.00
Beaver County - Buckner 345kV Build approximately 90 miles of 345kV from Beaver County - Buckner (construction by Sunflower)	\$5,821,763.18	\$64,600,000.00
Beaver County 345kV Expansion. Tap and tie in Hitchland - Woodward circuit #2.	\$315,420.61	\$3,500,000.00
Matthewson - Cimarron 345kV circuit #2. Build second 345kV transmission line from Matthewson to Cimarron.	\$2,322,882.05	\$42,903,753.00
Tatonga - Matthewson 345kV circuit #2. Build Matthewson substation. Build second 345kV transmission line from Tatonga to Matthewson.	\$8,167,221.70	\$104,260,473.00
Total	\$57,826,554.50	

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 \$3,281,972 of Transmission Owner Interconnection Facilities and Non-Shared Network Upgrades. At this time, the Interconnection Customer is also allocated \$57,826,554.50 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 \$61,108,526.50.



**Facilities Study For  
Southwest Power Pool (SPP)**  
299 MW Wind-Generated Energy Facility  
Hansford County, Texas  
SPP #GEN-2011-022

November 10, 2011

Transmission Asset Management  
Southwestern Public Service

## Executive Summary

[omitted text] (“Interconnection Customer”) requested the interconnection of a wind energy facility located in Hansford 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 299 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 11/30/2014 and 9/15/2014 respectively.

The Southwest Power Pool (SPP) originally evaluated the request to interconnect the wind farm facility to the SPS transmission system in a Definitive Interconnection System Impact Study (DISIS)-2011-001 for GEN-2011-022, which was completed in July 2011. The original interconnection request was studied using one-hundred-thirty (130) Siemens wind turbines at 2.3 MW each for a total output of 299 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) on the 345 kV, based on SPP’s DISIS-2011-001 for Cluster Group 2. The customer is required to add the capacitor banks on the 34.5 kV side of their collector’s 345/34.5 kV transformer. The customer does not show the size of the capacitor bank on their one-line diagram.

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/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. This document also has a section on Frequency and Frequency Control for the SPP Region on page 20, 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, 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 Texas.

As for this request (GEN-2011-022), 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 13 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:	<b>\$ 2,974,597</b>
Interconnection Facilities <sup>1</sup> :	<b>\$ 307,375</b>
Total:	<b>\$ 3,281,972</b>

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

## General Description of SPS Facilities<sup>2</sup>

1. **Construction of New Line Terminal:** See Appendix A, Figure A-1, 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 Appendix A, Figure A-2
  - 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.
  - 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, MVA<sub>r</sub>, and fault location.

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

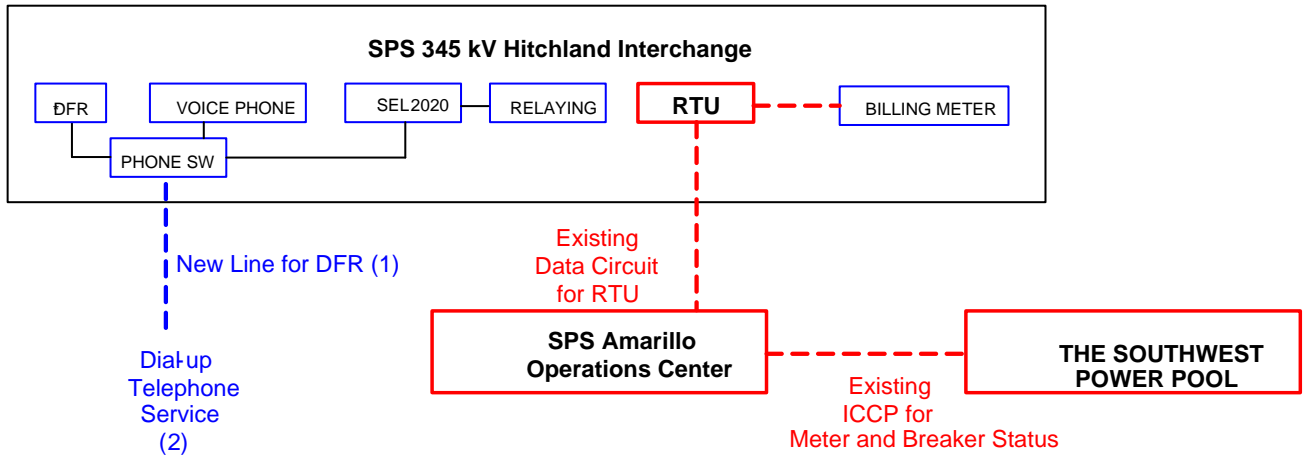


- 1.10. **Revenue Metering:** On the existing SPS Hitchland Interchange on the 345 kV line terminal to the Interconnection Customer's Substation, an individual billing meter will be installed along with a meter per ANSI C12.1 accuracy class 0.2 (3-PT's IEEE C57.13 accuracy class 0.3 and 3 CT's IEEE C57.13 accuracy class 0.15) for full 3-phase 4-wire metering. Also installed for the metering units will be 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:** 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 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, 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 Hitchland Interchange indicated in Section 1.9.

## 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 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) on the 345 kV by using switched capacitor banks, which is based on SPP's Definitive Interconnection System Impact Study (DISIS-2011-001) Table 4-2 "Power Factor Requirements". 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:

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-2011-022</b>				
Fault Location	Fault Current (Amps)		Impedance ( $\Omega$ )	
	Line-to-Ground	3-Phase	$Z^+$	$Z^0$
345 kV Bus	4,817	4,250	4.169+j46.677	2.15+j30.275

<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

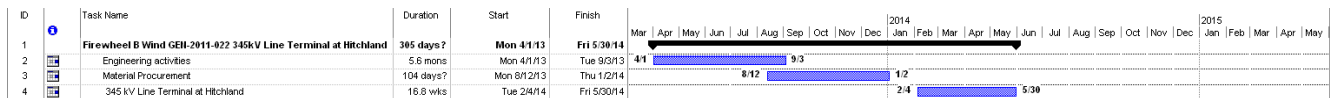
The projects required for the interconnection of this 299 MW Wind Farm facility consist of the projects summarized in the table below.

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

Project	Description	Estimate
<b>SPS Network Upgrades</b>		
1	Transmission Line Work and ROW <sup>4</sup> :	\$ 0
2	345 kV Line Terminal for Wind Farm Facility GEN-2011-022	\$ 2,974,597
<b>Subtotal:</b>		<b>\$ 2,974,597</b>
<b>Interconnection Facilities (at the Interconnection Customer's expense)</b>		
3	Communications <sup>5</sup>	\$ See footnote
4	Revenue metering	\$ 250,000
5	345 kV Line arrestors	\$ 57,375
<b>Subtotal:</b>		<b>\$ 307,375</b>
<b>Total Cost:</b>		<b>\$3,281,972</b>

## Engineering and Construction:

An engineering and construction schedule for the installation of the 345 kV line terminals is estimated at approximately 13 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.



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

<sup>3</sup> The cost estimates are 2011 dollars with an accuracy level of  $\pm 20\%$  except it does not include AFUDC.

<sup>4</sup> Transmission work cost estimate has an accuracy level of  $\pm 20\%$  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.

## Appendix A

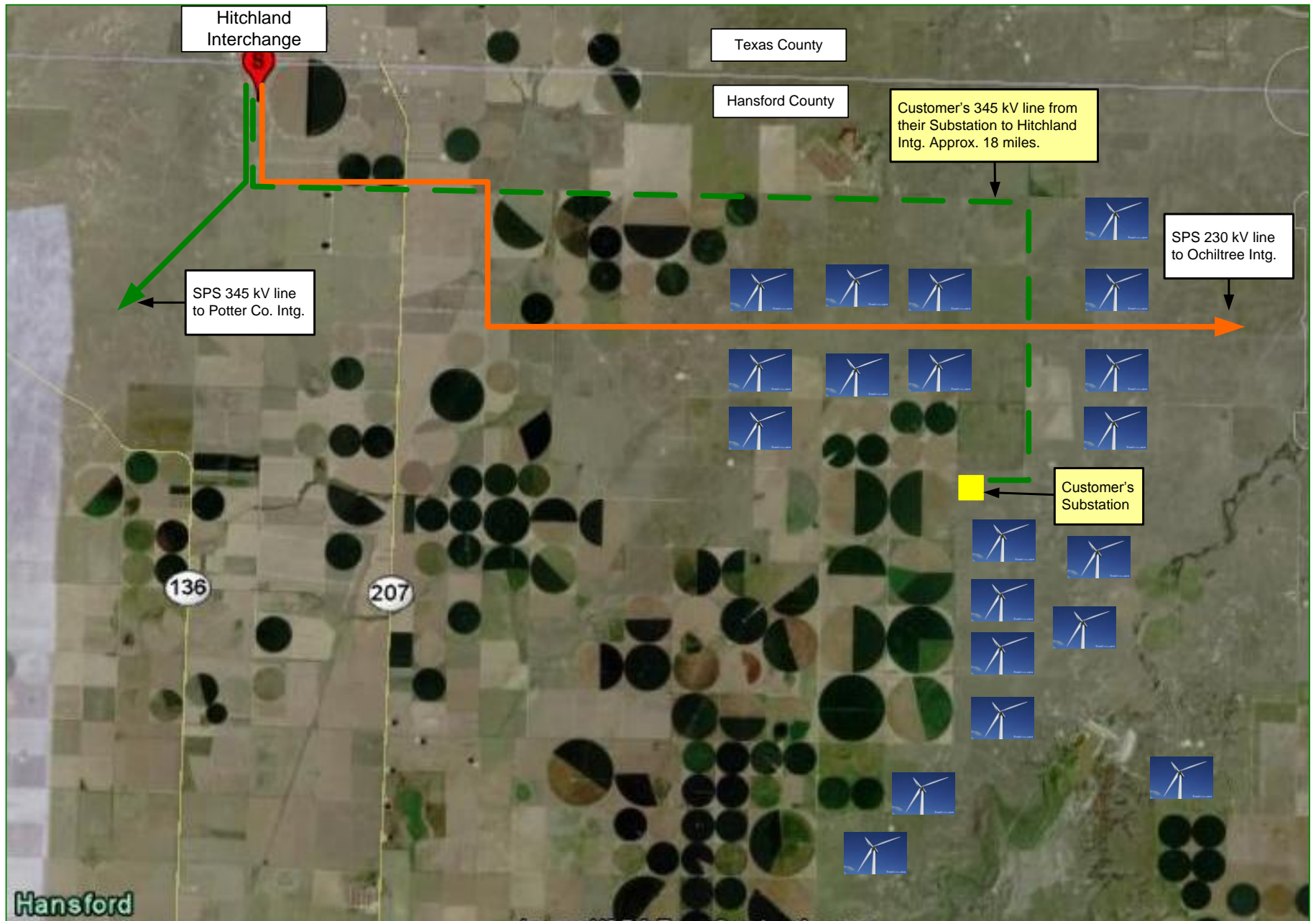
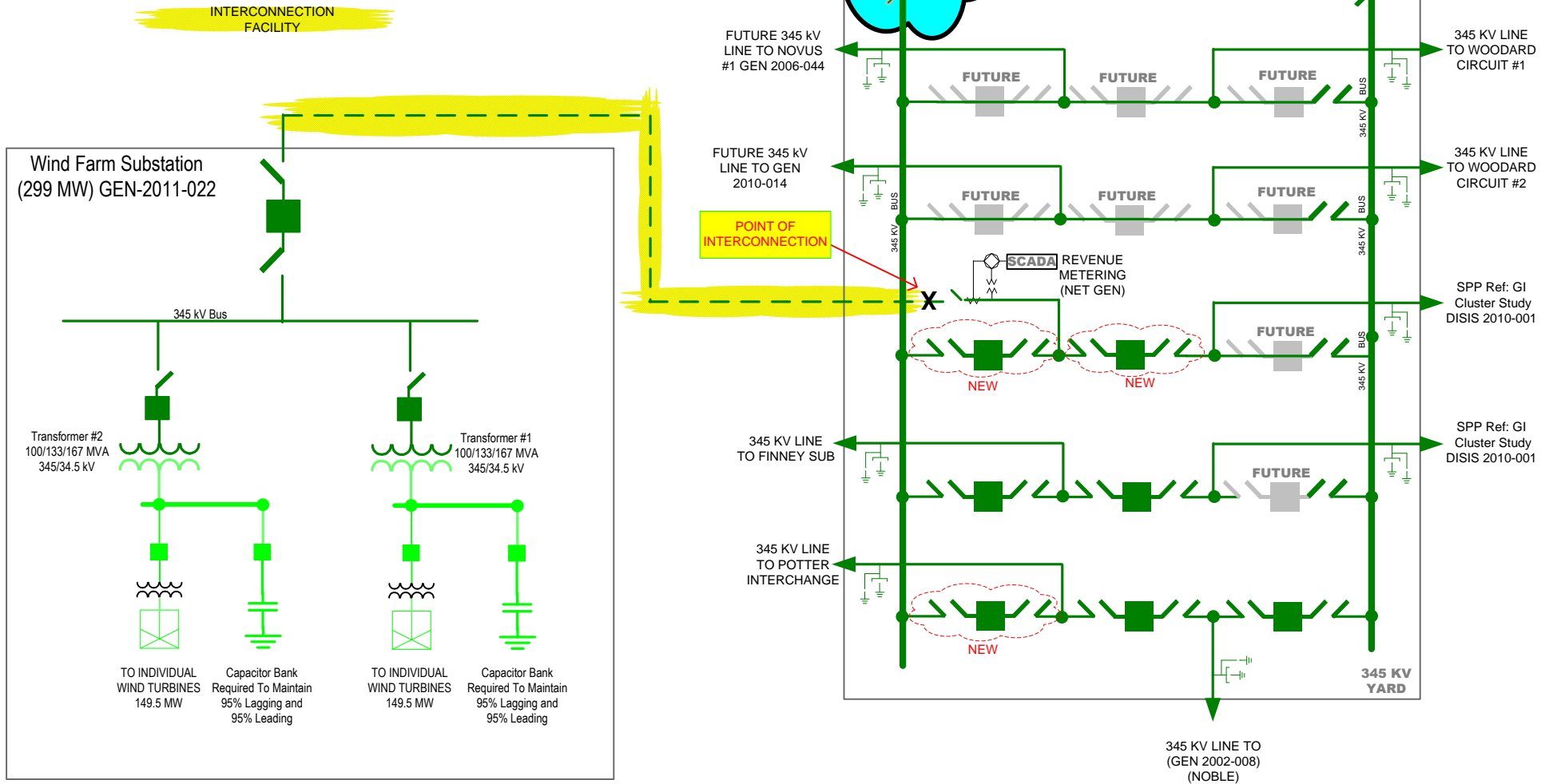


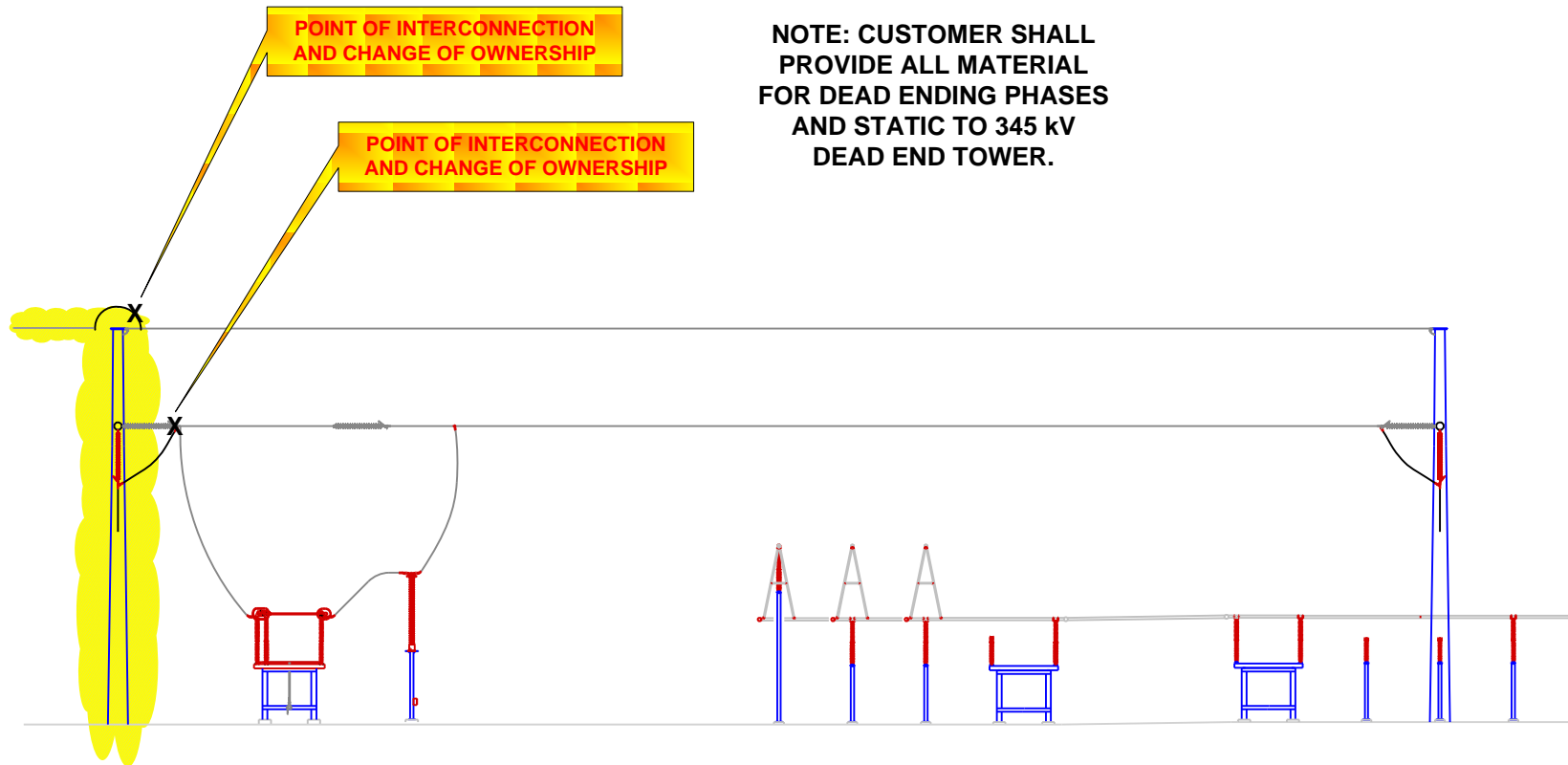
Figure A- 1 Approximate location of proposed Wind Farm Facility

**PRELIMINARY ONE-LINE DRAWING :  
FOR ILLUSTRATION PURPOSE ONLY  
NOT FOR CONSTRUCTION**



**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 –*