



SPP

*Southwest
Power Pool*

***Facility Study for Generation
Interconnection Request
GEN – 2002 – 022***

***SPP Coordinated Planning
(#GEN-2002-022)***

October 2005

Summary

Xcel Energy performed the following study at the request of the Southwest Power Pool (SPP) for SPP Generation Interconnection request Gen-2002-022. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff Attachment V, which covers new generation interconnections on SPP's transmission system.

Pursuant to the tariff, Xcel Energy was asked to perform a detailed Facility analysis of the generation interconnection requests to satisfy the Facility Study Agreement executed by the requesting customer and SPP.



**Facilities Study
For
[Omitted Text]**

240 MW Wind-Generated Energy Facility
Oldham County, Texas
SPP #GEN-2002-022

October 17, 2005

Xcel Energy Services, Inc.
Transmission Planning

Executive Summary

[Omitted Text] (the “Requester” or “Interconnection Customer”) has requested the interconnection of a wind energy facility to the Southwestern Public Service Company (SPS) (d/b/a Xcel Energy, Inc) 230kV transmission system. This facility will interconnect to the existing 230kV bus at Bushland Interchange, located approximately 10 miles west of Amarillo, TX. The Southwest Power Pool (SPP) evaluated the request to interconnect this wind energy facility to the SPS transmission system in two separate System Impact Studies completed in November 2003 and November 2004. This interconnection request was studied using different types of wind turbines; Mitsubishi MWT-1000A 1.0 MW, Vestas V80 1.8 MW, Gamesa G87 1.5 MW, and Bonus MKII 2.3 MW. It is understood that sufficient turbines of the Bonus MKII 2.3 MW will be used to populate the facility up to the 240 MW request level. It is expected that all requirements noted in the System Impact Study will be met for the respective wind turbine chosen. Additional requirements pertaining to the design of the wind facility are noted in Section 9.

Construction of the facility will be split into two phases; the initial phase having a rated output of 160 MW with commercial operation targeted for December 9, 2006, and the final phase adding the remaining output; with planned commercial operation on November 1, 2008. Additionally, a new customer owned and maintained 19-mile 230kV transmission line from the wind farm’s substation to Bushland Interchange will be built by the Requester.

The SPS facilities required at Bushland Interchange for the interconnection of this new wind energy facility consist of extending the 230kV bus and adding a new 230kV breaker terminal. Additionally, a new 230kV joint transmission crossing structure will also be required at the location where the existing SPS 230kV transmission circuit K59 (Potter County – Bushland Interchange) and the customer owned 230kV transmission circuit cross. The Requester shall add this joint 230kV transmission structure; see Section 2 for details.

At the present time it is not anticipated that a joint crossing structure for the 69kV transmission line crossings will be required. In the event that an SPS 69kV transmission line will be crossed, SPS shall be contacted and proper clearance shall be maintained above the 69kV transmission line as per SPS Transmission Standards. If the proper clearance is not maintained, the wind energy facility may be subject to disconnection from the grid until remedial actions are completed. Additionally, any crossing of a 69kV transmission line needs to be completed while the 69kV line is energized; the Requester will need an SPS Transmission Operations Transmission Work Request (TWR) for any work above or around SPS transmission lines.

A Certificate of Convenience and Necessity (CCN) from the Public Utility Commission of Texas for expansion of Bushland Interchange is not required.

Xcel Energy will require the Interconnection Customer to construct the Interconnection Facilities in compliance with the latest revision of the Xcel Energy Interconnection Guidelines for Transmission Interconnection Producer-Owned Generation Greater than 20 MW, Version 2.0 dated Jan. 20, 2004. This document describes the requirements for connecting new generation to the Xcel Energy operating company transmission systems including technical, protection, commissioning, operation, and maintenance. Xcel Energy 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

Council, (NERC), Southwest Power Pool, and Federal Energy Regulatory Commission or their successor organizations.

The Requester is responsible for the cost of the Requester's Interconnection Facilities and any Direct Assigned Facilities; inclusive of all construction required for the 230 kV transmission line from the Requester's substation to Bushland Interchange.

It is anticipated that the construction of a new 230kV breaker terminal at Bushland Interchange for the acceptance of wind generated electric energy from the Requester's Wind Farm, will require approximately 9 months for completion. The cost of these upgrades, inclusive of the Requester's cost for the interconnection of this new wind energy facility, is shown below, with the detailed description of the cost shown in Table 3.

Network Upgrade:	\$226,884
Direct Assigned Facilities ¹ :	\$35,000
Distribution Relocation ¹ :	\$0
Interconnection Facilities ¹ :	\$576,660
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Total:	\$ 838,544

¹ This is a direct assigned cost to the Requester.

Discussion

General Description of Existing SPS Facilities

The existing Bushland Interchange is made up of a straight bus design with 2-230kV breaker terminals on the lines toward Potter County Interchange and Deaf Smith Interchange. Also contained within the interchange are a 90 MVA 230/115kV autotransformer and a 115kV breaker as a 115kV source to the west side of Amarillo, TX.

General Description of Modifications to Existing SPS² Facilities

1. Bushland Interchange Modifications.

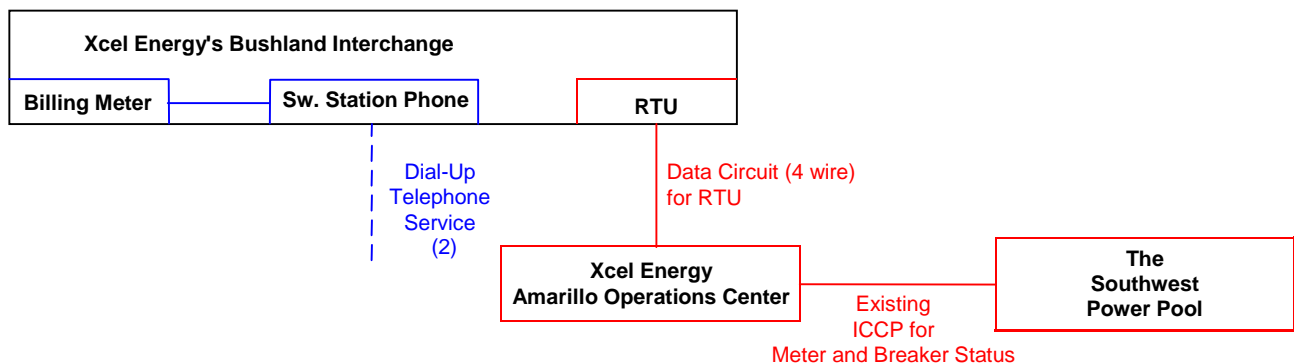
- 1.1. **Location:** Bushland Interchange is located approximately 10 miles west of Amarillo, TX. See Figure A - 2 for a map of the area.
- 1.2. **Bus Design:** The existing bus design at Bushland Interchange is a straight bus design with no transfer bus and has two existing 230kV and one 115kV breaker. Additionally, a 230/115kV 90 MVA transformer at this location provides an 115kV source to the west side of Amarillo.
- 1.3. **Additions/Modifications:** The existing bus design will not be modified at this time. To accommodate the output from the wind energy facility, the bus will be extended and a new 230kV breaker terminal will be added at Bushland Interchange. The addition of the new breaker terminal that is required is shown in Figure A - 1. Additionally, a new high side circuit switcher will be added to the existing 230/115kV autotransformer. The circuit switcher will be added to replace the existing high side switches currently in place. Figure A - 5 shows a plan view of the station.
- 1.4. **Control House:** The existing control house 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 230kV breaker terminal.
- 1.5. **Security Fence:** The existing fence at Bushland Interchange is made of 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 with the addition of this new breaker is approximately 300' x 350', with a rock yard surface.
- 1.6. **Ground Grid:** The interchange has an existing ground grid installed per previous versions of ANSI/IEEE STD 80 and will be extended to cover the new facilities.
- 1.7. **Site Grading:** The existing pad will be extended to the north for the addition of the new 230kV breaker terminal.
- 1.8. **Station Power:** Station power is provided from the local distribution system, with backup power off the tertiary of the 230/115kV autotransformer.

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

- 1.9. **Relay and Protection Scheme:** The Bushland substation to the customer owned line relaying will be step distance. An SEL 321-1 and an SEL 311-C will be used. An SEL 292H-2 will be installed; however no automatic re-closing will be installed. The SEL 292H-2 will be used for line/bus conditions and sync check with supervisory closing of the 230kV breaker. Finally, a SEL-501-0 will also be installed for breaker failure.
- 1.10. **Revenue Metering:** On the 230kV line from Bushland Interchange, a billing meter will be installed along with an ION 8400 meter unit, ANSI C12.1 accuracy class 0.2 (3 PTs IEEE C57.13 accuracy class 0.3 and 3 CTs IEEE C57.13 accuracy class 0.15) for full 3 phase 4-wire metering. The metering will utilize existing station PT's and new 230kV self-contained CTs will be installed. There will be two meters one will be primary and the other will be back-up, and each will have full 4 quadrant metering. Pulses out of the primary billing meter will be sent via SCADA to the Amarillo Control Center.
- 1.11. **Disturbance Monitoring Device:** Disturbance-monitoring equipment, capable of recoding faults, swings, and long term trending, will be installed to monitor and record conditions in the substation and on the transmission lines. This equipment will have communication capability with a dedicated communication circuit. The Disturbance equipment shall also be equipped with a GPS time syncing clock. The Disturbance equipment will have its own dedicated dial-up communications circuit.
- 1.12. **Communications:** The existing RTU will be utilized with communications. An SEL 2020 will be installed for relay communications and other functions as required.

Communications from Bushland Interchange to the Amarillo Control Center will consist of existing microwave telephone and data circuit.

A schematic outlining the proposed communications is provided below:



2. Transmission Work:

The Requester will construct, own, operate, and maintain the new 230 kV transmission line from the Requester's substation to Bushland Interchange. ***The Xcel Energy transmission design group prior to any construction by the Requester or its contractor on the customer owned 230kV transmission line, or doing work in close proximity to any SPS transmission line, will require an engineering review of the customer's design. It is the Requester's responsibility to initiate the design review in a timely manner before construction of the 230kV 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 Bushland Interchange will be delayed until the matters are resolved. Xcel Energy will not be held responsible for these delays.***

2.1. **Termination Structure:** The Requester's 230kV line termination structure located outside the Bushland Interchange will require final approval from the Xcel Energy Transmission Design Group. This is to assure, but is not limited to, the maintaining of proper clearance on the slack span from the termination structure into the substation. The Requester is required to terminate their 230kV transmission line at Bushland Interchange. See Figure A - 4, which shows the Point of Interconnection and Change of Ownership.

2.2. **Crossing Structure:** A joint 230kV crossing structure shall be built by the Requester per Xcel Energy specifications at the location where the customer owned 230kV transmission line and Xcel Energy's 230kV transmission circuit cross. Xcel Energy will provide the necessary material for this structure (see Figure A - 3) and deliver the material to the crossing location. An Xcel Energy inspector will be the final authority on the installation of this structure. The joint structure is required to provide proper clearance between circuit K59 and the customer owned 230kV transmission circuit. The Requester will also replace the adjacent structure to the east. Xcel Energy will provide drawings and material for this structure.

2.3. **69kV Transmission Line Crossings:** In the event that any SPS 69kV transmission line is crossed, proper clearances above these 69kV transmission lines shall be maintained. An Xcel Energy inspector will have final authority on whether proper clearance above these circuits has been maintained.

2.4. **Transmission Line Ground Clearance:** It is required that the Requester's 230kV transmission circuit maintain a minimum ground clearance of 39 feet at worst case sag (as per NESC³ rules) for the entire route along Samson Road; an Xcel Energy inspector will have final authority on whether proper clearance has been maintained.

3. Right-Of-Way:

3.1. **Additional Real Estate:** The purchase of additional land, for the work that will be performed at Bushland Interchange, is not required. Xcel Energy currently owns

³ National Electric Safety Code

sufficient real estate for addition of both the new 230kV breaker terminal and the 230kV circuit switcher.

- 3.2. **Permitting:** Permitting for the addition of the new breaker terminal is not required from the Public Utility Commission of Texas.
4. **Construction Power and Distribution Service:** It is the sole responsibility the Requester to make arrangements for both construction and station power which may be required for the Requester's wind energy facility. **Additionally, if the Requester's substation(s) and/or construction site(s) lie outside of the Xcel Energy service area, Xcel Energy cannot provide station power (retail distribution service) and the Requester needs to make arrangements for distribution service from the local retail provider.**
5. **Project and Operating Concerns:** Close work between the Transmission group, the Requester's personnel and local operating groups will be imperative in order to meet any in-service date that has been established.
6. **Fault Current:** The available fault current on the 230kV bus at Bushland Interchange, without any contribution from the wind farm, is shown in Table 1.

Table 1, Available Fault Current at 230kV Bushland Bus

Fault Type	Amps	MVA
Three Phase	8390.17	3342.41
Single-Line-To-Ground	7104.64	2830.29

Table 2, Source Impedance⁴ Data at 230kV Bushland Bus

Positive (Z^+)	Zero (Z^0)
0.00356 +j 0.02971	0.00884 +j 0.04538

7. **Customer's Interconnection Facilities:** Figure A-6 illustrates Customer's Facilities to be constructed at their wind farm location.

⁴ Values are in per-unit on a 100 MVA base.

Estimated Construction Costs:

The projects required for the interconnection of this 240 MW wind energy generating facility consist of the projects summarized in the table below:

Table 3, Required Interconnection Projects

Project	Description	Estimated Cost
	Network Upgrade	
1	230kV Circuit Switcher	\$ 146,884
2	Disturbance Monitor Device	\$ 80,000
	Subtotal:	\$226,884
	Direct Assigned Facilities ⁶	
3	Transmission 230kV Joint Crossing Structure	\$ 35,000
4	Transmission 69kV Joint Crossing Structure ⁵	\$ 0
	Subtotal:	\$35,000
	Distribution Relocation ⁶	
5	Relocation Of Distribution Circuit	\$ 0
6	Phase Raisers for 230kV Transmission Circuit	\$ 0
	Subtotal:	\$ 0
	Interconnection Facilities ⁶ (at the Requester's Expense)	
7	230kV Breaker Addition	\$ 555,860
8	230kV Bus Extension	\$ 20,800
	Subtotal:	\$576,660
	Total Cost:	\$ 838,544

⁵ At the present time it is not anticipated that 69kV crossings will be required, but if some are needed a cost will be incurred.

⁶ At the present time it is not anticipated that distribution relocation will be required, but if some are needed a cost will be incurred.

8. Engineering and Construction:

It is anticipated that the switching station and all associated components will be constructed and ready to receive power from the Requester's wind farm in approximately 9 months. A construction schedule is shown below.

ID	Task Name	Duration	Year 1												Year 2											
			11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
1																										
2	SPP - GEN - 2002 - 0022	180 days																								
3	Survey & dirt work at Bushland Substation	6 wks																								
4	Fence construction and relocation	2 wks																								
5	Pour foundations	6 wks																								
6	Transmission phase raisers & relocate distribution circuit	12 wks																								
7	Substation construction	10 wks																								
8	Final Testing and Inspection	4 wks																								
9	Substation Commissioning	2 wks																								
10	Completion	1 day																								

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

9. Requirements For Requester:

As such, Xcel Energy, prior to any construction of this wind energy facility, will require a review of the Requester's final design. It is the Requester's responsibility to initiate the design review in a timely manner; Xcel Energy will not be held responsible for any delays. The review is to assure that the design of the wind energy facility (substation locations, breaker arrangements, relaying, etc.) does not cause any future problems to the transmission system.

As a requirement to the design of the facility, the Requester should pay particular attention to the number of collection system substations that will be incorporated into the design. If more than one collection substation will be built, even if it's built after the initial interconnection, 230kV breakers will be required on the line looking towards Bushland Interchange (Breaker A in Figure 1) and on the line towards any additional substations (Breaker B in Figure 1). If only one substation is built to accommodate the entire output of the farm, the breakers are not required. In either case, proper relay settings need to be in place to eliminate the possibility of a slow clearing fault on the wind facility's 230kV transmission line(s), which could greatly affect the operation of the Potter-Bushland-Deaf Smith 230kV line.

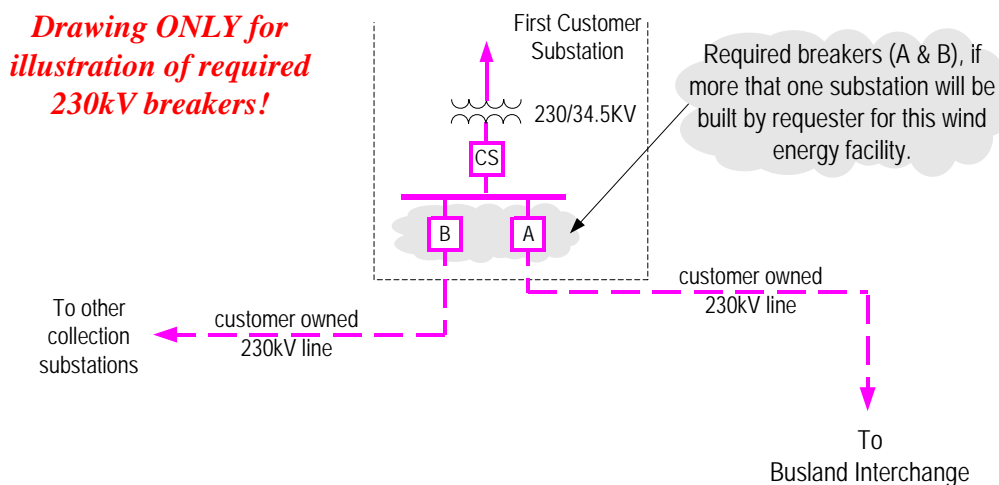


Figure 1 Customer Required 230kV Breakers

Additionally, any deviation from the wind energy facility design studied in the System Impact Studies will require additional studies investigating the new design and its capabilities to ride-through the disturbances studied. The Requester will be responsible for all costs associated with these new studies, potentially subjecting the wind farm to curtailment or disconnection until the studies prove that the new design meets acceptable guidelines. If the new studies find problems as a result of the new wind facility design, the Requester will be responsible for the installation of equipment required to mitigate the problems, prior to commercial operation of the wind energy facility.

Finally, See section 2.4 for transmission line sag requirements.

Appendix A

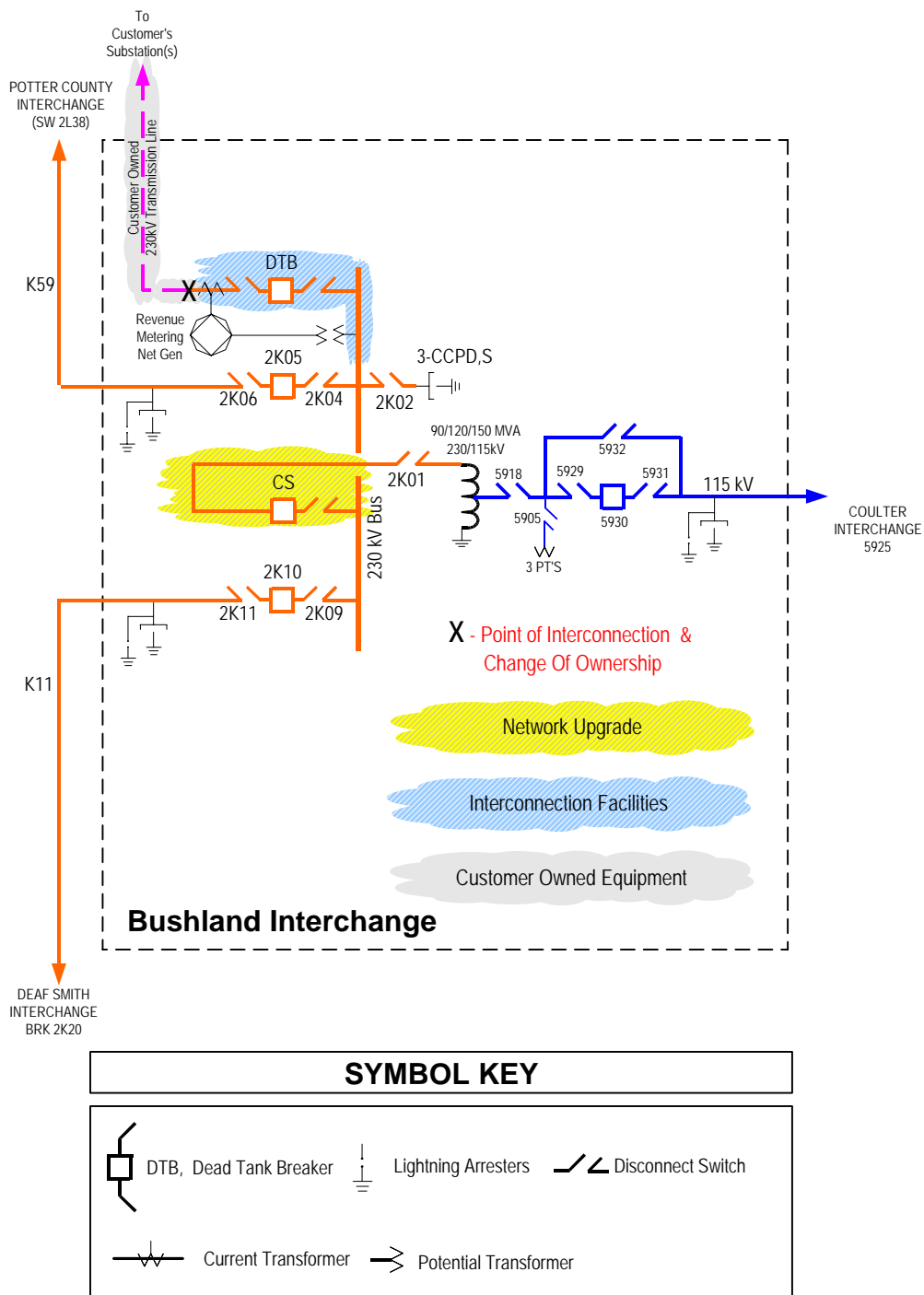


Figure A - 1 Bushland Interchange One-line Diagram

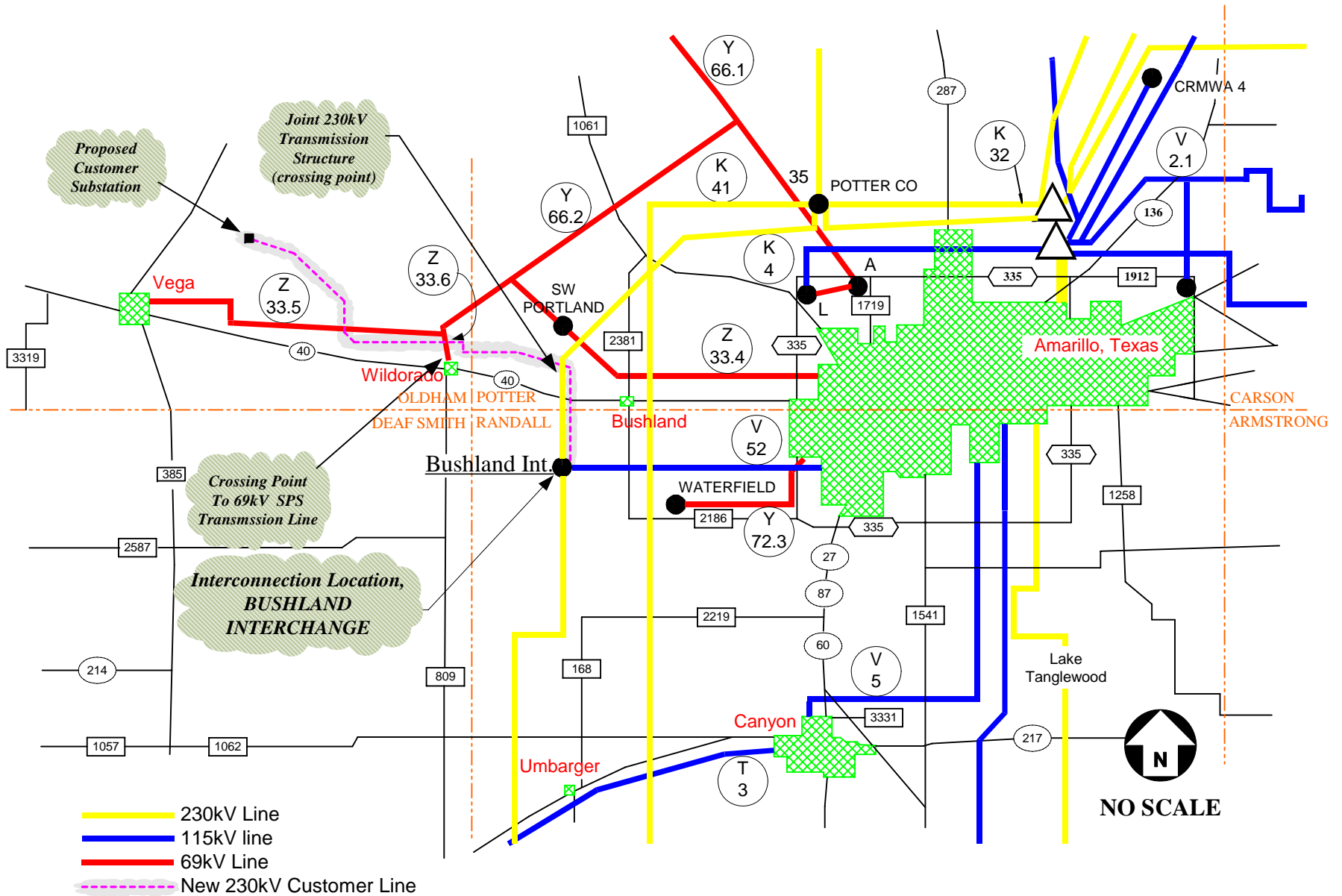


Figure A - 2 Proposed Interconnection Point

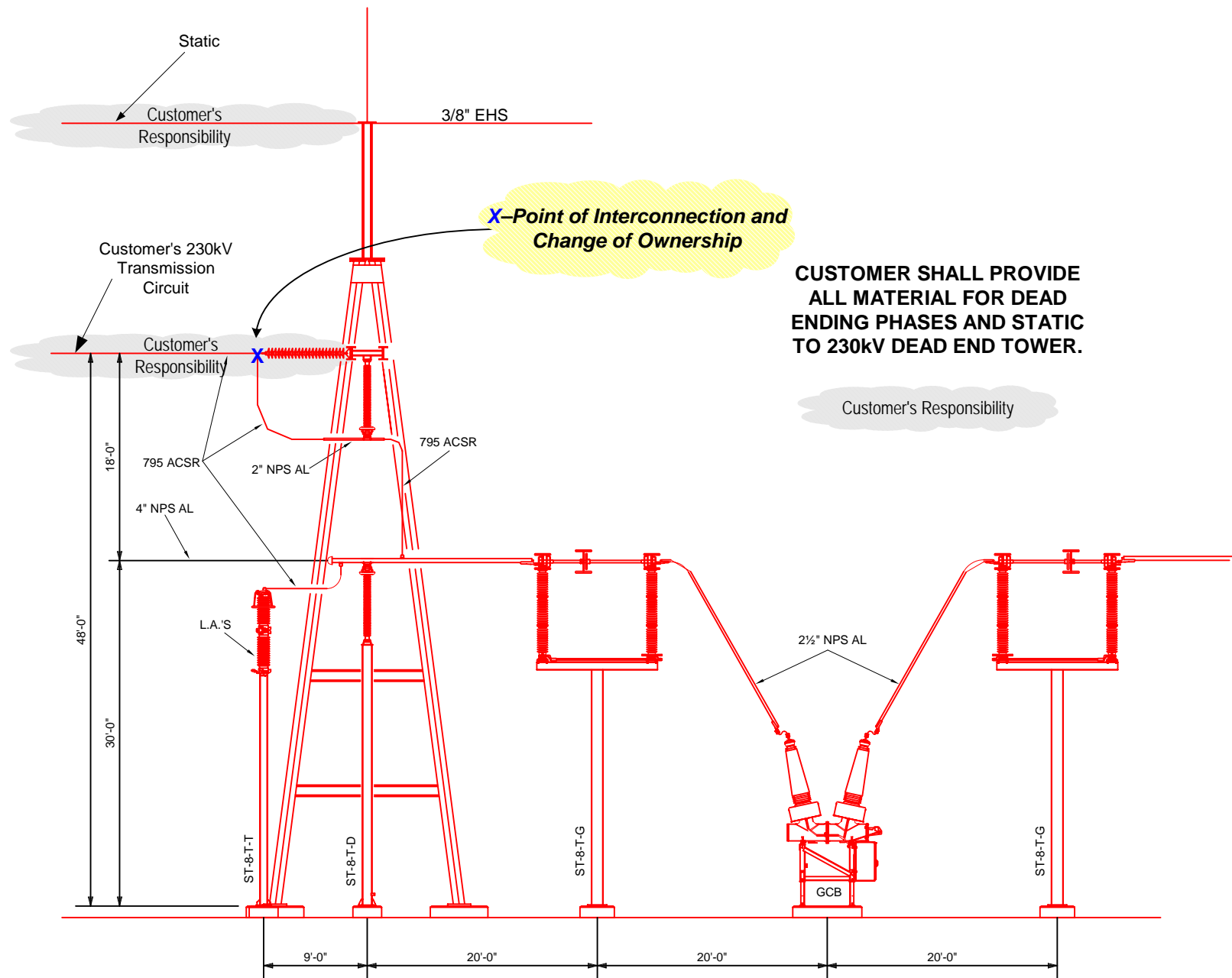


Figure A - 4 Point of Interconnection & Change of Ownership

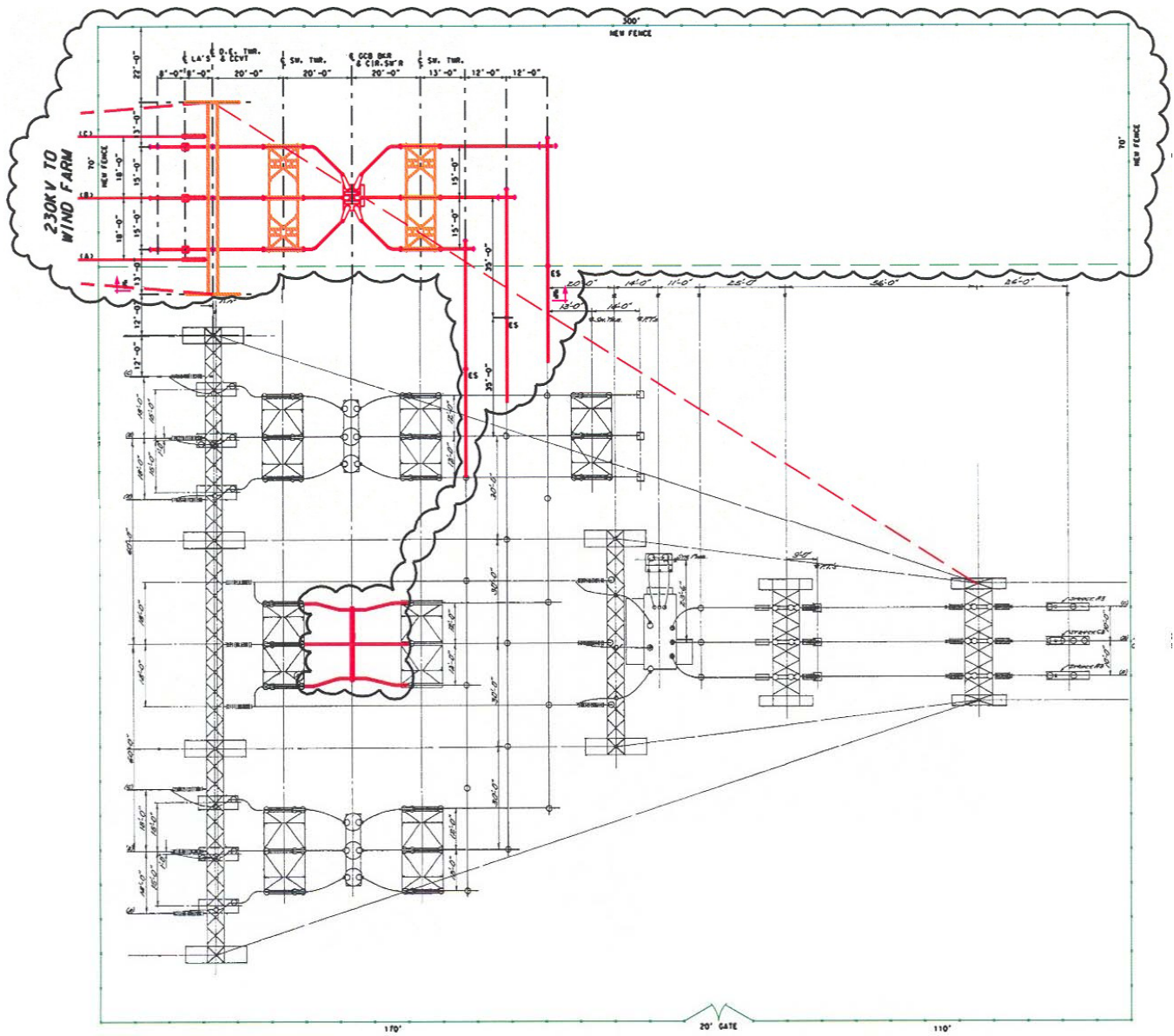


Figure A - 5 Bushland Interchange Plan View

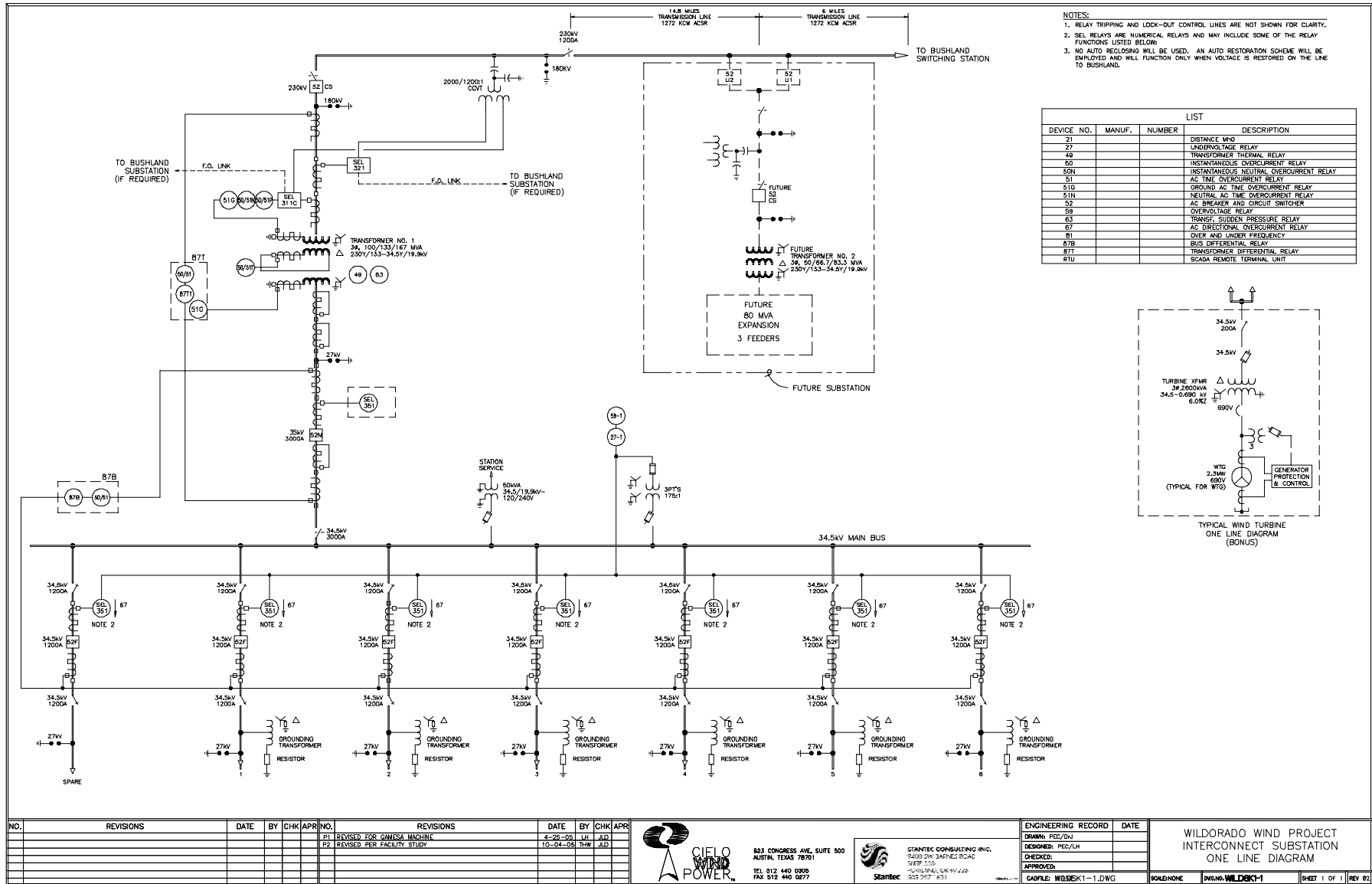


Figure A-6 Customer's Facilities