SPP Southwest Power Pool

Facility Study for Generation Interconnection Request GEN – 2005 – 002

SPP Tariff Studies
(#GEN-2005-002)

May, 2006

Summary

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Xcel Energy (Xcel) performed the following Facility Study to satisfy the Facility Study Agreement executed by the requesting customer and SPP for SPP Generation Interconnection request Gen-2005-002. The request for interconnection was placed with SPP in accordance SPP's Open Access Transmission Tariff, which covers new generation interconnections on SPP's transmission system.

Order #661A Compliance

Stability Analysis was originally performed for this request in September, 2005 by SPP. The Study indicated no stability problems existed for the request. However, the original study did not include analysis of the latest FERC Order #661A low voltage ride through specification. Order #661A was released in December, 2005 and requires wind farms to be able to meet low voltage ride through requirements. As long as an Interconnection agreement is signed this year, this request will be subject to the transitional requirements of the order in which the turbines should stay on line for a fault down to 0.15 pu at the point of interconnection for a period of 4-9 cycles.

An additional contingency was simulated using data from the Impact study to confirm Order #661A compliance. A three phase fault was simulated at the 115kV bus for 5 cycles, followed by a trip of the line to Riverview, followed 20 cycles later by another 5 cycle fault, followed by a lockout of the transmission line.

The results indicate that the Gamesa G87 2.0MW wind turbines can withstand the fault and therefore this request is compliant with Order #661A. A plot of the power output of the Gamesa turbines is shown in Figure 1.

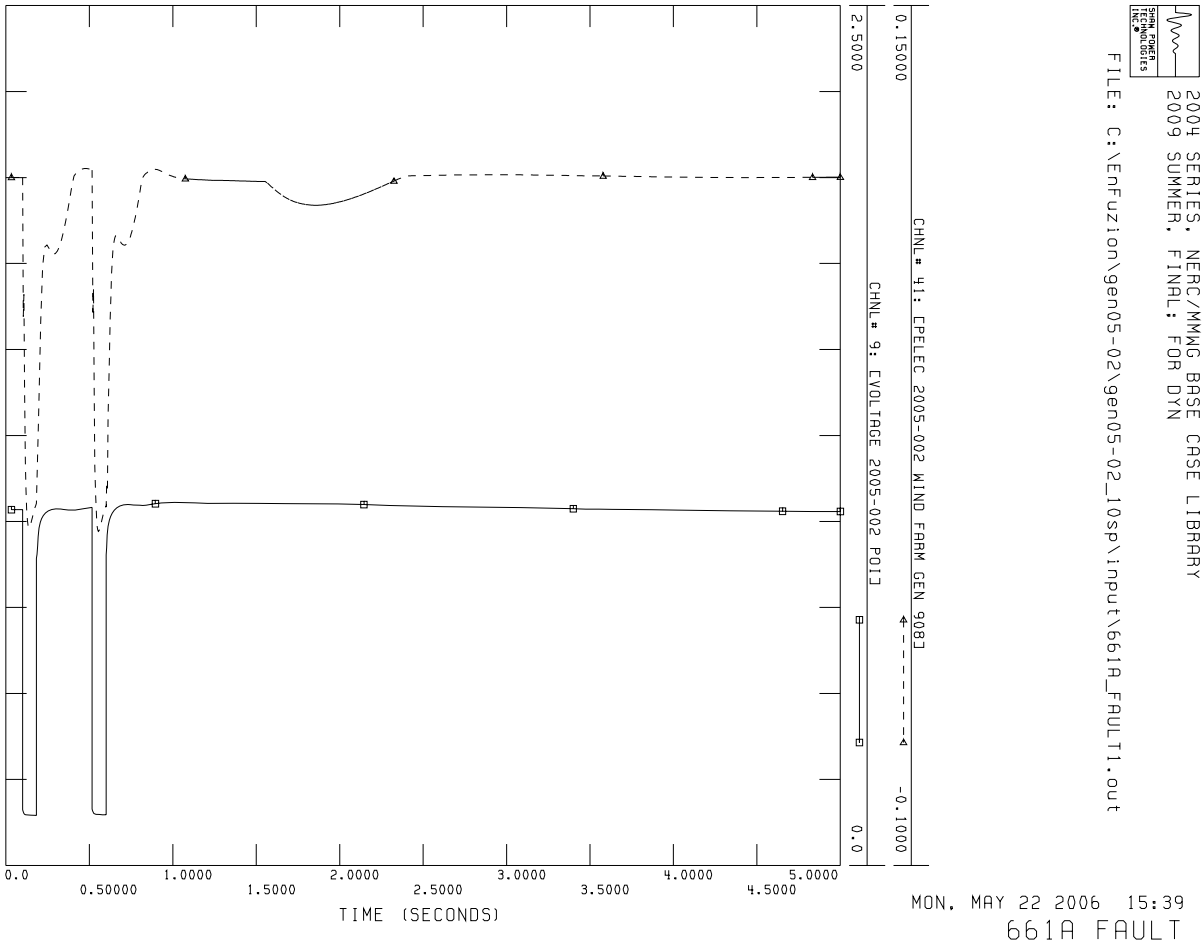


Figure 1. - Output of the Gamesa Turbines during an Order #661A Fault Simulation

Facilities Study For
Britain Wind Ranch Power Project

80 MW Wind-Generated Energy Facility
Hutchison County, Texas
SPP #GEN-2005-002

May 10, 2006

Xcel Energy Services, Inc.
Transmission Planning

Executive Summary

[Omitted Text] ("Interconnection Customer") has requested the interconnection of an 80 MW wind energy facility to the Southwestern Public Service Company (SPS) (d/b/a Xcel Energy, Inc) 115kV transmission system. The request is for interconnection to the existing 115 kV transmission line between Pringle Interchange and Riverview Substation. Pursuant to the Southwest Power Pool (SPP) Open Access Transmission Tariff (OATT), SPP evaluated the request to interconnect this wind energy facility to the SPS transmission system in a System Impact Study (SIS) completed in September 2005.

The interconnection request was studied using 40 individual 2.0 MW Gamesa G87 wind turbines for a total of 80 MW. In accordance with the results of the SIS, the Interconnection Customer is required to install a minimum of two (2) 15.3 MVAr capacitor banks at the Interconnection Customer's substation "*to maintain required power factor at the wind farm facility and for transmission support needed to export power from the interconnection point."* Additionally, the instantaneous voltage rise during the switching of these capacitors shall not exceed 2% on the 115kV at the new Xcel Energy switching station.

The facilities required for interconnection of this wind farm include the construction of a new three (3)-point ring-bus switching station and re-termination of the existing 115kV transmission circuit in-and-out of this new switching station.

A Certificate of Convenience and Necessity (CCN) from the Public Utility Commission of Texas for the construction of this new switching station is not required.

Xcel Energy will require 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, Version 2.0 dated Jan. 20, 2004, and is available at (http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_16699_24407-1428-0_0_0-0,00.html). 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 the Federal Energy Regulatory Commission or their successor organizations.

The Interconnection Customer is responsible for the cost of the Interconnection Customer's Interconnection Facilities and any Direct Assigned Facilities; inclusive of all construction required for their 115 kV transmission line from the Interconnection Customer's substation to the new switching station.

The new switching station's requested in-service date is 12/1/2008. It is anticipated that the construction of the new 115kV switching station for the acceptance of wind generated electric energy from the Interconnection Customer's wind farm, will require approximately 15 months for completion. The cost of these upgrades, inclusive of the Interconnection Customer's cost for the interconnection of this new wind energy facility, is shown below in Table 1, with the detailed description of the cost shown in Table 4.

Table 1, Cost Summary[1]

Stand-alone Network Upgrades:	$1,984,417
Network Upgrade:	$251,111
Interconnection Facilities [2]:	$92,152
Total:	$2,327,680

[1] The cost estimates are 2006 dollars with an accuracy level of ±10%.

[2] This is a direct assigned cost to the Interconnection Customer.

General Description of SPS[3] Facilities

1. **Construction 115kV Switching Station:** See Appendix A for one-line diagram.

   1.1. **Location:** Xcel Energy will construct a new 115kV switching station at the interception point to the Xcel Energy transmission circuit T07, located approximately 8.5 circuit miles from of Pringle Interchange. Figure A - 2 shows a one-line of the new switching station, while Figure A - 4 shows a plan view of the switching station.

   1.2. **Bus Design:** The bus design for this new switching station will be a ring-bus configuration with three 115kV line terminals, with the future possibility configuration being a 3-string breaker and one-half configuration.

   1.3. **Line Terminals:** The 115kV line 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:** A control house approximately 20 feet by 30 feet will be installed to contain the metering, protection and control devices, terminal cabinets, and any fiber-optic cable terminations, etc.

   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 250' × 160', 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 initial site grading and erosion control of the new switching station. Soil compaction shall be not less that 95% of laboratory density as determined by ASTM-D-698.

   1.8. **Station Power:** A 66kV/120-240 volt transformer tapped on one set of the PTs 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 switching station to Pringle line relaying will be directional comparison blocking (DCB) over power line carrier with a Pulsar TC10B. A SEL 321-1 (DCB) and a SEL 311-C (step distance) will be used. A SEL 279H-2 relay will be used for reclosing and a SEL 501-0 will be used for breaker failure.

   The new switching station to Riverview Substation line relaying will be directional comparison blocking (DCB) over power line carrier with a Pulsar TC10B. A SEL 321-1 (DCB) and a SEL 311-C (step distance) will be used. A SEL 279H-2 relay will be used for reclosing and a SEL 501-0 will be used for breaker failure.

   The new Switching Station to Interconnection Customer's wind farm line relaying will be step distance. A SEL 321-1 and a SEL 311-C will be used. A SEL 279H-2 relay will be installed;

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

however **there will not be any automatic reclosing**. The SEL 279H-2 will be used for line/bus conditions and sync check along with supervisory closing of the breaker. A SEL 501-0 will be used for breaker failure.

The bus voltage and GCB amps will be the SATEC PM type meters that shows all three phases eliminating the need for a switch and transducers. The batteries will be our standard set of 306 or 204 AH Varta batteries with a 35 or 25 amp charger.

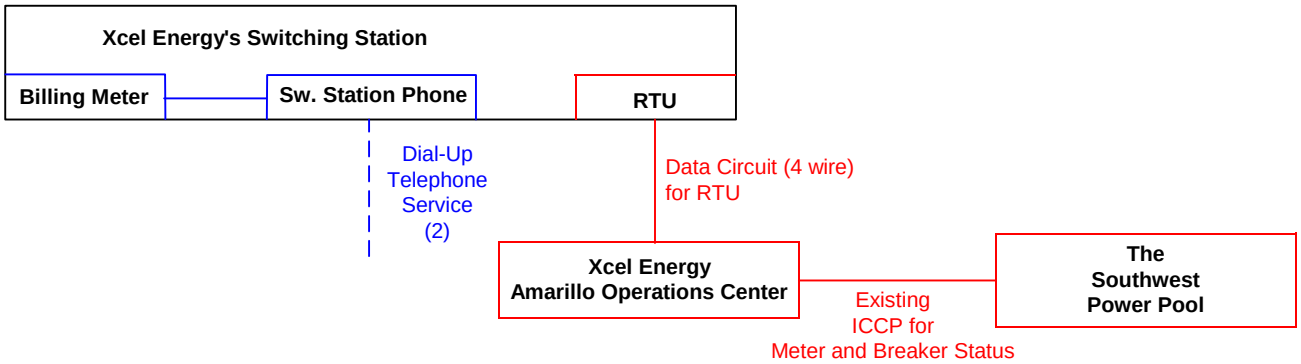
1.10. **Revenue Metering:** On the line to the Interconnection Customer's wind farm, a billing meter will be installed along with an ION 8400 meter unit, ANSI C12.1 accuracy class 0.2 (3 PTs IEEE C57.13 accuracy class 0.3 and 3 CTs IEEE C57.13 accuracy class 0.15) for full 3 phase 4-wire metering. Also installed with the 115 kV metering unit will be 3 PTs and 3 CTs for full 3 phase 4 wire metering. There will be two meters: 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, 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. 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 with communications. An SEL 2020 will be installed for relay communications and other functions as required.

1.13. **Communications:** Communications from the new switching station to the Amarillo Control Center will consist of a telephone and data circuit. ***It is the Interconnection Customer's responsibility to make arrangements with the local phone company to provide both the four-wire data circuit and both telephone circuits to the new switching station. Prior to any construction the Interconnection Customer is required to contact the Xcel Energy substation-engineering department for all details.***

A schematic outlining the proposed communications is provided below:



2. **Transmission Work:**

The Interconnection Customer will construct, own, operate, and maintain any customer owned 115kV transmission line from the Interconnection Customer's substation to the new switching station. ***The Xcel Energy transmission design group prior to any construction by the Interconnection Customer or its contractor on any customer owned 115kV 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 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 new switching station will be delayed until the matters are resolved. Xcel Energy will not be held responsible for these delays.

2.1. **Circuit T-07 Tap:** Xcel Energy will tap the existing transmission circuit T-07 in and out of the new Xcel Energy 115kV switching station. Based on the requested in-service date of 12/1/2008, at least two (2) months advanced notice must be provided to schedule the weeklong outage required for this work.

2.2. **115kV Line Terminations:** Xcel Energy will terminate both of its 115kV transmission circuits connecting to the new Xcel Energy switching station. (The Interconnection Customer is responsible for terminating its own 115kV transmission line from the wind farm to the 115kV terminal provided at the new switching station.)

2.3. **Termination Structure:** The Interconnection Customer's 115kV line termination structure located outside the new switching station 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 Interconnection Customer is required to terminate their 115kV transmission line at the new switching station. See Figure A - 3 which shows the Point of Interconnection and Change of Ownership.

3. **Right-Of-Way:**

   3.1. **Switching Station Real Estate:** Xcel Energy will provide Interconnection Customer with easement detailing the metes and bounds description for the required switching station real estate. The Interconnection Customer will obtain all necessary signatures from landowner(s) for the easement needed on the land where the new Xcel Energy switching station will be built.

   3.2. **Permitting**: Permitting for the construction of this new switching station is not required from the Public Utility Commission of Texas.

4. **Construction Power and Distribution Service:** It is the sole responsibility the Interconnection Customer to make arrangements for both construction and station power, which may be required for the Interconnection Customer's wind energy facility. **Additionally, if the Interconnection Customer's substation(s) and/or construction site(s) are located outside of the Xcel Energy service area, Xcel Energy 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:** 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.

6. **Fault Current:** The available fault current at the 115kV interconnection location, without any contribution from the wind farm, is shown in Table 2.

Table 2, Available fault current at interconnection location

Fault Type	Amps	MVA
Three Phase	7975	1600
Single-Line-To-Ground	5900	1175

Table 3, Source impedance[4] data at interconnection location

Positive (Z^+)	Zero (Z^0)
0.0118 +j 0.0611	0.0291 +j 0.1252

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

Estimated Construction Costs

The projects required for the interconnection of this 80 MW wind energy generating facility consist of the projects summarized in the table below:

Table 4, Required Interconnection Projects

Project	Description	Estimated Cost
	Stand-alone Network Upgrade	
1	115kV Ring-Bus Switching Station	$ 1,862,461
2	Control House	$ 106,956
3	Right-Of-Way [5]	$ 15,000
	Subtotal:	**$1,984,417**
	Network Upgrade	
4	Relay Upgrades (Riverview and Pringle)	$ 140,111
5	Transmission Line Work	$ 111,000
	Subtotal:	**$251,111**
	Interconnection Facilities (at the Interconnection Customer's expense)	
6	Communications [6]	*$ see footnote*
7	Remote Terminal Unit (RTU)	$ 43,957
8	Revenue metering	$ 44,595
9	115kV line arrestors	$ 3,600
	Subtotal:	**$92,152**
	Total Cost:	**$2,327,680**

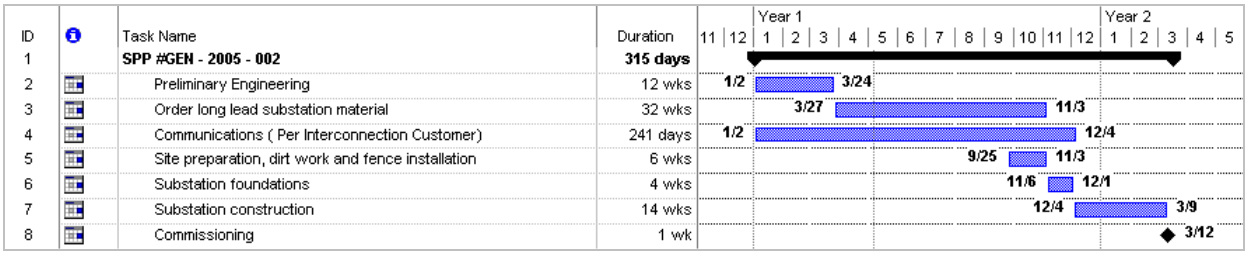
As of the date of this report, this project has not been granted internal management approval by Xcel Energy, nor has the necessary construction resource planning been performed. The required approval process and construction resource planning may impact this project's feasible in-service date.

[5] Surveying cost; Interconnection Customer will acquire the Xcel Energy easement needed for the land upon which the new switching station will be built, see Section 3.1.

[6] It is the Requester's responsibility to provide both the data circuit and both dial-up telephone circuits, see Section 1.13.

Engineering and Construction:

An engineering and construction schedule for this project is depicted below and is estimated at approximately 15 months. The schedule is shown for project duration purposes only and other factors associated with clearances, equipment delays and work schedules could cause additional delays. The schedule below 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.

Appendix A

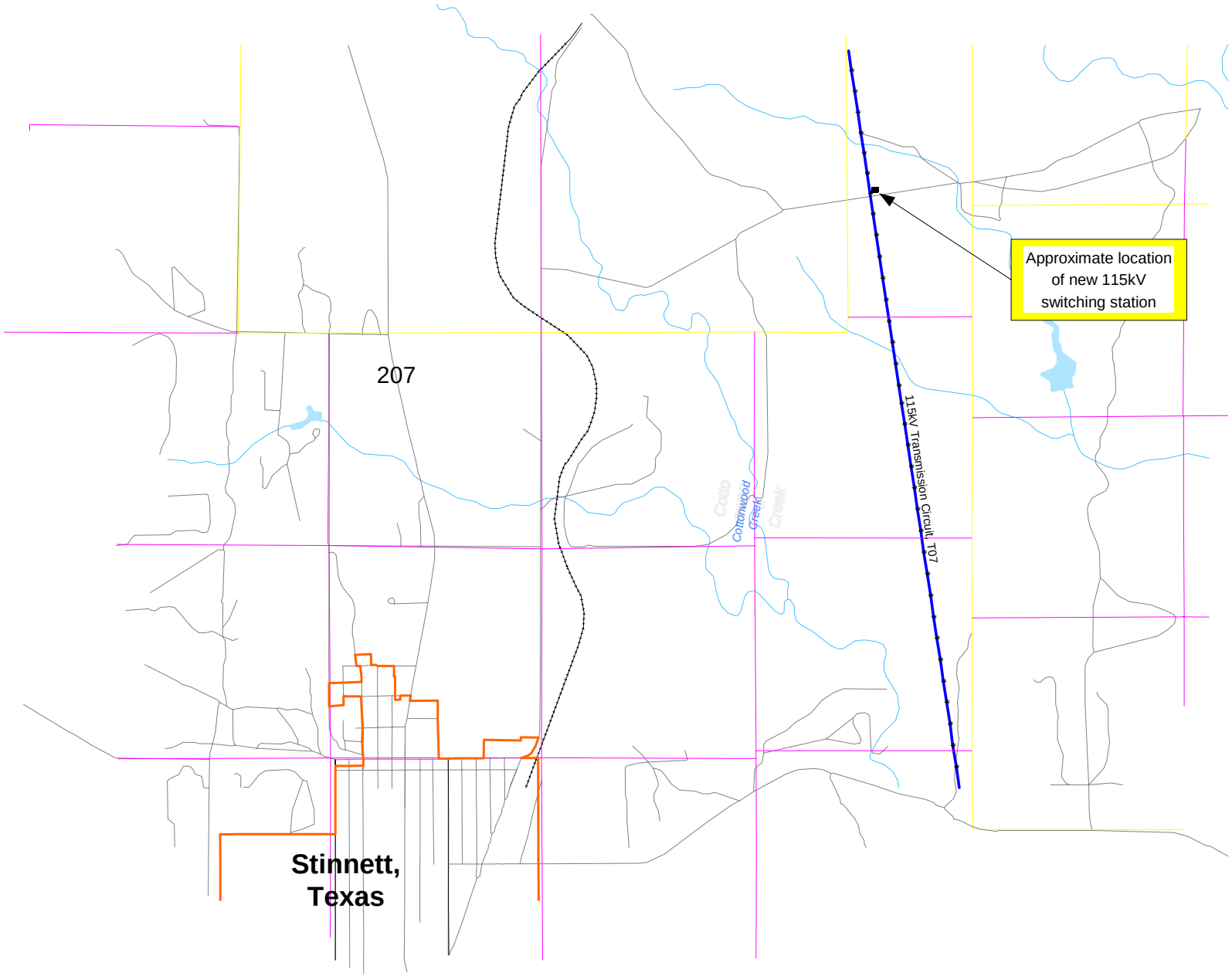


Figure A - 1 Approximate location of proposed switching station

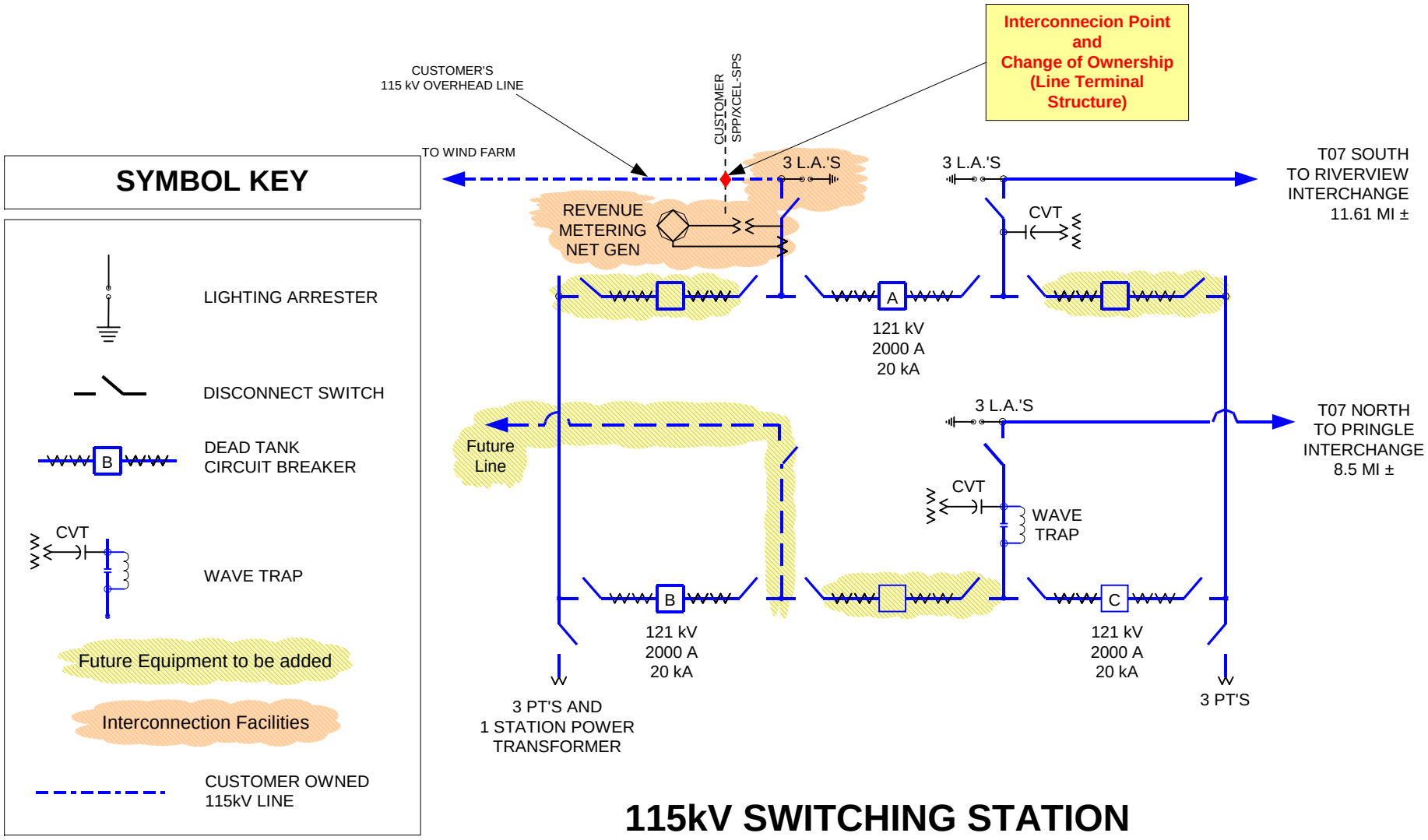


Figure A - 2 One-line Diagram of New Switching Station

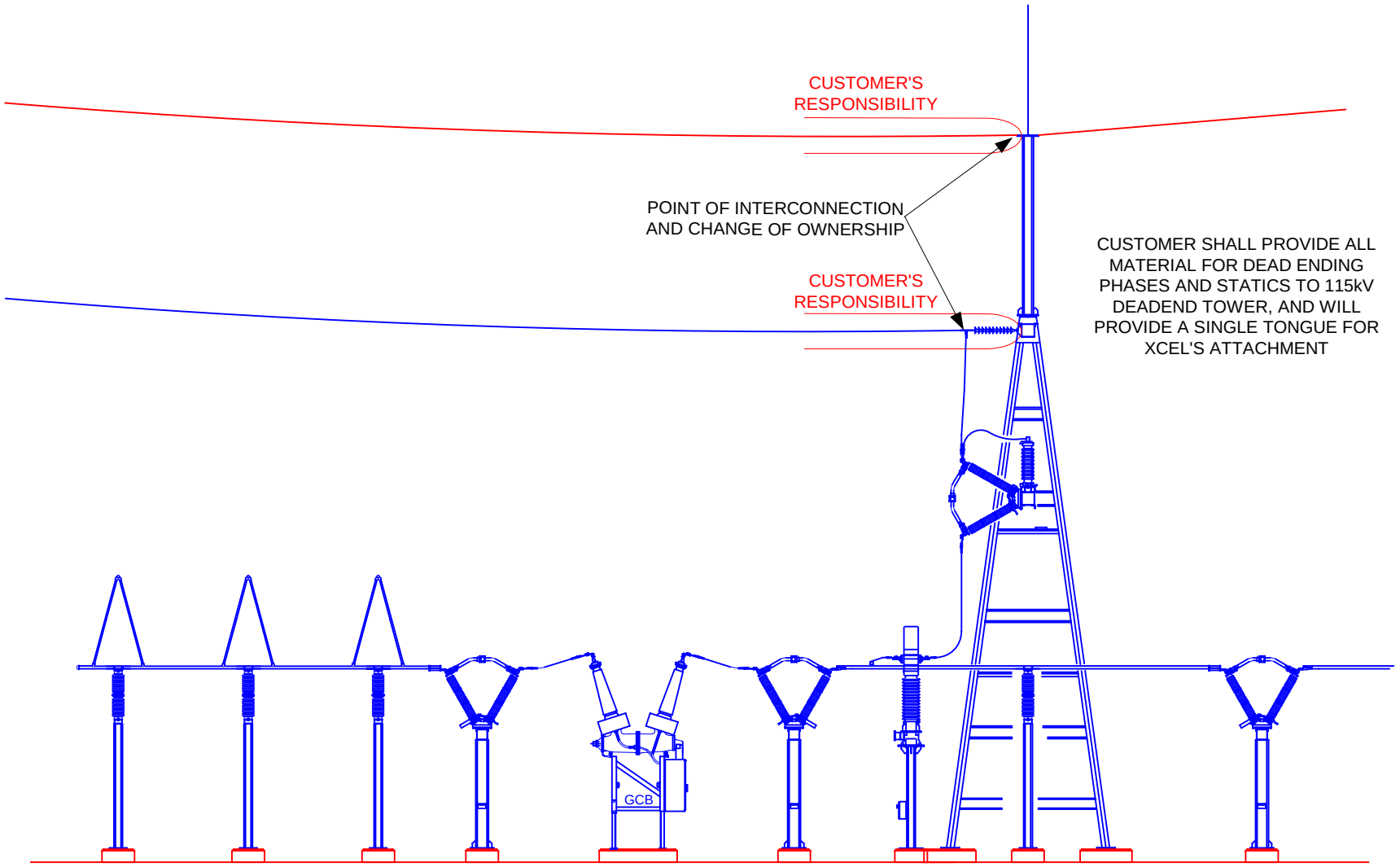


Figure A - 3 Point of Interconnection & Change of Ownership

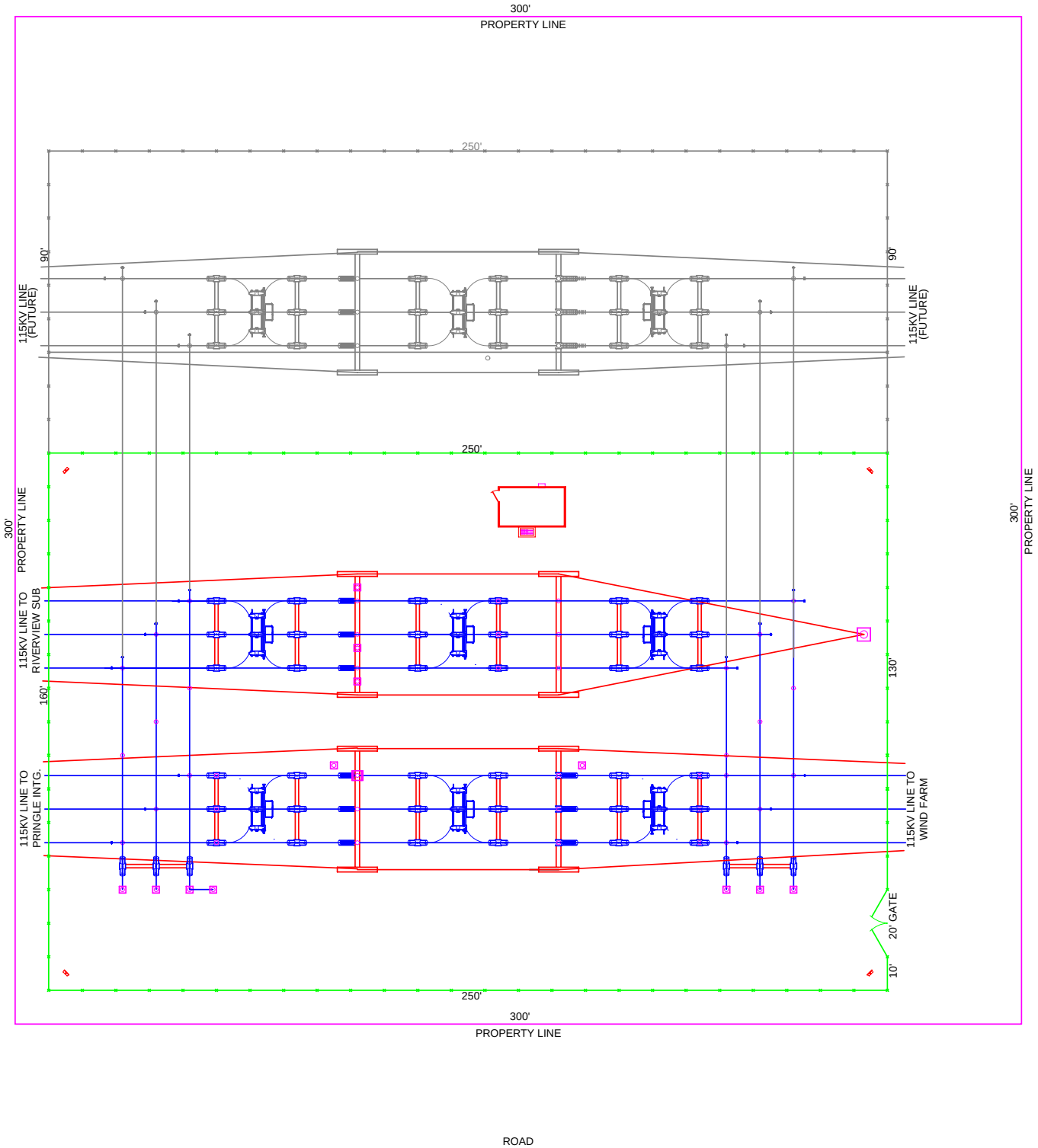


Figure A - 4 New Switching Station Plan View

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