SPP Southwest Power Pool

Facility Study for Generation Interconnection Request GEN – 2004 – 015

SPP Coordinated Planning
(#GEN-2004-015)

October 2005

Summary

Xcel Energy performed the following study at the request of the Southwest Power Pool (SPP) for SPP Generation Interconnection request Gen-2004-015. 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

150 MW Combustion Turbine
Yoakum County, Texas
SPP #GEN-2004-015

October 7, 2005

Xcel Energy Services, Inc.
Transmission Planning

Executive Summary

[Omitted Text] (the "Requester") has requested the interconnection of a new Frame-7 170 MW combustion turbine (CT) to Southwestern Public Service Company (SPS) (d/b/a Xcel Energy, Inc) transmission system by connecting to the 230 kV bus at Mustang Station. The Mustang Station is an existing facility where the requester currently owns three (3) generating units with the nominal capacity of 480 MW, and SPS owns the 230kV and 115kV transmission substation interconnecting these units.

The new unit is a simple cycle combustion turbine intended to be used as a summer peaking unit due to the limited hours of operation allowed under the air permit, but may be used in emergency situations in any season. The new unit has a nominal capacity of 150 MW and is expected to be fully operational by April 2006 to meet the requester's resource requirements.

Mustang Station is located about 5 miles east of Denver City, Texas and one-half (1/2) mile north of County Road 390. Further described as located in Section 887, Block D of the John H. Gibson Survey of Yoakum County, Texas. See Figure A1 for a map of the area.

The Southwest Power Pool (SPP) evaluated the request to interconnect the fourth generating unit at Mustang Station and thereby to the SPS transmission system in a System Impact Study completed in June 2005. Included in this facility study are the findings of another contingency study related to the 230/115kV autotransformer overload at Mustang Station. This overload and its mitigation will be addressed in the Transmission Service Study for the added generation from Mustang Unit #4. This facility study also reports the results of the short circuit study omitted in SPP's System Impact Study for the Mustang Unit #4 interconnection.

Xcel Energy requires 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. This document describes the technical and protection requirements for connecting new generation to the Xcel Energy operating company transmission system and also includes commissioning, operation, and maintenance guidelines. Xcel Energy will also require that the Interconnection Customer be in compliance with all applicable criteria, guidelines, standards, requirements, regulations, and procedures issues by the North American Electric Reliability Council, (NERC), Southwest Power Pool, and Federal Energy Regulatory Commission or their successor organizations.

Close work between the SPS substation design and construction group, the requester's personnel and local operating groups will be imperative to have this project in service on the scheduled date. The requester's construction has already begun, and SPS's modifications to the metering and controls should be completed before the requester takes service from the new auxiliary transformer. The following is the anticipated schedule.

- Tap the 230 kV line fed from DK00, November 5, 2005
- Take station power from new auxiliary transformer, November 21, 2005
- First Synch of Mustang Unit #4, January 27, 2006
- Mustang Unit #4 commissioned date, April 1, 2006

The requester or their contractor will be performing the major portions of the construction to add the Mustang Unit #4 generator. There will be minimal modifications to the SPS facilities, which include the modification to breaker controls, relocation of metering for the Mustang Unit #3 generator, and the additional metering for the Mustang Unit #4 and its auxiliary transformer. The estimated cost for SPS's modifications to the metering and controls is $45,000. This is an estimated cost, but the requester will be responsible for the actual cost.

Discussion

General Description

The requester will be interconnecting the Mustang Unit #4 to the SPS transmission system by connecting to the existing 230 kV service of Mustang Unit #3. This will require minimal modifications to the existing Mustang 230 kV substation. Primarily, these modifications will change the duty of one 230kV breaker, alter the metering point for the Mustang Unit #3, and expand metering to include the Mustang Unit #4 and a new auxiliary transformer. The requester will be making all of the 230 kV connections by tapping the SPS tie to the existing Mustang Unit #3 feeder, and then removing the jumpers to the Mustang Unit #3 GSU as indicated in Figure A4, and adding to the their facilities the equipment necessary to add Mustang Unit #4. There will be no modifications on the SPS facilities other than that which is described below.

General Description of Modifications at Mustang Substation

1. **Modifications at Mustang Substation:** See Figure A2 in Appendix A for one-line diagram and Figure A3 for a plan view of the station.

    1.1. **Location:** Mustang Station is located about 5 miles east of Denver City, Texas and one-half (1/2) mile north of County Road 390. Further described as located in Section 887, Block D of the John H. Gibson Survey of Yoakum County, Texas. See Figure A1 for a map of the area.

    1.2. **Bus Design:** There are no changes planned for the Mustang Substation 230kV bus arrangement as a result of this project. However, for future considerations, the requester will build their facilities so that the future expansion of the 230kV bus to a breaker and one-half arrangement is not hindered.

    1.3. **Controls:** Currently, the 230 kV breaker DK00 is a unit breaker for Mustang Unit #3. This breaker will be converted to a 230 kV tie breaker to serve the requester's Mustang Unit #3, Mustang Unit #4, and the new auxiliary transformer. Xcel Energy will install a control switch and add supervisory control to DK00 breaker operation. The requester will supply the necessary interlocks such that DK00 cannot be closed with the requester's 230 kV bus hot.

    1.4. **Line Reactors:** None.

    1.5. **Security Fence:** There will be no changes to the Mustang Substation fencing.

    1.6. **Ground Grid:** There will be no changes to the ground grid within the Mustang Substation. However, the requester will tie their ground grid to the Mustang Substation ground grid by connecting to the 4/0 copperweld outside the substation perimeter fence on the north side of the Mustang Substation.

    1.7. **Site Grading:** No changes for Xcel Energy.

    1.8. **Station Power:** No changes for Mustang Substation.

    1.9. **Relay and Protection Scheme**: Breaker DK00 is utilized in the differential protection of the Mustang Unit #3 GSU transformer. The differential protection associated with DK00 will change from the Mustang Unit #3 GSU transformer protection to the requester's 230 kV bus differential protection.

1.10. **Revenue Metering**:

Mustang Unit #3: The existing billing meter on DK00 will become a spare, and a new Xcel Energy supplied metering cabinet will be located near the Mustang Unit #3 GSU transformer. Within the metering cabinet Xcel Energy will install the billing meter (an ION 8400 meter unit). The requester will supply the new revenue metering CTs from the new 230kV Mustang Unit #3 breaker, (800:5 single ratio, 0.3% accuracy with a burden rating of B0.2[1]), and the existing Mustang Substation 230 kV PTs (0.3% accuracy) will supply the (3-phase 120 volts to ground) potential for the metering. The requester will supply and route six (6) wires from the new metering cabinet to the plant RTU for reporting the kWH pulses to the Amarillo Control Center.

Mustang Unit #4 and Auxiliary Transformer: Xcel Energy will supply a 19" metering rack to be located within the requester's control building for Mustang Unit #4. The requester will supply the 230 kV PT(s) with 0.3% accuracy to supply the (3-phase 120 volts to ground) potential for the metering. The new revenue metering CTs for Mustang Unit #4 generator, supplied by the requester, will be installed in the new 230kV Mustang Unit #4 breaker, (800:5 single ratio, 0.3% accuracy with a burden rating of B0.2). The metering CTs for the new auxiliary transformer, supplied by the requester, will be installed within the 230 kV transformer bushings, (200:5 single ratio, 0.3% accuracy with a burden rating of B0.2). The requester will be responsible for routing and termination of CT and PT wiring to a designated terminal block within the metering rack and Xcel Energy will wire from the terminal block to the meters.

The requester will supply and route twelve (12) wires from the new metering cabinet to the plant RTU for reporting the kWH pulses to the Amarillo Control Center.

1.11. **Communications:** A dedicated high-speed phone circuit will be supplied by the requester to the new Mustang Unit #3 meter cabinet for remote interrogation. The requester will also supply two (2) dedicated high-speed phone circuits to the new metering rack for the Mustang Unit #4, and new Auxiliary Transformer for remote interrogation

2. **Transmission Line:** There are no changes to the Xcel Energy system. The 795 MCM ACSR conductors from the tiebreaker DK00 that the requester will tap is adequate for the requester's expansion plans. The limiting factor on this tap is the continuous rating of the breaker disconnects of 1200 amps, or 478 MVA. The combined ratings of Unit #3 and Unit #4 are 330 MVA. Figure A2 and Figure A4 illustrate the point where the requester will tap the 230 kV service from the new tiebreaker DK00 and demarcation of ownership.

3. **Right-Of-Way (ROW):** There will be no physical expansion SPS facilities requiring new ROW. However, ROW to the north of Mustang Substation will be reserved by the requester for future expansion of the 230kV bus to a ring-bus, or breaker and one-half arrangement.

4. **Construction Power and Distribution Service:** Both Construction and Station power, in addition to any distribution service required for the Requester's interconnection of Mustang Unit #4, are the sole responsibility of the Requester.

5. **Engineering and Construction Schedule:** Close work between the SPS substation design and construction group, the requester's personnel and local operating groups will be

[1] Current Transformer Burdens – normally expressed in ohms such as B0.1, or B0.2 where the corresponding volt-ampere values are 2.5 and 5.0 respectively.

imperative to have this project in service on the scheduled date. The requester's construction has already begun, and SPS's modifications to the metering and controls should be completed before the requester takes service from the new auxiliary transformer. The following is the anticipated schedule.

- Tap the 230 kV line fed from DK00, November 5, 2005
- Take station power from new auxiliary transformer, November 21, 2005
- First Synch of Mustang Unit #4, January 27, 2006
- Mustang Unit #4 commissioned date, April 1, 2006

6. **Estimated Construction Costs:** The total estimated cost for the modifications to change the duty of one 230kV breaker, alter the metering point for the Mustang Unit #3, and expand metering to include the Mustang Unit #4 and a new auxiliary transformer is **$45,000**[2]. This is an estimated cost, but the requester will be responsible for the actual cost.

7. **Miscellaneous**:

   The Southwest Power Pool (SPP) evaluated the request to interconnect the fourth generating unit at Mustang Station and thereby to the SPS transmission system in a System Impact Study completed in June 2005. The SPP impact study did not contain a short circuit study. Therefore, this facility study reports the findings of another contingency study performed to verify SPP's results specifically related to the Mustang Station 230/115 kV autotransformer, and the results of the short circuit study.

   Contingency Study Results:

   For this contingency study the 2005 SPP planning model (without transactions) for the 2006 summer peak season as well as the 2005 SPP transaction case models (involving imports and exports relative to the SPS service area) were tested with and without the new generation from the Mustang Unit #4. These case models reflected the loading conditions for the 2006, 2007 and 2010 summer seasons.

   The SPP transaction case models include the approved long-term firm purchase power agreements, or transactions. Any modification to the transmission system that creates a positive change in a transmission element's Outage Transmission Distribution Factor (OTDF) greater than 3%, with a new, and or existing contingency overload, would be considered as having an adverse impact to existing transactions.

   Table 1 below illustrates the resulting overloads observed in this study.

[2] Estimated costs are in 2005 dollars and within +/- 20% as requested in the study application.

Table 1: Contingency Study Results

06SP Planning Model					
Contingency	Limiting Elements	Rating (MVA)	06SP-000 (BASE)	06SP-001 (TEST)	06SP-001 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	70.9%	95.8%	24.9%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	58.1%	83.1%	25.0%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	73.1%	88.1%	15.0%
06SP Export Model					
Contingency	Limiting Elements	Rating (MVA)	06SP-E00 (BASE)	06SP-E01 (TEST)	06SP-E01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	78.9%	102.5%	23.6%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	61.9%	87.4%	25.5%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	80.2%	94.6%	14.4%
06SP Import Model					
Contingency	Limiting Elements	Rating (MVA)	06SP-I00 (BASE)	06SP-I01 (TEST)	06SP-I01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	73.9%	104.4%	30.5%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	63.1%	97.3%	34.2%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	74.6%	92.6%	18.0%
07SP Export Model					
Contingency	Limiting Elements	Rating (MVA)	07SP-E00 (BASE)	07SP-E01 (TEST)	07SP-E01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	81.4%	105.0%	23.6%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	65.4%	90.5%	25.1%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	81.6%	96.0%	14.4%

RED indicates a new overload.

Table 1 (Cont.): Contingency Study Results

07SP Import Model					
Contingency	Limiting Elements	Rating (MVA)	07SP-I00 (BASE)	07SP-I01 (TEST)	07SP-I01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	76.0%	109.7%	33.7%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	65.4%	105.0%	39.6%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	75.7%	95.3%	19.6%
10SP Export Model					
Contingency	Limiting Elements	Rating (MVA)	10SP-E00 (BASE)	10SP-E01 (TEST)	10SP-E01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	92.1%	115.3%	23.2%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	77.1%	102.3%	25.2%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	89.6%	104.4%	14.8%
10SP Import Model					
Contingency	Limiting Elements	Rating (MVA)	10SP-I00 (BASE)	10SP-I01 (TEST)	10SP-I01 OTDF ΔVPU
Yoakum Interchange 230/115kV auto	Mustang 230/115kV auto	150	84.0%	108.5%	24.5%
Yoakum Interchange - Lea Co. Interchange 230kV line	Mustang 230/115kV auto	150	77.3%	102.0%	24.7%
Mustang 230/115kV auto	Yoakum Interchange 230/115kV auto	150	81.1%	96.4%	15.3%

RED indicates a new overload.

Short Circuit Study Results:

The Short Circuit Analysis was performed internally by Xcel Energy Services to determine if the added generation would cause the available fault currents to exceed the interrupting capability of the SPS facilities. The results are shown in Table 2 below.

Table 2: Short Circuit Information

Fault Location	Fault Current (A)		Interrupting Capability of the smallest breaker on the bus.
	Line-to-Ground	3–Phase	(Amps)
Mustang Station 230 kV Bus	11,450	10,800	40,000
Mustang Station 115 kV Bus	20,100	18,400	40,000
Yoakum Interchange 230 kV Bus	10,550	11,400	40,000
Amoco Wasson 230 kV Bus	9,750	10,000	40,000
Denver City 115 kV Bus	16,580	17,035	20,000

With the added generation of Mustang Unit #4, the available fault currents increased at the indicated locations by 20% to 28%. With the Mustang Unit #4 added, the increased available fault currents were still within the interrupting capability all identified breakers.

Appendix A

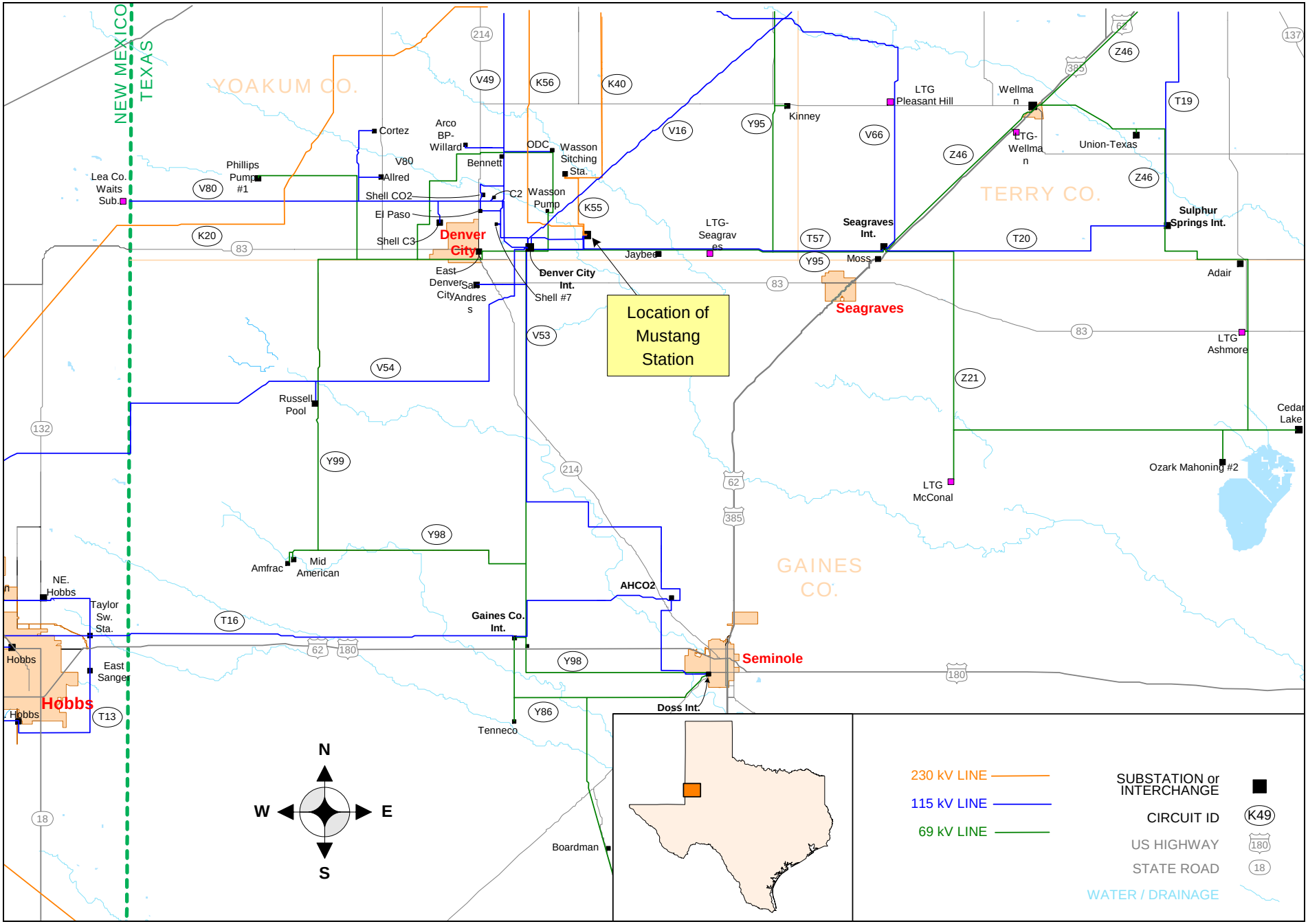
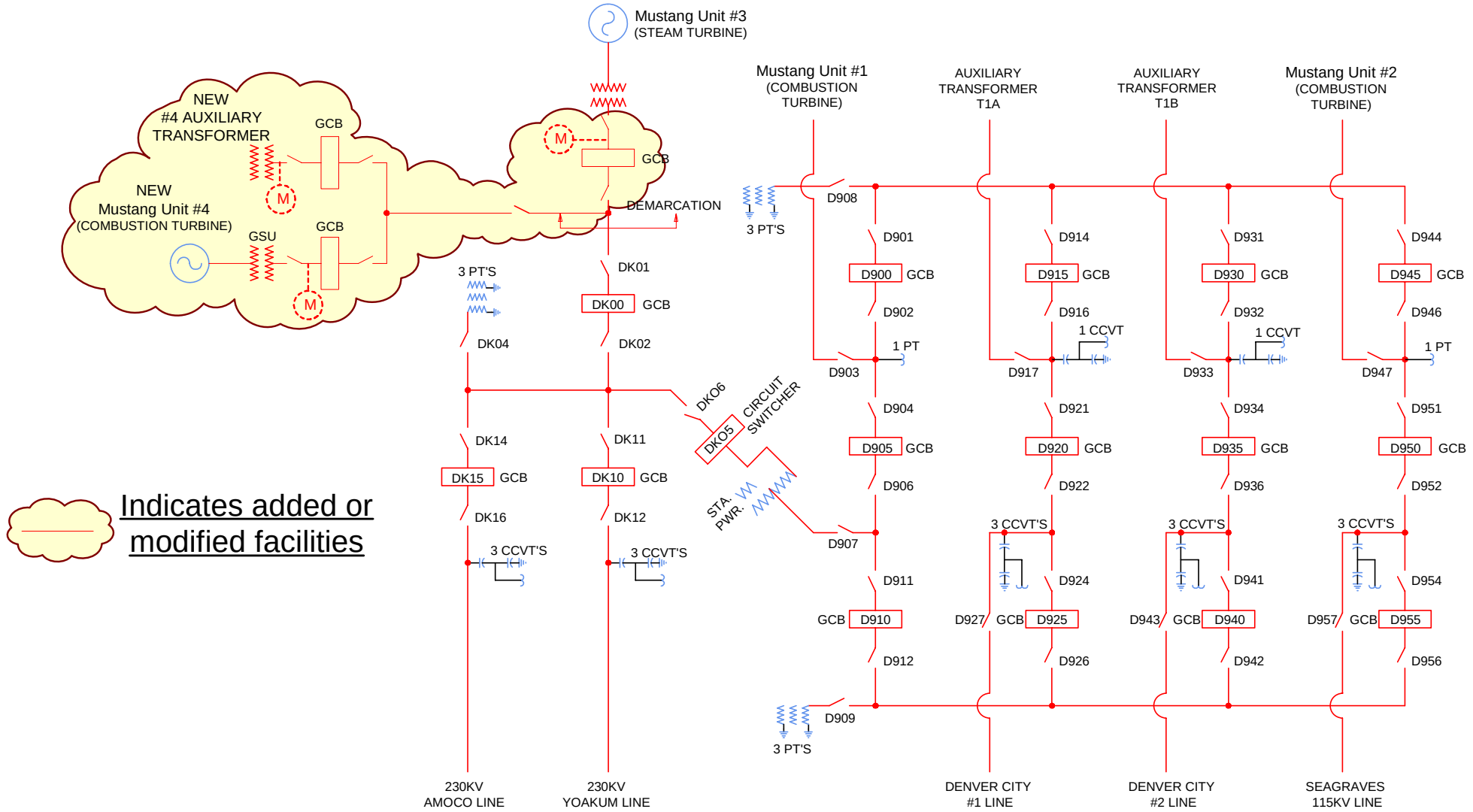


Figure A1 – Area Transmission and Location of Mustang Station



ONE LINE DIAGRAM

Figure A2 – Simplified One Line Diagram Illustrating Interconnection

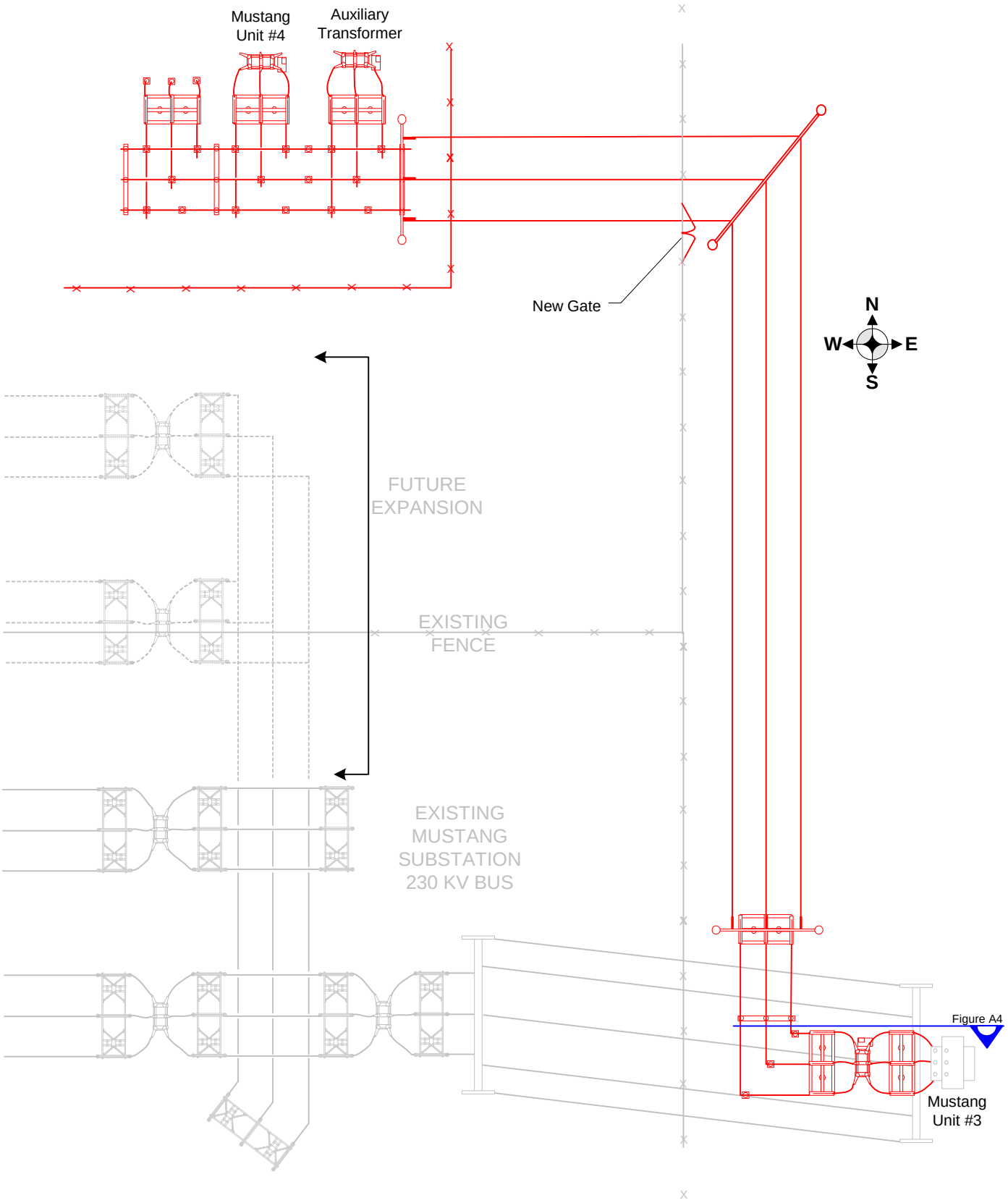
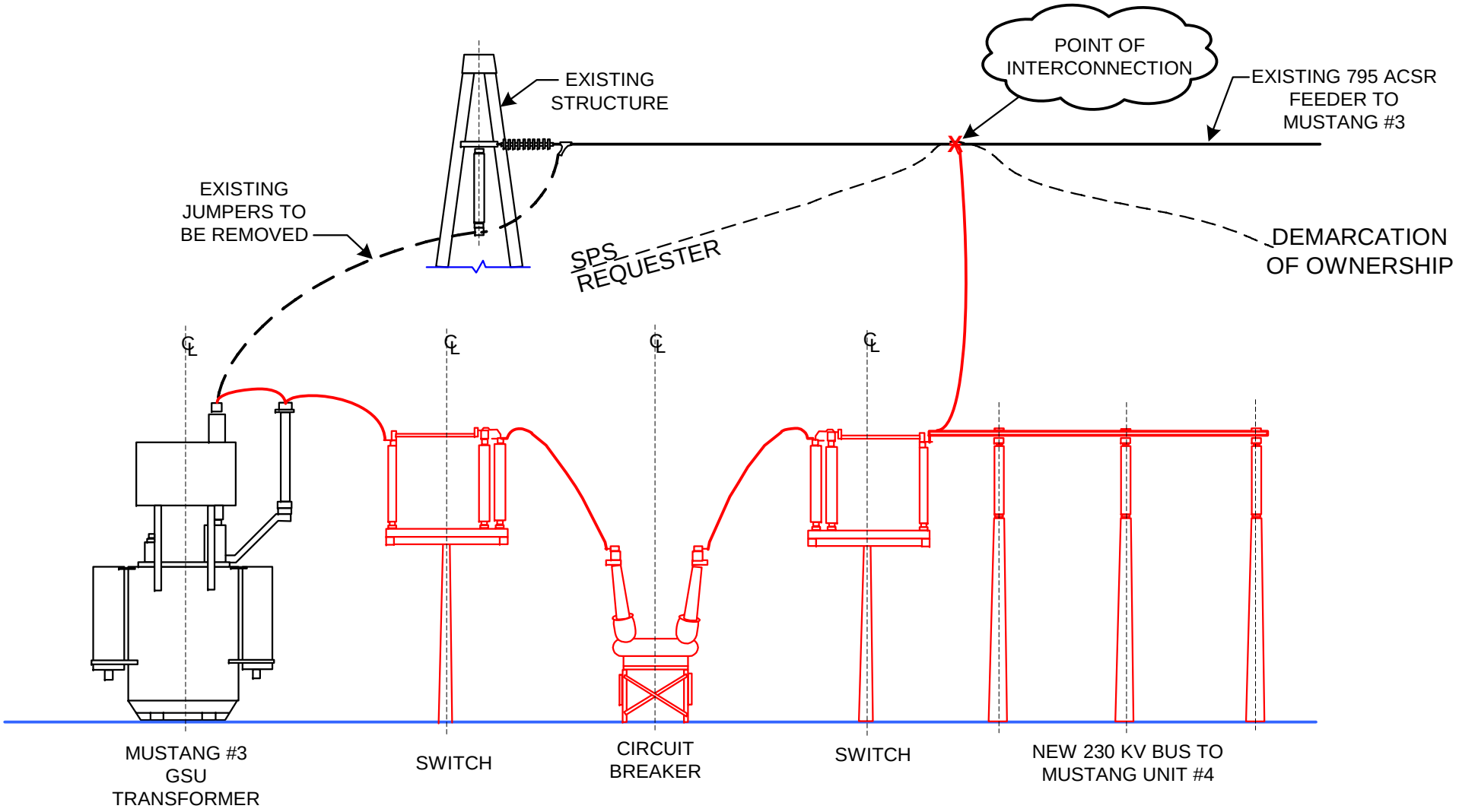


Figure A3 – Plan View of Requester's Additional Facilities



RED ITEMS ARE NEW
BLACK ITEMS ARE EXISTING

Figure A4 – Point of Interconnection & Change of Ownership