



***Facility Study  
For  
Generation Interconnection  
Request  
GEN-2006-018***

***SPP Tariff Studies***

***(#GEN-2006-018)***

***November 2007***

## **Summary**

Pursuant to the tariff and at the request of the Southwest Power Pool (SPP), Xcel Energy performed the following Facility Study to satisfy the Facility Study Agreement executed by the requesting customer and SPP for SPP Generation Interconnection request Gen-2006-018. 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.



**Facilities Study For  
Southwest Power Pool**

170 MW Gas Turbine  
Hale County, Texas  
SPP #GEN-2006-018

November 14, 2007

Xcel Energy Services, Inc.  
Transmission Planning

## Executive Summary

[Omitted Text] (the "Requester") has requested the interconnection of their Antelope Station, which is a new Frame-7 170 MW gas turbine (GT) to Southwestern Public Service Company (SPS) (an Xcel Energy Company) transmission system by connecting to the 230 kV bus at TUCO Interchange. SPS owns the 345 kV, 230 kV 115 kV, and 69 kV transmission systems at TUCO Interchange.

The new unit is a simple cycle gas turbine intended to be used as a summer peaking unit due to the limited hours of operation allowed under the air quality permit, but may be used in emergency situations in any season. The new unit has a nominal capacity of 170 MW and has requested that it be fully operational by June 1, 2009 to meet the requester's resource requirements. It is anticipated that the construction will require approximately 12 months for completion after the day an interconnection agreement is signed and after all internal approvals.

Antelope Station is located adjacent to SPS's TUCO Interchange and 4 miles north of Abernathy, Texas. Further described as located in Section 9, Block C-2 of the TTRR Survey of Hale County, Texas. See Figure 1 for a location map of the area.

The Southwest Power Pool (SPP) evaluated the request to interconnect the Antelope generator at TUCO and thereby to the SPS transmission system in a Feasibility and System Impact Study completed in December 2006. This facility study also reports the results of the short circuit study for the Antelope 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. Version 3.0 dated 12/31/06, and is available at [http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1\\_16699\\_24407-1428-0\\_0\\_0-0,00.html](http://www.xcelenergy.com/XLWEB/CDA/0,3080,1-1-1_16699_24407-1428-0_0_0-0,00.html). 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 Corporation (NERC), Southwest Power Pool (SPP), and Federal Energy Regulatory Commission (FERC) 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. SPS's facility modifications should be completed before the requester takes service from the new auxiliary transformer. The anticipated in-service date is June 2009.

The requester or their contractor will be performing the major portions of the construction to add the Requester's generator. There will be major modifications to the SPS facilities associated with the interconnection of the Antelope generator. These modifications include the installation of two 230 kV breakers including the steel associated with the new structures and switches. The estimated cost for SPS's modifications associated with the interconnection of the Antelope generator is \$1,056,872. New revenue metering for the Requester's generation Station will be on SPS's 230 kV at an estimated cost of \$171,591. The cost of these upgrades, inclusive of the Interconnection Customer's cost for the Interconnection Facilities required for the connection of this new gas turbine (GT) generation facility, is shown below. See Table 2 for a detail description of all the costs.

Stand-alone Network Upgrade:	\$	<b>998,266</b>
Network Upgrade:	\$	<b>58,606</b>
<hr/>		
Interconnection Facilities <sup>1</sup> :	\$	<b>171,591</b>
<hr/>		
Total:	\$	<b>1,228,463</b>
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<sup>1</sup> Direct Assigned Cost To Requester

# Discussion

## General Description

The requester will be interconnecting their Antelope Station at TUCO Interchange to the SPS transmission system by connecting their new 230 kV bus to the TUCO Interchange 230 kV bus with an overhead 230 kV transmission line. This will require modifications to the existing TUCO Interchange 230 kV bus. Primarily, these modifications include the addition of the 230 kV bus and breakers. New revenue metering for the Antelope Station will be on SPS's 230 kV bus. The requester will be making all of the 230 kV connections necessary to add their facilities and equipment at Antelope Station.

## General Description of Modifications at TUCO Interchange

1. **TUCO Interchange:** See Figure 2 in Appendix A for one-line diagram.
  - 1.1. **Location:** TUCO Interchange is located about 4 miles north of Abernathy, Texas and one-half (1/2) mile east of Interstate 27. Further described as located in Section 9, Block C-2 of the TTRR Survey, Hale County, Texas. See Figure 1 for a map of the area.
  - 1.2. **Bus Design:** There are modifications planned for the TUCO Interchange 230 kV bus arrangement as a result of this project. Antelope Station will require the addition of 230 bus and two 230 kV breakers shown on the one-line diagram (Figure 2). See Figure 4 for a simplified diagram illustrating the Interconnection.
  - 1.3. **Controls:** 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.
  - 1.4. **Line Reactors:** None.
  - 1.5. **Security Fence:** The fence will be extended 120' to the south from where it is today. The fence will be located within 10' of the new south property line.
  - 1.6. **Ground Grid:** There will be changes to the ground grid within TUCO Interchange. The requester will have multiple ties to their ground grid from their Antelope Station by connecting to the 4/0 copper outside the TUCO Interchange perimeter fence on the south side of TUCO Interchange and on the north side of the Antelope Station.
  - 1.7. **Site Grading:** Additional grading will be required for the new ROW obtained from the Requester.
  - 1.8. **Station Power:** A 133 kV/120-240 volt transformer tapped off of the 230 kV bus will provide station power. A backup station power source will be taken from local distribution. Additionally, an automatic throw over switch to automatically transfer the station power will be installed.
  - 1.9. **Relay and Protection Scheme:** TUCO Interchange to the customer's owned line relaying will be step distance. A SEL 321-1 and an SEL 311-L relay will be used. Communications for the protective relaying will be achieved via a fiber optic connection between the facilities. A 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. A SEL-501-0 will also be installed for breaker failure.
  - 1.10. **Revenue Metering:** On the 230kV line, revenue metering will be bi-directional and will be installed along with an ION 8600 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. **Communications:** A dedicated phone circuit will be provided by the requester for Antelope Station's revenue metering for remote interrogation. RTU or telemetry communication is necessary for Antelope Station SCADA and telemetry communication. All SCADA inputs and outputs will be wired into the control house. See section 1.09 for information on the relaying communications.
2. **Transmission Line:** There will be a 230 kV overhead transmission line connecting the TUCO 230 kV bus with the Antelope Station's 230 kV bus, which will be provided by the requester.
3. **Right-Of-Way (ROW):** There will be an additional 70' ROW expansion adjacent to the south property of TUCO Interchange from the Requester to SPS (See Figure A-2).
4. **Construction Power and Distribution Service:** Both Construction and Station power, in addition to any distribution service required for the Requester's interconnection of Antelope Station is the sole responsibility of the Requester.
5. **Engineering and Construction Schedule:** Close work between the SPS substation design and construction group, and the requester's personnel operating groups will be necessary in order to meet the in service date. The anticipated in-service date for the Generator step-up transformer to receive back feed power is February 1, 2009 with commercial operation scheduled for June 1, 2009. It is anticipated that the construction at TUCO will require approximately 12 months for completion after the day an interconnection agreement is signed and after all internal approvals.
6. **Estimated Construction Costs:** The total estimated cost for the additional 230 kV steel and bus with breakers, and the new metering for the Antelope Station is \$1,228,463. This is an estimated cost.
7. **Additional Studies Required:** The Antelope generator will not impact the current filter design (rating and number of filters needed) of the Static Var Compensator (SVC) being installed at TUCO Interchange. It should be noted that this statement is based on results from an ABB draft report titled 'Impact of Antelope Generator on TUCO Harmonic Impedances', which should be provided to Requester shortly. The report includes some strong recommendations for additional studies associated with interactions between the SVC and the Antelope generator. These studies need to be initiated by the generator owner for their unit protection, and a rough description of these studies are listed below:
  - Harmonic current level expected to flow into generator due to SVC operation
  - Voltage control interactions between the generator and SVC
  - Potential of sub-synchronous torsional interactions (SSTI) between SVC and generatorPlease review the ABB report for information on these additional studies.

8. **Miscellaneous:**

The Southwest Power Pool (SPP) evaluated the request to interconnect the generating unit at Antelope Station and thereby to the SPS transmission system in a System Impact Study completed in December 2006. The SPP impact study did not contain a short circuit study; therefore, this facility study reports the results of the short circuit study.

### 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 1 below.

Table 1: Short Circuit Information			
Fault Location	Fault Current (A)		Interrupting Capability of the smallest breaker on the bus. (Amps)
	Line-to-Ground	3-Phase	
Antelope Station 230 kV Bus	11,450	10,650	40,000

### Estimated Construction Costs:

The projects required for the interconnection of the 170 MW gas turbine (GT) facility consist of the projects summarized in the table below:

**Table 2, Required Interconnection Projects**

Project	Description	Estimated Cost
<b>Stand-alone Network Upgrade</b>		
1	230 kV 2-breakers (breaker and a half configuration)	\$ 997,266
2	Right-of-Way Cost	\$ 1,000
	<b>Subtotal:</b>	<b>\$ 998,266</b>
<b>Network Upgrade</b>		
3	Relay Modifications at TUCO Interchange	\$ 58,606
	<b>Subtotal:</b>	<b>\$ 58,606</b>
<b>Interconnection Facilities (at the Interconnection Customer's Expense)</b>		
4	230 kV Arresters and Metering	\$ 171,591
	<b>Subtotal:</b>	<b>\$ 171,591</b>
	<b>Total Cost:</b>	<b>\$ 1,228,463</b>

These costs were estimated using 2007 costs (2007 dollars) with no AFUDC<sup>2</sup> added with an estimated accuracy is ± 20%.

**Capital budget approval has not been sought for this project as of the date of this report. The required approval process may impact the projected in-service date requested by the Interconnection Customer.**

<sup>2</sup> AFUDC - Allowance for Funds Used During Construction.



**Appendix A**

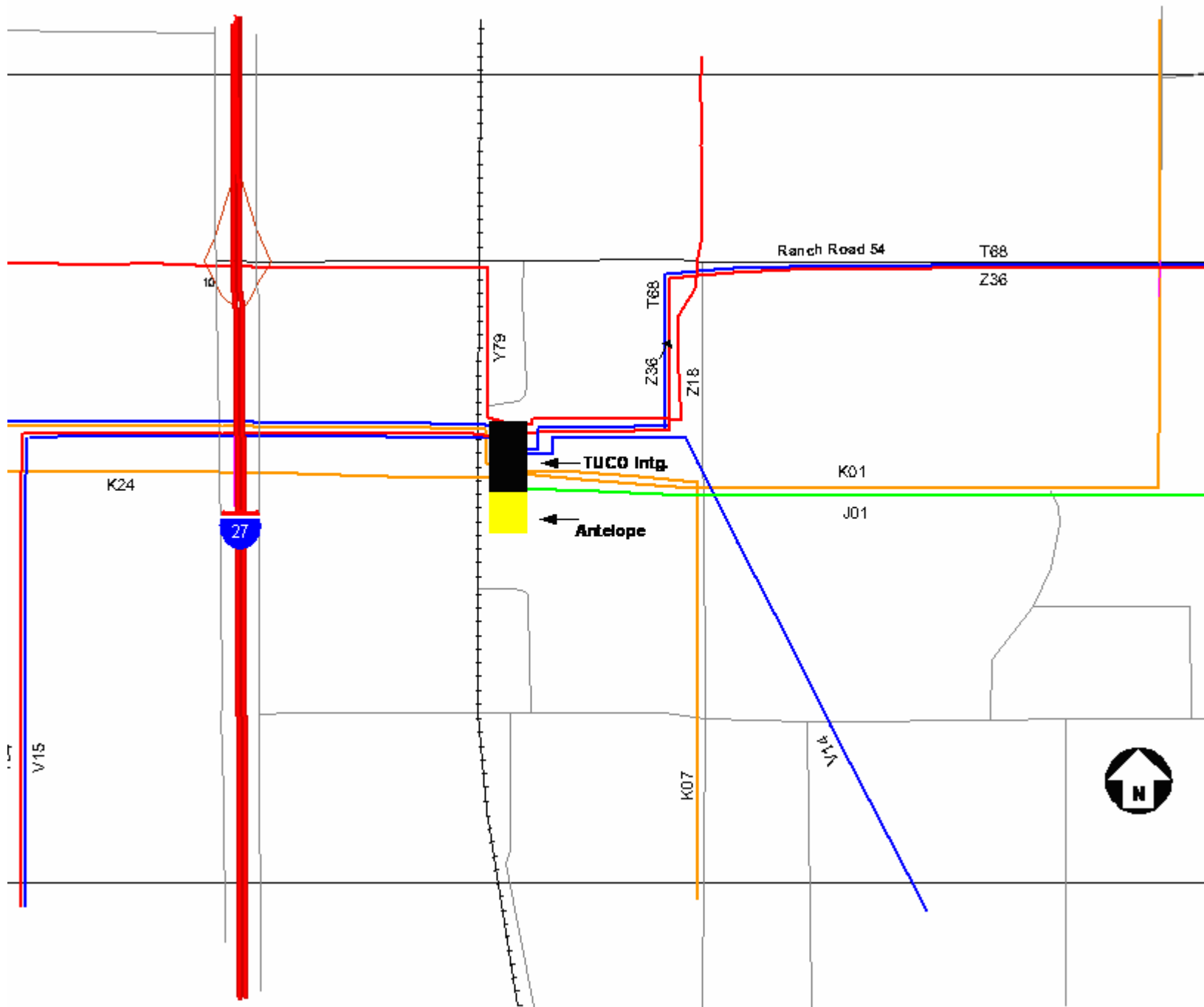


Figure A1 – Area Transmission and Location of Antelope Station





NO.	REVISIONS	BY	CHKD.	APPR.	DATE

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**Southwestern  
Public Service**

ELEVATION A-A  
230KV ANTELOPE ADDITION  
TUCO PLANT INTERCHANGE

DESIGNED	DATE	08-01-00	DRAWN	-	SCALE	1/4" = 1'-0"
REVISIONS	-	-	APP. ENGR.	-		
APPROVAL	-	-	ENGR.	CHD ENCL. NO.		REV. NO. 0

Figure A-3. Elevation plan of interconnection of Antelope to TUCO Interchange.

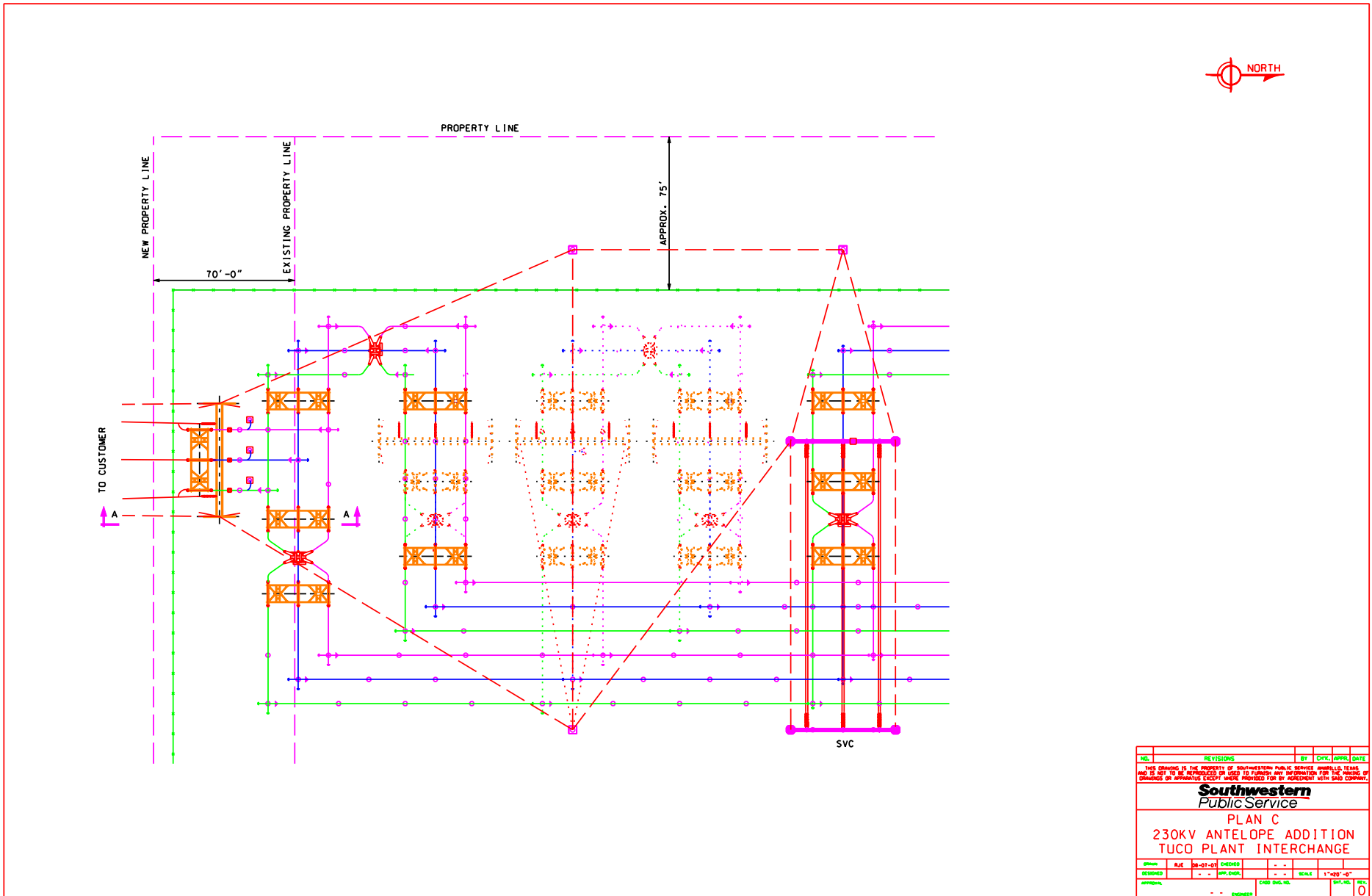


Figure A-4. Simplified Diagram Illustrating Interconnection.