Xcel Energy

Draft
Interconnection Facilities Study Report

Request # GI-2006-1a

Plains End II LLC Facility Study

October 2006

Xcel Energy Services, Inc.
Transmission Planning – Denver, CO

I. Executive Summary

This Interconnection Facilities Study Report summarizes the analysis performed by Public Service Company of Colorado (PSCo) to specify and estimate the cost of the equipment, engineering, procurement, and construction needed to interconnect 115 MW of gas generation at the existing PSCo's Plains End Substation near Golden, CO in Jefferson County. The Customer generation would interconnect at an expanded PSCo Plains End Substation. The requested estimated commercial in-service date of the generation facilities is April 1, 2008 with a requested estimated back feed date of September 1, 2007. The study results show that it should be feasible to implement the upgrades required for interconnection to facilitate the back feed date of September 1, 2007.

The total estimated cost for facilities required for interconnection is approximately **$1.145 million**[1] including:

- $0.489 million for Transmission Provider Interconnection Facilities (Customer-funded facilities)
- $0.656 million for PSCo Network Upgrades for Interconnection

The estimated time required to engineer, permit and construct the facilities described above is at least 10 to 12 months after receiving authorization to proceed.

The project was studied as a Network Resource per the System Impact Study Agreement. The Network Upgrades recommended for firm delivery of the generation were identified in the System Impact Study, and consist of expanding the existing Plains End Substation to sectionalize the Lookout to Niwot 230 kV Transmission at Plains End and uprating the Lookout to Plains End 230 kV transmission circuits (created by tying the two circuits at Plains End) to achieve continuous rating of 525 MVA by May 31, 2008. The estimated time frame to implement the facilities required for delivery is at least 18 months after authorization to proceed. Therefore, it may not be feasible to implement the facilities required to accommodate delivery of the generation to PSCo customers on a firm basis by the requested in-service date and some re-dispatch of generation may be required under certain operating conditions.

A simple diagram for Network Upgrades for Delivery and the regional transmission system for this request is depicted in Figure 1, and a simple one-line diagram of the proposed interconnection facilities shown in Figure 2.

[1] Appropriation estimate considered to have an accuracy of +/- 20%.

Figure 1: PSCo's Regional 230 kV Transmission System One-Line Diagram

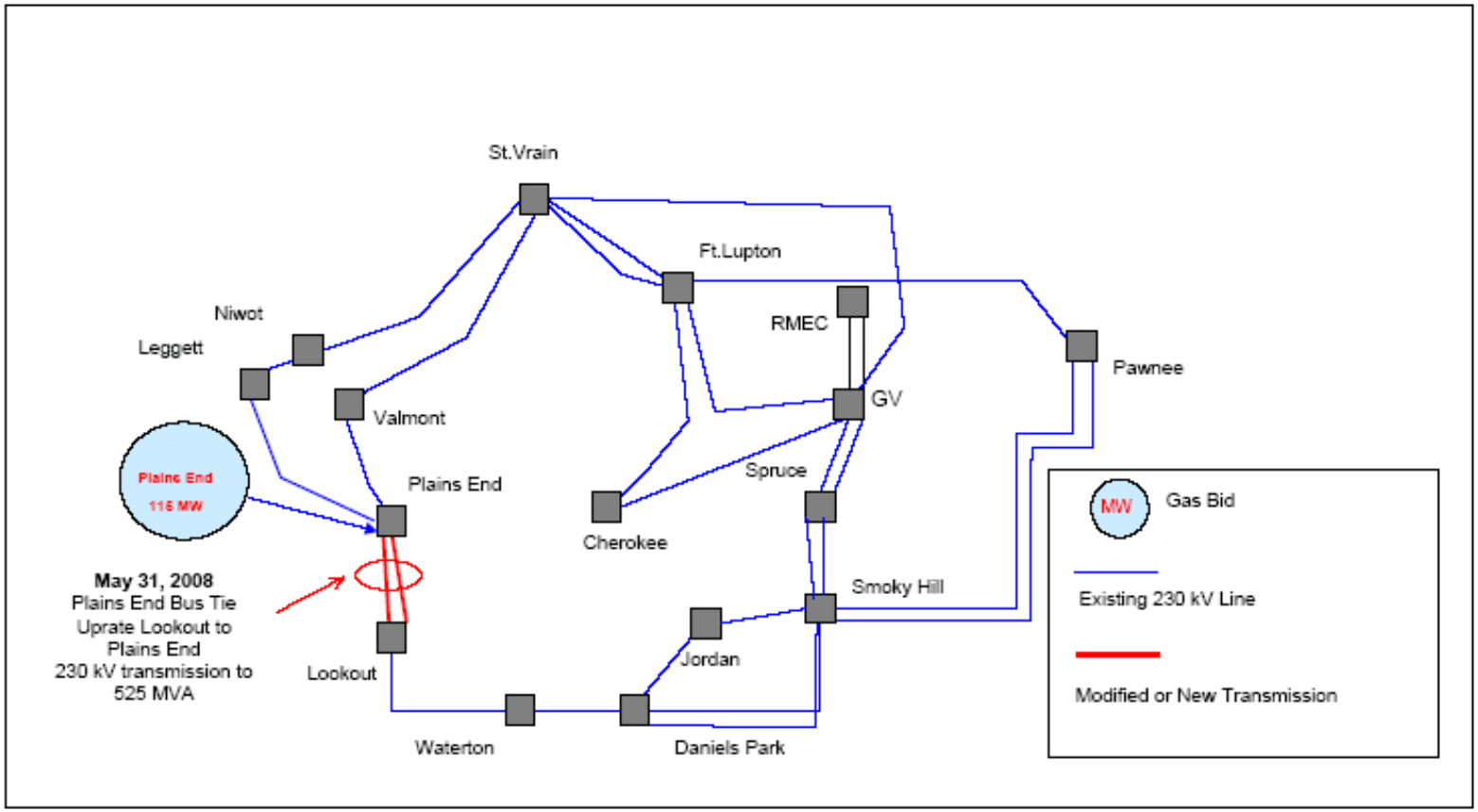
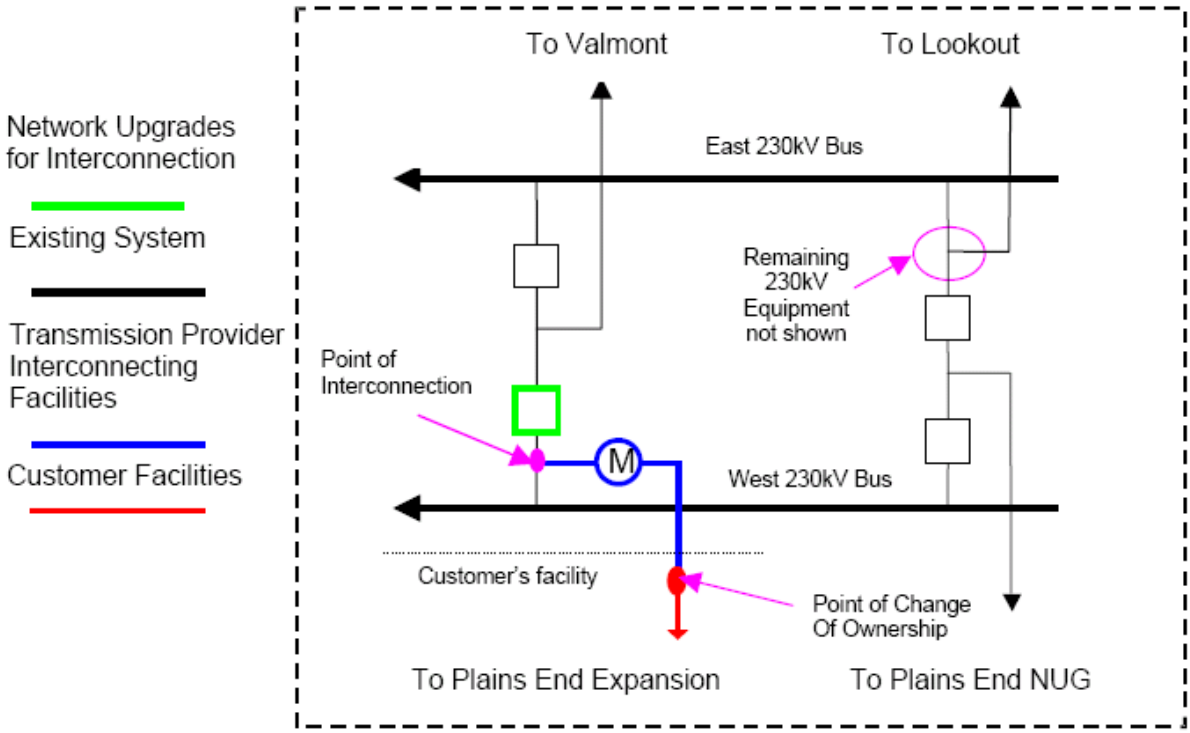


Figure 2: Interconnection One-Line Diagram[2]



II. Introduction

On February 10, 2006 Xcel Energy Transmission received a request to conduct a System Impact Study that would evaluate the integration of a "cluster" of potential generation resources. The Plains End Project was one of the resources considered in the "cluster-study". The System Impact Study report was issued and posted on the Rocky Mountain Area OASIS (RMAO) web site on May 25, 2006. On June 21, 2006 the Plains End Project was identified on the RMAO website as a project that would proceed with the Facility Study process. An Interconnection Facilities Study Agreement was executed with the Customer on July 11, 2006.

III. General Interconnection Facilities Description

1. Project Purpose & Scope

The purpose of this project is to interconnect a gas-powered generation facility of 115 MW into the existing PSCo Plains End 230 kV Substation. The Plains End Substation will be expanded to accommodate the new 230 kV transmission from the generating

[2] Conceptual one-line depicts equipment necessary for interconnection only. Additional equipment required for delivery is not shown.

facility to Plains End Substation. The recommended Network Upgrades for Interconnection at Plains End Substation include a 230 kV circuit breaker, associated switches, and metering. PSCo will design, construct, own, operate, and maintain the 230 kV transmission between Plains End Substation and the Customer's facility. However, the Customer will fund the design, procurement and construction of the 230 kV transmission interconnecting Plains End Substation and the Customer's facility. Figure 4 shows a preliminary one-line diagram of the interconnection to Plains End Substation. Figure 5 shows a general arrangement of the Plains End Substation.

To accommodate full delivery of the 115 MW generation, it will be necessary to expand the existing Plains End Substation to sectionalize the Lookout to Niwot 230 kV Transmission at Plains End and uprate the Lookout to Plains End 230 kV transmission circuits (created by tying the two circuits at Plains End) to achieve continuous rating of 525 MVA by May 31, 2008.

2. Background

Plains End Substation is a three-breaker ring bus, currently providing delivery for the existing Plains End generation tapping the Valmont to Lookout 230 kV transmission line.

3. Other Considerations

None.

4. Interconnection & Network Upgrades for Interconnection

Requirements for interconnection can be found in the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW – Version 2.0, last revised in January 2004. Xcel Energy requires the Interconnection Customer to construct the Interconnection Facilities in compliance with this document. 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 also requires 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, Western Electricity Coordinating Council, and Federal Energy Regulatory Commission or their successor organizations.

a) Removals and Relocations

Bus conductors and insulators on two of the switch structures will need to be removed in order to install the dead-end structure to terminate the 230 kV transmission to deliver the Customer generation from the generating facility to the Plains End Substation.

b) Fault Current

The worst-case 3-phase short circuit fault current is approximately 22.4 kA at the approximate location of Plains End Substation. These values were obtained from power system models that included the proposed generation addition and implementation of network upgrades necessary to deliver the generation at Plains End.

c) Electrical Installations

The Plains End Substation will be expanded to accommodate the new 230 kV transmission to interconnect the Customer's facility.

The interconnection guidelines mentioned above require the Customer to install 230 kV 3,000 Amp 40 kA circuit breaker protection on the Customer's end of the 230 kV transmission line to isolate PSCo equipment from the generating facility.

The step-up transformer at the customer facility shall be designed to meet the interconnection guidelines mentioned above. The configuration shall be grounded wye on the 230 kV primary side and delta on the 13.8 kV secondary side. The Customer must specify this transformer to meet PSCo's requirements for an effectively grounded system.

d) AC & DC Systems

No new AC and DC panels will be needed in the Electrical Enclosure Equipment (EEE). The existing battery and charger are adequate for the added circuit breaker.

e) Control Building (EEE)

The existing control building is adequate for the new Customer generation.

f) Grounding

All standard grounding practices in the substation will be observed. All equipment and associated structures will be connected to the ground mat.

g) Lightning Protection

Arresters will be installed on the 230 kV transmission interconnecting at Plains End and the Customer's facility to protect the metering equipment. Static masts and static wire will be installed to protect the substation equipment.

5. Civil Features

a) Grading and Fencing

Grading and fencing are not necessary.

b) Foundation and Structural

The following is a list of equipment that will be required to expand the existing 230 kV Plains End Substation:

- One (1) dead-end tower foundation and tower
- One (1) dead-end girder
- One (1) breaker foundation
- Three (3) 230 kV metering instrument foundations and structures

c) Removals and Relocations:
No foundations are required to be removed or relocated.

6. Protection and Control Features

a) Protection Equipment
The primary protective relay (PKG-P) will be a SEL 311L relay using a dedicated fiber pair, in fiber optic ground wire, as the communication channel in a transmission line current differential (87T) protection scheme. Directional step distance and directional ground over-current functions will also be used without communications.

The secondary relay (PKG-S) will be a SEL-321 utilizing mirror bits in a DCB protection scheme communicating over a dedicated fiber optic pair.

Re-closing will be provided remotely via SCADA and supervised by the existing synchronization check relay.

Breaker failure will be performed by the SEL-501 relay with a standard 12 cycles of time delay.

b) Load Control Equipment
A new RTU for Load Frequency/Automatic Generation Control (LF/AGC) will be required at the Customer's substation, which will provide information to a new RTU to be installed at the PSCo Control Center. Customer will supply all necessary AC and DC station service and space for the required equipment.

c) Electrical Installations
The high voltage equipment to be installed includes one 230 kV circuit breaker, three metering units, three line arresters and two 230 kV gang switches. The devices will need to be controlled from a new relay panel installed at the existing EEE.

d) RTU
The existing RTU at the Plains End Substation will be utilized, and if necessary expanded for Local SCADA information.

7. Disturbance Monitoring Device

A disturbance monitoring device is not required at the Plains End Substation.

8. Communications

Customer will need to supply protective relaying circuits going from the Customer's substation to the PSCo Plains End substation. PSCo requires this circuit to be a fiber optic circuit. The fiber optic cable will be installed in the transmission line overhead ground wire. Customer will need to supply a communication circuit for the RTU located at the Customer's facility to the PSCo Control Center.

9. Revenue Metering

The 230kV revenue metering instruments will be installed at PSCo's Plains End Substation to measure the MW and Mvar from Customer's 115 MW generation. PSCo meters will be 4-quadrant, bi-directional meters with recorders. Meters/recorders will be equipped such that they can be accessed remotely through a phone circuit. PSCo will own and operate the metering equipment.

Metering instruments will be installed on Customer's station service feeds to measure the MW and Mvar's. Customer will be required to install revenue class CT's and PT's on their station service transformers and wire to the metering panel to be installed by PSCo. Customer will be required to provide room for PSCo's metering panel installed at the generator to measure the station service loads. Station service meters/recorders will be equipped such that they can be accessed remotely through a phone circuit. PSCo will own and operate the station service metering equipment.

10. Outages

Scheduled outages will be kept to a minimum during the expansion of the 230 kV Plains End Substation. Outages may create unusual operating conditions during construction.

11. Project and Operating Concerns

None.

12. Assumptions for Plains End II Gas Generator Facility

Customer will engineer, procure, and construct all equipment up to the Customer's 230 kV dead-end structure, just inside the Customer's 230 kV switchyard. PSCo will engineer, procure, and construct all equipment between the Point of Change of

Ownership at Customer's facilities and the Point of Interconnection at Plains End Substation.

The Customer will fund the engineering, procurement and construction of all equipment between the Point of Change of Ownership and Point of Interconnection.

PSCo needs approximately 4-6 weeks to conduct testing. Much of the testing can be performed in parallel with the construction schedule.

IV. Costs Estimates and Assumptions:

1. Interconnection

Table 1 describes the costs assumed for work to be performed by PSCo, and funded by the Customer, for the dedicated "sole-use" interconnection facilities installed between the 230 kV Point of Interconnection located at Plains End Substation, and the customer generation facility. The estimated total cost for the PSCo Interconnection Facilities and Network Upgrades to provide an interconnection for the Customer generation is:

- **$0.489 million for Transmission Provider Interconnecting Facilities at Plains End Substation (Customer funded).**
- **$0.656 million for PSCo Network Upgrades for Interconnection at Plains End Substation (PSCo funded).**
- **Total Estimated cost of Interconnection = $1.145 million**

The estimated costs shown above are "appropriation estimates" with an accuracy of ± 20%. These estimates are in 2006 dollars, do not include escalation, and are based upon typical construction costs for previously performed similar construction. These estimates do not include any costs for any customer-owned, supplied, and installed equipment and associated design and engineering for the Customer's facilities.

Table 1: Transmission Provider Interconnecting Facilities (Customer funded):

Element	Description	Cost ($Million)
PSCo Plains End Substation	Interconnect Customer's 230 kV generation facilities to the existing Plains End Switchyard. The new equipment required includes: • One (1) 230 kV dead-end structure • One (1) 230 kV relay panel • One (1) RTU and associated meters • One (1) JEM-10 230 kV metering unit	**$0.352**
	Transmission Line tap structures and tap	**$0.137**

Element	Description	Cost ($Million)
Time Frame	**Months – Substation**	**10 to 12 months**
Total	**Transmission Provider Interconnecting Facilities**	**$0.489**

Table 2 describes the estimated costs of PSCo Transmission Network Upgrades associated with the Plains End Project Interconnection.

Table 2: PSCo Transmission Network Upgrades Required for Interconnection:

Element	Description	Cost ($Million)
PSCo Plains End Substation	Upgrade the existing Plains End 230 kV Switchyard to accommodate a new line termination to interconnect the Customer's generation facilities. The new equipment required includes: • One (1) 230 kV 3000 amp 40 kA circuit breaker • One (1) 230 kV gang switch • Foundations and structures • Revenue metering - bidirectional	**$0.656**
	Siting & Land Rights	**N/A**
Total Cost	**Estimated Costs for Network Upgrades for Interconnection**	**$0.656**
Time Frame	**Months - Substation**	**10-12 months**

2. Major Assumptions related to Table 1, Table 2 and the attached schedule

- The estimated costs provided are "appropriation estimates" with an accuracy of ± 20%.
- All applicable overheads are included. AFUDC has been included with the PSCo Network Upgrades and removed from the Customer Interconnection Facilities.
- There is no contingency added to the estimates.
- Estimates have not been escalated. All estimates are in 2006 dollars.
- PSCo (or its contractor) crews will perform all construction and wiring associated with PSCo-owned and maintained equipment.
- A Certificate of Public Convenience and Necessity (CPCN) will not be required from Colorado Public Utility Commission (CPUC) for the PSCo network upgrades for interconnection.

- The estimated time for design, procurement and construction for the PSCo network upgrades required for the interconnection is estimated at 10 to 12 months after authorization to proceed.
- All required transmission outages necessary to support construction will be obtained as needed.
- No additional land will be required.
- The Customer generation is in PSCo retail service territory and it is assumed that PSCo will provide station service to the Customer.

V. Engineering, Procurement & Construction Schedule

The following schedule identifies milestones needed to complete the interconnection of the proposed Plains End II 115 MW gas generation facility.

The following schedule, depicted in Figure 3, identifies project milestones for three separate phases of work needed to complete the proposed interconnection: Siting, Permitting & Land Acquisition, Substation Design & Construction and Transmission Line Design & Construction. The total estimated duration to complete all of the required activities and tasks for the interconnection is 10 to 12 months after receiving authorization to proceed.

Figure 3: Engineering, Procurement & Construction Schedule

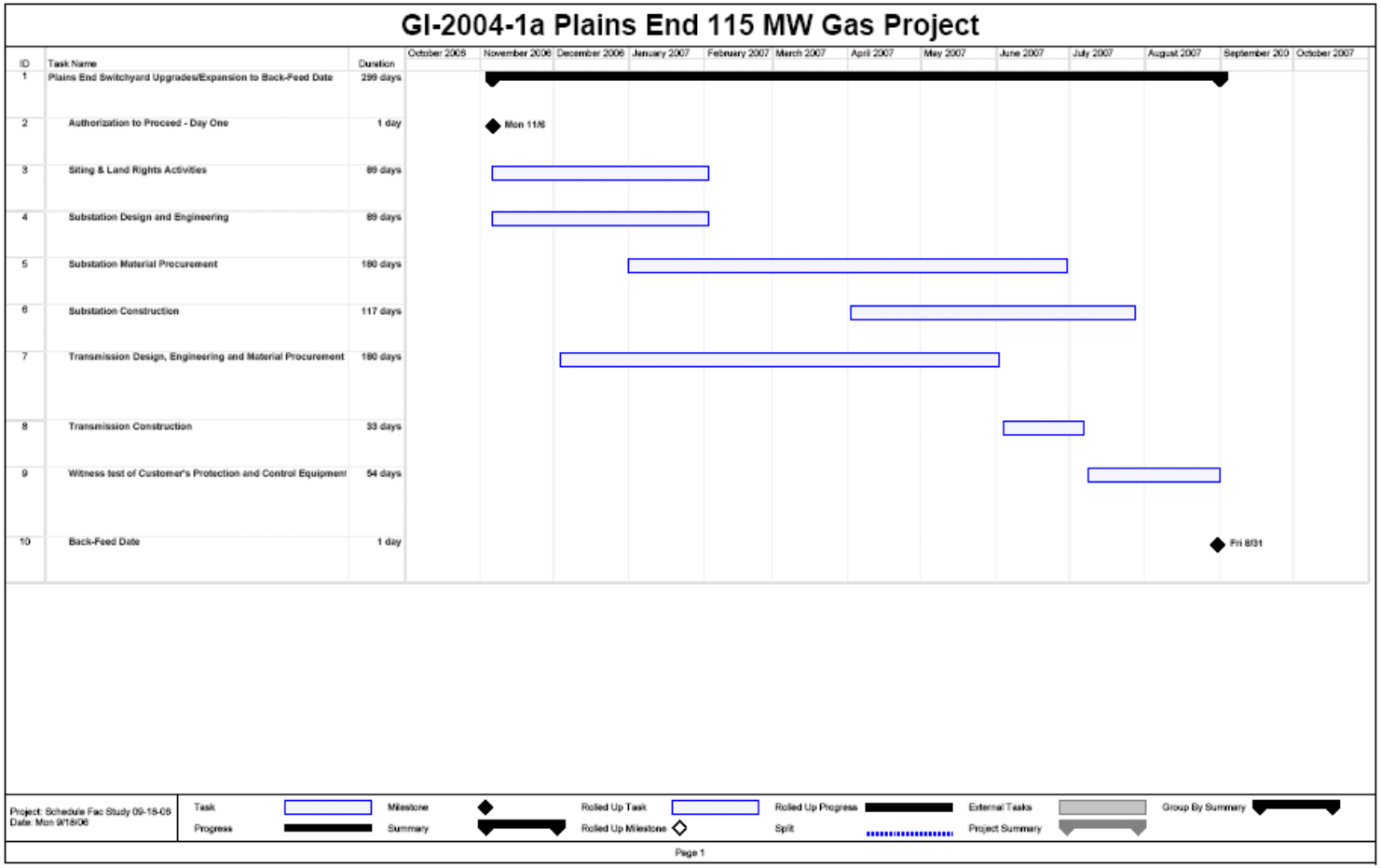


Figure 4: PSCo's Plains End Substation: Proposed One-Line Diagram

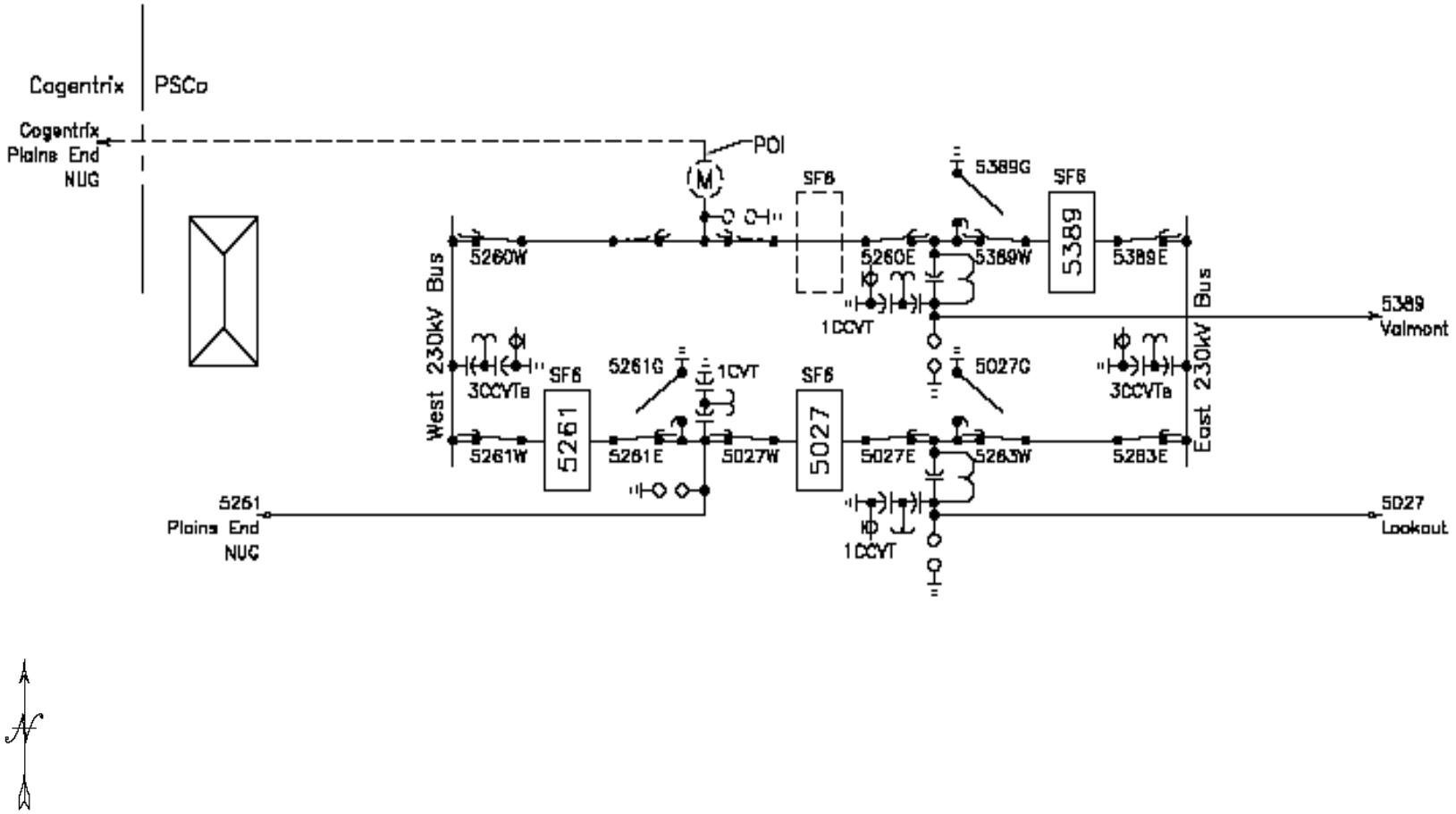


Figure 5: Plains End Substation: Proposed General Arrangement Drawing

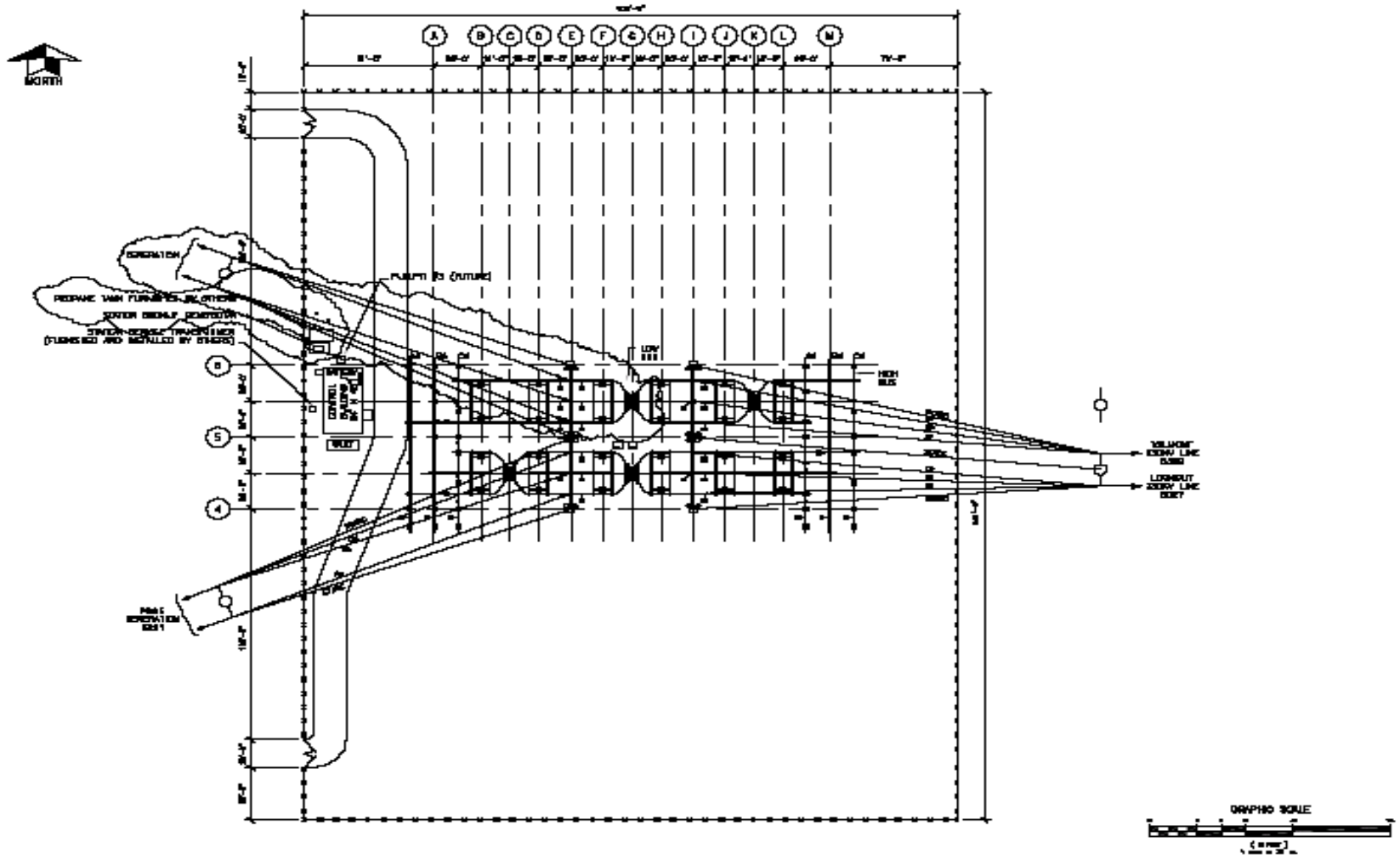


Figure 6: Plains End Substation: Proposed Elevation Drawing