Elbert County 500 MW Generation Addition
Interconnection Feasibility Study Report
OASIS POSTING # GI-2003-2

Xcel Energy Transmission Planning
January 2004

Executive Summary

This Interconnection Feasibility Study Report summarizes the analysis performed by the Transmission Planning group of Public Service Company of Colorado (PSCo) to interconnect 500 MW of proposed generation in Elbert County. At the request of the Customer, the Project was evaluated as both a Network Resource (NR) and as an Energy Resource (ER) with the power going to PSCo customers. This study indicated that the most effective method to interconnect the 500 MW of generation was with a new 230kV switching station (herein referred to as Corner Point) that would bisect the existing PSCo Pawnee – Daniels Park 230kV line and provide a point of interconnection for the 230kV transmission from the new generation. The switching station would be constructed at a location approximately four miles northwest of the town of Deer Trail.

Energy Resource:
As an Energy Resource, an interconnected generator is only eligible to deliver on an "as available" basis using the existing capacity of the transmission system. Studies indicated that the output of the facility without requiring any additional network upgrades would be in the range of 470 to 500 MW, depending on regional generation patterns. The estimated cost of the minimal interconnection for an Energy Resource is $4.5 Million. The time frame to get the transmission requirements constructed for the generation addition would be approximately 24 months.

Network Resource:
For a Network Resource, studies must determine whether system upgrades are necessary to deliver full output of the facility. Studies indicate that the integration of the full 500 MW of new generation would require approximately 64 miles of new 230kV transmission between the Corner Point Switching Station and the Daniels Park Substation. The total estimated cost of the project for the 500 MW interconnection and associated transmission is approximately $68 Million. The time frame to get the transmission requirements constructed for the generation addition would be a minimum of 54 months.

Interconnection:
At the request of the Customer, a preliminary estimate was prepared for the transmission between the proposed new generator and the Corner Point Switching Station. For an approximately 25-mile, single-circuit 230kV line, the estimated cost is $11 Million.

A simple diagram of the regional transmission system is included in Appendix A.

The study did not address any impacts to regional transmission paths, or some regional performance issues on lower voltage networks. This study was performed using powerflow analysis, and no transient stability studies were performed. Some preliminary short circuit fault analysis was done of the existing system. For any additional pursuit of this project, it is recommended that all of the above issues be evaluated through system impact and/or system facilities studies.

Background

On November 3, 2003 a formal request that was dated October 31, 2003 was received by Xcel Energy Transmission to conduct a feasibility study that would evaluate the integration of a 500 MW coal fired generating unit in Elbert County, Colorado. The approximate location of the interconnection will be four miles northwest of the town of Deer Trail, Colorado. The approximate in-service date for commercial operation of the facility is June 1, 2008, with a back-feed date of January 1, 2008. An Interconnection Feasibility Study Agreement was executed on December 17, 2003 indicating a targeted completion date for studies of 45 days from that date.

Study Approach

Large Generator Interconnection Procedures

PSCo adheres to the recent Federal Energy Regulatory Commission (FERC) Large Generator Interconnection Procedures (LGIP). As per section 6.2 of the FERC LGIP, the Study considered the Base Case as well as all Generating Facilities (and with respect to (iii), any identified Network Upgrades) that exist on the date the Interconnection Feasibility Study was commenced:

(i) are directly interconnected to the Transmission System;
(ii) are interconnected to Affected Systems and may have an impact on the Interconnection Request;
(iii) that have a pending higher queued Interconnection Request to interconnect to the Transmission System; and
(iv) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC.

Rocky Mountain Area Oasis Queue

According to the LGIP, interconnection studies must consider other requests that have a higher queue positions and prior in-service dates when performing system analyses. For this study, system models included a 300 MW generator interconnection in Morgan County, Colorado and associated infrastructure. That project is listed on the Rocky Mountain Area Oasis web site (www.rmao.com) as Generator Interconnection Request number GI-2003-01 with an in-service date of December 1, 2006. The infrastructure associated with that project includes:

1. Rebuild the existing Pawnee - Ft. Lupton 230kV, 416 MVA rated line to double-circuit with 834 MVA/circuit capability.
2. Uprate the Pawnee – Smoky Hill 230kV line from 637 MVA to 800 MVA.

If Project # GI-2003-01 drops out of the queue, a Re-Study of the Interconnection Feasibility Study would be required according to the rules of the LGIP, due to the potential for additional infrastructure requirements for this large generator request.

Powerflow Model
For this analysis, a 2008 heavy summer load flow model. Data representation in the area of study was reviewed and modified to accurately reflect the Rocky Mountain regional transmission system. The power transfers from north to south were increased from the base to provide some additional stress to the system between Pawnee and Denver. The new generation was modeled as two 250 MW units, connected to the PSCo system by a single 25 mile 230kV line. Several scenarios for displacement of the 500 MW injection were modeled and worst case results recorded. Single contingencies were modeled in the region of study for 115kV and 230kV transmission elements.

Study Methodology

For planning studies, PSCo adheres to the WECC Reliability Criteria. For system intact conditions, PSCo planning criteria is to maintain system bus voltages between 0.95 and 1.05 per unit. Operationally, PSCo tries to maintain a system voltage profile ranging from 1.02 at generators to 1.0 or higher at load buses in the Denver/Boulder area. Following a single contingency, voltages must be within 0.90 and 1.10 per unit. Facility loadings must remain within 100% of their nominal steady state ratings for both system intact and single contingency conditions.

Power Flow Study Results

Power Flow Analysis
Three alternatives were evaluated for the interconnection to the PSCo system. Since the specified point of interconnection for the new generation is not near an existing substation or switching station, a new switching station will have to be constructed. Approximately four miles from Deer Trail, Colorado, there are two 230kV lines that are adjacent to each other that run from the Pawnee Station to the Denver metro system. This study evaluated the connection to either line individually, or to both lines. The alternative that bisected the existing Pawnee – Daniels Park 230kV line exhibited the best system performance and lowest contingency overloads, but studies showed that the existing transmission system was not sufficient to accommodate the delivery of the full 500 MW of new generation.

Energy Resource
Studies showed that a maximum of 470 MW could be delivered into the PSCo system without the addition of transmission infrastructure.

Network Resource
The worst contingency was loss of the existing Pawnee – Smoky Hill 230kV line, which caused 102% overloads on the parallel Corner Point to Daniels Park 230kV line. To accommodate the full 500 MW of generation, approximately 64 miles of new 230kV

transmission had to be modeled between Corner Point Switching Station and Daniels Park Substation.

Some sensitivity analysis was performed to determine other transmission alternatives. For example, new 230kV transmission was modeled between Corner Point and Smoky Hill, but studies showed that alternative to exhibit unacceptable performance.

The new 230kV transmission between Corner Point and Daniels Park should be constructed as follows:

- Between Corner Point Switching Station and the Smoky Hill Substation, the existing 230kV line (that originates at Pawnee and terminates at Daniels Park) should be rebuilt to double-circuit configuration. One rebuilt circuit will replace the existing circuit. The other rebuilt circuit would be the new circuit. Neither circuit would tie in at Smoky Hill. To minimize future siting and construction concerns, new transmission should consist of 345kV construction, although initially be operated at 230kV.
- From Smoky Hill, the new circuit would continue to Daniels Park using new 230kV transmission within the existing corridor. To minimize future siting and construction concerns, this transmission should be built with double-circuit 345kV capability.

Short Circuit Study Results

The following short circuit analysis is for present (2004) system normal conditions, and due to the lack of Customer model data, including generator step-up transformer data, do not include any fault current contribution from the existing PSCo or proposed additional Customer generation. The actual fault current contribution from the generation would have to be determined from additional, more detailed studies.
Analysis of the existing (2004) system indicated 3-phase fault current at Daniels Park 230kV switchyard of approximately 25,000 Amps and at the Pawnee 230kV switchyard of 22,000 Amps. It is expected (without having been studied) that the addition of 500 MVA of generation at Corner Point would add approximately 2000 fault Amps at Daniels Park and 1000 Amps at Pawnee. In addition, a new 230kV circuit is planned to be added to the Daniels Park Substation in 2005, which will contribute to the fault current. Although Pawnee does not appear to be a concern, there are some breakers at Daniels Park that have a 31.5 kA rating. Power injection from a new circuit from Corner Point and the new generation could result in the requirement to replace some breakers. It is recommended that additional short circuit analysis with detailed representation be performed in subsequent studies.

Cost Estimates and Assumptions

The estimated costs shown are “indicative” (+/-25%) preliminary budgetary estimates, and are based upon typical construction costs for previously performed similar construction. These estimated costs include all applicable labor and overheads associated with the engineering, design, and construction of these new PSCo facilities.

These estimates do not include any costs for any Customer-owned, supplied, and installed equipment and associated design and engineering. These estimates also do not include any costs that may, or may not be required for other entities systems.

Based upon the Feasibility Study performed here, in order for PSCo to provide an interconnection for the Customer requested generation interconnection a new switching station must be built at Corner Point. Cost responsibilities for the facilities would be as per current FERC rules.

Interconnection Facilities:
The estimated cost of the minimal interconnection for an Energy Resource is **$4.5 Million.** The time frame to get the transmission requirements constructed for the generation addition will be approximately 24 months.

Interconnection Switching Station Requirements:
The 230kV station would be configured as a 3-breaker ring bus, at Corner Point with the following:

1. Site development
2. Control building
3. 3 circuit breakers
4. 8 disconnect switches
5. 3 dead-end structures, associated bus and connectors
6. High voltage metering with associated revenue metering equipment
7. Bus voltage transformers and line synchronizing transformers
8. Relaying and communication equipment

A simple one-line diagram is provided in Appendix B.

Transmission Facility Requirements:
The total estimated cost of the project for the 500 MW interconnection and associated transmission facilities are approximately **$68 Million**. The time frame to get the transmission requirements constructed for the generation addition will be a minimum of 54 months.

Network Resource Switching Station Requirements:
The 230kV station would be configured as a 6-breaker, breaker and a half arrangement, at Corner Point with the following:

1. Site development
2. Control building
3. 6 circuit breakers
4. 12 disconnect switches
5. 4 dead-end structures, associated bus and connectors
6. High voltage metering with associated revenue metering equipment
7. Bus voltage transformers and line synchronizing transformers
8. Relaying and communication equipment

A simple one-line diagram is provided in Appendix B.

Network Resource Transmission Requirements:

1. Between Corner Point Switching Station and the Smoky Hill Substation, the existing 40 mile 230kV line (that originates at Pawnee and terminates at Daniels Park) should be rebuilt to double-circuit configuration. One rebuilt circuit will replace the existing circuit. The other rebuilt circuit would be the new circuit. Neither circuit would tie in at Smoky Hill. To minimize future siting and construction concerns, new transmission should consist of 345kV construction, although initially be operated at 230kV. Standard conductor is bundled 954 kcmil ACSR.
2. From Smoky Hill, the new circuit would continue to Daniels Park using 24-miles of new 230kV transmission within the existing corridor. To minimize future siting and construction concerns, this transmission should be built with double-circuit 345kV capability. Standard conductor is bundled 954 kcmil ACSR.

Customer Interconnection:

At the request of the Customer, a preliminary estimate was prepared for the transmission between the proposed new generating facility and the Corner Point Switching Station. For an approximately 25-mile, single-circuit 230kV line, the estimated cost is **$11 Million**.

Transmission Requirements:

1. Construct approximately 25 miles of 230kV transmission. Structures would be steel pole, and have the capability to accommodate a second future circuit. Standard conductor is bundled 954 kcmil ACSR.

<u>Major Assumptions for Cost Estimates</u>

1. Any NEPA requirements imposed on transmission as a result of the generation addition will most likely have adverse effects on schedule and deliverables.
2. No screening has been estimated at any of the substations. If this is required the cost will be significant at each location.
3. Detailed field investigations have not been conducted and could increase these estimates.
4. Only minimal transmission line ROW acquisition is assumed for infrastructure related facilities, since existing ROW will be utilized.
5. Where prudent, Xcel Energy pre-constructs 230kV lines to 345kV specifications. Permitting the new double-circuit 345kV transmission line from Smoky Hill to Daniels Park will be extremely difficult and could require legal action. These estimates do not include any cost for legal fees.
6. All necessary transmission line outages can be obtained. If not, construction duration times will be longer.
7. All cost estimates have been escalated to reflect the appropriate year of project activity.

Overall timeline to complete all required transmission and substation facilities is expected to require a minimum of 54 months. If there are problems with local and state approvals, this could require an additional year.

APPENDIX A

SYSTEM DIAGRAM

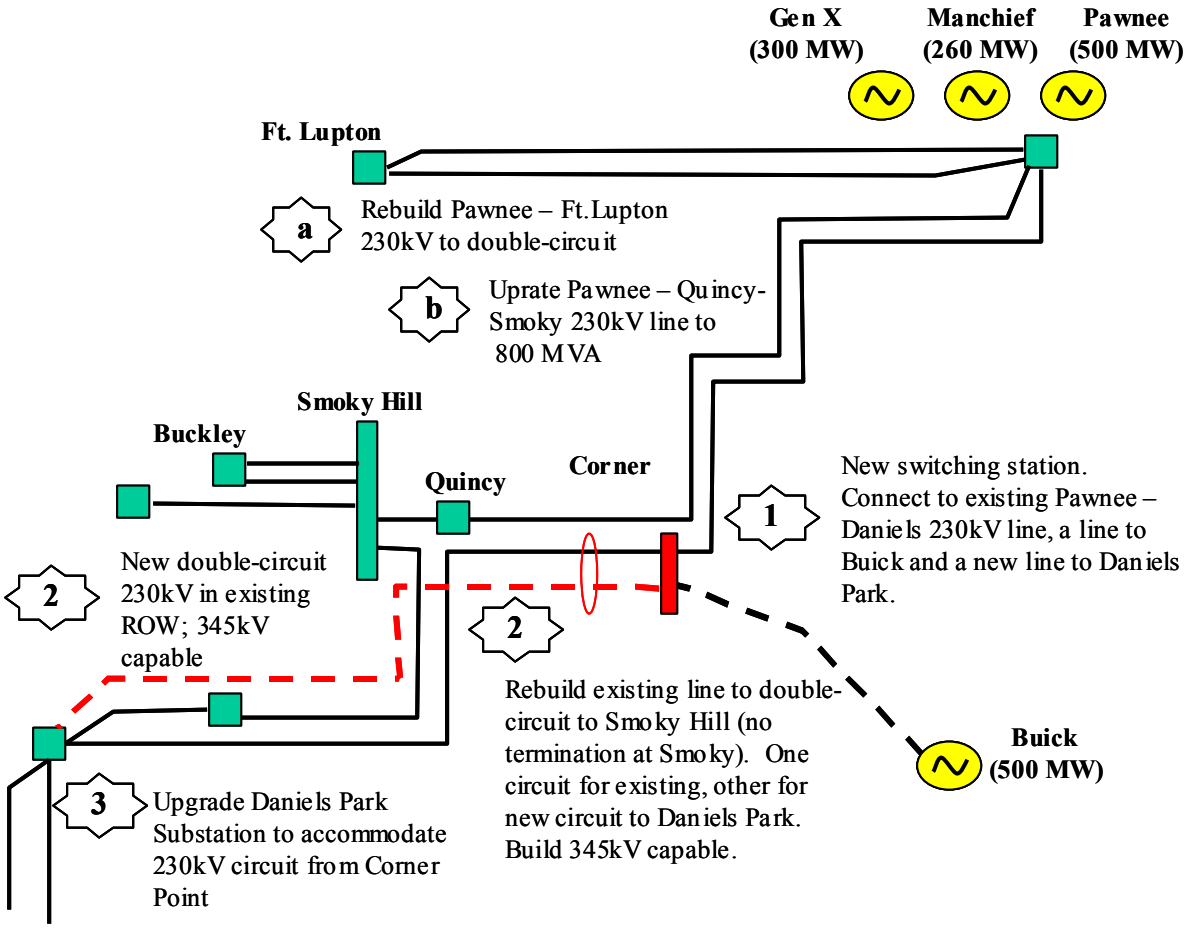
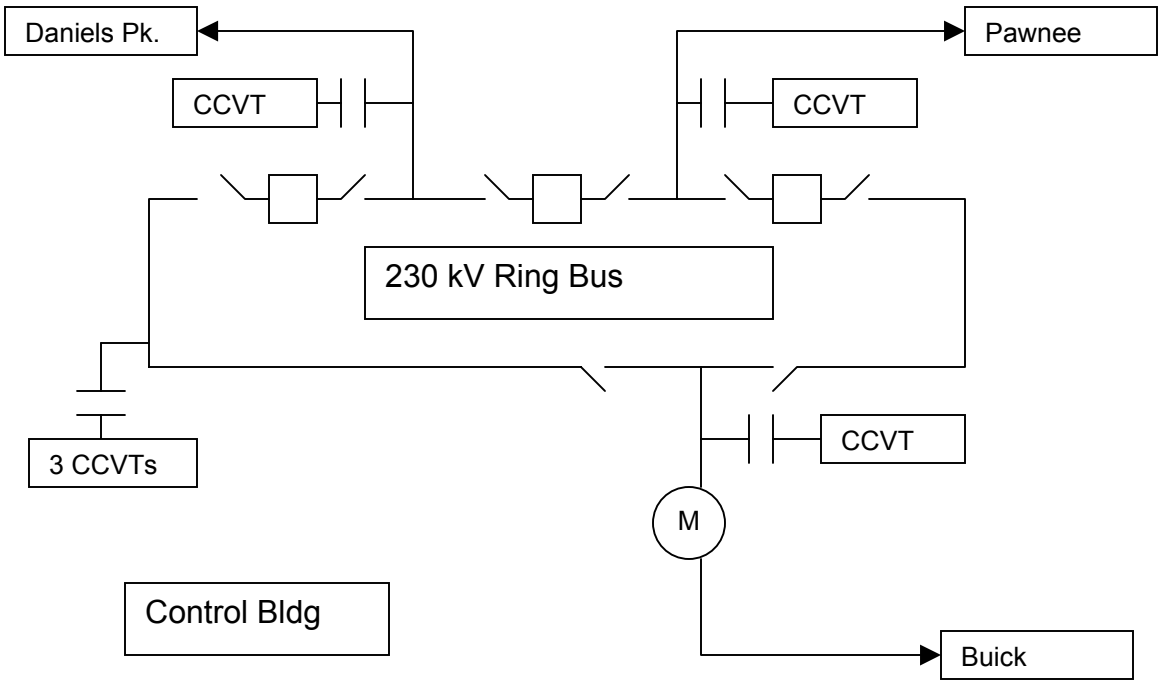


Figure 1

Figure 1 shows a basic diagram of the regional system. Items (a) and (b) are infrastructure associated with the 300 MW of generation (shown as Gen X), from RMAO Posting # GI-2003-1. Between Corner Point Switching Station and the Smoky Hill Substation, the existing 230kV line (that originates at Pawnee and terminates at Daniels Park) should be rebuilt to double-circuit configuration. One rebuilt circuit will replace the existing circuit. The other will make up the first section of the new circuit. From Smoky Hill, the new circuit will continue to Daniels Park using new 230kV transmission within the existing corridor. To minimize siting and right-of-way issues, the new transmission should be built using existing right-of-way. In order to allow for future upgrades, the new transmission should consist of 345kV construction, although initially be operated at 230kV.

APPENDIX B
SWITCHING STATION ONE-LINE DRAWINGS

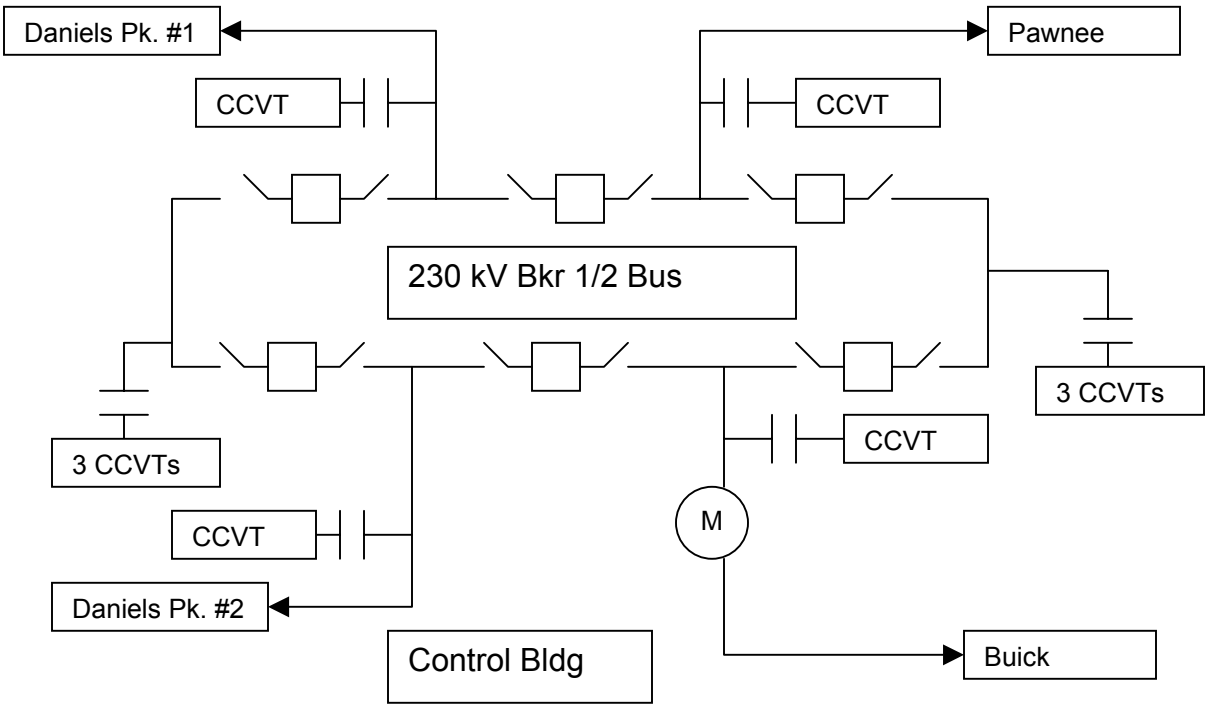


PRELIMINARY

XcelEnergy

Corner Point (Energy Resource)

1/30/04 GI-2003-2



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I. XcelEnergy

Corner Point (Network Resource)

1/30/04 GI-2003-2