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Interconnection Facilities Study Report

Request # GI-2004-6

250 MW Wind Farm Located Near Akron, Colorado
Interconnecting at Pawnee Station

March 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 250 MW of new generation at the Pawnee Station in Morgan County, Colorado. The new wind farm would be located North of Akron, Colorado and would interconnect at Pawnee station via the Customer's 28-mile 230 kV transmission line. The requested commercial in-service date is December 31, 2006 and a requested back feed date of July 1, 2006. However, the results of this study indicate that it is not feasible to implement the upgrades required to provide interconnection for the project by the requested date.

The recommended Network Upgrades for Interconnection at Pawnee Station include a 230 kV circuit breaker, associated switches, metering, and transmission line rearrangement with an estimated cost of $0.935 million. The time frame to get the interconnection constructed for the generation addition would be at least 9 months.

The total estimated cost for the facilities required for interconnection is approximately **$0.935 million**[1] including:

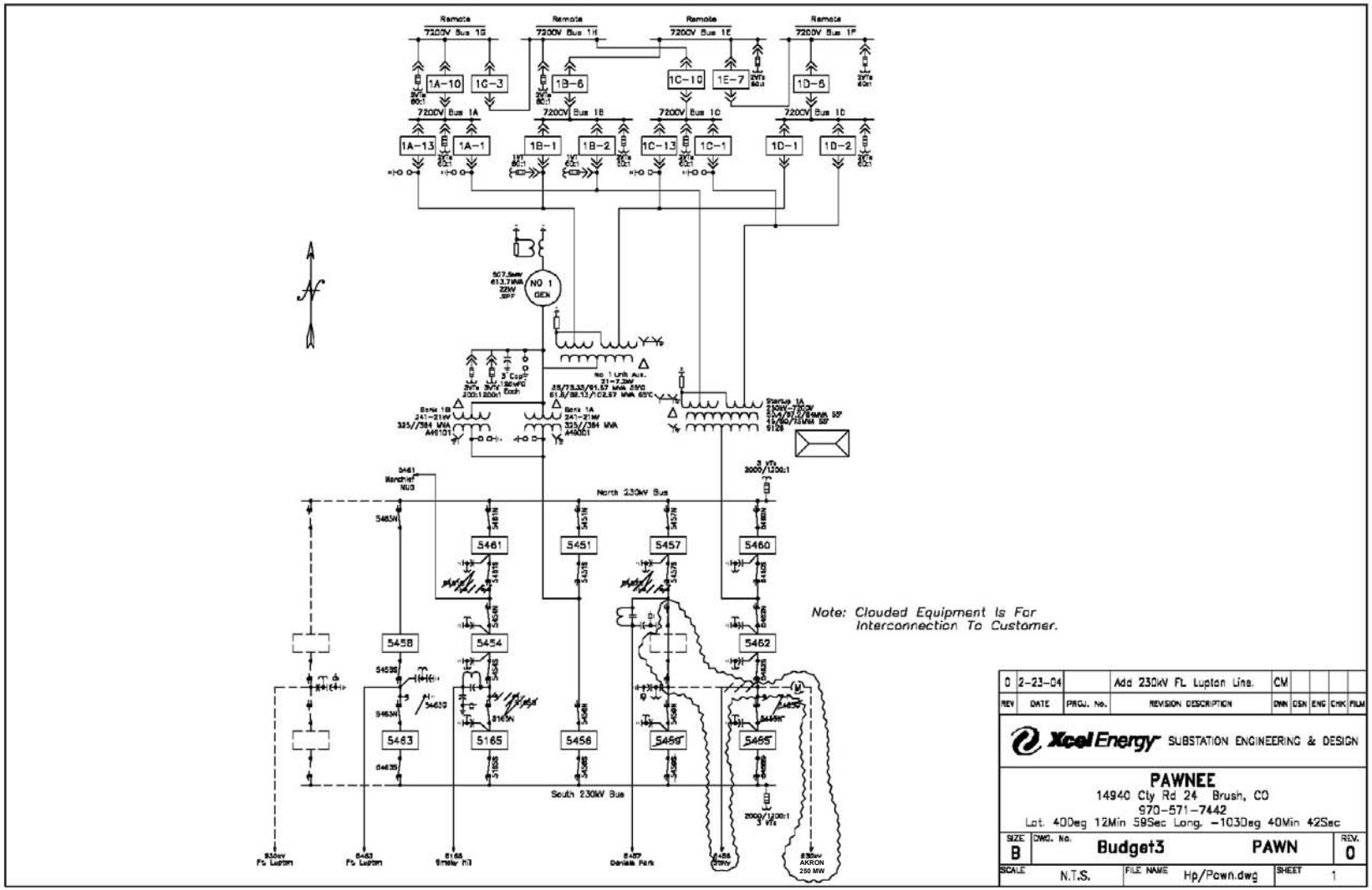
- $0.375 million for Customer-funded Interconnection Facilities (Table 1)
- $0.560 million for PSCo Network Upgrades for Interconnection (Table 2)

The estimated time required to engineer, permit, and construct the facilities described above is at least **9 months**.

A proposed Station One-Line diagram for the Pawnee Switchyard is shown in Figure 1.

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

Figure 1: Pawnee Switchyard: Proposed Substation One-Line Diagram



II. Introduction

On August 16, 2004 Xcel Energy Transmission received a request to conduct a feasibility study that would evaluate the integration of a 250 MW wind power generating facility in Morgan County, Colorado. The Feasibility Study report was issued and posted on the Rocky Mountain Area OASIS (RMAO) web site in November 2004. An Interconnection System Impact Study (SIS) Agreement was executed with the Customer on or around July 28, 2005, with the SIS Final report posted on RMAO and issued to the Customer on September 19, 2005. An Interconnection Facilities Study Agreement was executed with the Customer on November 21, 2005.

III. General Interconnection Facilities Description (Project Design Guide)

Project Purpose & Scope

The purpose of this project is to interconnect a Customer's wind generation of 250 MW into PSCo's existing Pawnee 230 kV Substation. The Customer proposes to build a 28-mile 230 kV transmission line from their site to the substation. The Customer's proposed site is East of Pawnee substation. The additional equipment at Pawnee due to the Customer's new transmission line will have little effect on the size of the switchyard. The new transmission line to the Customer's wind site will terminate into an existing bay that will be vacated by swinging an existing transmission line over one bay to accommodate the new transmission line.

Background

Pawnee substation is a 5 bay breaker and half transmission switching station, which sits adjacent to the Pawnee Generating Station. Presently the Pawnee Generating Station injects approximately 500 MW into Pawnee substation. The additional injection of 250 MW into Pawnee from the Customer's wind site requires upgrading and/or replacing various facilities throughout Xcel Energy's Denver Metro region.

Other Considerations

The desired back feed date for the Customer is June 2006. Equipment lead times are 9 months and work for the project cannot begin until an Interconnection Agreement has been executed.

A. Interconnection & Network Upgrades for Interconnection as a 'Stand Alone" Project

Fault Current

Existing 3 phase and SLG fault currents are 19,321A and 22,233A respectively at the Pawnee 230 kV bus.

Physical - Electrical Installations

The installation at Pawnee substation will consist of adding one 230 kV SF6 circuit breaker, two 230 kV gang switches, one line CCVT, three 230 kV combo CT/PT metering units, metering, and various structures will be installed to accommodate the Customer's interconnection

The Customer shall be required to install a 230 kV circuit breaker on the Customer's end of the 28-mile transmission line to meet the PSCo/Xcel Energy interconnection guidelines.

The Customer's step-up transformer(s) shall be designed to meet PSCo's interconnection guidelines. The configuration shall be GROUNDED - WYE on the 230 kV side, WYE on the 34.5 kV side, and DELTA on the tertiary. This will ensure that the Customer meets PSCo's requirements for an effectively grounded system.

AC & DC Systems

Existing AC and DC panels are adequate for new substation equipment.

Control Building

All new equipment will fit into existing building.

Grounding

All equipment and associated structures will be connected to the ground mat.

Lightning Protection

The static wires on the transmission lines will be connected to the dead-end structures within the substation to provide overhead direct stroke protection.

Grading & Fencing

No grading or fencing is required as all new equipment is going into existing bays.

Foundations & Structural

Circuit Breaker, metering units, and CCVT foundations will be new. Structures for gang switches are existing - bus supports will be reused.

Removals & Relocations

The 230 kV Pawnee to Story transmission line will be relocated one bay west to accommodate the new transmission line from the Customer.

Control & Protection - Electrical Installations

A new relay panel will be installed in the control building. Line protection will consist of a primary relay with pilot communication over fiber in a differential scheme with step distance protection elements utilized as a backup feature, a secondary relay also using fiber in a blocking scheme with step distance protection elements used as a backup feature, and a breaker-failure relay. Since this is a radial line owned by the Customer, no automatic reclosing will be utilized. Transmission line relay settings and coordination will be performed in conjunction with the Customer. Transmission line relay design by the Customer shall be subject to review by PSCo.

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), WECC, and Federal Energy Regulatory Commission or their successor organizations

Disturbance Monitoring Device

Disturbance monitoring for Customers transmission equipment will be added to the existing Fault Recorder at Pawnee.

Communications

The existing RTU at Pawnee will handle the additional SCADA information for the new transmission line and generating facility. An SEL 2030 will be installed for relay communications and other functions as required. A phone line will also be added for the SEL 2030 communication.

Outages

The existing Pawnee to Story 230 kV line will be out of service during the line swing period. This cutover period shall be minimized as much as possible.

Project and Operating Concerns

Work will be performed inside an energized 230 kV substation.

Related Substation & Transmission Projects

None

Assumptions for Akron Wind

Customer will provide power factor correction equipment to meet voltage tolerances at point of interconnection, if needed.

Customer will comply with FERC guidelines for low voltage ride through.

Customer will engineer, procure, and construct all equipment up to the Pawnee 230 kV dead-end structure. This includes transmission line relay equipment at Customer's site.

The Customer will need to arrange for station service power through the local utility/service provider, as Customer's site may not be in PSCo service territory.

Customer has proposed to construct the transmission line with fiber optic ground wire built into the static wire for relay communication.

PSCo needs approximately 2-4 weeks to test per requirements of Interconnection Guidelines For Transmission Interconnected Producer-Owned Generation Greater Than 20 MW. Much of the testing can be performed in parallel with the construction schedule.

Assumptions for Pawnee

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. PSCo will engineer, procure, construct, own, and maintain all 230 kV facilities associated with the substation expansion.

Equipment lead times will dictate the time needed to build facilities. Current lead times are 9 months.

IV. Costs Estimates and Assumptions as a Stand Alone Project:

A. Interconnection

The estimated non-binding good faith total cost for the PSCo Interconnection Facilities and Network Upgrades to provide an Interconnection for the Customer requested generation is:

- **$ 0.375 million for Customer Interconnection Facilities at Pawnee Station (Customer funded).**
- **$0. 560 million for PSCo Network Upgrades for Interconnection at Pawnee Station (PSCo funded).**
- **Total Estimated cost of Interconnection = $0.935 million**

The estimated costs shown above are "appropriation estimates" with an accuracy of ± 20%. 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. Detailed appropriation level estimates were not performed for estimating the Network Upgrades for Delivery; these upgrades are discussed later, with only scoping level estimates repeated here as performed for the earlier System Impact Study.

B. Stand-Alone

"Stand Alone Network Upgrades" are defined by the FERC LGIP as Network Upgrades that the Interconnection Customer may construct without affecting the day-to-day operations of the Transmission System during their construction. The Transmission Provider and Interconnection Customer must agree as to what constitutes Stand Alone Network Upgrades and identify them in Appendix A to the Standard Large Generator Interconnection Agreement.

For this generation interconnection request, it is assumed that there are not any Stand Alone Network Upgrades.

The Project Design Guide included in Part III of this report describes the assumptions and additional details associated with this project. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines.

C. Interconnection Facilities Component Costs Estimates and Assumptions:

Table 1 describes the improvements assumed necessary to be performed by PSCo Transmission, as dedicated "sole-use" facilities at PSCo Pawnee Station Substation for the new Customer interconnection. It does not include all of the costs associated with Network Upgrades, required at or beyond the Point of Interconnection (POI) to the PSCo transmission system, or delivery (Network Resource) of the generation. It is assumed that all of the Customer owned, supplied, and operated equipment, both installed at PSCo Pawnee Station Substation, and equipment installed between and at the Customer generation site, will be designed, and installed by the Customer, or its contractors. (Such as the Customer's 230 kV transmission line from their site to Pawnee and other

associated Customer–owned substation / plant equipment). The costs of these Customer owned / operated facilities have not been estimated for by PSCo Transmission. The General Arrangement drawing for the Pawnee switchyard is shown in Figure 5.

Table 1: PSCo Transmission Interconnection Facilities (Customer funded):

Substation	Description	Cost ($Million)
PSCo Pawnee Generation Station	Interconnect Customer's 230kV line, which will require the relocation of the existing Pawnee to Story 230kV line to one bay west to allow the new Customer owned line to terminate in this position. The new equipment required includes: • 230kV bi-directional revenue metering; • supporting cable, foundations and structures; • associated control and relaying changes, additions and testing	$0.310
Transmission	Construct new tie-line into plant substation	$0.045
Siting and Permitting	Siting and Land Rights activities for required easements, reports, permits and licenses	$0.020
	Total Cost Estimate for Interconnection Facilities	**$0.375**

Table 2 describes the costs associated with providing an interconnection to PSCo Transmission's system. .

Table 2: PSCo Transmission Network Upgrades Required for Interconnection:

Location	Description	Cost (millions)
PSCo Pawnee Generating Station	Upgrade/expand the existing 230KV transmission plant substation to accommodate the relocation of the existing Pawnee to Story 230kV line to one bay west to allow the new Customer owned line to terminate in this position. The new equipment required includes: • one 230KV, 3000 amp, 50 kA gas breakers; • two 230KV, 3000 amp gang switches; • one 230KV CCVT transformer; • associated communication upgrades, transmission line and bus relaying and testing; • supporting station wiring, cable, foundations and structures	$0.560
	Total PSCo Network Upgrades Required for Interconnection	**$0.560**
Time Frame		**9 Months (Back-feed)**

Assumptions:

1. The estimated costs provided for Interconnection costs are "Appropriation Estimates" with an accuracy of ± 20%. The estimated costs provided for
2. All applicable overheads are included. AFUDC has been removed.
3. PSCo (or its contractor) crews will perform all construction and wiring associated with PSCo-owned and maintained equipment..
4. Detailed field investigations (surveys, etc.) have not been conducted and could increase these estimates.
5. 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 estimates are in 2006 dollars.
8. The Customer will be responsible for funding and constructing approximately 28 miles of transmission line from the wind farm to the point of interconnection (Pawnee Station).
9. The last span into Pawnee Station from the Customer owned 230kV line will be a slack span between the PSCo substation dead-end and the Customer's last structure, which is assumed to be a dead-end tangent structure.
10. Detailed field investigations (surveys, etc.) have not been conducted and could increase this cost estimate.
11. No land requirements for Pawnee Substation.

The overall timeline to complete all required transmission and substation facilities is expected to require at least of 9 months.

V. Engineering, Procurement & Construction Schedule

The following schedule identifies milestones needed to complete the interconnection of the proposed 250 MW wind farm.

Figure 4: Engineering, Procurement & Construction Schedule

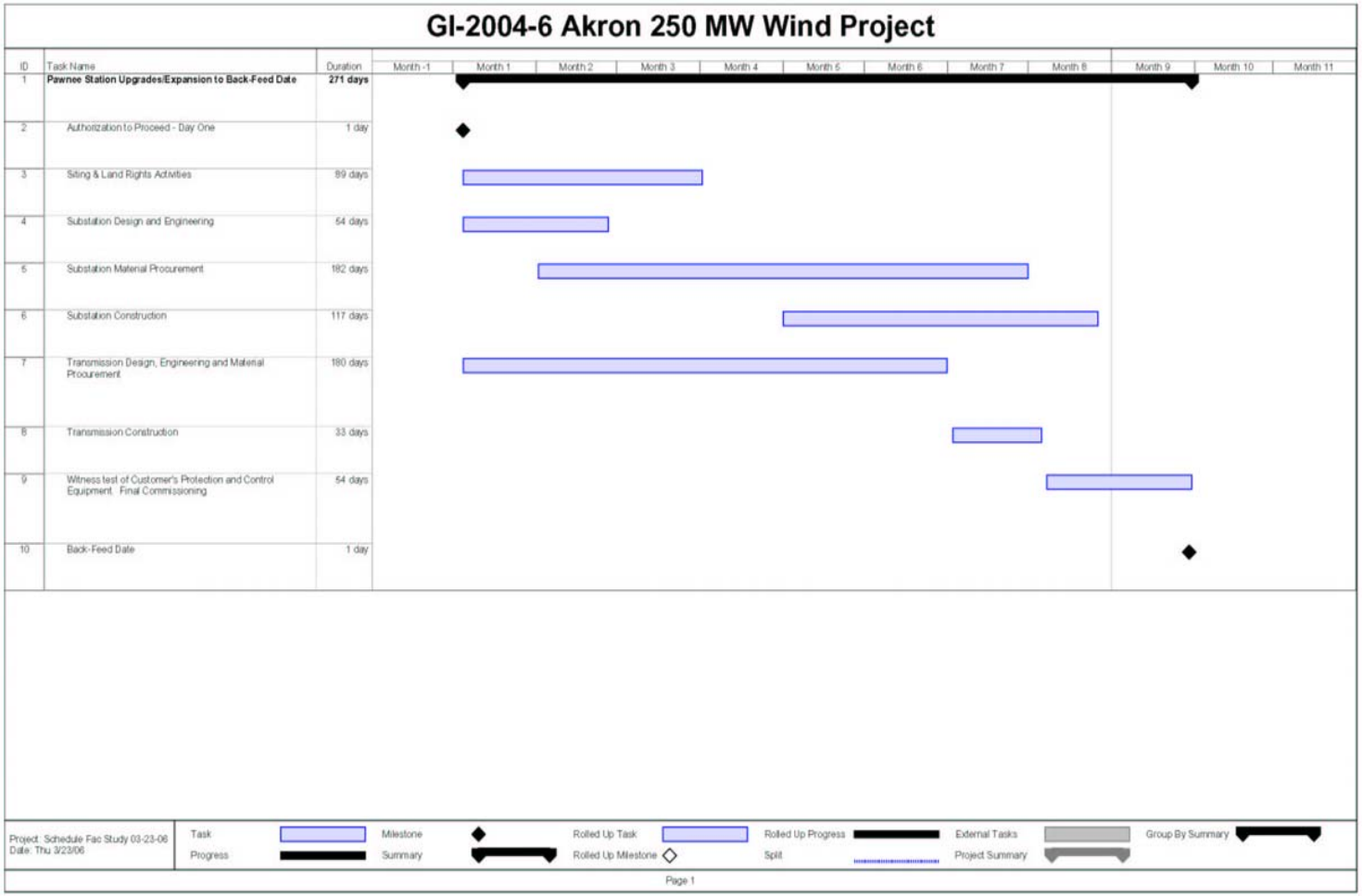


Figure 5: Pawnee Switchyard: Proposed General Arrangement Drawing as a Stand Alone Project