# Interconnection Facilities Study Report
# Generation Interconnection Request # GI-2016-15

200 MW Wind Generating Facility
Shortgrass 345 kV Switching Station
Lincoln County, Colorado

Xcel Energy - Transmission Planning West
Xcel Energy
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## A. Executive Summary

This Interconnection Facility Study Report summarizes the analysis performed by Public Service Company of Colorado (PSCo) to specify and estimate the cost of the siting, engineering, equipment procurement and construction needed to physically and electrically connect the GI-2016-15, 200 MW wind Generation Facility (GF) in Lincoln County, Colorado.

The Point of Interconnection (POI) requested for GI-2016-15 is the Missile Site 345 kV bus. The GF will connect to the POI via the Rush Creek Gen-Tie with a physical connection to the Gen-Tie at the Shortgrass Switching Station through an approximately 22 mile 345 kV line originating from the wind GF. The GF will be made up of approximately sixty (60) Vestas 3.45 MW, 0.90 PF Type IV wind turbines, each with its own 660V/34.5kV, 2800 kVA, Z=6.0% pad-mounted step-up transformer. The GF will include two (2) 34.5/345 kV, 68/90/112 MVA, Z=8.5% main step-up transformers.

The proposed commercial operation in-service date is December 31, 2020 with an assumed back feed date of six months prior to Commercial Operation Date (COD[1]); however, this requested COD is no longer feasible based on the estimated schedule.

This request was studied as an Energy Resource Interconnection Service (ERIS)[2].

The estimated time required to site, engineer, procure and construct the facilities described is at least 18-24 months from the date the customer meets all applicable milestones as agreed to in any future Large Generator Interconnection Agreement (LGIA). An Engineering & Procurement Agreement can be executed to facilitate completion of the interconnection facilities.

[1] **Commercial Operation Date** of a unit shall mean the date on which the Generating Facility commences Commercial Operation as agreed to by the Parties pursuant to Appendix E to the Standard Large Generator Interconnection Agreement.

[2] **Energy Resource Interconnection Service** shall mean an Interconnection Service that allows the Interconnection Customer to connect its Generating Facility to the Transmission Provider's Transmission System to be eligible to deliver the Generating Facility's electric output using the existing firm or non-firm capacity of the Transmission Provider's Transmission System on an as available basis. ERIS in and of itself does not convey transmission service

Figure 1, in Appendix A, shows the proposed one-line diagram for the expansion of the Shortgrass 345 kV Switching Station to a six breaker ring bus configuration in order to accommodate interconnection of the GF..

The total estimated cost of the recommended system upgrades to interconnect the project is approximately **$ 10.645 Million** and includes:

- $1.784 million for Transmission Provider Interconnection Facilities.
- $8.861 million for Reactive Support Upgrades for Interconnection.

## B. Introduction

PSCo and a Generation Provider (the "Customer") signed an Interconnection Facility Study Request (GI-2016-15) to provide cost estimates, a project schedule, and to address the impacts, as identified in the System Impact Study, of physically interconnecting a 200 MW wind generation facility (GF) to the 345 kV bus at PSCo's Shortgrass Switching Station. The GF will connect to the Missile Site Point of Interconnection (POI) via the Rush Creek Gen-Tie with a physical connection to the Gen-Tie at the Shortgrass Switching Station through an approximately 22 mile 345 kV line originating from the wind GF.

The Customer's GF will consist of approximately sixty (60) Vestas 3.45 MW, 0.90 PF Type IV wind turbines, each with its own 660V/34.5kV, 2800 kVA, Z=6.0% pad-mounted step-up transformer. The GF will include two (2) 34.5/345 kV, 68/90/112 MVA, Z=8.5% main step-up transformers. The proposed commercial operation in-service date is December 31, 2020 with an assumed back feed date of six months prior to Commercial Operation Date (COD). However, based on results of the System Impact Study, the COD for Energy Resource Interconnection Service cannot be met based on the construction schedule for the interconnection and the identified required reactive support upgrades. The reactive support upgrades include the addition of a 15 MVAR shunt reactor at the Shortgrass Switching Station and a 400 MVAR shunt capacitor at the Pronghorn Switching Station.

## C. Costs Estimates and Assumptions

PSCo has specified and estimated the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the "GI-2016-15 Interconnection System Impact Study" (SIS). The results of the engineering analysis are summarized in Tables 1 and 2.

Table 1: “Transmission Provider’s Interconnection Facilities” includes the nature and estimated cost of the Transmission Provider's Interconnection Facilities and an estimate of the time required to complete the construction and installation of such facilities.

Table 2: “Reactive Support Upgrades for Interconnection” includes the nature and estimated cost of any reactive support facilities necessary to accomplish the interconnection and an estimate of the time required to complete the construction and installation of such facilities.

Tables 1 and 2 are illustrated in the one-line diagrams of the Shortgrass and Pronghorn Switching Stations, Figures 1 and 2 respectively. Figure 1 shows the GI-2016-15 Interconnection Facilities and Reactive Support Upgrades in the Shortgrass Switching Station, identifying the physical and electrical connection of the Customer’s Interconnection Facility to the Transmission Provider’s Interconnection Facility. Figure 2 shows the GI-2016-15 Reactive Support Upgrades in the Pronghorn Switching Station. The one-line diagrams also identify the electrical switching configuration of the equipment.

The estimated total cost for the required upgrades for is $10.645 Million. Tables 1 and 2 below list the improvements required to accommodate the interconnection of GI-2016-15 and the delivery of its rated electrical output. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines. System improvements are subject to change upon a more detailed and refined design.

## Table 1: Transmission Provider's Interconnection Facilities

| Element | Description | Cost Est. (Millions) |
|---|---|---|
| PSCo's Shortgrass 345kV Bus | Interconnect Customer to physically tap at the Shortgrass 345kV substation, with a point of interconnection on the Missile 345kV bus.<br><br>The new equipment includes:<br>• One 345kV 3000A breaker<br>• Three 345kV 3000A disconnect switches<br>• Three 345kV arresters<br>• Two 2000A wave traps<br>• One set (of three) high side metering units<br>• Fiber communication equipment<br>• Station controls<br>• Associated electrical equipment, bus, wiring and grounding<br>• Associated foundations and structures<br>• Associated transmission line communications, fiber, relaying and testing. | $1.709 |
| | Transmission line tap into substation: | $0.055 |
| | Siting and Land Rights support for siting studies, land and ROW acquisition and construction: | $0.020 |
| | **Total Cost Estimate for Transmission Providers Interconnection Facilities** | **$1.784** |
| **Time Frame** | **Site, design, procure and construct** | **18 Months** |

## Table 2: Reactive Support Upgrades for Interconnection

| Element | Description | Cost Est. (Millions) |
|---|---|---|
| PSCo's Shortgrass 345kV Bus | Network Upgrade to add a 15MVAR reactor on the 345kV bus at PSCo's 345kV Shortgrass Switching Station.<br><br>The new equipment includes:<br>• One 345kV 3000A breaker<br>• One 345kV 15MVAR reactor<br>• One 345kV 3000A disconnect switch •<br>Relocation of GI-2016-14 metering equipment, wave traps, and surge arrester to accommodate reactor installation.<br>• Station controls<br>• Associated electrical equipment, bus, wiring and grounding<br>• Associated foundations and structures<br>• Associated fiber, reactor differential relaying and testing. | $3.253 |
| PSCo's Pronghorn 345kV Bus | Network Upgrade to add a 400MVAR capacitor bank in four 100MVAR stages at PSCo's 345kV Pronghorn Switching Station in a new ring position.<br><br>The new equipment includes:<br>• Four 345kV 3000A breakers<br>• Four 345kV 100MVAR capacitor bank<br>• Six 345kV 2000A disconnect switches<br>• Station controls<br>• Associated electrical equipment, bus, wiring and grounding<br>• Associated foundations and structures<br>• Associated fiber, reactor differential relaying and testing. | $5.608 |
| | Siting and Land Rights support for substation construction | $0.000 |
| | **Total Cost Estimate for Network Upgrades for Interconnection** | **$8.861** |
| **Time Frame** | **Site, design, procure and construct** | **24 Months** |

**Cost Estimate Assumptions**

- Scoping level cost estimates for Interconnection Facilities and Network Upgrades have a specified accuracy of +/- 20%.
- Estimates are based on 2019 dollars (appropriate contingency and escalation applied, AFUDC is not included).
- Labor is estimated for straight time only – no overtime included.
- Lead times for materials were considered for the schedule.
- Estimates are developed assuming typical construction costs for previous completed projects. These estimates include all applicable labor and overheads associated with the siting support, engineering, design, material/equipment procurement, construction, testing and commissioning of these new substation and transmission line facilities.
- The Generation Facility is not in PSCo's retail service territory. Therefore, no costs for retail load metering are included in these estimates.

- PSCo (or its Contractor) crews will perform all construction, wiring, and testing and commissioning for PSC owned and maintained facilities.
- The estimated time to site, design, procure and construct the upgrades required for Interconnection is approximately 18-24 months after authorization to proceed has been obtained.
- A CPCN will not be required for the interconnection facilities construction.
- Line and substation bus outages will be necessary during the construction period. Outage availability could potentially be problematic and necessitate extending the back-feed date.
- Estimates do not include the cost for any Customer owned equipment and associated design and engineering.
- The Customer will be required to design, procure, install, own, operate and maintain a Load Frequency/Automated Generation Control (LF/AGC) RTU at the Customer Substation. PSCo / Xcel will need indications, readings and data from the LFAGC RTU.
- Power Quality Metering (PQM) will be required on the Customer's 345 kV line terminating into the Shortgrass Switching Station.
- Customer will string optical ground wire (OPGW) cable into the substation as part of their transmission line construction scope.

# Appendix

**Figure 1: GI-2016-15 Interconnection Facilities and Reactive Support at Shortgrass Switching Station**

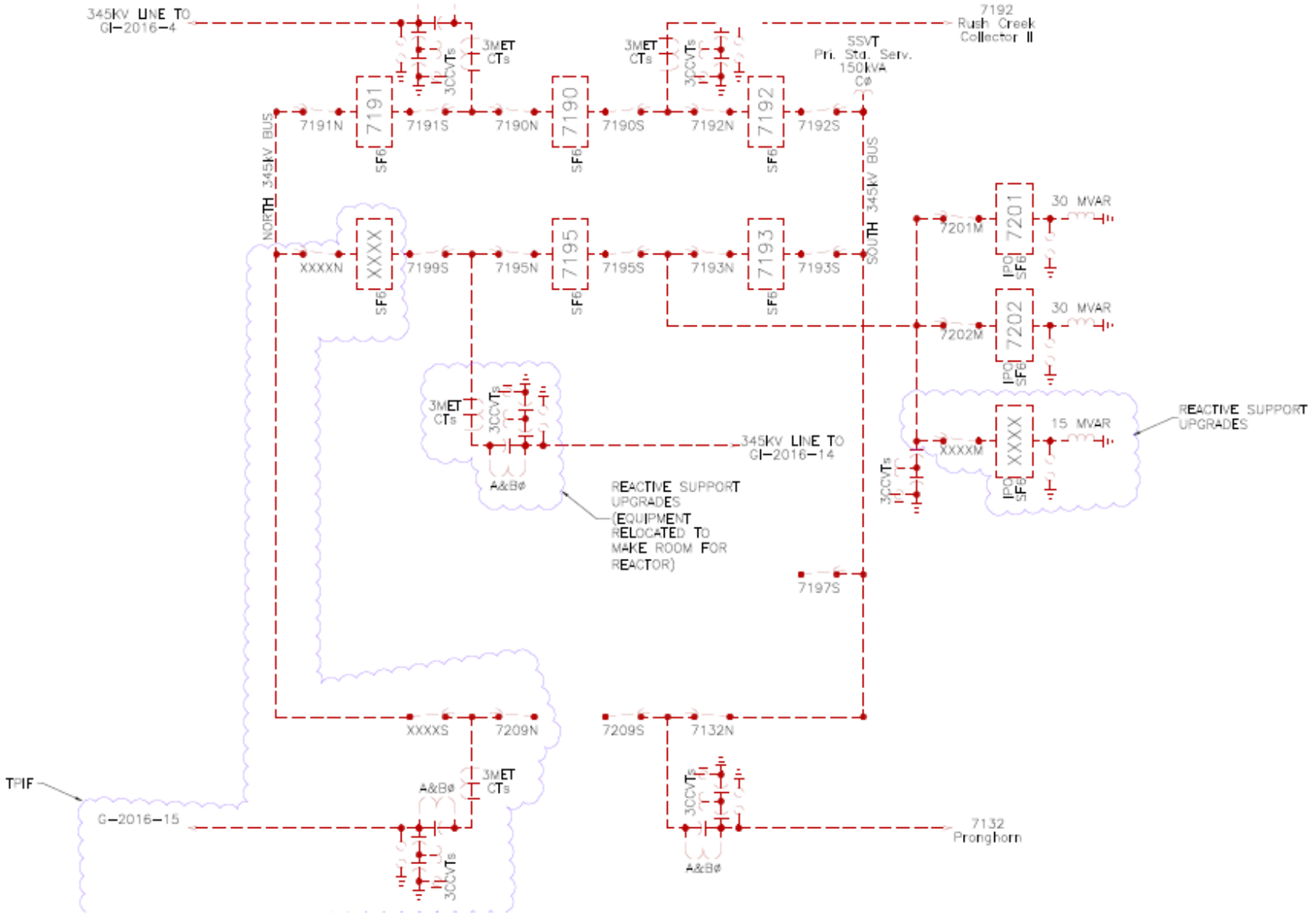

**Figure 2: Reactive Support Upgrades at Pronghorn Switching Station**