



**Interconnection Facilities Study  
Final Report  
Request # GI-2016-3**

**600 MW Wind Generating Facility  
Missile Site 345 kV Substation, Colorado**

**Xcel Energy – Public Service Company of Colorado  
Transmission Planning  
February 10, 2017**



## I. Executive Summary

Public Service Company of Colorado (PSCo) received an Interconnection Request (IR) on February 12, 2016 which was assigned GI-2016-3 queue position. GI-2016-3 is a wind generating facility rated at 600 MW gross electrical output that will be located in Elbert, Lincoln and Kit Carson Counties in Colorado. The point of interconnection (POI) requested for GI-2016-3 is the 345 kV bus within the PSCo Missile Site Substation. The commercial operation date (COD) requested for the generating facility is December 31, 2018 and the requested back-feed date is August 1, 2018.

This Interconnection Facilities Study Report summarizes the construction schedule and cost of siting, engineering, equipment procurement and construction needed to interconnect the proposed GI-2016-3 wind generating facility at Missile Site 345kV substation.

The one-line drawing of Missile Site 345kV substation provided in Appendix A shows the Point of Interconnection of GI-2016-3, the Interconnection Facilities required for GI-2016-3, as well as the Point of Change of Ownership between the Transmission Provider's and Interconnection Customer's Interconnection Facilities.

The estimated total cost for the Transmission Provider Interconnection Facilities is **\$6.051M**, as follows:

- \$3.423 million for Customer-Funded, PSCo-Owned Interconnection Facilities
- \$2.628 million for PSCo-Funded, PSCo-Owned Interconnection Facilities

The estimated time required to design, engineer, procure and construct the Interconnection Facilities is 18 months from the date the Customer meets all applicable milestones as agreed to in any future LGIA. An Engineering & Procurement Agreement can be executed to facilitate completion of the Interconnection Facilities.

The estimated total cost for the Network Upgrades for Delivery – that is, the Pawnee–Daniels Park 345kV Project – is **\$178.3M**. The CPCN (Certificate of Public Convenience and Necessity) for Pawnee – Daniels Park 345kV Project has been granted by the CPUC (Colorado Public Utilities Commission) and the estimated total cost for this Network Upgrade has also been approved by the CPUC.

The estimated time required to design, engineer, procure and construct the Network Upgrades for Delivery is 30 months from the date the Customer meets all applicable milestones as agreed to in any future LGIA.

**Total Estimated Cost for Interconnecting GI-2016-3 as NRIS = ~\$184.5M**

**Total Estimated Cost for Interconnecting GI-2016-3 as ERIS = ~\$6.2M**

## II. Introduction

Public Service Company of Colorado (PSCo) received an Interconnection Request (IR) on February 12, 2016 which was assigned GI-2016-3 queue position. GI-2016-3 is a wind generating facility rated at 600 MW gross electrical output that will be located in Elbert, Lincoln and Kit Carson Counties in Colorado. The point of interconnection (POI) requested for GI-2016-3 is the 345 kV bus within the PSCo Missile Site Substation. The commercial operation date (COD) requested for the generating facility is December 31, 2018 and the requested back-feed date is August 1, 2018.

This Interconnection Facilities Study Report summarizes the construction schedule and cost of siting, engineering, equipment procurement and construction needed to interconnect the proposed GI-2016-3 wind generating facility at Missile Site 345kV substation.

## III. General Interconnection Facilities Description

### A. Project Purpose & Scope

#### Summary

This project provides for a new line terminal in the Missile Site 345kV yard for a new 345kV transmission line from Missile Site to a new 345kV Rush Creek (Pronghorn) Switching Station. The GI-2016-3 Generating Facility (Rush Creek Wind) will connect to the new 345kV Rush Creek (Pronghorn) Switching Station. This project at Missile Site will add a new bay to the 345kV yard with three new 345kV breakers. This project will also include a 50Mvar cap bank along with a 345kV IPO breaker. Metering will be located at this site for the new line.

#### Background

Interconnection facilities are needed to interconnect the GI-2016-3 generation and providing Energy/Network Resource Interconnection Service.

#### Future Considerations

The existing Missile Site 345kV yard is arranged in a breaker and a half configuration with space for future bays. This project will utilize the existing open space to add a bay with two elements. The rest of the 345kV yard will remain available for future breaker-and-a-half build-outs.

#### Distribution vs. Transmission Asset Ownership and Cost Responsibility

The substation primary function is presently defined as Transmission. This project will not change the primary function of the substation when complete assuming no other changes.

### B. FERC and/or NERC Compliance Requirements



Critical Infrastructure Protection (CIP) Asset

The CIP status of this substation was verified on 9/26/2016.

Power System Restoration Plan Impact

Power system restoration plan impact was verified on 9/21/2016.

Facility Ratings and Smart One-Lines

This substation has BES facilities.

A smart one-line already exists for this substation. The existing smart one-line will be updated to include the changes made by this project. Facility ratings changes will be handled via the GIST2 system, and will be reviewed and approved per the Procedure for Review and Approval of GIST2-Created Facility Ratings.

**C. Right of Way/Permitting**

Land purchase or expansion will not be required for this project.

**D. Electrical Features**

Transmission Lines: Current Carrying Capacity of Affected/Tapped/New

The new 345kV line will be double 1272 ACSR 45/7 “Bittern”, rated at 2740A, to meet audible noise requirements. Therefore, all the new substation equipment will meet the line rating of 2740A.

Fault Current

<b>Location \ Type of Fault</b>	<b>Three Phase (A)</b>	<b>Single-Line-to-Ground (A)</b>
Existing 230kV Bus	10,444	9,835
Existing 345kV Bus	13,371	11,630
230kV Bus – After Rush Creek 345kV Line Termination (8/1/2018)	15,687	15,832
345kV Bus – After Rush Creek 345kV Line Termination (8/1/2018)	18,040	17,872

Electrical Removals & Relocations

This project will require the removal of three high bus supports.

Electrical Installations (Major Equipment)

There will be three 345kV breakers and four 345kV switches installed to make up the new bay. Three 345kV Metering CCVT's, two 345kV wave traps, three 345kV CT's, and one 345kV line disconnect switch will be installed on the line terminal to new Rush Creek substation. One 345kV disconnect switch and one 345kV IPO circuit breaker will be installed for the 50MVAR Capacitor Bank.

### Electrical Equipment Enclosure (EEE)

This project will utilize the new EEE that will be installed as part of the 345kV Pawnee – Daniels Park project.

### AC System

The primary station service source includes two single phase 100kVA 230kV/120/240V SSVT's. The backup station service is comprised of three 167kVA 13.8kV/277V transformers in combination with 480/120/240V dry type transformers. The new station load will not cause load to grow beyond 167kVA. An upgrade of the AC system will not be required.

### DC System

This project will use the dual battery DC system which will be installed as part of the 345kV Pawnee-Daniels Park project.

### Grounding

The existing ground grid will be expanded and modified to accommodate the new equipment and will be connected to the new and existing ground grid. Equipment connections will use #4/0 AWG copper and 8-ft sectional ground rods. All below grade connections will be Cadweld.

### Lightning Protection

The existing lightning protection will be modified with this design. Additional static wire will be installed to protect the new equipment.

### Trenching & Cable

New duct bank will be installed between the EEE and the new equipment in the yard. Existing trenches and pull pits will be utilized per their availability.

### Wave/Line Traps

Two new wave traps will be installed on the new line terminal to Rush Creek substation. They will be supported by pedestal mounting support.

## **E. Civil Features**

### Grading & Fencing

Existing grading will be sufficient for this project. The southern fence will be moved 60' to accommodate the new Capacitor Bank.

### Storm Water Permit

A new SWMP will not be required for this project.

### SPCC (Oil Containment)

Existing oil containment will be sufficient for this project.



### Civil Removals & Relocations

N/A

### Foundations & Structures

Foundation work will be required for all new installations as part of this project.

There is an existing soil boring report from the 230 construction that can be used for this project. Standard designs are anticipated.

The dead ends will not require beams at the bottom, there will be bus supports directly underneath them.

### Switchgear Building

N/A

### Fire protection (Fire protection wall, and fire protection layer around EEE)

N/A

## **F. Control Features**

### Transmission Breaker Reclosing Controls

The relays associated with each new circuit breaker will provide the reclosing control for that breaker.

### Transformer LTC Controls

N/A

### Auto-Sectionalizing/Auto-Transfer

N/A

### Digital Fault Recorder

A new DFR will be installed as part of the Pawnee-Daniels Park project at Missile, and will be utilized on this project as well.

### Control Panel Locations

There will be five (4) new control panels installed as a part of this project. Two (2) of these panels will be for the new 345kV breakers being installed, one (1) will be for the new 345kV line terminal, and one (1) will be for the new cap bank.

Removals

N/A

**G. Communication Features**RTU

This project will utilize the new RTU that will be installed as part of the Pawnee-Daniels Park project.

Local Annunciation

N/A

Telephone protection

N/A

Relay Remote Access

The new equipment will utilize a communication system for remote relay access.

PLC (programmable logic controller)/Feeder Load Monitoring/Information-flow/Others

N/A

Fiber Optic Cable

OPGW will be installed on the new 345kV transmission line. The fiber cable will be terminated in a fiber box on each of the dead end tower. The fiber will be routed from the fiber box to the EEE and terminated at a patch panel inside the EEE. This fiber will be used for standard line relaying.

Removals

N/A

**H. Project Operating Concerns and Outages**Outages/Temporary Configurations

Construction for this project will require an outages on the 345kV main busses. Outages can be taken one bus at a time for the construction.

Mobile Substation or Transformer

N/A



## Environmental

N/A

### **I. Material Staging Plan**

All major equipment will be shipped directly to site and store in the existing substation yard.

### **J. Related Projects**

There are no related Work Orders at this time.

## **IV. Cost Estimates and Assumptions**

The one-line drawing of Missile Site 345kV substation provided in Appendix A shows the Point of Interconnection of GI-2016-3, the Interconnection Facilities required for GI-2016-3, as well as the Point of Change of Ownership between the Transmission Provider's and Interconnection Customer's Interconnection Facilities.

Scoping level cost estimates for Transmission Provider Interconnection Facilities and Network Upgrades for Delivery (+/- 20% accuracy) were developed by Public Service Company of Colorado (PSCo) / Xcel Energy (Xcel) Engineering. Estimates are developed based on typical construction costs for previous completed projects. These cost estimates include all applicable labor and overheads associated with the siting, engineering, design, material/equipment procurement, construction, testing and commissioning of these new substation and transmission line facilities. This cost estimate does not include the cost for any other Interconnection Customer owned equipment and associated design and engineering.

The estimated total contingency level for this project is \$1,737,470 based on risks identified as part of the Risk Register.

The following tables list the transmission improvements required for the interconnection and the delivery of generation output. The estimated total cost for the Transmission Provider Interconnection Facilities is **\$6.051M**, and that for the Network Upgrades for Delivery is **\$178.3M**. The cost responsibilities associated with these facilities shall be handled as per current FERC guidelines.



**Table 1: Transmission Provider Interconnection Facilities – PSCo Transmission Owned, Interconnection Customer Funded**

Element	Description	Cost Estimate (Millions)
<b>PSCo's Missile Site 345 kV Transmission Substation</b>	Interconnect Customer to the 345kV bus at the Missile Site Substation. The new equipment includes: <ul style="list-style-type: none"> <li>• One 345kV, 3000 amp IPO circuit breaker</li> <li>• One 345kV, 50MVAR shunt capacitor bank</li> <li>• Two 345kV, 3000 amp gang switches</li> <li>• Three 345kV CT metering units</li> <li>• Three 345kV PT metering units</li> <li>• Six 345kV lightning arresters</li> <li>• Primary metering for Load Frequency/Automated Generation Control</li> <li>• Power Quality Metering</li> <li>• Associated electrical equipment, bus, wiring and grounding</li> <li>• Associated foundations and structures</li> <li>• Associated transmission line communications, fiber, relaying and testing</li> </ul>	<b>\$3.348</b>
	Transmission line tap from Customer's last line structure outside of PSCo's yard into new bay position (assumed 300' span, conductor, hardware and labor).	<b>\$0.075</b>
	<b>Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities</b>	<b>\$3.423</b>
<b>Time Frame</b>	<b>Site, design, procure and construct</b>	<b>18 Months</b>

**Table 2: Transmission Provider Interconnection Facilities – PSCo Transmission Owned and Funded**

Element	Description	Cost Estimate (Millions)
<b>PSCo's Missile Site 345kV Transmission Substation</b>	Interconnect Customer to the bus at the Missile Site Substation. The new equipment includes: <ul style="list-style-type: none"> <li>• Three 345kV, 3000 amp circuit breakers</li> <li>• Six 345kV, 3000 amp gang switches</li> <li>• Associated station controls, communications, supervisory and SCADA equipment</li> <li>• Associated electrical equipment, bus, wiring and grounding</li> <li>• Associated foundations and structures</li> <li>• Associated equipment and system testing</li> </ul>	<b>\$2.628</b>

	<b>Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities</b>	<b>\$2.628</b>
<b>Time Frame</b>	<b>Site, design, procure and construct</b>	<b>18 months</b>

**Table 3: PSCo Network Upgrades for Delivery**

<b>Element</b>	<b>Substation Cost (Millions)</b>	<b>Cost Est. (Millions)</b>
<b>Siting and Land Rights Permitting / Acquisition</b>		<b>\$8.81</b>
<b>Substation Costs</b>		<b>\$55.68</b>
Pawnee Substation	\$5.890	
Smoky Hill Substation	\$9.585	
Daniels Park Substation	\$9.250	
Harvest Mile Substation	\$23.935	
Missile Site Substation	\$7.020	
<b>Transmission Line Costs</b>		<b>\$113.81</b>
Pawnee – Daniels Park		
<b>Time Frame to site, design, procure and construct</b>		<b>30 months</b>
<b>Total Cost Estimate for PSCo Network Upgrades for Delivery</b>		<b>\$178.3</b>

**Cost Estimate Assumptions**

- Scoping level project cost estimates for Interconnection Facilities and Network Upgrades for Delivery ( $\pm$  20% accuracy) were developed by PSCo Engineering.
- Estimates are based on 2016 dollars (appropriate contingency and escalation included).
- Labor is estimated for straight time only – no overtime included.
- AFUDC has been excluded.
- Lead times for materials were considered for the schedule.
- The estimated time to site, design, procure and construct the Interconnection Facilities is approximately 18 months after authorization to proceed has been obtained.
- For construction of Interconnection Facilities, a CPCN will not be required and no new substation land will need to be acquired.
- The estimated time to site, design, procure and construct the Network Upgrades is approximately 30 months after authorization to proceed has been obtained.
- The CPCN for Network Upgrades – that is, Pawnee – Daniels Park Project – has been approved by the CPUC for an in-service date of October 2019.
- Xcel Energy (or its Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo Transmission owned and maintained facilities.

## V. Engineering, Procurement & Construction Schedule

Work Order #MSSLTERM		Missile Site - New 345kV Line Term to Pronghorn Switching Station, Sub																						
Run Date 02/08/17		Schedule Data Date 02/01/17																						
MSSLTERM - B2																								
Activity ID	Activity Name	Org Duration	LATE START	LATE FINISH	2016				2017				2018				2019							
					Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
MSSLTERM	Missile Site - New 345kV Line Term to Pronghorn Switching Station, Sub	129.4w	07/01/16	01/16/19																				
MSSLTERM.1	PERMITTING - PROJ MANAGEMENT	103.4w	07/01/16	08/01/18																				
MSSLTERM.2	ENGINEERING DESIGN	64.8w	01/09/17	04/24/18																				
MSSLTERM.3	MATERIAL PROCUREMENT	41.5w	06/23/17	03/27/18																				
MSSLTERM.4	CONSTRUCTION INSTALL	60.6w	04/10/17	10/18/18																				
MSSLTERM.6	COMMISSION	1.0w	07/26/18	08/01/18																				
MSSLTERM.7	IN SERVICE DATES & CLOSEOUT	26.0w	08/01/18	01/16/19																				

# Appendix A – GI-2016-3 Interconnection to 345kV Bus in Missile Site Substation

