



INTERCONNECTION FACILITIES STUDY REPORT

GENERATOR INTERCONNECTION REQUEST # GI-2016-14

**500 MW Wind Generating Facility
Interconnecting to the Rush Creek Gen Tie
with Point of Interconnection at
Missile Site 345kV Substation**

Xcel Energy – Public Service Company of Colorado (PSCo)
August 28, 2018

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 siting, engineering, equipment procurement and construction needed to physically and electrically connect the GI-2016-14, 500 MW wind generation facility (GF) in Cheyenne and Kit Carson Counties in Colorado.

The Point of Interconnection (POI) requested for GI-2016-14 is the Missile Site 345kV substation. The Customer's GF will interconnect 500 MW of generation to the POI via the 85 mile Rush Creek Gen Tie – a 345kV transmission line between the Missile Site 345kV substation and the Rush Creek II collector station – being constructed for the planned Rush Creek Generating Facility. The proposed GF will consist of approximately two-hundred fifty (250) 2.0 MW wind turbines that will be grouped together into two 34.5 kV collector systems, and each 34.5 kV collector system will connect to a 34.5/345kV Main Step-up Transformer (MST). The two MSTs will connect via an approx. 55 mile 345kV transmission line to a new 345kV Rush Creek II switching station located near the far end of the Rush Creek Gen Tie.

The proposed Commercial Operation Date (COD¹) is October 1, 2019 with an assumed back feed date of six months prior to the COD. The proposed COD is not feasible based on the site, design, procure and construct time-frames noted in Tables 1 and 2 of this report.

The estimated time required to site, engineer, procure and construct the facilities described is at least 48 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.

The conceptual one-line diagram for GI-2016-14 interconnection and the proposed one-line diagram for the new 345kV Rush Creek II switching station are shown in Figures 1 and 2 respectively in the Appendix.

This request was studied both as an Energy Resource Interconnection Service (ERIS)² and a Network Resource Interconnection Service (NRIS)³.

The estimated costs of the recommended transmission system upgrades to interconnect the GI-2016-14 project include:

- \$2.209 million for Interconnection Customer Interconnection Facilities for the Physical Interconnection of GI-2016-14 (cf. Table 1).
- \$67.402 million for additional Network Upgrades required for NRIS (cf. Table 2).

The total estimated cost of the transmission system improvements required for GI-2016-14 to qualify for:

- **ERIS is \$2.209 Million (Table 1); and**
- **NRIS is \$69.611 Million (Tables 1 and 2)**

This is contingent upon completion of the Network Upgrades identified for all applicable higher-queued Interconnection Requests (see footnotes to Table 1 and 2).

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

³ **Network Resource Interconnection Service** shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as all other Network Resources. NRIS in and of itself does not convey transmission service.

For GI-2016-14 interconnection:

NRIS (after required transmission system improvements) = 500 MW

ERIS (after required transmission system improvements) = 500 MW (output delivery assumes the use of existing firm or non-firm capacity of the PSCo Transmission System on an as-available basis.)

Note: NRIS or ERIS, in and of itself, does not convey transmission service.

Cost Estimates and Assumptions

Transmission Provider has specified and estimated the cost of the equipment, engineering, procurement and construction work needed to interconnect GI-2016-14. The results of the engineering analysis for Interconnection Facilities required to interconnect GI-2016-14 to the Rush Creek Gen Tie (owned by PSCo as the existing Interconnection Customer) are estimates and are summarized in Table 1.

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.

Upgrades identified in Table 1 are conceptually illustrated in Figure 1 in the Appendix which shows the physical and electrical connection of the Interconnection Customer’s Generating Facility to the Transmission Provider’s Transmission System via the Rush Creek Gen Tie. The one-line diagram in Figure 2 identifies the electrical switching configuration of the equipment comprising the Transmission Provider’s Interconnection Facilities (i.e. the new 345kV Rush Creek II switching station), including, without limitation: the transformer, switchgear, meters, and other station equipment.

Transmission Provider has also specified and estimated the cost of the equipment, engineering, procurement and construction work of additional Network Upgrades required for NRIS. The results of the engineering analysis for facilities owned by the Transmission Provider are estimates and are summarized in Table 2.

Table 2: “Additional Network Upgrades required for NRIS” includes the nature and estimated cost of the Transmission Provider's additional Network Upgrades required for NRIS and an estimate of the time required to complete the construction and installation of such facilities.

The total estimated cost of the transmission system improvements required for GI-2016-14 to qualify for:

- ERIS is \$2.209 Million (Table 1); and
- NRIS is \$69.611 Million (Tables 1 and 2)

The following tables list the transmission system improvements required to accommodate the interconnection of GI-2016-14. The cost responsibilities associated with these transmission system improvements shall be handled as per current FERC guidelines.

Table 1: Transmission Provider's Interconnection Facilities required for the Physical Interconnection of GI-2016-14 to the Existing PSCo Owned Interconnection Customer Interconnection Facilities, i.e. to the 345kV Rush Creek Gen-Tie (applicable for either ERIS or NRIS) *

Element	Description	Cost Est. (Millions)
PSCo's New Rush Creek II 345kV Station	Interconnect Customer to tap at the Rush Creek II 345kV Bus. The new equipment includes: <ul style="list-style-type: none"> • One 345kV 3000A Circuit Breaker • Two 345kV 3000 A disconnect switches • One set (of three) high side metering units • Station controls • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures 	\$1.044
PSCo's New Rush Creek II 345kV Station	Interconnect Customer to tap at the Rush Creek II 345kV Bus The new equipment includes: <ul style="list-style-type: none"> • One 345kV motor operated gang switch • Three 345kV arresters • One set (of three) high side metering current transformers • One set (of three) high side CCVTs • Fiber Optic & PLC communications termination • 345kV line relaying panel • Station controls • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated line communications, fiber, relaying and testing. 	\$1.070
	Transmission line tap into station	\$0.055
	Siting and Land Rights support for siting studies, land and ROW acquisition and construction	\$0.040

	Total Cost Estimate for Interconnection Facilities	\$2.209
Time Frame	Site, design, procure and construct	18 Months

*** Contingent on completion of the Interconnection Customer Interconnection Facilities required for GI-2016-3 (i.e. the 85 mile Missile Site – Pronghorn – Rush Creek II 345kV line, aka Rush Creek Gen Tie) and the Transmission Provider Interconnection Facilities required for GI-2016-4. For details, refer to the one-line diagrams in Figures 1 and 2 in the Appendix, and to Table 1 in the Facilities Study reports for GI-2016-3 and GI-2016-4.**

Table 2: Additional Network Upgrades required for NRIS *

Element	Description	Cost Est. (Millions)
PSCo's 5281 Greenwood-Leetsdale 230kV OH Line	Wreckout/Rebuild the 5281 Greenwood-Leetsdale line with 700 MVA rating.	\$11.900
PSCo's Greenwood 230kV Substation	Replace two (2) 230kV disconnect switches and one (1) 230kV ground switch.	\$0.618
PSCo's Monroe 230kV Substation	Replace two (2) 230kV disconnect switches (one with a motor operator) and one (1) 230kV ground switch.	\$0.652
PSCo's 5283 Elati-Monroe 230kV UG Line	The 5283 Elati-Monroe 230 kV HPFF underground line is continuously rated at 398 MVA. Replace the line and any other termination equipment with an XLPE underground line to achieve rating of 616 MVA (1545A) or higher.	\$54.232
	Total Cost Estimate for Network Upgrades	\$67.402
Time Frame	Site, design, procure and construct	48 months

*** Contingent on completion of the Network Upgrades for NRIS identified for higher-queued Interconnection Requests GI-2016-3, GI-2015-1 and GI-2016-6. For details, refer to Table 3 in the Facilities Study reports for GI-2016-3 and GI-2015-1 and to Table 3 in the System Impact Study report for GI-2016-6.**

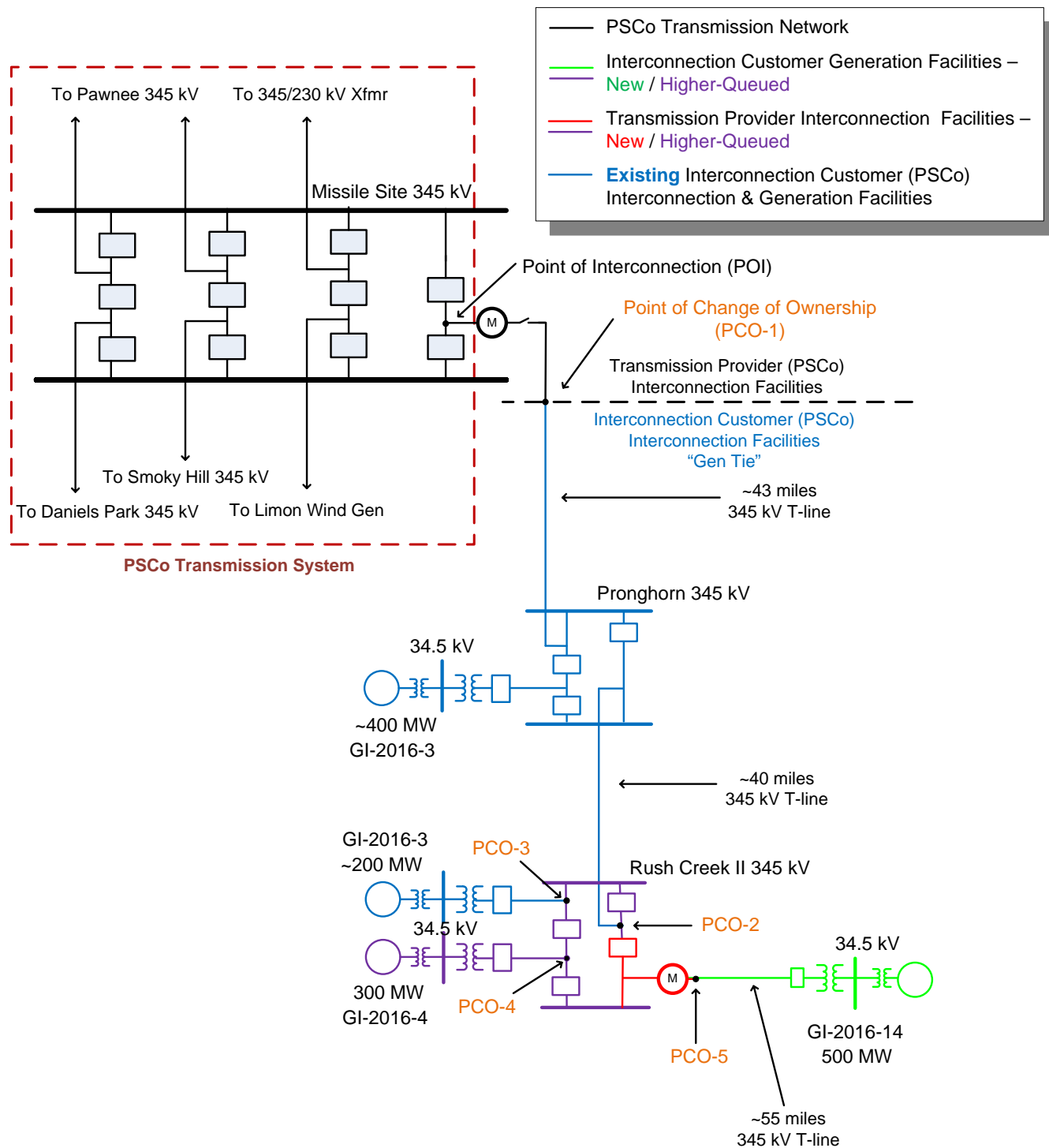
Cost Estimate Assumptions

- Appropriations level cost estimates for Interconnection Facilities and Network Upgrades have a specified accuracy of +/- 20%.
- Estimates are based on 2018 dollars (appropriate contingency and escalation applied).

- Labor is estimated for straight time only – no overtime included. Assumes contracted construction for the majority of the work.
- 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 in PSCo's retail service territory. Therefore, 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 Transmission Provider's Interconnection Facilities is approximately 18 months after authorization to proceed has been obtained.
- A CPCN will be required for the construction of Network Upgrades required for NRIS. The time to secure the CPCN is included in the 48 months estimated duration for site, design, procure and construct.
- 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 230 kV line terminating into the POI.
- Customer will string optical ground wire (OPGW) cable into the substation as part of their transmission line construction scope.

Appendix

Figure 1. Conceptual One-Line for GI-2016-14 Interconnection



**Figure 2. Interconnection Facilities required for GI-2016-14 Interconnection to the Rush Creek Gen-Tie
(by tapping the Pronghorn – Rush Creek II line section)**

