Interconnection Facilities Study Report
Generation Interconnection Request # GI-2016-7

240MW Solar Photovoltaic Generating Facility
Boone 230kV Substation
Pueblo County, Colorado

Xcel Energy – Public Service Company of Colorado
August 26, 2019

Introduction

GI-2016-7 is a 240MW solar photovoltaic generation facility that will be located in Pueblo County, Colorado. The Point of Interconnection (POI) requested is the 230kV bus within Public Service Company of Colorado's (PSCo) Boone 230kV Substation. The Generating Facility will be made up of one hundred and twenty (120) SMA Sunny Central 2200-US inverters equally distributed over three groups, and each group will consist of twenty 4MVA generator step-up transformers. The three groups will connect to a 240MVA main step-up transformer which will connect to the Boone 230kV POI using a Generator Interconnection Customer owned 230kV tie-line.

The Customer originally requested a Commercial Operation Date (COD[1]) of December 31, 2018. During the Feasibility study report review meeting, the Customer revised the COD to November 30, 2019 and backfeed date to October 1, 2019. Based on the 18 month construction time frame required to build the transmission improvements (noted in Tables 1, 2 and 3 of this report), the proposed COD is not achievable.

The GI-2016-7 was studied for both Energy Resource Interconnection Service (ERIS[2]) and Network Resource Interconnection Service (NRIS[3]). For both ERIS and NRIS evaluations, the 240MW rated output of GI-2016-7 is assumed to be delivered to PSCo native load, so existing PSCo generation is reduced to balance the output of GI-2016-7.

This Interconnection Facilities Study Report summarizes the analysis performed by PSCo to specify and estimate the cost of the siting, engineering, equipment procurement and construction needed to physically and electrically connect the GI-2016-7 Generating Facility.

The proposed one-line diagram for the GI-2016-7 POI is shown in Figure 1

The estimated costs of the recommended transmission system upgrades to interconnect GI-2016-7 project include:

- $ 1.362 Million for Transmission Provider's Interconnection Facilities (cf. Table 1)
- $ 2.543 Million for Network Upgrades required for either NRIS or ERIS (cf. Table 2)
- $ 383,000 for additional Network Upgrades required for NRIS (cf. Table 3)

[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. Energy Resource Interconnection Service 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. Network Resource Interconnection Service in and of itself does not convey transmission service.

The total estimated cost of the PSCo transmission system improvements required for GI-2016-7 to qualify for:

- **ERIS is $3.905 Million (Tables 1 and 2); and**
- **NRIS is $4.288 Million (Tables 1, 2 and 3)**

The ERIS and NRIS results above are contingent upon the mitigation of all overloads and Network Upgrades identified in the Affected Systems and the PSCo system, and Network Upgrades identified for all applicable higher-queued Interconnection Requests (see footnotes to Table 2 and Table 3).

If there is a change in status of one or more higher-queued Interconnection Requests due to withdrawal from the queue or changing from NRIS to ERIS, and the Network Upgrades identified for the higher queued Interconnection Requests are not constructed, the Network Upgrade costs would become the responsibility of GI-2016-7 to the extent they are necessary to interconnect GI-2016-7. A restudy will be performed as needed to identify the new Network Upgrade responsibilities.

For GI-2016-7 interconnection:

NRIS (after required transmission system improvements) = 240MW

ERIS (after required transmission system improvements) = 240MW (output delivery assumes the use of existing firm or non-firm capacity of the PSCo Transmission System on as as-available basis)

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

Cost Estimates and Assumptions

The Transmission Provider has specified and estimated the cost of the equipment, engineering, procurement and construction work needed to interconnect GI-2016-7. The results of the engineering analysis for facilities owned by the Transmission Provider are estimates and are summarized in Table 1 and Table 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: "Network Upgrades required for Interconnection (applicable for either ERIS or NRIS)" includes the nature and estimated cost of the Transmission Provider's Network Upgrades necessary to accomplish the interconnection and an estimate of the time required to complete the construction and installation of such facilities.

Upgrades identified in Table 1 and Table 2 are illustrated in Figure 2 in the Appendix A which shows the physical and electrical connection of the Interconnection Customer's Generating

Facility to the Transmission Provider's Transmission System. The one-line diagram also identifies the electrical switching configuration of the interconnection equipment, 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 3.

Table 3: "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 PSCo transmission system improvements required for GI-2016-7 to qualify for:

- **ERIS is $3.905 Million (Tables 1 and 2); and**
- **NRIS is $4.288 Million (Tables 1, 2 and 3)**

The following tables list the transmission system improvements required to accommodate the interconnection of GI-2016-7. The cost responsibilities associated with these transmission system improvements shall be handled as per current FERC guidelines.

Table 1 –Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Millions)
PSCo's Boone 230kV Bus	Interconnect Customer to tap at the Boone 230kV Bus The new equipment includes: - One 230kV gang switch with MOD - Three 230kV Arrestors - Three 230kV metering CTs - Three 230kV metering PTs - Station controls - Associated electrical equipment, bus, wiring and grounding - Associated foundations and structures - Associated transmission line communications, fiber, relaying and testing.	$1.277
	Transmission line tap into substation:	$0.055
	Siting and Land Rights support for siting studies, land and ROW acquisition and construction:	$0.030
	Total Cost Estimate for Transmission Providers Interconnection Facilities	**$1.362**
Time Frame	**Site, design, procure and construct**	**18 Months**

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Table 2 - Network Upgrades for Interconnection (applicable for either ERIS or NRIS) *

Element	Description	Cost Est. (Millions)
PSCo's Boone 230kV Bus	Interconnect Customer to tap at the Boone 230kV Bus. The new equipment includes: - Three 230kV breakers - Six 230kV gang switches - Station controls - Associated electrical equipment, bus, wiring and grounding - Associated foundations and structures - Associated transmission line communications, fiber, relaying and testing	$2.543
	Siting and Land Rights support for substation construction:	N/A
	Total Cost Estimate for Network Upgrades for Interconnection	**$2.543**
Time Frame	**Site, design, procure and construct**	**18 Months**

*** Contingent on completion of Network Upgrades for Interconnection identified for GI-2014-8.**

Table 3 – Additional Network Upgrades for NRIS *

Element	Description	Cost Est. (Millions)
PSCo's Daniels Park 230kV Bus	Upgrade the 230kV terminal to Jackson Fuller to 488MVA. Rating after upgrade is 557MVA.	$0.063
Greenwood-Prairie 3 230 Line/Sub	Upgrade 230kV line to 482MVA. Rating after upgrade is 637MVA.	$0.320
	Total Cost Estimate for Network Upgrades for Delivery	**$0.383**
Time Frame	**Site, design, procure and construct**	**18 Months**

*** Contingent on completion of the Network Upgrades for NRIS and the mitigation of overloads identified in Affected Systems for higher-queued Interconnection Requests GI-2009-8, GI-2010-8, GI-2014-2, GI-2014-6, GI-2014-8, GI-2014-9, GI-2014-12, GI-2104-13, GI-2014-14 and GI-2016-4. For details, refer to their respective System Impact Study reports.**

Cost Estimate Assumptions

- Appropriations level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery have a specified accuracy of +/- 20%.
- Estimates are based on 2019 dollars (appropriate contingency and escalation applied).
- 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 previously 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.

- 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 and Network Upgrades is approximately 18 months after authorization to proceed has been obtained.
- A CPCN will not be required for the construction of Transmission Provider Interconnection Facilities and Network Upgrades.
- The Solar Generation Facility is not in PSCo's retail service territory. Therefore, no costs for retail load metering are included in these estimates.
- Line and substation bus outages will be necessary during the construction period. Outage availability could potentially be problematic and extend the construction time beyond the estimate 18 months.
- 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 Energy will need indications, readings and data from the LF/AGC RTU.
- Power Quality Metering (PQM) will be required on the Customer's 230kV line terminating into the POI.
- Customer will string optical ground wire (OPGW) cable into the substation as part of their transmission line construction scope.

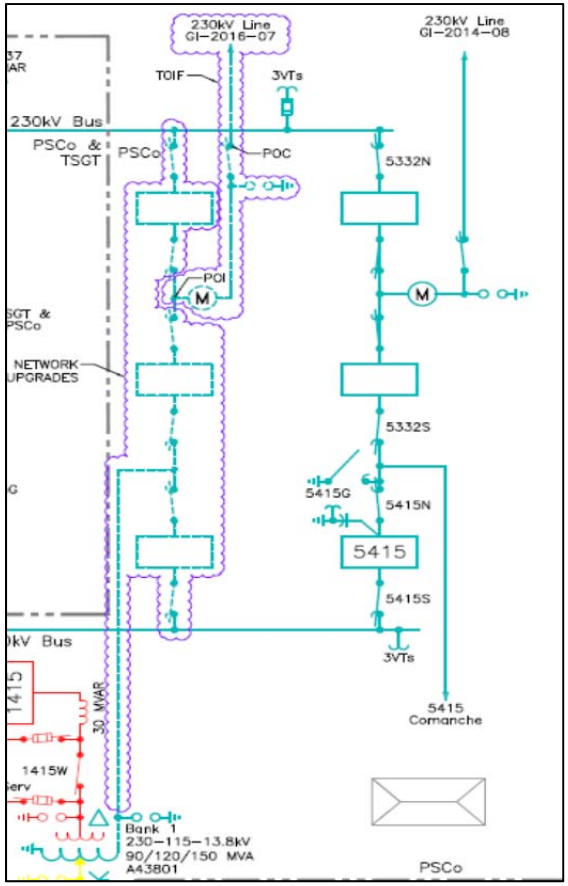

Figure 1 – Preliminary one-line of GI-2016-7 POI within the Boone 230kV Substation