Generation Interconnection Facilities Study
Report Request # GI-2008-26

100 MW Solar Thermal Plant
Saguache County, Colorado

Public Service Company of Colorado
Transmission Planning

January 4, 2013

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 siting, engineering, equipment procurement and construction needed to interconnect a 100 MW solar thermal generation plant near Saguache County, Colorado. The original capacity of the requested generation interconnection was 250 MW, the Customer has since notified PSCo to reduce the plant capacity to 100 MW.

The Customer's 100 MW solar thermal generator is proposed to interconnect to the PSCo system on the Poncha – San Luis Valley 230 kV transmission line between Western Area Power Administration (WAPA)'s Poncha Substation and Tri-State Generation & Transmission Inc (Tri-State)'s San Luis Valley Substation. The proposed generation will tap the 230 KV line at approximately 10 miles north of the San Luis Valley Substation. The 100 MW steam turbine generator will utilize the collected solar energy and pass it through a heat-exchanger to produce steam for the prime mover. The Customer's facility will be located approximately 0.9 mi from the Poncha – San Luis Valley 230 kV line and would be connected to the tap point on the 230 kV line via a Customer owned radial 230 kV line. The proposed commercial in-service date is April 1st, 2016 with a back feed date of April 1st, 2015

The total estimated cost for the facilities required for interconnection is $6.585 million[1] and includes a new 230 kV substation sectionalizing the Poncha – San Luis Valley 230 kV line, three 230 kV gas circuit breakers, ten 230 kV gang switches, bus work, metering, communications, transmission line bus tie connection and associated equipment, and 230 kV in-and-out tap from the new substation to the Poncha – San Luis Valley 230 kV line. The Poncha – San Luis Valley 230 kV line is jointly owned by PSCo and Tri-State.

- $1.130 million for PSCo owned Customer-Funded Network Facilities
- $5.455 million for PSCo owned, PSCo Funded Network Facilities

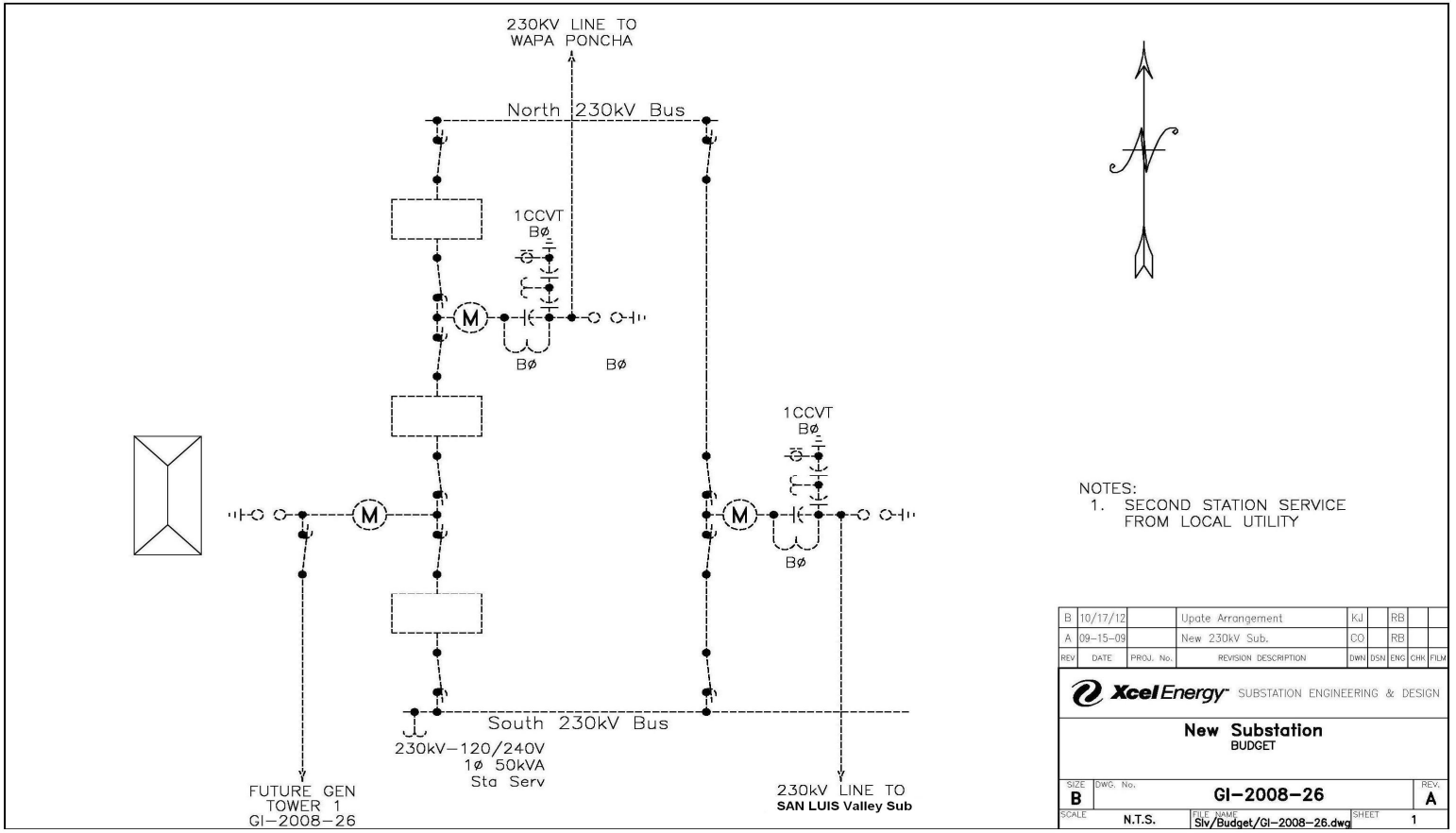
The estimated time required to site, engineer, procure and construct the facilities described is at least 12 months from the date the Customer meets all applicable Milestones as agreed to in any future LGIA.

A proposed Station One-Line diagram of the new 230 kV substation is shown in Figure 1.

There are no PSCo Network Upgrades for Delivery required for this Interconnection.

[1] Scoping estimates considered to have an accuracy of +/- 30%.

Figure 1: Budget One-Line Diagram of the new 230 kV substation sectionalizing the Poncha – San Luis Valley 230 kV Line



II. Introduction

On February 11, 2009 PSCo Transmission received a generation interconnection request for a 250 MW solar thermal generation plant interconnecting to the Poncha – San Luis Valley 230 kV line. In June 2009, the customer has reduced the proposed generation capacity to 100 MW. The Feasibility Study report for this interconnection request was issued on April 1, 2010. The preliminary System Impact Study report was issued on November 8, 2011, and the revised System Impact Study report was issued in June 2012. The original requested in-service date for the proposed interconnection is June 1, 2013 with a back feed date of December 31, 2012. During the facilities study stage, the Customer has revised the in-service date to April 1, 2016 and the back feed date to April 1, 2015. The 100 MW steam turbine generator will utilize the collected solar energy and pass it through a heat-exchanger to produce steam for the prime mover. This report documents the results of PSCo's Facility Study efforts.

III. General Interconnection Facilities Description

A. Project Purpose & Scope

This is a new substation being installed to connect a proposed solar generator to the 230 kV line between the WAPA Poncha 230 kV substation and the Tri-State San Luis Valley 230 kV substation. The substation will initially be built as a three (3) breaker ring bus with provisions to expand to a four (4) breaker ring bus to accommodate the interconnection of two (2) solar generators. The estimate cost of this substation does not include any transmission line work or work in the WAPA and Tri-State owned substations. Tri-Sate and WAPA are affected parties to this project.

Background

A solar generator has requested an interconnect to sell the power they will generate to Xcel Energy – PSCo.

Future Considerations

The substation will be initially built in a three (3) ring bus to accommodate the first solar generation facility. The ring bus will be configured in a breaker and a half configuration. The ultimate configuration of the substation will be a four (4) breaker ring bus built in a breaker and a half configuration.

Interconnection / Customer Cost Responsibility

A portion of the project cost will be reimbursable by the customer. Xcel Energy will have the cost associated with the sectionalizing of the 230 kV line and metering associated with this line. The costs associate with the communications equipment for this substation will also be paid by Xcel Energy. The solar

generator will pay the costs of the metering, relaying and communications equipment to safely connect their generator to the transmission system. The solar generator will also pay the cost of the LF-AGC equipment to interface the generator with the Xcel Energy control center. The Poncha – San Luis Valley 230 kV line is jointly owned by PSCo and Tri-State.

B. FERC and/or NERC Compliance Requirements

Critical Infrastructure Protection (CIP) Asset

The CIP status of this substation has not been determined at this time. Once this becomes a viable project, the status will be determined.

Facility Ratings

The new substation will be designed to meet all of the facility rating requirements.

Other Applicable Compliance Issues

Since this new substation will sectionalize a transmission line which is between two (2) substations owned and operated by WAPA and Tri-State, coordination with WAPA and Tri-State will be required for the line protection and interchange metering.

C. Right of Way/Permitting

The solar generator will provide adequate property for the building and access to the substation.

D. Electrical Features

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

WAPA and Tri-State will need to be contacted about the ratings of the equipment in their respective substations and any affect this new generation will have. The new substation will be designed using Xcel Energy standard 3000 A breakers and 5 inch aluminum tube and flexible conductor jumpers which will exceed the requirements of the line and the new generation.

Fault Current

The new equipment will be purchased with a minimum rating of 40 kA which will exceed the fault current at the site. The substation will be designed to be able to withstand fault current in excess of the fault current.

Type of Fault / Location	Three Phase (A)	Single-Line-to-Ground (A)
New Substation	2600	2400

Electrical Removals & Relocations

There will be no removals or relocations for the substation.

Electrical Installations (Major Equipment)

The major electrical equipment to be install will be three (3) 230 kV, 3000 A, 40 kA circuit breakers, 10 – 230 kV,2000 A disconnect switches, nine (9) 230 kV combination metering units. The Bus will be 5 inch aluminum tube which is rated above 2000 A and jumpers to equipment will be rated in excess of 2000 A.

The new substation will require the cutting of the existing line and short slack spans into the substation deadends.

Electrical Equipment Enclosure (EEE)

A new medium EEE will be installed at the substation.

AC System

Station service will be provided by a single SSVT connected to one of the line positions. Back up station service will be provided by the local distribution utility. The construction contract will be required to provide construction power.

The station service equipment will be sized to meet the current and proposed future load.

DC System

The DC station service will be provided for the new substation and will be sized to handle the current and future loading..

Grounding

The station grounding system will be designed in accordance with Xcel Energy practices and will meet the requirement of IEEE 80.

Lightning Protection

Lightning protection will be provided by overhead shield wires and static masts as needed to protect the substation. The rolling sphere method of calculating lightning protection will be used along with Xcel Energy standard practice.

Trenching & Cable

This is a new substation and all conduit and duct runs will be design to handle current and future equipment.

E. Civil Features

Grading & Fencing

The substation is being built in the San Luis Valley which is relatively flat. The estimate for the this substation include grading and site preparation work. The fence will be the standard Xcel Energy chain link fence.

Storm Water Permit

A storm water permit will be required.

SPCC (Oil Containment)

No equipment with quantities of oil that would require a SPCC..

Civil Removals & Relocations

This is a new substation so there are no Civil removals or relocations.

Foundations & Structures

Foundations will be required for the circuit breakers, switches, instrument transformers, bus supports and dead ends.

The substation has not been design so the exact quantity and size of foundations and quantity of structures are only an estimate at this time

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

None.

F. Protection Features

Transmission Line Protection (230 kV)

This protection recommendation provides for the installation of a new 230kV, 3-Breaker ring-bus substation being installed between Poncha (WAPA) and San Luis Valley (Tri-State), (sectionalizing existing line 3006) and associated relay upgrades at Poncha Junction and San Luis Valley.

The existing protection for line 3006 is assumed to be electromechanical distance and overcurrent relays. The protection will be upgraded during the installation of the new substation to new SEL microprocessor based relaying.

New line protection for the 230kV transmission line between Poncha Substation and the new substation will consist of primary protection provided by a directional comparison blocking (DCB) scheme utilizing SEL-421 relays (PKG-P) and RFL-9785 transceiver sets. The SEL-421 relays will also contain backup step

distance, and ground overcurrent protection. Backup protection will be provided by SEL-311C relays (PKG-S) which will provide step distance and ground overcurrent protection. Breaker failure and synchronous closing will be provided by SEL-351 relays which will also provide direct transfer tripping of remote end breakers through RFL-9780 transceivers.

New line protection for the 230kV transmission line between San Luis Valley Substation and the new substation will consist of primary protection provided by a directional comparison blocking (DCB) scheme utilizing SEL-421 relays (PKG-P) and RFL-9785 transceiver sets. The SEL-421 relays will also contain backup step distance, and ground overcurrent protection. Backup protection will be provided by SEL-311C relays (PKG-S) which will provide step distance and ground overcurrent protection. Breaker failure and synchronous closing will be provided by SEL-351 relays which will also provide direct transfer tripping of remote end breakers through RFL-9780 transceivers.

New line protection for the 230kV transmission line between the new substation and the solar facility will consist of primary protection provided by an SEL-311L relay with line differential using direct fiber communication, step distance, and overcurrent protection. Backup protection will be provided by an SEL-421 relay which will provide directional comparison blocking using direct fiber, step distance and ground overcurrent protection. Breaker failure and synchronous closing will be provided by an SEL-351 relay which will also provide direct transfer tripping of remote end breakers during a breaker failure operation. Communication with the solar facility's relays will be provided by direct fiber using OPGW.
As part of the substation installation a new Digital Fault Recorder (DFR) will be installed to provide fault and disturbance monitoring.

G. Control Features

General

- New Substation with Xcel Energy standard breaker controls.

RTU

- New RTU
- New LCU

Transmission Breaker Reclosing Controls

- Transmission line breaker reclosing will be included in the design of the substation and will be Xcel Energy standard.

Telephone protection

- New phone service required.

Relay Remote Access

- Remove relay access will be designed as part of the substation design.

Fiber Optic Cable

- There will be a fiber optic cable between the substation and the generator. This will be install as part of the transmission line overhead shield wire.

Control Panel Locations

- New control panels will be installed in the new EEE.

H. Project Operating Concerns and Outages

Outages/Temporary Configurations

An outage on the 230 kV line will be required to intercept the line and route it to the new substation.

Mobile Substation or Transformer

Not required.

I. Material Staging Plan

Material will be delivered to the site once construction forces have begun their work

J. Related Projects

None at this time.

IV. Costs Estimates and Assumptions

Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by PSCo Engineering. The cost estimates are in 2012 dollars with escalation and contingency included (AFUDC is not included) and are based upon typical construction costs for previously performed similar construction. These estimated costs include all applicable labor and overheads associated with the siting support, engineering, design, and construction of these new PSCo facilities. This estimate does not include the cost for any other Customer owned equipment and associated design and engineering.

The estimated total cost for the required upgrades for is **$6,585,000.** Figure 1 represents a conceptual one-line of the proposed interconnection at the New PSCo 230kV Transmission Substation sectionalizing the San Luis Valley-Poncha Jct. 230kV OH Transmission Line. These estimates do not include costs for any other Customer owned equipment and associated design and engineering. The following tables list the improvements required to accommodate the interconnection and the delivery of the Project generation 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 – PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Est. (Millions)
PSCo's New 230kV Transmission Substation	Interconnect Customer to tap at PSCo's New 230kV Substation (sectionalizing the SLV-Poncha Jct. 230kV OH Line). The new equipment includes: • One 230kV gang switch • Three 230kV combination CT/PT metering units • Three 230kV lightning arresters • One relay panel • Associated bus, wiring and equipment • Associated foundations and structures • Associated transmission line communications, relaying and testing	**$0.495**
	Transmission line in and out tap into substation. Structure, conductor, hardware and installation labor.	**$0.300**
Customer's 230kV Substation	Load Frequency/Automated Generation Control (LF/AGC) RTU and associated equipment.	**$0.185**
	Transmission line interconnection/tie (estimated at 2,000') between PSCo's New Sub and Customer's Solar Facility Sub	**$0.150**
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	**$1.130**
	Site, design, procure and construct	**12 Months**

Table 2 PSCo Owned; PSCo Funded Interconnection Network Facilities

	Description	Cost Estimate (Millions)
PSCo's New 230kV Transmission Substation	Interconnect Customer to tap at PSCo's New 230kV Transmission Substation (sectionalizing the Poncha-San Luis Valley 230kV OH Line). The new equipment includes: • Three 230kV gas circuit breakers • Ten 230kV gang switches • Eight 230kV CCVT's • One 230kV SSVT (station service) • Six 230kV lightning arresters • One Electric Equipment Enclosure (control bldg.) • Associated communications, supervisory and SCADA equipment • Associated line relaying and testing • Associated bus, miscellaneous electrical equipment, cabling and wiring • Associated foundations and structures • Associated road and site development, fencing and grounding	**$5.275**
	Siting and Land Rights support for substation land acquisition and construction.	**$0.180**
	Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities	**$5.455**
	Site, design, procure and construct	**12 Months**

Table 3 – PSCo Network Upgrades for Delivery

Element	Description	Cost Est. (Millions)
	N/A	

Cost Estimate Assumptions

- Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by PSCo Engineering.
- Estimates are based on 2012 dollars (appropriate contingency and escalation applied).
- AFUDC has been excluded.
- Labor is estimated for straight time only – no overtime included.
- Lead times for materials were considered for the schedule.
- The Solar Generation Facility is not in PSCo's retail service territory. Therefore, no costs for retail load metering are included in these estimates.
- PSCo (or it's Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.
- The estimated time to design, procure and construct the interconnection facilities is approximately 12 months after authorization to proceed has been obtained.
- A CPCN will not be required for the interconnection facilities construction.
- Customer will string OPGW fiber into substation as part of the transmission line construction scope.
- All land will be acquired and required permitting completed by the Customer. PSCo will require a 10-acre substation yard. A subdivision process will be required to acquire PSCo's substation land.
- Breaker duty study determined that no breaker replacements are needed in neighboring substations.
- Station service provided primarily from a station service VT and secondly by the local utility provider.

V. Notes From Facilities Study Meeting on 1/4/2013

PSCo, TSGT and WAPA will work together to figure out the cost for relay upgrades at Poncha Substation and funding. As the project goes forward, the estimated "PSCo owned PSCo funded" costs in Table 2 will be discussed under the "Utilities Service Agreement" between PSCo and TSGT.

GI-2008-26 (Facilities Study Report)
100 MW Solar Interconnection Project