



**GENERATION INTERCONNECTION
REQUEST # GI-2014-14**

**FACILITY STUDY REPORT
50 MW PV SOLAR, ALAMOSA COUNTY, COLORADO**

XCEL ENERGY – PSCO TRANSMISSION PLANNING WEST
August 22, 2016

A. Executive Summary

This Interconnection Facility Study Report summarizes the analysis performed by Public Service Company of Colorado (PSCO), designated as GI-2014-14, to specify and estimate the cost of the siting, engineering, equipment procurement and construction needed to physically and electrically connect the GI-2014-14, 50 MW photovoltaic (PV) generation facility (GF) in Alamosa County, Colorado.

The requested Point of Interconnection (POI) is at the San Luis Valley 115 kV bus. The Customer's GF will connect 50 MW of solar photovoltaic generation tapping the Customer's existing 115 kV line at San Luis Valley 115 kV Substation. The GF will consist of thirty (30) 1.67 MVA Eaton Power Xpert Solar inverters and will connect to a common 34.5 kV collector bus. Each inverter will have a dedicated step-up transformer with an arrangement referred to as a Power Conversion Station (PCS). A single transformer will step the voltage from 34.5 kV to 115 kV for delivery. The collection station will be adjacent to the POI.

Figure 1 is a diagram of the SLV area. Figure 2, in Appendix A, shows the budget one-line of the SLV substation. The requested commercial operation in-service date is April 15, 2019 with an assumed back feed date of six months prior to Commercial Operation Date (COD¹).

This request was studied both as an Energy Resource Interconnection Service (ERIS)² and a Network Resource Interconnection Service (NRIS)³. The System Impact Study consisted of power flow (steady-state) contingency, dynamics, and short circuit analyses. The power flow

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

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.

analysis results identified a single contingency violation that can be attributed to the GI-2014-14 facility. While this is an ERIS and NRIS study report, the purpose of this study is neither to guarantee transmission service nor to serve as documentation for the GF to be a designated network resource for PSCo. Per PSCo's Operations' document posted on the Open Access Same-Time Information System (OASIS), there is currently zero available transfer capability between Poncha/SLV and the Denver Metro area. PSCo has yet to determine the network upgrades for delivery to mitigate the criteria violations in San Luis Valley to allow the export of power from any new generation interconnection to the Denver Metro area. There is an ongoing joint transmission study effort between PSCo and Tri-State Generation and Transmission (TSGT) for the SLV area through the Colorado Coordinated Planning Group (CCPG). Phase 1 was completed in early 2016 and Phase 2 is underway with the expected completion date of the 4th quarter of 2016. The Phase 1 study report can be found on the WestConnect website under "San Luis Valley Subcommittee".

This Interconnection Facility Study Report summarizes the analysis performed by PSCo to specify and estimate the cost of the siting, engineering, equipment procurement and construction needed to interconnect a 50 MW solar photovoltaic generation facility at the San Luis Valley 115 kV Substation in Alamosa County, Colorado.

There is a proposed component for this scope of work:

Customer Funded Interconnection

- \$0.040 million for the customer funded portion of the 115 kV 50 MW Customer Solar Facility

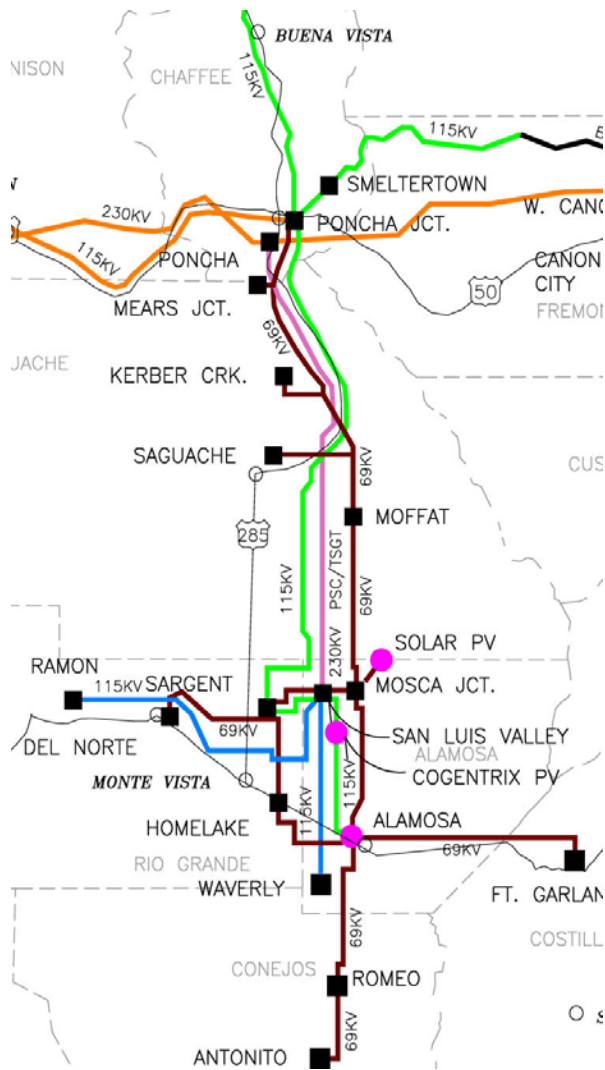
The estimated time required to site, engineer, procure and construct the facilities described is at least 9 months from the date the customer meets all applicable milestones as agreed to in any future Large Generator Interconnection Agreement (LGIA). An Engineering & Procurement Agreement can be executed to facilitate completion of the interconnection facilities.

The total estimated cost of the recommended system upgrades to interconnect the project is approximately **\$ 0.040 million** and includes:

- \$0.040 million for PSCo Owned, Customer Funded Interconnection Facilities.

- \$0.000 million for PSCo Owned, PSCo Funded Interconnection Facilities.
- \$0.000 million for PSCo Network Upgrades for Delivery (pending future studies).

Figure 1. San Luis Valley region



B. Introduction

PSCo and a Generation Provider (the “Customer”) signed an Interconnection Facility Study request (GI-2014-14) to provide cost estimates, a project schedule, and to address the impacts, as identified in the System Impact Study, of interconnecting a 50 MW PV generation facility tapping the Customer’s existing 115 kV line at PSCo’s San Luis Valley substation. The GF will consist of thirty (30) 1.67 MVA Eaton Power Xpert Solar inverters and will connect to a common 34.5 kV collector bus. Each inverter will have a dedicated step-up transformer with an arrangement referred to as a Power Conversion Station (PCS). A single transformer will step the voltage from 34.5 kV to 115 kV for delivery. The collection station will be adjacent to the POI. The requested commercial operation in-service date is April 15, 2019 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 Network Resource Interconnection Service cannot be met until after the overload has been mitigated in the San Luis Valley and additional transmission line(s) constructed to export additional generation out of the San Luis Valley to the Denver Metro area.

There is an ongoing joint transmission study effort between PSCo and Tri-State Generation and Transmission (TSGT) for the SLV area through the Colorado Coordinated Planning Group (CCPG). Phase 1 of the SLV Coordinated Planning Study has been completed and the study report can be found on the WestConnect website. Phase 2 has just been kicked off and the study is underway to analyze different transmission alternatives beyond Poncha Substation.

The purpose of Interconnection Facility Study is to specify and estimate the cost of the equipment, engineering, procurement and construction work needed to implement the conclusions of the Interconnection System Impact Study in accordance with Good Utility Practice to physically and electrically connect the GI-2014-14 large generating facility to PSCo’s transmission system at the SLV 115 kV substation.

C. General Interconnection Facilities Description

PSCo's requirements for interconnection can be found in the Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW – Version 8.0, last revised in August 2015. Xcel Energy requires the interconnection customer to construct the Interconnection Facilities in compliance with this document. The guidelines describe the technical and protection requirements for connecting new generation to the Xcel Energy Operating Company transmission system and also requires that the Interconnection Customer be in compliance with all applicable criteria, guidelines, standards, requirements, regulations, and procedures issued by the North American Electric Reliability Council (NERC), Colorado Public Utility Commission (CPUC) or their successor organizations.

I. Project Purpose and Scope

Summary

The purpose of this project is to increase the Customer's existing 115 kV line to 90 MVA in response to additional capacity being added by the Customer. This project is being funded by the Customer under GI-2014-14. To get line 9191 to 90MVA two CT ratios will need to increase. There will be no new equipment therefore this project would be viewed as an O&M work order.

Interconnection / Customer Cost Responsibility

The project cost will be 100% reimbursable by the customer.

II. FERC and/or NERC Compliance Requirements

Critical Infrastructure Protection (CIP) Asset

The CIP status of this site (San Luis Valley Substation) was verified by Real Time Transmission Planning on June 03, 2016. The scope of this project will not change or affect the CIP Status of this site.

Facility Ratings

This substation has BES facilities.

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

III. Right of Way/Permitting

Not Applicable

IV. Electrical Features

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

There will be no new equipment required. One CT ratio will need to be increased and one metering unit tap ratio.

Fault Current

This project will increase the fault current slightly but not significantly enough to affect the overall site design.

| Type of Fault Location | Three Phase (Amps) | Single-Line-to- Ground (Amps) |
|---------------------------|-----------------------|----------------------------------|
| SLVA_230 kV | 2567 | 3048 |
| SLVA_115 kV | 4649 | 4913 |

Electrical Installations (Major Equipment)

Not applicable

Mobile Substation or Transformer

Not applicable

Electrical Equipment Enclosure (EEE)

Not applicable

DC System

Not applicable

Grounding

Not applicable

Lightning Protection

Not applicable

Trenching & Cable

Not applicable

V. Civil Features

Not applicable

VI. Protection Features

Not applicable

VII. Control Features

Not applicable

VIII. Communication Features

Summary

Minor changes to transducers. Changing the CT ratio from 400:5 to 500:5. The specialist will need to adjust the transducers and confirm SCADA is reading these values correctly.

RTU

The Xcel RTU is extremely old but should be replaced prior to this project starting. If it has not been replaced some additional work will be required by the specialist. We're not adding or removing points only adjusting the CT ratio.

IX. Project Operating Concerns and Outages

Outages/Temporary Configurations

Outage will only be needed on line 9191. The outage will last between 2 days and 1 week, exact outage window will need to be discussed with the crews performing the work.

X. Material Staging Plan

Not applicable

XI. Related Projects

There is one system upgrade that is required to support this project. Line 9811 to Sargent needs to be upgraded to 120 MVA. That project only requires a few CTs to be re-tapped and will be a minor O&M project as well.

XII. Related Projects

The standard contingency factors for estimates are as follows:

- Appropriation Est. Contingency Factors: Material: 10%; Labor and Equipment: 10%
- The estimate for this project utilizes the standard contingency levels.

D. Costs Estimates and Assumptions

The cost responsibilities associated with the facilities described in the following estimates shall be handled per current FERC guidelines. The estimated engineering, procurement & construction schedule can be found below.

Appropriation level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 20% accuracy) were developed by Public Service Company of Colorado (PSCo) / Xcel Energy (Xcel) Engineering. The cost estimates are in 2016 dollars with escalation and contingency factors included. AFUDC is not included. 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. 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 \$40,000. 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 San Luis Valley 115 kV Transmission Substation | Interconnect Customer to the 115 kV bus at the San Luis Valley Substation. The new equipment required for the Customer's line capacity upgrades to 90 MVA includes: <ul style="list-style-type: none"> • AR15 Two-Way Communication Equipment • Station Controls • Associated transmission line relaying, testing and commissioning | \$0.040 |
| | Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities | \$0.040 |
| Time Frame | Site, design, procure and construct | 9 months |

Table 2: PSCo Owned; PSCo Funded Interconnection Network Facilities

| Element | Description | Cost Estimate (Millions) |
|-------------------|---|--------------------------|
| | Not yet identified | TBD |
| | Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities | TBD |
| Time Frame | Site, design, procure and construct | |

Table 3: PSCo Owned; PSCo Funded Network Upgrades for Delivery

| Element | Description | Cost Est. (Millions) |
|-------------------|--|----------------------|
| | Not yet identified | TBD |
| | Total Cost Estimate for PSCo Network Upgrades for Delivery Facilities | TBD |
| Time Frame | Site, design, procure and construct | |

Cost Estimate Assumptions

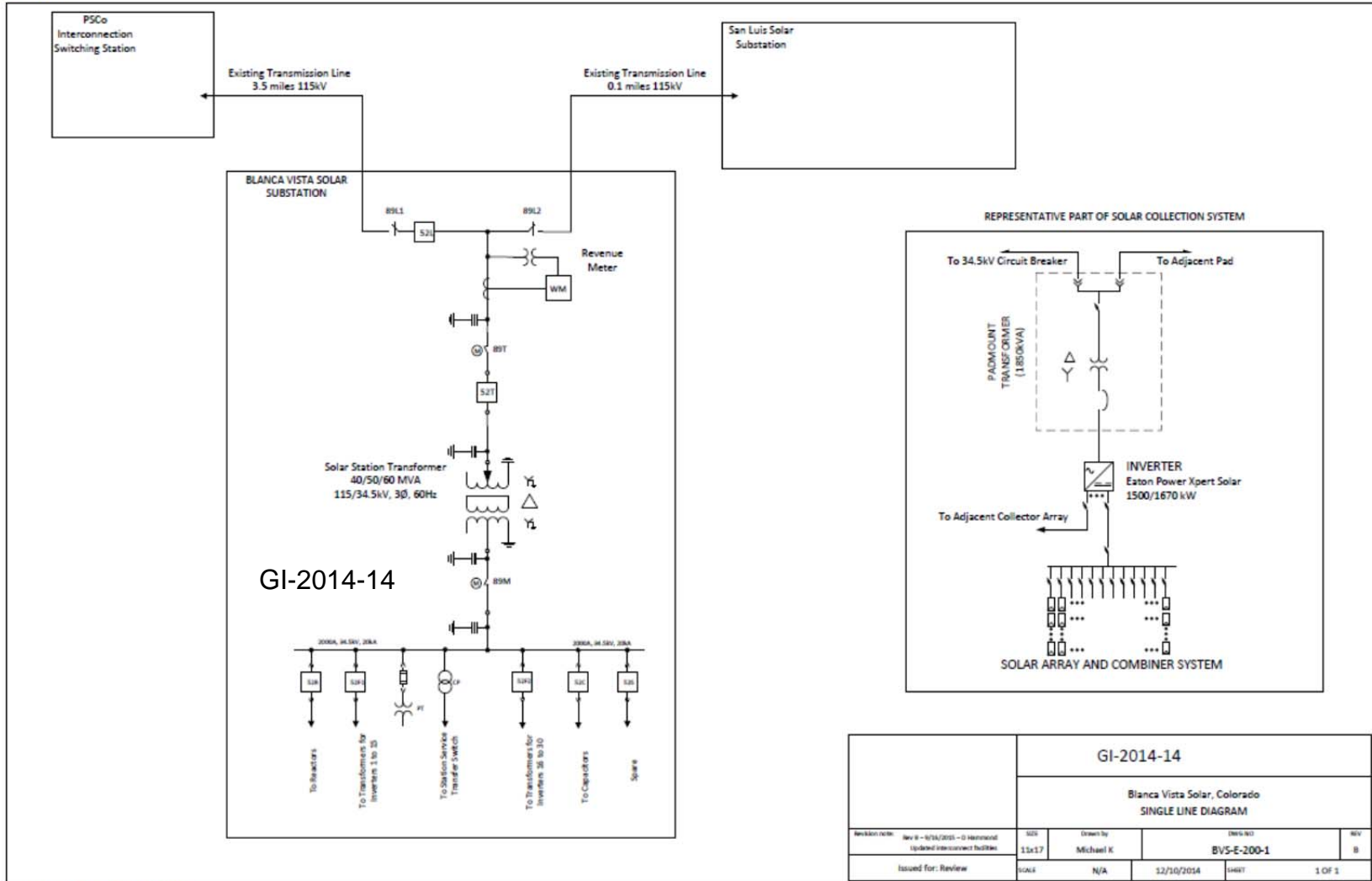
- Line 9191 rating needs to be increased to at least 90 MVA.

- Appropriation level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 20% accuracy) were developed by Xcel Energy/PSCo Engineering.
- Estimates are based on 2016 dollars (appropriate contingency and escalation applied).
- AFUDC has been excluded.
- Engineering and Design will be completed by Xcel.
- Lead times for materials were considered for the schedule.
- The Solar Generation Facility is not in PSCo's retail service territory.
- PSCo (or it's Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.
- Construction labor is estimated for straight time only – no overtime included.
- The estimated time to design, procure and construct the interconnection facilities is approximately 9 months after authorization to proceed has been obtained.
- This project is completely independent of other queued projects and their respective ISD's.
- A CPCN will not be required for the interconnection facilities construction.
- Line and substation bus outages will be authorized during the construction period to meet requested backfeed dates.
- The Customer will be required to (modify) design, procure, install, own, operate and maintain a Load Frequency/Automated Generation Control (LF/AGC) RTU at their Customer Substation. PSCo / Xcel will need indications, readings and data from the LFAGC RTU.
- Customer will have available OPGW fiber into substation as part of the transmission line construction scope.
- No new substation land will need to be acquired.
- Breaker duty study determined that no breaker replacements are needed in neighboring substations.
- The Customer is not interconnecting into a new bay/line termination position into the substation – but adding generation through their existing line.

Appendix

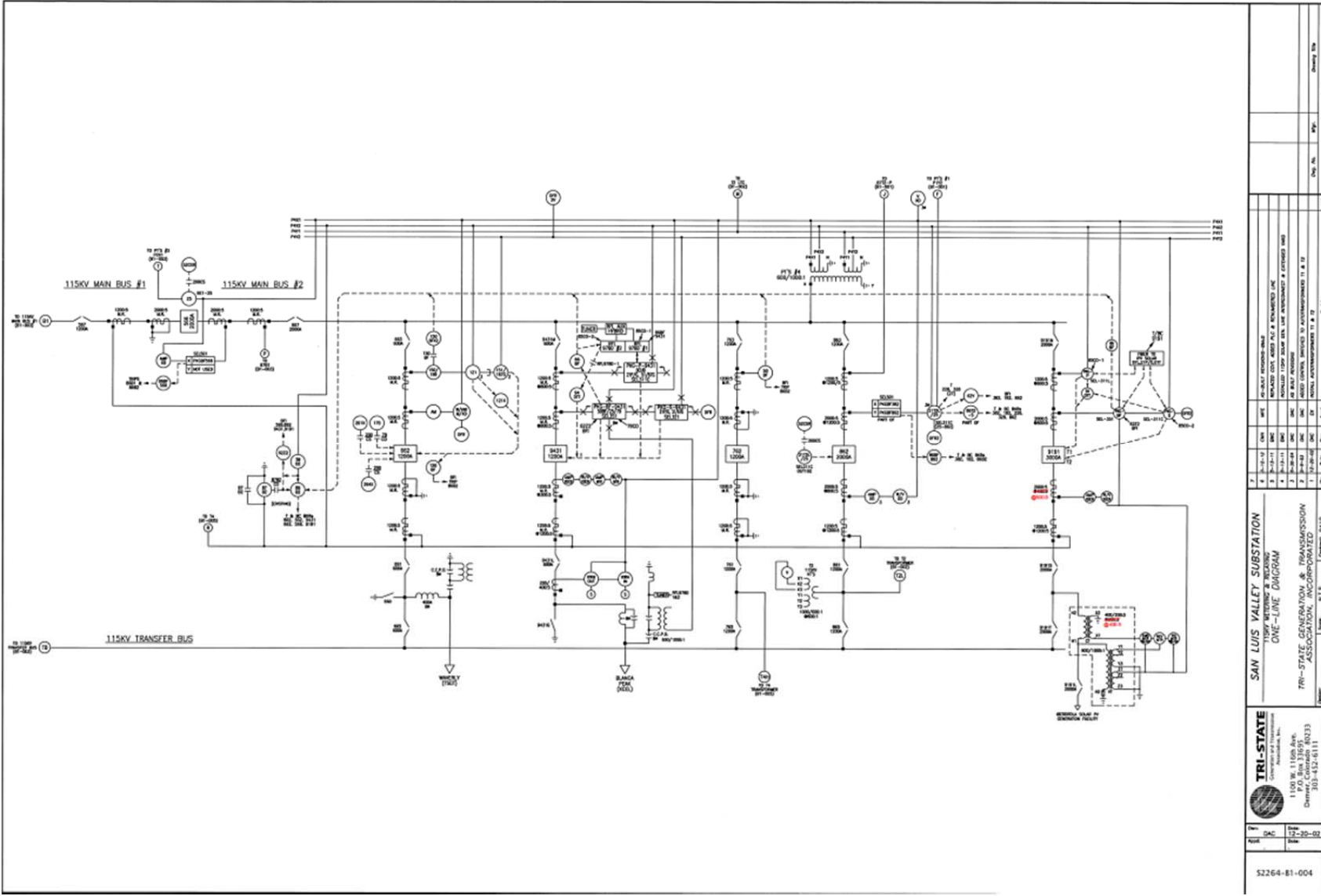
A. Figure 2. Project One-Line of the San Luis Valley Substation

BVS-E-200-1B

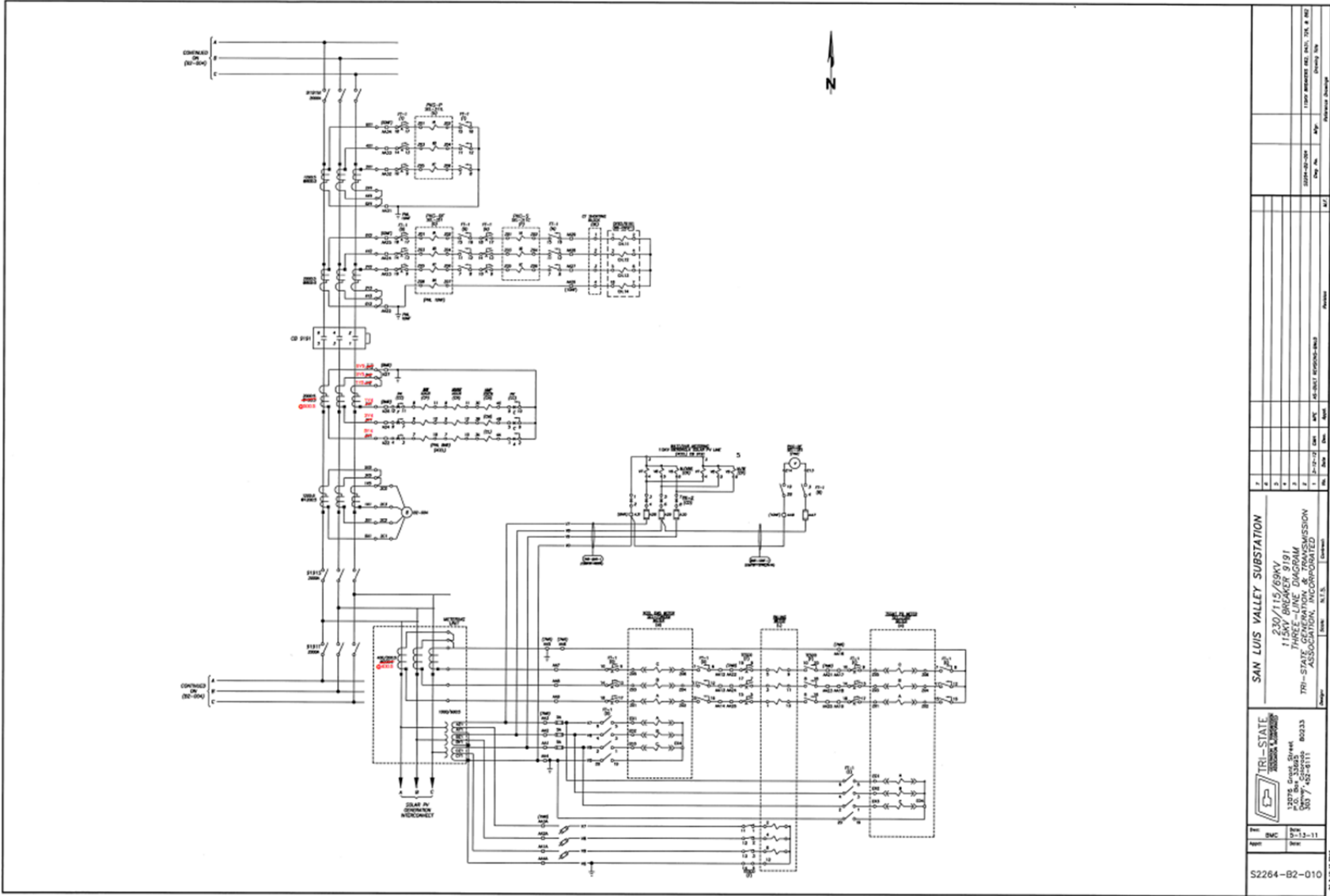


Wednesday, September 16, 2015

B. Figure 3. Metering and Relays



| | | | |
|---|--|--|--|
| | | SAN LUIS VALLEY SUBSTATION 115KV METERING & RELAYING ONE-LINE DIAGRAM | |
| 1100 W. 116th Ave. Denver, Colorado 80233 303-452-4111 | DATE: 01.15 DRAWN: KLS | NO. 004 SHEET 01 OF 02 | PROJECT: 004 |
| 115KV METERING & RELAYING 115KV MAIN BUS #1 & #2 115KV TRANSFER BUS 115KV LINE ATTACHMENT & EXTENSION 115KV DISCONNECT SWITCHES 115KV CIRCUIT BREAKERS 115KV POTENTIAL TRANSFORMERS 115KV CAPACITOR BANK | 115KV MAIN BUS #1 115KV MAIN BUS #2 115KV TRANSFER BUS 115KV LINE ATTACHMENT & EXTENSION 115KV DISCONNECT SWITCHES 115KV CIRCUIT BREAKERS 115KV POTENTIAL TRANSFORMERS 115KV CAPACITOR BANK | 115KV MAIN BUS #1 115KV MAIN BUS #2 115KV TRANSFER BUS 115KV LINE ATTACHMENT & EXTENSION 115KV DISCONNECT SWITCHES 115KV CIRCUIT BREAKERS 115KV POTENTIAL TRANSFORMERS 115KV CAPACITOR BANK | 115KV MAIN BUS #1 115KV MAIN BUS #2 115KV TRANSFER BUS 115KV LINE ATTACHMENT & EXTENSION 115KV DISCONNECT SWITCHES 115KV CIRCUIT BREAKERS 115KV POTENTIAL TRANSFORMERS 115KV CAPACITOR BANK |



| | | | |
|---|----------|---|-----|
|  | | SAN LUIS VALLEY SUBSTATION 230/115/69KV 115KV BREAKER 5191 69KV BREAKER 5191M THREE LINE DIAGRAM TRI-STATE GENERATION & TRANSMISSION ASSOCIATION, INCORPORATED | |
| REV | DATE | BY | CHK |
| 1 | 12-12-11 | AMC | AMC |
| S2264-B2-010 | | 115KV BREAKER 5191, 115KV & 69KV 115KV BREAKER 5191M 115KV BREAKER 5191M | |

C. Figure 4. Preliminary Project Schedule

