DRAFT

GENERATION INTERCONECTION
REQUEST # GI-2009-08
SYSTEM IMPACT RE-STUDY

SYSTEM IMPACT RE-STUDY
30 MW PV SOLAR, ALAMOSA COUNTY, COLORADO

XCEL ENERGY – PSCO TRANSMISSION PLANNING WEST

June 2015

Executive Summary

In 2009, Public Service Company of Colorado (PSCo) received an Interconnection Request (GI-2009-08) for a 40 MW PV solar generation facility in Alamosa County, Colorado connecting to the Alamosa Terminal 69 kV substation (see Figure 1 below) in the San Luis Valley (SLV) area of the Colorado interconnected transmission system. Following a Feasibility Study, the request was reduced to 30 MW. The System Impact Study for 30 MW was completed in October 2012. The Facilities Study was completed July 24, 2013. During the LGIA negotiations, since the requested and studied in-service date of March 31, 2013 was past, the Developer was notified that a System Impact Restudy would be required once the Developer determined they were ready to move forward with the project. The Developer requested a SIS Restudy on August 7, 2014 and a SIS Restudy Agreement was executed on October 2, 2014. The requested Commercial Operation Date (COD) is December 1, 2016 with a back-feed date (for site energization) of July 15, 2016.

The System Impact Restudy consisted of steady-state power flow analyses to examine the impact of the proposed PV solar generating facility on the thermal and voltage performance of the transmission grid. The System Impact Restudy was conducted using two book-end loading scenarios derived from the 2016 heavy summer base case – first scenario for peak (maximum) load in the SLV area and second scenario for light (minimum) load in the SLV area.

This request was studied as a Network Resource and an Energy Resource. The request was studied as a stand-alone project only with no evaluations made of other potential new generation requests that may exist in the Large Generator Interconnection Request (LGIR) queue, other than the generation projects that are already approved and are planned to be in service by the summer of 2016, consistent with the modeled system conditions. The main purpose of this System Impact Restudy was to evaluate the potential impact on the PSCo transmission infrastructure as well as that of neighboring utilities when injecting the additional 30 MW of generation at the Alamosa Terminal 69 kV substation, and delivering the additional generation to native PSCo loads.

The results of the Network Resource Interconnection Service (NRIS) NERC Category B (P1.1-P1.3) and selected Category C (P2, P4.1-P4.3, P4.5, P5.1-P5.3, P5.5, P7.1) contingency analyses show that the proposed project will need Network Upgrades for Delivery to achieve 30 MW

NRIS. There are two contingency overloads that present limitations to the proposed project. Under light load condition, for the loss of San Luis Valley – Blanca Peak 115 kV line, the 69 kV line between Mosca substation and San Luis Valley substation gets overloaded. Also, for the loss of the Poncha – San Luis Valley 230 kV line, the 115 kV line between San Luis Valley and Sargent gets overloaded. Currently, there is a study effort going on at the Colorado Coordinated Planning Group (CCPG) to look at the reliability and the export capability of the San Luis Valley area. It is possible that a recommended project from this San Luis Valley Subcommittee may strengthen the reliability and increase the export capability of SLV, and will likely mitigate the overloaded elements found in this study. Cost estimates to engineer and construct the Alamosa Terminal 69 kV interconnection facilities can be found below without the cost of the network upgrade for delivery.

The amount of Energy Resource Interconnection Service (ERIS) available at any particular point in time varies depending on actual system conditions. Some firm or non-firm transmission capability should be available depending upon actual generation dispatch levels, demand levels and the operational status of transmission facilities.

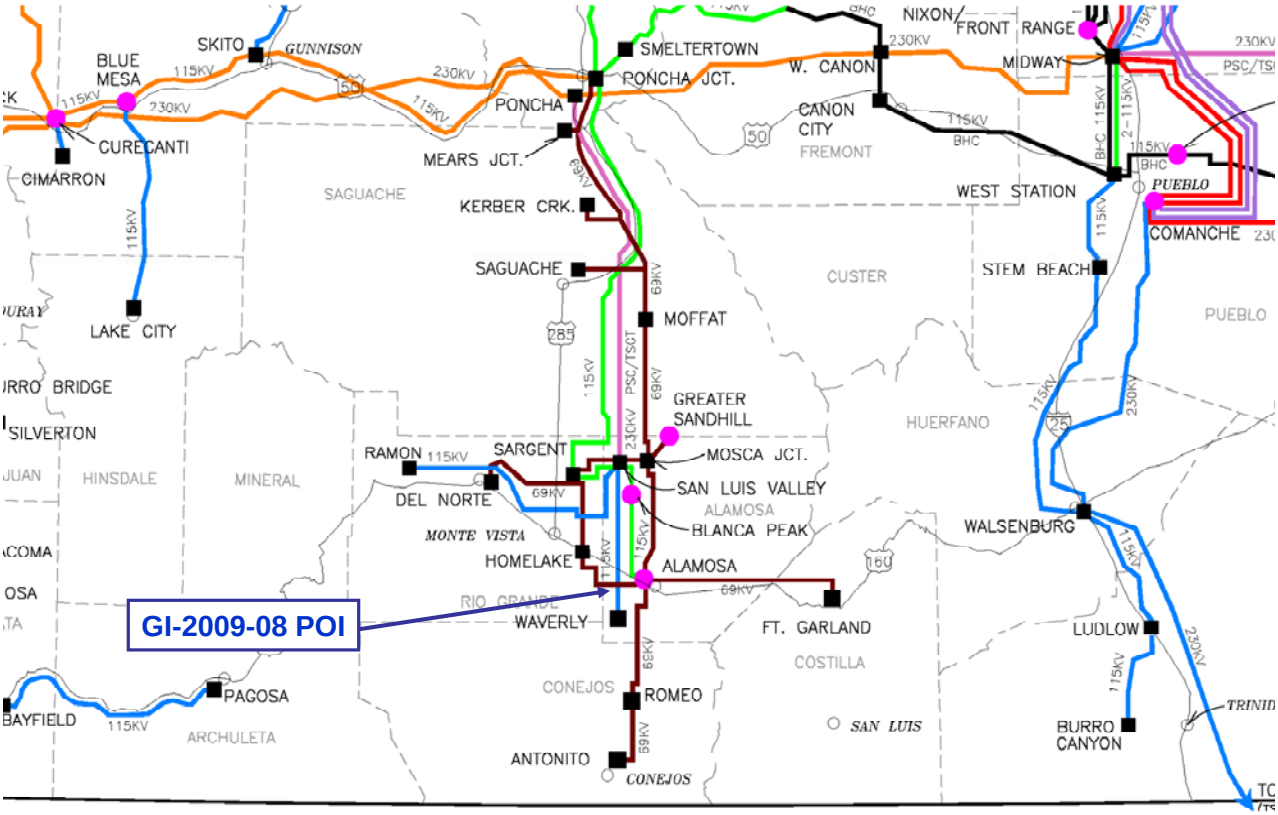
Cost Estimates

The total estimated cost to interconnect the project (in 2015 dollars) is approximately **$1,935,000** and it does not include the cost for Network Upgrades.

- $1,435,000 for PSCo-Owned, Customer-Funded interconnection facilities
- $500,000 for PSCo-Owned, PSCo-Funded interconnection facilities
- $0 for Network Upgrades for Delivery (To be determined)

See cost and schedule for an approximate in service date in Table 4, Table 5, and Table 6. There will be major network upgrades needed to the current transmission system to transfer full power output to PSCo native loads. The cost and the timeframe for completing that work has yet to be determined pending studies perform by San Luis Valley Subcommittee of Colorado Coordinated Planning Group.

Figure 1. Alamosa Terminal Substation and Surrounding Transmission System



A. Introduction

In 2009, Public Service Company of Colorado (PSCo) received an Interconnection Request (GI-2009-08) for a 40 MW PV solar generation facility in Alamosa County, Colorado connecting to the Alamosa Terminal 69 kV substation (see Figure 1 above). The Feasibility Study for this request was completed in July 2011. Following the Feasibility Study, the request was reduced to 30 MW. The System Impact Study for 30 MW was completed in October 2012. The Facilities Study was completed July 24, 2013. During the LGIA negotiations, since the requested and studied in-service date of March 31, 2013 was past, the Developer was notified that a System Impact Restudy would be required once the Developer determined they were ready to move forward with the project. The Developer requested a SIS Restudy on August 7, 2014 and a SIS Restudy Agreement was executed on October 2, 2014.

B. Study Scope and Analysis

The Feasibility Study consisted of steady-state power flow analyses to examine the impact of the proposed PV solar facility on the thermal and voltage performance of the transmission grid. 2016 peak summer and SLV area light load power flow base cases were used for the studies. The results of these studies were used to identify network upgrades required to deliver the proposed generation to PSCo loads.

PSCo adheres to North American Electric Reliability Corporation (NERC) and Western Electricity Coordinating Council (WECC) Reliability Criteria, as well as internal Company criteria for planning studies. During system intact conditions, criteria are to maintain transmission system bus voltages between 0.95 and 1.05 per unit (pu) of nominal and steady-state power flows below the continuous thermal ratings of all facilities. Following a NERC Category P1 (B+) contingency, transmission system steady state bus voltages should remain within 0.90 per unit to 1.05 per unit, power flows on transmission lines should remain within 100% of their continuous thermal ratings, and transformer flows should remain within their 8 hour emergency thermal ratings. This applies to all transmission and sub-transmission facilities. Following a NERC Category P2-P7 (C+) contingency, transmission system steady state bus voltages should remain within 0.90 per unit to 1.05 per unit, and power flows on transmission

lines and transformers within 100% of their 30 minute emergency thermal ratings. This applies to transmission facilities only (100 kV and above). The Alamosa Terminal 69 kV POI is in Region 5 in the Colorado Coordinated Planning Group's (CCPG) Rocky Mountain Area Voltage Coordination Guidelines. For this region, ideal voltage ranges at regulating and non-regulating buses are not provided.

This interconnection request was evaluated for both Network Resource Interconnection Service (NRIS) and Energy Resource Interconnection Service (ERIS).

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 Regional Transmission Organization (RTO) or Independent System Operator (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.

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.

For this project, the Affected Party in the SLV area is Tri-State Generation & Transmission (TSG&T).

C. Power Flow Study Models

The power flow studies were based on the WECC approved 2016HS and 2016LSp cases. PSCo loads in the case were adjusted to reflect the most recent PSCo load forecast available by the end of January 2014. IREA load was also adjusted to reflect IREA's last available load forecast at the commencement of the study (November 2013). The topology was also updated to reflect current project plans. Updates and adjustments were included for the PSCo, Tri-State G&T (TSG&T, rec'd 10/15/14), Basin Electric Power Cooperative (BEPC), Black Hills Energy

(BHE), Colorado Springs Utilities (CSU), Intermountain REA (IREA), Platte River Power Authority (PRPA), and Western Area Power Authority (WAPA) systems.

Six main power flow generation dispatch scenarios were evaluated. These scenarios modeled both 2016 peak summer load (with and without GI-2009-08) and San Luis Valley light load condition (with and without GI-2009-08). Light load condition has been used for studies in this area to check the contingency loading on the San Luis Valley – Sargent – Poncha Jct. 115 kV circuit for the loss of Poncha – San Luis Valley 230 kV line. The SLV light load scenario modeled the radial SLV transmission system at 45 MW. Historically, the 45 MW was the minimum load in the spring time for the SLV when the existing solar photovoltaic generation got above 85% of nameplate rating. The 2016 SLV peak load was 144.8 MW (combined PSCo & TSG&T SLV load in Zone 710).

The scenarios also modeled the two Alamosa Terminal combustion turbine generators as out of service in all scenarios for economic reasons.

Table 1 below provides an organized listing of these cases. For all cases, the existing PV solar (by 2016 summer) was dispatched at 85% of nameplate.

In the cases with the proposed generation, the 30 MW of new PV solar generation was added using models provided by the Developer. The PV plant model included a developer-owned 69 kV line, one 34.5/69 kV main step-up transformer, an equivalent 34.5 kV collector system branch, one equivalent 0.4/34.5 kV generator step-up transformer, and one equivalent PV solar generator. The generator in the model from the Developer included no reactive capability limits and a fixed capacitor bank. However, consistent with the data in the SIS Restudy Interconnection Request Form received, the equivalent generator model from the Customer was modified to include a +/- 0.95 power factor (pf) reactive capability and the fixed capacitor taken out of service. This is also consistent with Xcel Energy voltage regulating capability guidelines (see Section G below). The generation level in the model was also lowered to result in exactly 30 MW injected at the POI. The main step-up transformer and generator step-up transformer high-side taps were set to the 1.00 p.u. tap.

The generation dispatches for the various dispatch scenarios can be found in Appendix B.

Table 1 – Listing of GI-2009-08 Power Flow Study Cases

Case	SLV Area Load	Alamosa Terminal CT Gens*	Alamosa Terminal Transformer	GI-2009-08
A_bm	Peak Load	0 MW	Repl 46.7 MVA	0 MW
A_gn	Peak Load	0 MW	Repl 46.7 MVA	30 MW
B_bm	Light Load 45 MW	0 MW	Repl 46.7 MVA	0 MW
B_gn	Light Load 45 MW	0 MW	Repl 46.7 MVA	30 MW
C_bm	Light Load 45 MW	0 MW	Repl 46.7 MVA	0 MW
C_gn	Light Load 45 MW	0 MW	Repl 46.7 MVA	30 MW

D. Power Flow Study Process

Contingency power flow studies were completed on the reference models and the models with the proposed new generation using Siemens-PTI's PSSE Ver. 33.4.0 program. Results from each of the cases were compared and new overloads or overloads that increased significantly in the cases with the new generation were noted. Voltage criteria violations were also recorded. The PSSE Ver. 33.4.0 ACCC contingency analysis activity was used to perform the power flow contingency analysis. The PSCo Category B (P1.1-P1.3) & selected C (P2, P4.1-P4.3, P4.5, P5.1-P5.3, P5.5, P7.1), contingency analyses were performed using contingency definitions that reflect breaker to breaker outages. Single branch switching was also performed for branches in power flow case Zones 700, 704, 705, 709, 710, 712, 757, 790 and 791. Single unit outages were also modeled for generators in these same zones. These zones were also monitored for overloads and voltage problems.

E. Power Flow Thermal Results

Network Resource Interconnection Service

The results of the Network Resource NERC Category B (P1.1-P1.3) & selected C (P2, P4.1-P4.3, P4.5, P5.1-P5.3, P5.5, P7.1) contingency analyses are summarized in Tables 7-9 in Sections A through E of the Appendix.

Peak System Load

Cases A_bm & A_gn – Refer to Table 7. There are no Category B or C contingency overloads, either in the benchmark cases or in the cases with the proposed generation. For the benchmark

cases, however, contingency low voltages in the 80% range resulted from the loss of the Alamos Terminal – Blanca Peak 115 kV circuit. These voltages improved significantly with the addition of the new generation, resulting in voltages in the low to mid 90% range. These cases illustrate that for Peak Load system conditions, Cases "A", "B" & "C" are of primary concern in this area.

Light System Load

Cases B_bm & B_gn – Refer to Table 8. The overloaded elements due to GI-2009-08 will be examined in the Colorado Coordinated Planning Group's San Luis Valley Subcommittee Study and the recommended plan for the area will likely mitigate such overloads.

Sensitivity Study with Light Load Condition

Cases C_bm & C_gn – Refer to Table 9. This sensitivity study takes into account of Tri-State's 30 MW of generation in their queue for the San Luis Valley. Since Tri-State has half of the load in the San Luis Valley and joint ownership of many facilities in the area, PSCo opted to consider TSGT's queue in all generation interconnection studies for the valley as a sensitivity. The overloaded elements due to GI-2009-08 will be examined in the Colorado Coordinated Planning Group's San Luis Valley Subcommittee Study and the recommended plan for the area will likely mitigate such overloads.

Energy Resource Interconnection Service

In addition to the Network Resource contingency analysis, the Energy Resource status of the proposed generation was also considered. As defined in Section C above, Energy Resource Interconnection Service (ERIS) allows the Customer to deliver a 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. Therefore, the amount of Energy Resource Interconnection Service (ERIS) available at any particular point in time varies depending on actual system conditions. Some firm or non-firm transmission capability should be available depending upon actual generation dispatch levels, demand levels and the operational status of transmission facilities.

F. Voltage Regulation and Reactive Power Capability

Interconnection Customers are required to interconnect their Large Generating Facilities with Public Service of Colorado's (PSCo) Transmission System in conformance to the *Xcel Energy Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW* (available at http://www.xcelenergy.com/staticfiles/xe/Regulatory/Transmission-Interconnection-Guidelines-Great-20MW.pdf). The following voltage regulation and reactive power capability requirements (at the POI) are applicable to this interconnection request:

- During system intact conditions, criteria are to maintain transmission system bus voltages between 0.95 and 1.05 per unit (pu) of nominal. Following a single contingency, transmission system steady state bus voltages should remain within 0.90 per unit to 1.05 per unit. Following a NERC Category C contingency, transmission system steady state bus voltages should remain within 0.90 per unit to 1.05 per unit.
- To ensure reliable operation, all Generating Facilities interconnected to the PSCo transmission system should adhere to the CCPG Rocky Mountain Area Voltage Coordination Guidelines. These can be found by clicking on the • Reports link at http://www.westconnect.com/planning_ccpg_voltage_coord.php. The Alamosa Terminal 69 kV POI is in Region 5 in the Colorado Coordinated Planning Group's (CCPG) Rocky Mountain Area Voltage Coordination Guidelines. For this region, ideal voltage ranges at regulating and non-regulating buses are not provided. However, it is the responsibility of the Generator Owner to review the information that is in the Guidelines and specifically with regard to Region 5.
- Xcel Energy's OATT requires all Interconnection Customers to have the reactive capability to achieve +/– 0.95 power factor at the POI, with the maximum "full output" reactive capability available at all output levels. Furthermore, Xcel Energy requires all Interconnection Customers to have dynamic voltage control and maintain the voltage specified by the Transmission Operator within the limitation of +/– 0.95 power factor at the POI, as long as the generating plant is on-line and producing power.
- The *Xcel Energy Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW* also specify that Generators generally must

provide for their own reactive power needs, including the reactive power needs of their Generator Step-Up transformer (GSU).

- It is the responsibility of the Interconnection Customer to determine the actual type (switched shunt capacitors and/or switched shunt reactors, etc.), size (MVAR), and locations (400 V, 34.5 kV or 69 kV bus) of any additional static reactive power equipment needed within the generating plant in order to have the reactive capability to meet the +/– 0.95 power factor.
- The Interconnection Customer is required to demonstrate to the satisfaction of PSCo Transmission Operations prior to the commercial in-service date of the generating plant that it can safely and reliably operate within the required power factor and voltage ranges (noted above).

Based on the equivalent steady state solar facility model provided by the Developer, with the modifications to conform to PSCo voltage regulation capability guidelines, there were no line-charging problems found when the facility is energized but the PV solar inverters are not in service. With the solar facility in-service and generating at the 30 MW maximum output, the modeled +/- 0.95 reactive capability of the equivalent generator was sufficient to make up for the facility reactive losses and provided satisfactory reactive power support to the system.

G. Harmonics

The *Xcel Energy Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW* include requirements for curbing the introduction of excessive voltage and current distortion into PSCo's transmission system. These requirements can be found in Sections II.G and IV.A. As specified, generator developers are required to adhere to the harmonics distortion limits in IEEE Standard 519. These limits are applicable to the generator Point of Interconnection. For the proposed generation, this is the Alamosa Terminal 69 kV Substation. The proposed photovoltaic solar generation facilities include inverters. Since inverters can be a significant source of harmonics, the Developer is required to conform explicitly to IEEE 519. Additional information and requirements can be found in Sections II.G and IV.A of the Interconnection Guidelines. In particular, output energy present at any

frequency (harmonic or non-harmonic) in the range of 220-420 Hz shall be limited to 1.0% of the fundamental current. As needed, harmonics mitigation measures shall be included in the design and construction of the proposed PV solar generation facility. The Developer will need to provide documentary evidence of planned compliance measures to conform to the IEEE 519 Standard.

H. Short Circuit

Table 2. Short Circuit data

System Condition	3Φ (A)	S-L-G (A)
Pre-Project	3192.2	3964.47
Post-Project	3423.13	4315.79
Post-Project/A263 OOS	2710.49	3048.76

Table 3. Thevenin Impedance (per unit)

System Condition	+ Seq	- Seq	0 Seq
Pre-Project	0.06511 + j0.25390	0.06512 + j0.25391	0.00742 + j0.11022
Post-Project	0.06670 + j0.25676	0.06671 + j0.25677	0.00750 + j0.11079
Post-Project/A263 OOS	0.12681 + j0.32075	0.12682 + j0.32076	0.03642 + j0.24994

I. Costs Estimates and Assumptions

GI-2009-08 (System Impact Re-study Report)

Table 4 – PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Est. (Millions)
PSCo's Alamosa Terminal 69 kV Transmission Substation	Interconnect Customer to the 69 kV bus at the Alamosa Terminal Substation. The new equipment includes: • One 69 kV, gas circuit breakers • Three 69 kV, 1200 amp gang switches • One 69 kV combination CT/PT metering unit • Three 69 kV lightning arresters • Primary metering for Load Frequency/Automated Generation Control • Associated electrical equipment, bus, wiring and grounding • Associated site work, foundations and structures • Associated transmission line communications, fiber, relaying and testing	**$1.120**
PSCo's Alamosa Terminal 69 kV Transmission Substation	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).	**$0.055**
	Sitting and Land Rights and Project Management support	**$0.010**
Customer's 69kV Substation	Load Frequency/Automated Generation Control (LF/AGC) RTU and associated equipment	**$0.250**
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	**$1.435**
Time Frame	**Site, design, procure and construct**	**18 Months**

Table 5: PSCo Owned; PSCo Funded Interconnection Network Facilities

Element	Description	Cost Estimate (Millions)
PSCo's Alamosa Terminal 69 kV Transmission Substation	Interconnect Customer to the bus at the Alamosa Terminal Substation. The new equipment includes: • Associated station controls, communications, supervisory and SCADA equipment • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated equipment and system testing • Associated yard surfacing, landscaping, fencing	**$0.500**
	Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities	**$0.500**
Time Frame	**Site, design, procure and construct**	**18 months**

Table 6 – PSCo Network Upgrades for Delivery (To be determined)

Element	Description	Cost Est. (Millions)
	None - Not Applicable	
	Total Cost Estimate for PSCo Network Upgrades for Delivery	**TBD**
Time Frame	**Site, design, procure and construct**	
	Total Project Estimate	**$1.935**

Cost Estimate Assumptions

- Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by Xcel Energy/PSCo Engineering.
- Estimates are based on 2015 dollars (appropriate contingency and escalation applied).
- AFUDC has been excluded.
- Engineering will be contracted out to a Design Consultant.
- 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 site (support), design, procure and construct the interconnection facilities is approximately 18 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 back-feed dates.

Appendix A

GI-2009-08
Alamosa Terminal 69 kV – 30 MW PV Solar

A. Power flow Thermal Results – 2016 100% Peak Summer Conditions (SLV = 145 MW)
SLV Existing or Planned PV Solar In-Service at 85% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 7 – GI-2009-08 Summary Listing of Worst Case Low Voltages[1] (Category B Contingencies)

		Bus Voltage Without GI-2009-08	Bus Voltage With GI-2009-08		
Monitored Facility (Station or Bus)	Station or Bus Owner	% Voltage	% Voltage	% Change	NERC Category B Contingency Outage
Alamosa Terminal 115 kV	PSCo	85.7%	96.4%	10.7	Alamosa Terminal – Blanca Peak 115 kV
Antonito 69 kV	PSCo	84.4%	93.6%	9.2%	Alamosa Terminal – Blanca Peak 115 kV
Ft Garland 69 kV	PSCo	87.5%	96.2%	8.7%	Alamosa Terminal – Blanca Peak 115 kV
Romeo 69 kV	PSCo	85.4%	94.5%	9.1%	Alamosa Terminal – Blanca Peak 115 kV
REA Tap 69 kV	PSCo	86.9%	95.8%	8.9%	Alamosa Terminal – Blanca Peak 115 kV

Category B Worst Case Overloaded Facilities – None
Category C Worst Case Overloaded Facilities – None
Category C Worst Case Low Voltages – None

[1]Contingency low voltages that fall below 90.0%.

B. Power flow Thermal Results – Light Load Conditions – SLV = 45.0 MW (31% of 2016 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 85% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 8 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category B Contingencies)

				Branch Contingency Loading Without GI-2009-08		Branch Contingency Loading With GI-2009-08			
Monitored Facility (Line or Transformer)	**Type**	**Facility Owner**	**Branch Rating MVA (Norm/Emer)**	**Cat B Flow in MVA (Current Equiv[2])**	**Cat B Flow in % Current Equiv of Normal/Emer Rating**	**Cat B Flow in MVA (Current Equiv[2])**	**Cat B Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category B Contingency Outage**
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	29.0/29.0	19.7	66% / 66%	31.5	**106% / 106%**	46.6% / 46.6%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	63.3	63.3% / 63.3%	81.7	81.7% / 81.7%	18.4% / 18.4%	Poncha Branch – San Luis Valley 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	67.6	56.3% / 56.3%	95.9	80% / 80%	23.7% / 23.7%	Poncha Branch – San Luis Valley 230 kV

Category B Worst Case Low Voltages – None

[1] Includes relevant facilities with an Impact Factor of 2% or more of the proposed 30 MW generation.
[2] Current-corrected flows for transmission lines only

C. Power flow Thermal Results – Light Load Conditions – SLV = 45.0 MW (31% of 2016 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 85% Nameplate
Sensitivity – Tri-State's 30 MW Queue in SLV at 85% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 9 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category B Contingencies)

				Branch Contingency Loading Without GI-2009-08		Branch Contingency Loading With GI-2009-08			
Monitored Facility (Line or Transformer)	**Type**	**Facility Owner**	**Branch Rating MVA (Norm/Emer)**	**Cat B Flow in MVA (Current Equiv[2])**	**Cat B Flow in % Current Equiv of Normal/Emer Rating**	**Cat B Flow in MVA (Current Equiv[2])**	**Cat B Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category B Contingency Outage**
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	29.0/29.0	19.7	66% / 66%	31.7	**106% / 106%**	46% / 46%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	85.5	85.5% / 85.5%	104.3	**104.3% / 104.3%**	18.8% / 18.8%	Poncha Branch – San Luis Valley 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	92.7	77.3% / 77.3%	117.6	98.0% / 98.0%	24.9% / 24.9%	Poncha Branch – San Luis Valley 230 kV

Category B Worst Case Low Voltages – None

[1] Includes relevant facilities with an Impact Factor of 2% or more of the proposed 30 MW generation.
[2] Current-corrected flows for transmission lines only

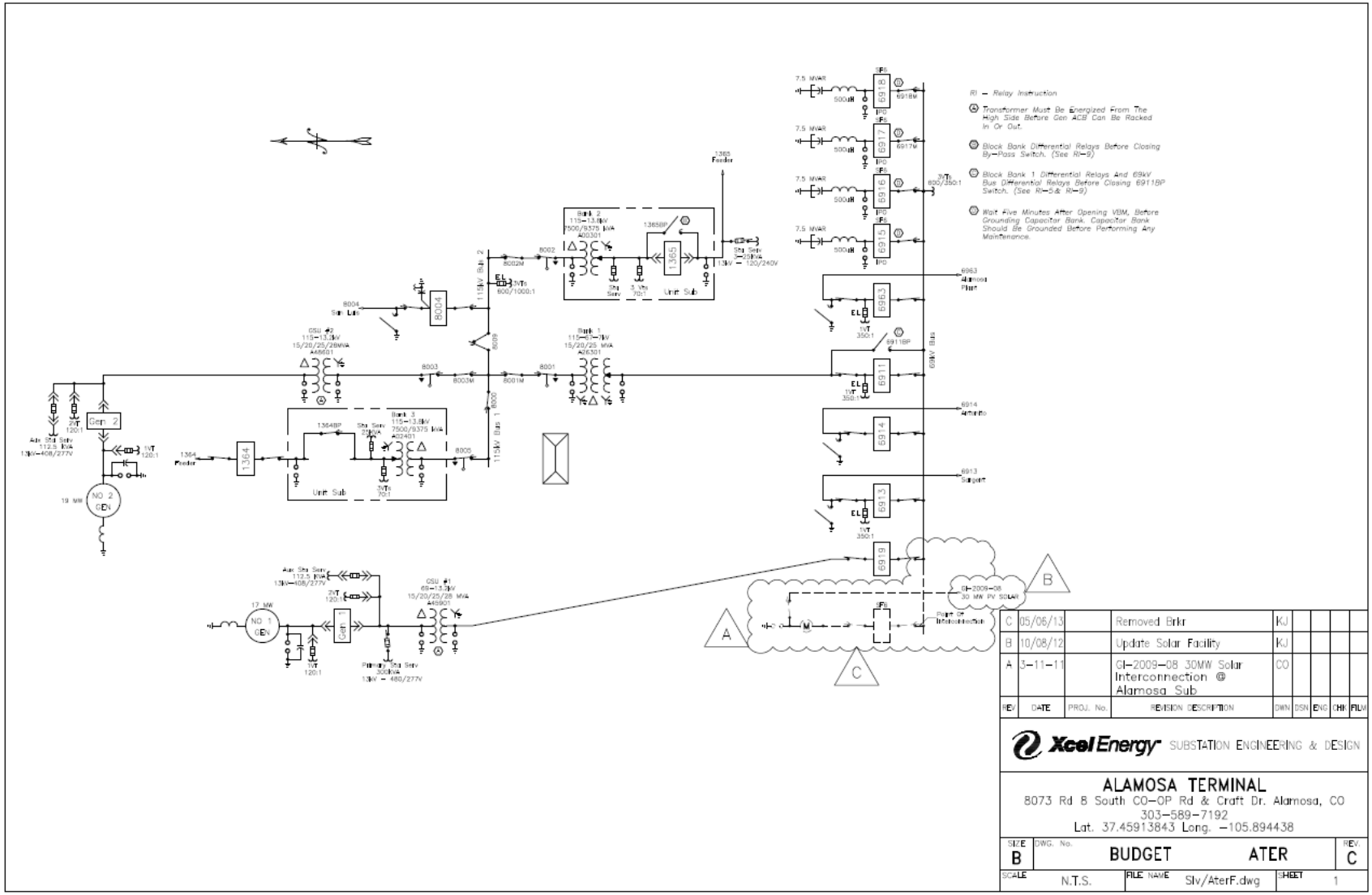
Appendix B - Generation Dispatch

Dispatch of All Generating Units in the Immediate Vicinity of GI-2009-08 (Zone 710)

Bus	LF Id	Maximum Generation MW	Case A (100% Peak Load)	Case B (45 MW of Load)	Sensitivity (45 MW of Load)
G-SANDHIL_PV	S1	16	13.6	13.6	13.6
IBERDROLA_PV	S2	30	25.5	25.5	25.5
COGENTRIX_PV	S1	30	25.5	25.5	25.5
SUNPOWER	S1	52	44.2	44.2	44.2
ALMSACT1	G1	17	Off-line	Off-line	Off-line
ALMSACT2	G2	19	Off-line	Off-line	Off-line
GI-2009-08	**S1**	**30**	**30**	**30**	**30**
MOSCA	NT	8	6.8	6.8	6.8
TRI-STATE'S QUEUE	S1	30	0	0	25.5

*Note – On average, all photovoltaic generation in the San Luis Valley are at 85% of name plate for all generation interconnection studies per PSCo Planning interconnection guidelines, effective March, 2015.

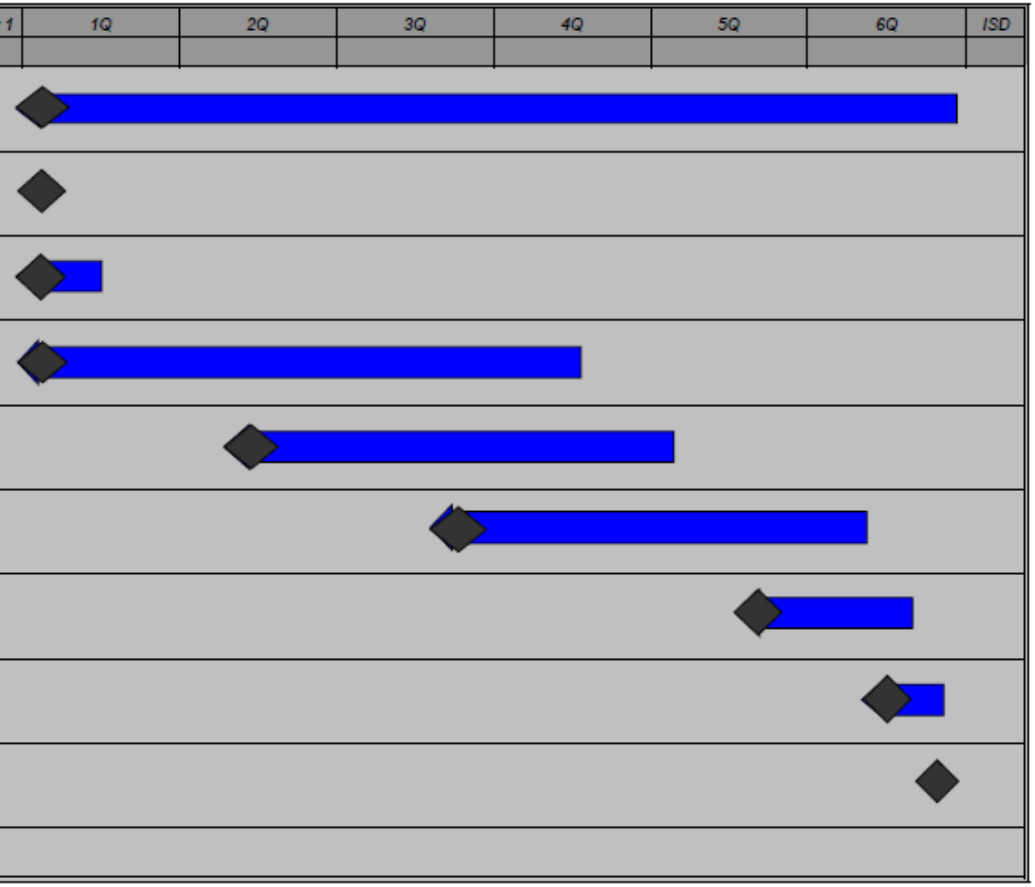
Appendix C – Alamosa Terminal Substation One-Line with GI-2009-08 Interconnection Upgrades



Appendix D – GI-2009-08 Generator Interconnection Project Schedule

GI-2009-8 System Impact Study Report (Restudy)
30 MW Solar Interconnection @ Alamosa Terminal 69kV Substation

ID	Task Name	Duration
1	GI-2009-8 System Impact Study Report (Restudy) 30 MW Solar Interconnection	78w
2	Authorization to Proceed: Execution of Interconnection Agreement	0w
3	Sighting & Land Rights and Permitting	6w
4	Substation Design/Transmission Line Design & Engineering	40w
5	Substation/Transmission Line Material Procurement	36w
6	Substation/Transmission line Construction	36w
7	Relay, Protection & Control Equipment Testing	10w
8	Final Commissioning	4w
9	Project Completion / Backfeed	0w
10		



Appendix E – GI-2009-08 General Arrangement Sketch

For Illustration purpose only