Generator Interconnection
System Impact Restudy
Request # GI-2009-08
Interim Report

30 MW PV Solar Generation
Alamosa County, Colorado

Xcel Energy Services
Transmission Planning – West
March 16, 2015

DRAFT

A. 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). 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 backfeed 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. 2017 peak summer and SLV area light load power flow base cases were used for the studies. This interim report does not include the results of a short circuit.

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 planned to be in service by the summer of 2017, 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 can be accommodated without the need for transmission system upgrades. Pre-existing facility contingency overloads that could present a limitation to the proposed project will be addressed in PSCo's capital budget proceedings and/or the Colorado Coordinated Planning Group's San Luis Valley Subcommittee Study. Cost estimates to engineer and construct the Alamosa Terminal 69 kV interconnection facilities can be found below (not provided in this Interim Report).

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.

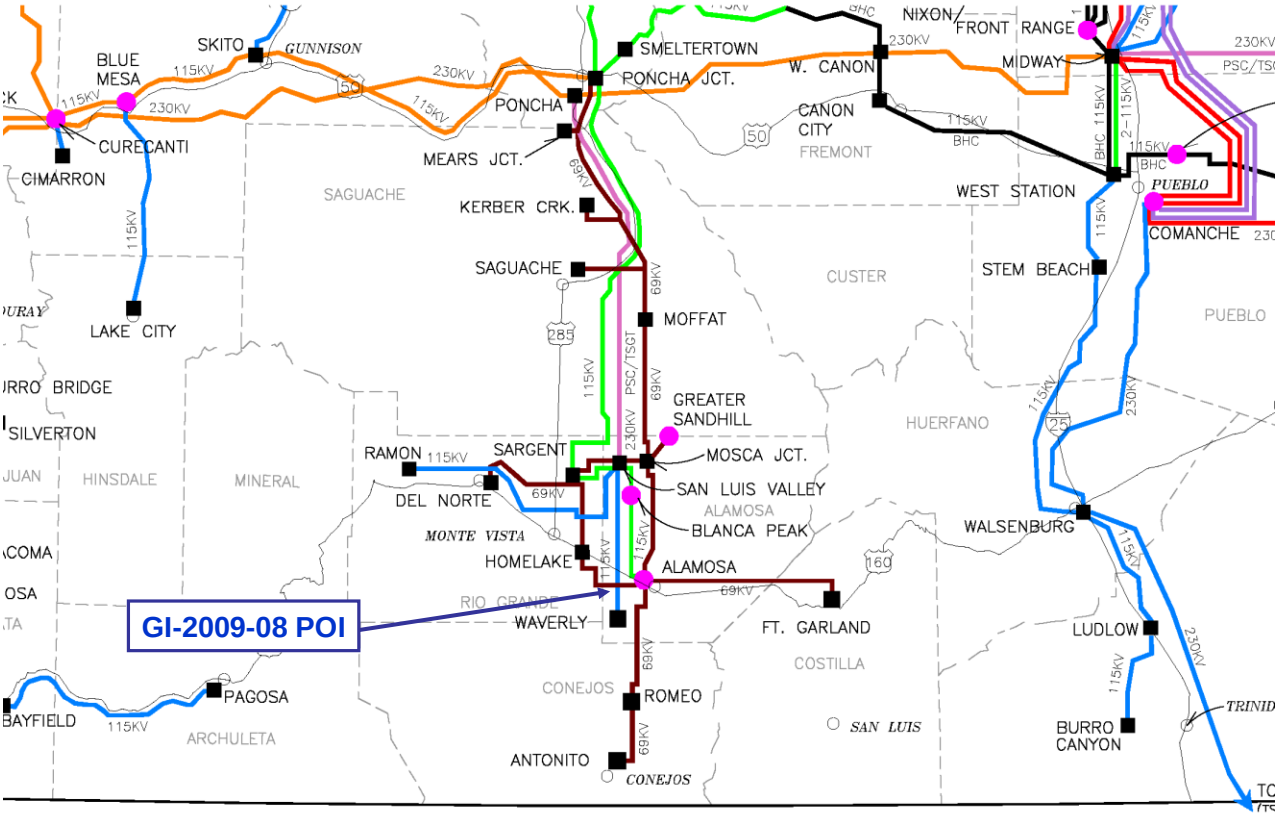
Short circuit analysis results - TBD

Cost Estimates

TBD

DRAFT

Figure 1 Alamosa Terminal Substation and Surrounding Transmission System



B. 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.

C. 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. 2017 peak summer and SLV area light load power flow base cases were used for the studies. Short circuit analyses will be performed but results are not yet available for this Interim Report. The results of these studies were used to identify network upgrades required to deliver the proposed generation to PSCo loads.

PSCo adheres to NERC & 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

DRAFT

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.

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, potential Affected Parties were Tri-State Generation & Transmission (TSG&T) and Western Area Power Administration (WAPA).

D. Power Flow Study Models

The power flow studies were based on the WECC approved 19HS2A1_R335 case. This case was modified to represent 2017 peak summer conditions in the Colorado Coordinated Planning Group area. 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.

Twelve main power flow generation dispatch scenarios were evaluated. These scenarios modeled both 2017 peak summer load and two San Luis Valley light load conditions. Light load conditions are usually 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 2017 SLV peak load was 144.8 MW (combined PSCo & TSG&T SLV load in Zone 710). The SLV light load scenarios modeled the radial SLV transmission system at 65.2 MW and 45.0 MW. 65.2 MW represents 45% of peak load or 65.2 MW. This percentage is comparable to the same light load scenario as was used in the previous SIS (44.1%). 45.0 MW represents a SLV area load level that is at or close to the minimum area load experienced during 2014 during hours when the existing PV solar was near maximum (70 MW or greater).

The scenarios also modeled the two Alamosa Terminal combustion turbine generators as either in-service or out of service (peak load and 65 MW SLV load levels only). These units are mainly used to provide local system support to the SLV area. Therefore cases were created both with and without the CTs in service to determine whether they were required to provide support.

DRAFT

A companion set of cases also replaced the Alamosa Terminal 115/69 kV transformer with a "newer" one that was being considered as a replacement at the outset of this study as a part of PSCo's Asset Renewal Program. Installation of the newer transformer was examined because of the proximity to the POI and the differing impedances and ratings between the old and newer transformers. The disposition of this plan is still uncertain due to questions regarding the condition of the newer one. The current plan is to relocate the transformer to Alamosa Terminal by the end of 2015.

Table 1 below provides an organized listing of these cases. For all cases, the existing or planned PV solar (by 2016 summer) was dispatched at 100% and the remaining PSCo thermal generation was dispatched according to their relative generation costs. The total existing or planned PV solar generation dispatched in the SLV is 136.4 MW.

In the cases with the proposed generation, the 30 MW of new PV solar generation was added using models provided by the Developer. The wind 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 1.000 pu tap.

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

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	100% of Peak	27 MW	Exist 25 MVA	0 MW
A_gn	100% of Peak	27 MW	Exist 25 MVA	30 MW
B_bm (sensitivity)	100% of Peak	13 MW (#1)	Exist 25 MVA	0 MW
B_gn (sensitivity)	100% of Peak	13 MW (#1)	Exist 25 MVA	30 MW
C_bm	100% of Peak	27 MW	Repl 46.7 MVA	0 MW
C_gn	100% of Peak	27 MW	Repl 46.7 MVA	30 MW
D_bm	100% of Peak	0 MW	Exist 25 MVA	0 MW
D_gn	100% of Peak	0 MW	Exist 25 MVA	30 MW
E_bm	100% of Peak	0 MW	Repl 46.7 MVA	0 MW

DRAFT

E_gn	100% of Peak	0 MW	Repl 46.7 MVA	30 MW
F_bm	65.2 MW	27 MW	Exist 25 MVA	0 MW
F_gn	65.2 MW	27 MW	Exist 25 MVA	30 MW
G_bm	65.2 MW	27 MW	Repl 46.7 MVA	0 MW
G_gn	65.2 MW	27 MW	Repl 46.7 MVA	30 MW
H_bm	65.2 MW	0 MW	Exist 25 MVA	0 MW
H_gn	65.2 MW	0 MW	Exist 25 MVA	30 MW
I_bm	65.2 MW	0 MW	Repl 46.7 MVA	0 MW
I_gn	65.2 MW	0 MW	Repl 46.7 MVA	30 MW
J_bm	45 MW	0 MW	Exist 25 MVA	0 MW
J_gn	45 MW	0 MW	Exist 25 MVA	30 MW
K_bm	45 MW	0 MW	Repl 46.7 MVA	0 MW
K_gn	45 MW	0 MW	Repl 46.7 MVA	30 MW

*Alamosa Terminal Unit 1 (69kV) – 13 MW (Summer Gross Dependable Capability)
*Alamosa Terminal Unit 2 (115 kV) – 14 MW (Summer Gross Dependable Capability)

E. 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) and 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.

F. Power Flow Thermal Results

Network Resource Interconnection Service

The results of the Network Resource NERC Category B (P1.1-P1.3) and selected C (P2, P4.1-P4.3, P4.5, P5.1-P5.3, P5.5, P7.1) contingency analyses are summarized in Tables 7-21 in Sections A through K of the Appendix.

DRAFT

Peak System Load

Cases A_bm & A_gn – For the cases with peak load in the San Luis Valley with the Alamosa Terminal Combustion Turbines in service (Table 7), the Alamosa Terminal 115/69 kV transformer and Mosca Jct. – San Luis Valley 69 kV line are both overloaded with the proposed generation for the Category B contingency outage of the Blanca Peak – San Luis Valley 115 kV circuit. Since the Alamosa Terminal transformer is also overloaded in the benchmark case, this SLV generation dispatch scenario is operationally unlikely. Either the Blanca Peak PV solar plant or the Alamosa Terminal 115 kV CT#2 would need to be curtailed or out of service. As cases B_bm & B_gn (Table 8) show, the overload of the existing Alamosa Terminal transformer is alleviated with the Alamosa Terminal 115 kV CT#2 out of service. This also mitigates the Mosca Jct. – San Luis Valley 69 kV circuit overload. The "B" cases also illustrate that Alamosa Terminal CT#2 is not needed for area voltage support.

Cases C_bm & C_gn – The results for these cases (Table 9) show that replacement of the existing Alamosa Terminal 115/69 kV T1 transformer with the newer one for the same system conditions as the "A" Cases results in a similar overload of the Mosca Jct. – San Luis Valley 69 kV line with the proposed generation. Since the replacement transformer has a higher thermal rating, this transformer is no longer overloaded. The Mosca Jct. – San Luis Valley 69 kV circuit is still overloaded with the proposed generation. However, because of the existence of the benchmark overload for the 45 MW light SLV area load scenarios ("J" & "K" cases), the overload of this facility for these system conditions do not require alleviation for this project (GI-2009-08).

For all of these cases ("A" through "C"), there were no Category C contingency overload problems detected. There were also no Category B or C low voltage problems detected.

The benchmark case overloads of the Alamosa Terminal 115/69 kV T1 transformer and the Mosca Jct. – San Luis Valley 69 kV circuit in the "J" & "K" cases will be addressed through PSCo's Asset Renewal Program and/or PSCo's Annual Capital Budget Process. The Colorado Coordinated Planning Group has also formed a subcommittee to perform a study to review transmission system performance in the San Luis Valley.

Cases D_bm , D_gn, E_bm & E_gn – For the cases with peak load in the San Luis Valley with the Alamosa Terminal CTs out of service (Tables 10-11), 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 show that for these system conditions in the benchmark case, at least one of the Alamosa Terminal CTs would likely be in service to provide voltage support to the area. These cases illustrate that for Peak Load system conditions, Cases "A", "B" & "C" are of primary concern in this area.

DRAFT

Light System Load

Cases F_bm & F_gn – For the cases with a light load in the San Luis Valley of 65.1 MW with the Alamosa Terminal CTs in service (Tables 12-13), there are a number of circuits with contingency overloads for Category B contingencies with the proposed generation in service. Two of these elements are also contingency overloaded in the benchmark case. The Alamosa Terminal CTs are usually used to provide support the SLV system, as needed. As cases "H" & "I" demonstrate, there is no need for these units to be in service to provide system support. Therefore, because of the benchmark case contingency overloads and because the CTs would not be needed for this system scenario, these overloaded facilities do not require mitigation for these system conditions.

For cases F_bm & F_gn, two Category C contingency overloads were also found. For the same reasons as the Category B contingency overloads, since the Alamosa Terminal CTs are unlikely to be in service for these system conditions, these overloaded facilities do not require mitigation for these system conditions.

Cases G_bm & G_gn – The results for these cases (Tables 14-15) are similar to the "F" cases. Except for the Alamosa Terminal transformer, all of the other contingency overloaded facilities for cases F_bm & F_gn are similarly overloaded for cases G_bm & G_gn. For the same reasons as delineated in the "F" cases, these overloaded facilities also do not require mitigation for these system conditions.

For the "F" & "G" cases, there were no low voltage problems detected.

Cases H_bm & H_gn – For the cases with light load in the San Luis Valley of 65.1 MW with the Alamosa Terminal CTs out of service (Table 16), the Mosca Jct. – San Luis Valley 69 kV line is overloaded with the proposed generation for the Category B contingency outage of the Blanca Peak – San Luis Valley 115 kV circuit. It is not overloaded in the benchmark case. This circuit overload might have required mitigation for these system conditions, except that as reported in the **Section D – Power Flow Study Models**, 65.1 MW is comparable to the load level used in the previous System Impact Study but does not represent the lightest load levels typically experienced in the SLV area. Therefore, please see Cases J_bm & J_gn for further consideration of the area when experiencing light load conditions.

Cases I_bm & I_gn – Except for the Alamosa Terminal transformer, the results for these cases (Table 17) are similar to the "H" cases.

For the H & I cases, there were no Category C contingency overload problems detected. There were also no Category B or C low voltage problems detected. As mentioned in the discussion for the "F" cases, these cases illustrate that there is no need for the Alamosa Terminal CTs to provide system support for these system conditions.

Cases J_bm & J_gn – These cases were created to check light area load conditions at the 45 MW load level with the Alamosa Terminal CTs out of service. This load level is much closer to the

DRAFT

minimum load level typically experienced in the SLV area. The results can be found in Tables 18-19. These cases included the existing Alamosa Terminal 115/69 kV T1 transformer. The results of these cases illustrate that the San Luis Valley – Sargent and Sargent – Poncha Jct. 115 kV circuits are not overloaded for the loss of the Poncha – San Luis Valley 230 kV line. Therefore, under these conditions, these two circuits do not present a limitation to the proposed generation.

However, two other elements do have overload issues, both for the Category B contingency outage of the Blanca Peak – San Luis Valley 115 kV circuit. The Alamosa Terminal 115/69 kV transformer and the Mosca Jct. – San Luis Valley 69 kV transmission line are overloaded for both the benchmark case and the case with the proposed generation. In order to prevent these overloads, the generation output of the existing PV solar at Blanca Peak and possibly Mosca Jct. Greater Sandhill would need to be curtailed. Since the Alamosa Terminal 115/69 kV transformer and the Mosca Jct. – San Luis Valley 69 kV circuit are both overloaded in the benchmark case, the costs to upgrade these facilities are not being included in this study. These facilities will be addressed in PSCo's capital budget proceedings and/or the Colorado Coordinated Planning Group's San Luis Valley Subcommittee Study. Also, PSCo is currently planning to swap out the existing Alamosa transformer with a newer one.

Cases K_bm & K_gn – The results for these cases (Tables 20-21) are similar to the "J" cases. Except for the Alamosa Terminal transformer, all of the other contingency overloaded facilities for cases J_bm & J_gn are similarly overloaded in cases K_bm & K_gn and the same comments apply. The benchmark overload of the Mosca Jct. – San Luis Valley 69 kV circuit will be addressed in PSCo's capital budget proceedings and/or the Colorado Coordinated Planning Group's San Luis Valley Subcommittee Study.

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.

G. 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*

DRAFT

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

DRAFT

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.

H. 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.

I. Short Circuit

TBD

Tables 2-3 Reserved

J. Costs Estimates and Assumptions

GI-2009-08 (System Impact Restudy Report)

TBD

Tables 4-6 Reserved

DRAFT

Appendix

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

A. Power flow Thermal Results – 2017 Peak Summer Conditions (SLV = 144.8MW)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Table 7 – 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**
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	29.3	**117.3% / 117.3%**	30.1	**120.4% / 120.4%**	3.1% / 3.1%	Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	17.3	72.4% / 72.4%	27.9	**116.8% / 116.8%**	44.4% / 44.4%	Blanca Peak – San Luis Valley 115 kV

Category B Worst Case Low Voltages – None

Category C Worst Case Overloaded Facilities – None
Category C 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

DRAFT

B. Power flow Thermal Results – 2017 Peak Summer Conditions (SLV = 144.8MW)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal Unit 1 CT In-Service at Summer Nameplate (13 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Sensitivity Case

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**
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	15.4	61.6% / 61.6%	15.4	61.7% / 61.7%		Alamosa Terminal – Blanca Peak 115 kV
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	15.1	60.4% / 60.4%	16.1	64.3% / 64.3%		Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	15.8	66.2% / 66.2%	3.4	14.2% / 14.2%		Mosca Jct. – Mirage Jct. 69 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	12.8	53.6% / 53.6%	22.7	94.9% / 94.9%		Blanca Peak – San Luis Valley 115 kV

Category B Worst Case Low Voltages – None

Category C Worst Case Overloaded Facilities – None
Category C 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

DRAFT

C. Power flow Thermal Results – 2017 Peak Summer Conditions (SLV = 144.8MW)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW)
Tentative Planned Replacement 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	23.9 / 23.9	17.3	72.3% / 72.3%	27.9	**116.8% / 116.8%**	44.5% / 44.5%	Blanca Peak – San Luis Valley 115 kV

Category B Worst Case Low Voltages – None

Category C Worst Case Overloaded Facilities – None
Category C 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

DRAFT

D. Power flow Thermal Results – 2017 Peak Summer Conditions (SLV = 144.8MW)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Table 10 – 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	83.8%	95.6%	11.8%	Alamosa Terminal – Blanca Peak 115 kV
Antonito 69 kV	PSCo	84.1%	93.5%	9.4%	Alamosa Terminal – Blanca Peak 115 kV
Ft Garland 69 kV	PSCo	87.3%	96.2%	8.9%	Alamosa Terminal – Blanca Peak 115 kV
Romeo 69 kV	PSCo	85.1%	94.4%	9.3%	Alamosa Terminal – Blanca Peak 115 kV
REA Tap 69 kV	PSCo	86.6%	95.8%	9.2%	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%.

DRAFT

E. Power flow Thermal Results – 2017 Peak Summer Conditions (SLV = 144.8MW)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Tentative Planned Replacement Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 11 – 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%.

DRAFT

F. Power flow Thermal Results – Light Load Conditions – SLV = 65.1 MW (45.0% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Table 12 – 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**
Alamosa Switchyard – Mosca Jct. 69 kV	Line	PSCo	25.8 / 25.8	18.4	71.4% / 71.4%	18.6	72.0% / 72.0%	0.6% / 0.6%	Mosca Jct. – San Luis Valley 69 kV
Alamosa Switchyard – Mosca Jct. 69 kV	Line	PSCo	25.8 / 25.8	13.5	52.4% / 52.4%	27.8	**107.7% / 107.7%**	55.3% / 55.3%	Blanca Peak – San Luis Valley 115 kV
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	37.4	**149.8% / 149.8%**	39.8	**159.4% / 159.4%**	9.6% / 9.6%	Blanca Peak – San Luis Valley 115 kV
Alamosa Terminal – Homelake 69 kV	Line	PSCo	43.7 / 43.7	25.5	58.4% / 58.4%	42.9	98.2% / 98.2%	39.8% / 39.8%	Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	30.7	**128.4% / 128.4%**	41.0	**171.4% / 171.4%**	43.0% / 43.0%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	85.4	85.4% / 85.4%	103.0	**103.0% / 103.0%**	17.6% / 17.6%	Poncha Branch – San Luis Valley 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	95.4	79.4% / 79.4%	124.0	**103.3% / 103.3%**	23.9% / 23.9%	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

DRAFT

Table 13 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category C 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 C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**Cat C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category C Contingency Outage**
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	85.4	85.4% / 85.4%	103.3	**103.3% / 103.3%**	17.9% / 17.9%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	95.3	79.4% / 79.4%	123	**103.4% / 103.4%**	24.0% / 24.0%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV

Category C Worst Case Low Voltages – None

DRAFT

[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

G. Power flow Thermal Results – Light Load Conditions – SLV = 65.1 MW (45.0% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW)
Tentative Planned Replacement Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 14 – 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**
Alamosa Switchyard – Mosca Jct. 69 kV	Line	PSCo	25.8 / 25.8	18.4	71.5% / 71.5%	18.6	71.9% / 71.9%	0.4% / 0.4%	Mosca Jct. – San Luis Valley 69 kV
Alamosa Switchyard – Mosca Jct. 69 kV	Line	PSCo	25.8 / 25.8	13.6	52.9% / 52.9%	27.6	**107.1% / 107.1%**	54.2% / 54.2%	Blanca Peak – San Luis Valley 115 kV
Alamosa Terminal – Homelake 69 kV	Line	PSCo	43.7 / 43.7	25.6	58.6% / 58.6%	42.8	98.0% / 98.0%	39.4% / 39.4%	Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	30.7	**128.4% / 128.4%**	40.9	**171.3% / 171.3%**	42.9% / 42.9%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	85.2	85.2% / 85.2	103.6	**103.6% / 103.6%**	18.4% / 18.4%	Poncha Branch – San Luis Valley 230 kV
Blanca Peak – San Luis Valley 115 kV	Line	PSCo	60 / 60	43.8	73.0% / 73.0%	60.7	**101.2% / 101.2%**	28.2% / 28.2%	Mosca Jct. – San Luis Valley 69 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	95.4	79.5% / 79.5%	124.0	**103.4% / 103.4%**	23.9% / 23.9%	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

DRAFT

Table 15 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category C 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 C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**Cat C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category C Contingency Outage**
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	85.1	85.1% / 85.1%	103.9	**103.9% / 103.9%**	18.8% / 18.8%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	95.3	79.4% / 79.4%	124.1	**103.5% / 103.5%**	24.1% / 24.1%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – W Canon 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	95.3	79.4% / 79.4%	124.2	**103.5% / 103.5%**	24.1% / 24.1%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV

Category C Worst Case Low Voltages – None

DRAFT

[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

H. Power flow Thermal Results – Light Load Conditions – SLV = 65.1 MW (45.0% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Table 16 – 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**
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	23.8	95.1% / 95.1%	24.4	97.8% / 97.8%	2.7% / 2.7%	Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	20.5	85.6% / 85.6%	31.6	**132.1% / 132.1%**	46.5% / 46.5%	Blanca Peak – San Luis Valley 115 kV

Category B Worst Case Low Voltages – None

Category C Worst Case Overloaded Facilities – None
Category C 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

DRAFT

I. Power flow Thermal Results – Light Load Conditions – SLV = 65.1 MW (45.0% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Tentative Planned Replacement Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 17 – 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	23.9 / 23.9	20.5	85.8% / 85.8%	31.6	**132.2% / 132.2%**	46.4% / 46.4%	Blanca Peak – San Luis Valley 115 kV

Category B Worst Case Low Voltages – None

Category C Worst Case Overloaded Facilities – None
Category C 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

DRAFT

J. Power flow Thermal Results – Light Load Conditions – SLV = 45.0 MW (31.1% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Existing Alamosa Terminal 115/69 kV 15/20/25 MVA T1 Transformer In-Service

Table 18 – 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**
Alamosa Terminal 115/69 kV T1	Xfmr	PSCo	25 / 25	26.2	**104.7% / 104.7%**	27.3	**109.1% / 109.1%**	4.4% / 4.4%	Blanca Peak – San Luis Valley 115 kV
Mosca Jct. – San Luis Valley 69 kV	Line	PSCo	23.9 / 23.9	24.0	**100.3% / 100.3%**	35.1	**146.7% / 146.7%**	46.4% / 46.4%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	79.4	79.4% / 79.4%	97.2	97.2% / 97.2%	17.8% / 17.8%	Poncha Branch – San Luis Valley 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	88.0	73.3% / 73.3%	117.6	98.0% / 98.0%	24.7% / 24.7%	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

DRAFT

Table 19 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category C 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 C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**Cat C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category C Contingency Outage**
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	79.3	79.3% / 79.3%	97.3	97.3% / 97.3%	18.0% / 18.0%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – W Canon 230 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	79.3	79.3% / 79.3%	97.4	97.4% / 97.4%	18.1% / 18.0%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	87.9	73.3% / 73.3%	117.6	98.0% / 98.0%	24.7% / 24.7%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – W Canon 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	87.9	73.3% / 73.3%	117.7	98.1% / 98.1%	24.8% / 24.8%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV

Category C Worst Case Low Voltages – None

DRAFT

[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

K. Power flow Thermal Results – Light Load Conditions – SLV = 45.0 MW (31.1% of 2017 Summer Peak)
SLV Existing or Planned PV Solar In-Service at 100% Nameplate
Alamosa Terminal CTs Out of Service (0 MW)
Tentative Planned Replacement Alamosa Terminal 115/69 kV 28/37.3/46.7 MVA T1 Transformer In-Service

Table 20 – 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	23.9 / 23.9	24.0	**100.3% / 100.3%**	35.1	**146.9% / 146.9%**	46.6% / 46.6%	Blanca Peak – San Luis Valley 115 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	79.0	79.0% / 79.0%	97.7	97.7% / 97.7%	18.7% / 18.7%	Poncha Branch – San Luis Valley 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	88.0	73.3% / 73.3%	117.6	98.0% / 98.0%	24.7% / 24.7%	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

DRAFT

Table 21 – GI-2009-08 Summary Listing of Worst Case Overloaded Facilities[1] (Category C 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 C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**Cat C Flow in MVA (Current Equiv[2])**	**Cat C Flow in % Current Equiv of Normal/Emer Rating**	**% Change**	**NERC Category C Contingency Outage**
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	78.9	78.9% / 78.9%	97.8	97.8% / 97.8%	18.9% / 18.9%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – W Canon 230 kV
San Luis Valley – Sargent 115 kV	Line	PSCo	100 / 100	78.9	78.9% / 78.9%	97.9	97.9% / 97.9%	19.0% / 19.0%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	87.9	73.3% / 73.3%	117.7	98.1% / 98.1%	24.8% / 24.8%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – W Canon 230 kV
Sargent – Poncha Junction 115 kV	Line	PSCo	120 / 120	87.9	73.3% / 73.3%	117.7	98.1% / 98.1%	24.8% / 24.8%	Poncha Branch – San Luis Valley 230 kV Poncha Branch – Curecanti 230 kV

Category C Worst Case Low Voltages – None

DRAFT

[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

L. Generation Dispatch

Case Description: 2017 Peak Summer Loads (CCPG), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW
Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW
Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	13 MW
Alamosa Unit 2	14 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW
Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	120.9 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW
Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW

DRAFT

Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW
San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	90.9 MW

Case Description: 2017 Peak Summer Loads (CCPG), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal Unit 1 CT In-Service at Summer Nameplate (13 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW
Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW
Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	13 MW
Alamosa Unit 2	0 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW
Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	134.3 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW

DRAFT

Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW
Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW
San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	104.7 MW

Case Description: 2017 Peak Summer Loads (CCPG), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal CTs Out of Service (0 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW
Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW
Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	0 MW
Alamosa Unit 2	0 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW

DRAFT

Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	147.9 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW
Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW
Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW
San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	117.5 MW

Case Description: 2017 Light Loads in SLV Only (SLV Load = 65.1 MW), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal CTs In-Service at Summer Nameplate (27 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW
Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW

DRAFT

Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	13 MW
Alamosa Unit 2	14 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW
Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	40.8 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW
Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW
Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW
San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	12.8 MW

Case Description: 2017 Light Loads in SLV Only (SLV Load = 65.1 MW), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal CTs Out of Service (0 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW

DRAFT

Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW
Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	0 MW
Alamosa Unit 2	0 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW
Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	67.4 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW
Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW
Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW
San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	38.0 MW

DRAFT

Case Description: 2017 Extreme Light Load in SLV Only (SLV Load = 45.0 MW), SLV Existing or Planned PV Solar In-Service at 100% Nameplate, Alamosa Terminal CTs Out of Service (0 MW), Based on WECC 19hs2ap.sav with updates from CCPG companies.

Benchmark Case – GI-2009-08

Arapahoe Unit 3 & 4	0 MW
Cabin Creek Units	210 MW
Cherokee Units 1 – 3	0 MW
Cherokee Unit 4	383 MW
Cherokee Unit 5-7	603.8 MW
Comanche Unit 1	360 MW
Comanche Unit 2	365 MW
Ft Lupton Units 1 & 2	0 MW
Pawnee Unit 1	536 MW
Manchief Units 1 & 2	0 MW
Ft St Vrain Units 1-4	700 MW
Valmont Unit 5	196 MW
Valmont Unit 6	0 MW
Alamosa Unit 1	0 MW
Alamosa Unit 2	0 MW
JM Shaffer – Ft Lupton	150 MW
Brush Units 1, 3, & 4	0 MW
Brush Unit 2	66 MW
Arapahoe Units 5-7	118 MW
Lamar DC Tie	0 MW but regulating voltage
Spruce Units 1 & 2	268 MW
Knutson Units 1 & 2	80 MW
Fountain Valley Units	0 MW
Plains End Units	47.7 MW
RMEC Units 1-3	586 MW
Spindle Units 1 & 2	278 MW
Comanche Unit 3	788 MW
Ft St Vrain Units 5 & 6	295 MW
Jackson Fuller Wind	57.5 MW (23%)
Colorado Grn/Twin Buttes	54.5 MW (23%)
Spring Canyon Wind	13.8 MW (23%)
Ridgecrest Wind	6.8 MW (23%)
Cedar Point Wind (MS 230 kV)	57.5 MW (23%)
Limon Wind (MS 345 kV)	138.1 MW (23%)
Peetz Logan 230 kV	132.4 MW (23%)
Cedar Creek Wind	126.8 MW (23%)
Comanche Solar	120 MW
Mosca Jct. Trans Solar	16.1 MW
Mosca Jct. Distr Solar	7.9 MW

DRAFT

San Luis Valley Solar 1	30.4 MW
San Luis Valley Solar 2	52.0 MW
Blanca Peak Solar	30.0 MW

GI-2009-08 Case Adjustments (with loss changes)

GI-2009-08	30.3 MW (30.0 MW @ POI)
Plains End Units	18.6 MW

DRAFT

M. Alamosa Terminal Substation One-Line with GI-2009-08 Interconnection Upgrades

TBD

DRAFT

N. GI-2009-08 Generator Interconnection Project Schedule

TBD

DRAFT