Interconnection Feasibility/System Impact Study Report
Request # GI-2014-12

53MW Solar PV Generation Facility
Boone 115 kV Substation, Colorado

Public Service Company of Colorado
Transmission Planning
October 6, 2015

Executive Summary

Public Service Company of Colorado (PSCo) received an interconnection request (GI-2014-12) for a 53MW Photovoltaic (PV) solar generation interconnection at PSCo's Boone 115 kV Substation, Colorado. The GI facility will consist of twenty six SMA KODIAK 2.2MVA inverters and will connect to the Boone 115 kV bus using a 4.8 mile Customer owned 115 kV transmission line. The Customer proposed in-service date for GI-2014-12 is April 1, 2016 and commercial operation date is July 1, 2016. The Primary Point of Interconnection (POI) is Boone 115 kV bus. The Customer did not select a secondary POI.

The study request was for both Energy Resource and Network Resource Interconnection Services. The studies were performed using 2016 heavy summer power flow case with South – North stress on the Comanche – Midway - Jackson Fuller – Daniels Park transmission path. The affected parties for this study are Colorado Springs Utilities (CSU), Black Hills Colorado Electric (BHCE) and Tri-State Generation & Transmission Inc. (TSGT).

This request was studied as a stand-alone project, with no evaluations made of other potential new generation requests that may exist in the Generator Interconnection Request queue, other than the resource acquisitions for which Power Purchase Agreements have been signed. The scope of the combined Feasibility and System Impact study includes steady state power flow contingency analysis, short circuit analysis and dynamic stability analysis.

Steady State Contingency Analysis: The single contingency analysis found three CSU lines overloading at their normal rating after the addition of GI-2014-12. However, CSU operates lines at emergency ratings under single contingency conditions. At emergency rating, only Monument - Flyhorse 115 kV line loading increases from 98.4% to 101.4% due to the addition of GI-2014-12. The overload on this case can be mitigated by implementing the operating procedure to open the Palmer Lake – Monument 115 kV line. Hence, there were no thermal violations attributable to GI-2014-12. In addition, GI-

2014-12 caused no new voltage violations and the increase in the existing voltage violations is in the range of 0.005, so there are no voltage violations attributable to GI-2014-12.

Stability Analysis:

A dynamic stability analysis was not deemed necessary for this GI based on the "DSGMod" (set to 1) and "QVarMod (Set to 1) settings chosen by the Customer. The previous GI studies performed using the SMA KODIAK inverters for the SanLuis Valley 230 kV POI (GI-2010-11 report posted in July 2014) with the "DSGMod" set to '1' and "QvarMod" set to '1' showed acceptable dynamic performance. The SanLuis Valley 230 kV bus is a much weaker bus compared to the Boone 115 kV bus. The GI-2014-12 facility is expected to demonstrate acceptable dynamic performance with the "DSGMod" and "QvarMod" set to '1'.

Based on the study results
GI-2014-12 Energy Resource Interconnection Service is 53MW
GI-2014-12 Network Resource Interconnection Service is 53MW

Short – Circuit Analysis: No circuit breakers are overdutied due to the addition of GI-2014-12. See Table-1 for fault current levels at the POI.

Cost Estimates

The cost for the transmission interconnection (in 2015 dollars):

The total estimated cost of the recommended system improvements to interconnect the project is approximately **$1.322 Million** and includes:

- $ 1.229 million for PSCo-Owned, Customer-Funded Interconnection Facilities
- $ 0.093 million for PSCo-Owned, PSCo-Funded Network Upgrades for Interconnection
- $ 0 million for PSCo Network Upgrades for Delivery to PSCo Loads

This work can be completed in 18 months following receipt of authorization to proceed.
The Interconnection Agreement (IA) requires that certain conditions be met, as follows:

1. The conditions of the Large Generator Interconnection Guidelines (LGIG) are met.
2. PSCO will require testing of the full range of 0 MW to 53 MW operational capability of the facility to verify that the facility can safely and reliably operate within required power factor and voltage ranges.
3. A single point of contact needs to be provided to PSCo Operations to facilitate reliable management of the transmission system.

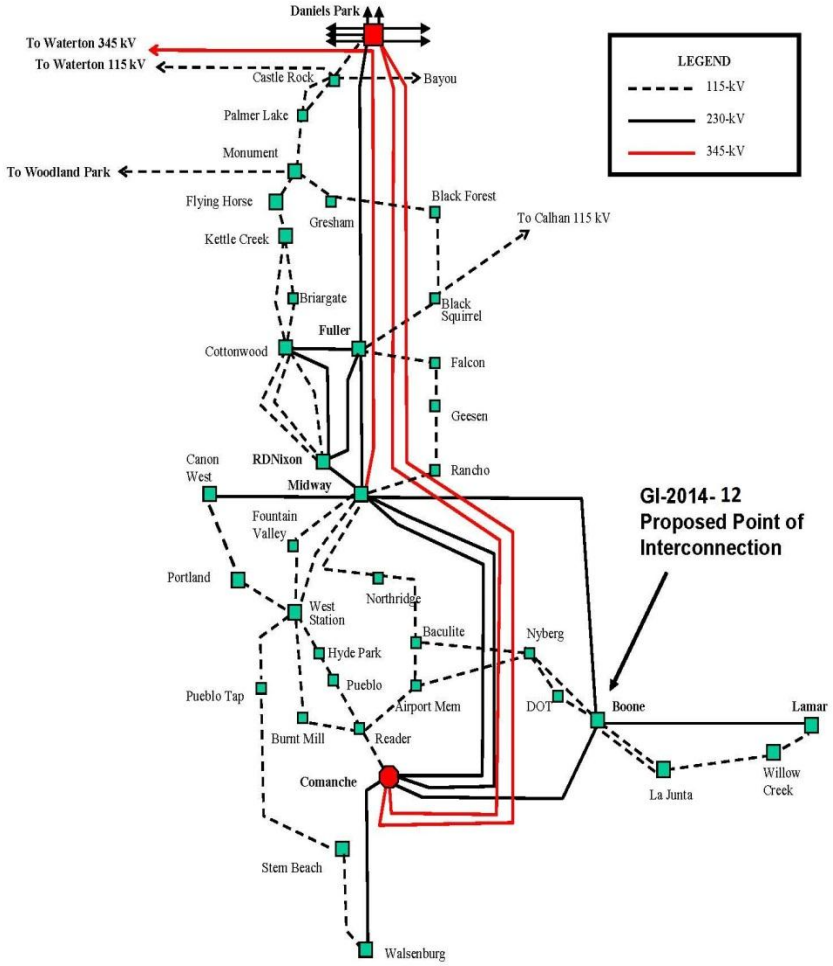

Figure 1 Boone Substation and Surrounding Transmission System

Introduction

PSCo received the study request for GI-2014-12 on November 13, 2014. The original request was for a 52MW solar PV generating facility interconnection at the Boone 115 kV Substation. The original design of GI-2014-12 consisted of sixty eight 750KW inverters and two 500 KW inverters. The Customer has later revised the request on January 21, 2015 to include an injection capacity of 53MW at the Boone 115 kV POI. The new design of GI-2014-12 will consist of twenty six SMA KODAIAK 2.2MVA inverters. The gross output at the inverter terminals will be 54.3MW and net injection capacity at the Boone 115 kV Substation will be 53MW. Each inverter will have a 385V/34.5 kV step up transformer in an arrangement referred to as a Power Conversion Station (PCS). The entire Generating facility will consist of 26 PCS. A single 34.5/115 kV star grounded/star grounded/delta 33/55MVA transformer will step-up the voltage to 115 kV for delivery through the generator tie line. A 6 Mvar shunt capacitor will connect to the 34.5 kV collector bus for additional voltage support as required.

The customer selected Boone 115 kV Substation as the primary POI. The Customer has initially requested Boone 230 kV Substation as the secondary POI, however, PSCo's OATT does not facilitate selection of two POIs at the same substation, so the secondary POI has been withdrawn by the Customer. The GI facility will connect to the POI using a Customer owned 4.8 mile 115 kV transmission tie line. The proposed in-service date of the GI-2014-12 is April 1, 2016 with a commercial operation date of July 1, 2016. The study request is for both Energy Resource Interconnection Service (ERIS) and Network Resource Interconnection Service (NRIS).

Study Scope and Criterion

The study request is for a combined Feasibility and System Impact study. The Customer initially requested a Feasibility study only, but, the study request was revised to include System Impact Study during the scoping meeting held on December 15, 2014.

The Feasibility study of GI-2014-12 evaluated the potential impacts on the PSCo transmission infrastructure as well as that of neighboring utilities when an additional 53 MW of generation is interconnected at the Boone 115 kV bus. The Feasibility analysis identified thermal and voltage limit violations resulting from the installation of the proposed generation. Several single and double contingencies were studied. The short circuit analysis identified any new circuit breakers overdutied due to the proposed generation and the short circuit current levels at the POI. The System Impact study includes dynamic stability analysis to identify any transient and oscillatory stability impacts due to the addition of the new generation.

Feasibility study Criteria: 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 of nominal and thermal loadings below the normal rating of the facility. Operationally, PSCo tries to maintain a transmission system voltage of 1.02 per unit or higher at regulating (generator) buses and 1.0 per unit or higher per unit at transmission load buses in the Boone area. Following a single or double contingency, transmission system steady state bus voltages must remain within 0.90 - 1.05 per unit, and power flows must remain within 100% of the facility's continuous thermal ratings. Also, voltage deviations should not exceed 5%.
Note-CSU operates lines at emergency ratings following single or double contingency. This report analyzed thermal overloads on the CSU lines using the emergency rating of the facility.

Transient stability criteria require that all generating machines remain in synchronism and all power swings should be well damped. Also, transient voltage performance should meet the following criteria:

- Following fault clearing for Category B contingencies, voltage may not dip more than 25% of the pre-fault voltage at load buses, more than 30% at non-load buses, or more than 20% for more than 20 cycles at load buses**.**
- Following fault clearing for Category C contingencies, voltage may not dip more than 30% of the pre-fault voltage at any bus or more than 20% for more than 40 cycles at load buses.

In addition, transient frequency performance should meet the following criteria:

- Following fault clearing for Category B contingencies, frequency should not dip below 59.6 Hz for 6 cycles or more at a load bus.
- Following fault clearing for Category C contingencies, frequency should not dip below 59.0 Hz for 6 cycles or more at a load bus.

Note that load buses include generating unit auxiliary loads.

The proposed facility was requested to be studied as both Energy Resource and Network Resource interconnection.

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.

Network Resource Interconnection Service shall mean an Interconnection Service that allows the Interconnecting Customer to integrate its Large Generating Facility with the Transmission Provider's Transmission System (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load

customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as all other Network Resources. Network Resource Interconnection Service in and of itself does not convey transmission service. This facility was not studied as a Network Resource.

The affected parties for this study are CSU, TSGT and BHCE.

Power Flow Study Models

The study was based on 2016HS power flow case created from the WECC 2015HS power flow case released on December 5, 2014. The 2016HS was updated to include topology, generation, load and rating updates to the PSCo, TSGT, BHCE, IREA and CSU systems.
BHCE updates included modeling of a fifth 90MW Baculite Mesa Generator connecting to BHCE's Baculite substation. Total Baculite Mesa generation modeled in the 2016HS cases was 470MW.

To assess the impact of GI-2014-12 on the interconnected transmission system, the generation dispatch in the reference case was adjusted to create a heavy south to north stress on the Comanche - Midway - Jackson Fuller - Daniels Park transmission path. This was accomplished by adopting the generation dispatch described in Table - 8 below. PSCo generation dispatch in zones 700, 704, 710 and 712 in the power flow case was dispatched such that wind generation is at 85% name plate capacity, solar generation is at 80% name plate capacity and conventional non-coal generation is at 90% name palate capacity, coal generation is dispatched at 100% name plate capacity. The study did not include any generation in the Generation Interconnection queue except resources for which PSCo has acquired a Power Purchase Agreements (PPA's) have been signed.

Two power flow cases were created for evaluating the impact of the proposed generator – the benchmark case and the study case. The benchmark case did not model GI-2014-12 whereas the study case included GI-2014-12. PSCo's Fort Saint Vrain unit #1 is used as the sink for GI-2014-12 generation addition. The GI-2014-12 power flow modeling data provided by the Customer was created for a 230 kV POI, so the study case modeled GI-2014-12 using zero impedance tie line and Generator model with Pmax=53MW, Pgen=53MW, Pmin=0MW and zero Qmax and Qmin values.

Power Flow Study Process

The study was performed using PTI's PSSE Version 33.4.0. Feasibility study analysis was performed using PSSE ACCC tool.
The monitored area for the study included zones 700, 704, 710, 712, 752, 757, 790, 791 and 121.
The Category B contingency analysis was performed by running bus-bus contingencies for area 70, area 73 and zone 712. Also, where bus-bus contingencies are not

applicable, the correct breaker – breaker contingency was run. The category C contingency analysis was performed by running all contingencies in the study area. The feasibility study monitored all new thermal violations and any existing thermal violations which increased by 1% due to addition of GI-2014-12. The feasibility study also monitored any new voltage violations, new voltage deviations and increases in the existing voltage violations and voltage deviations caused due to addition of GI-2014-12.

Power Flow Results

Addition of GI-2014-12 caused no new voltage violations and none of the existing voltage violations increased by more than 0.005 per unit; the feasibility study analysis found no voltage violations attributable to GI-2014-12.

The power flow results from the Category-B contingency analysis are given in Table-5. The study case showed three CSU lines with thermal loading above 100% of the normal rating of the line when GI-2014-12 is modeled at Boon 115 kV Substation. However, CSU uses emergency rating for facilities under single or double contingency, only the FLyhorse – Monument 115 kV line is overloaded at emergency rating. PSCo has an operating procedure to open the Palmer Lake – Monument 115 kV line which would mitigate the thermal violation of this line. Table-6 lists the results of single contingency analysis when Palmer Lake – Monument 115 kV line operating procedure is implemented. Hence there are no thermal violations attributable to the addition of GI-2014-12.
Since injection of the 53MW solar PV generation at the Boone 115 kV POI did not cause any thermal or voltage violations
ERIS capacity of GI-2014-12 is 53MW
NRIS capacity of GI-2014-12 is 53MW

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). Wind and Solar generating plant interconnections (Variable Energy Resources) must also conform to the performance requirements in FERC Order 661-A. Accordingly, the following voltage regulation and reactive power capability requirements (at the POI) are applicable to this interconnection request:

- To ensure reliable operation, all Generating Facilities interconnected to the PSCo transmission system should adhere to the Rocky Mountain Area Voltage Coordination Guidelines. Accordingly, since the POI for this interconnection request is located within Southeast Colorado Region 4; the applicable ideal

transmission system voltage profile range is 1.02 – 1.03 per unit at regulated buses and 1.0 – 1.03 per unit at non-regulated buses.

- 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.
- It is the responsibility of the Interconnection Customer to determine the type (switched shunt capacitors and/or switched shunt reactors, etc.), the size (MVAR), and the locations (690 V, 34.5 kV or 230 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 and the 1.02 – 1.03 per unit voltage range standards at the POI. The Interconnection Customer may need to perform additional studies for this purpose.
- It is the responsibility of the Interconnection Customer to ensure that its generating facility is capable of meeting the voltage ride-through and frequency ride-through (VRT and FRT) performance specified in NERC Reliability Standard PRC-024-1.
- 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.

Stability Analysis – Results

A dynamic stability analysis was not deemed necessary for this GI based on the "DSGMod" (set to 1) and "QVarMod (Set to 1) settings chosen by the Customer. The previous GI studies performed using the SMA KODIAK inverters for the SanLuis Valley 230 kV POI (GI-2010-11 report posted in July 2014) with the "DSGMod" set to '1' and "QvarMod" set to '1' showed acceptable dynamic performance. The SanLuis Valley 230 kV bus is a much weaker bus compared to the Boone 115 kV bus. The GI-2014-12 facility is expected to demonstrate acceptable dynamic performance with the "DSGMod" and "QvarMod" set to '1'.

Short Circuit

The calculated short circuit levels and Thevenin system equivalent impedances for the Boone 115 kV bus for the current system configuration are tabulated below.

Table 1 – Short Circuit Parameters at the Boone 115 kV POI

System Condition	Three-Phase Fault Level (Amps)	Single-Line-to-Ground Fault Level (Amps)	Thevenin Equivalent Impedance R+jX (ohms)
Before GI-2014-12 Interconnection	10901.9	10167.8	Z1(pos) = 0.83323+j6.03300 Z2(neg) = 0.85990+j6.02914 Z0(zero) = 0.99245+j7.34277
After GI-2014-12 Interconnection	11301.7	10507.1	Z1(pos) = 0.83323+j6.03300 Z2(neg) = 0.85990+j6.02914 Z0(zero) = 0.99245+j7.34277

Costs Estimates and Assumptions

Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by PSCo Engineering. The cost estimates are in 2015 dollars with escalation and contingencies applied (AFUDC is not included) and are based upon typical construction costs for previously performed similar construction. These estimated costs include all applicable labor and overheads associated with the siting support, engineering, design, and construction of these new PSCo facilities. This estimate does not include the cost for any other Customer owned equipment and associated design and engineering.

Figure 2 below represents a conceptual one-line of the proposed interconnection at the Boone 115kV Substation. 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 GI-2014-12 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 2 – PSCo Owned; Customer Funded Transmission Provider Interconnection Facilities

Element	Description	Cost Est. (Millions)
PSCo's Boone 115kV Transmission Substation	Interconnect Customer to the 115kV bus at the Boone 115kV Substation. The new equipment includes: • One 115kV circuit breaker • Two 115kV gang switch • One 115V combination CT/PT metering units • Power Quality Metering (115kV line from Customer) • One 115kV lightning arresters • One relay panel (transformer breaker panel) • Associated bus, wiring and equipment • Associated foundations and structures • Associated transmission line communications, relaying and testing	**$1.179**
	Transmission line tap into substation. Structure, conductor, hardware and installation labor.	**$0.050**
	Total Cost Estimate for PSCo-Owned, Customer-Funded Interconnection Facilities	**$1.229**
Time Frame	**Design, procure and construct**	**18 Months**

Table 3: PSCo Owned; PSCo Funded Interconnection Network Facilities

Element	Description	Cost Estimate (Millions)
PSCo's Boone 115kV Transmission Substation	Interconnect Customer to the 115kV bus at the Boone 115kV Substation. The new equipment includes: • One 115kV gang switches • Associated communications, supervisory and SCADA equipment • Associated line relaying and testing • Associated bus, miscellaneous electrical equipment, cabling and wiring • Associated foundations and structures • Associated road and site development, fencing and grounding	**$0.083**
	Siting and Land Rights support for substation land acquisition and construction.	**$0.010**
	Total Cost Estimate for PSCo-Owned, PSCo-Funded Interconnection Facilities	**$0.093**
Time Frame	**Site, design, procure and construct**	**18 Months**

Table 4 – PSCo Network Upgrades for Delivery

Element	Description	Cost Est. (Millions)
	Not Applicable	**$0.00**
	Total Cost Estimate for PSCo Network Upgrades for Delivery	**$0.00**
	Design, procure and construct	**N/A**
	Total Project Estimate	**$1.322**

Cost Estimate Assumptions

- Scoping level cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades for Delivery (+/- 30% accuracy) were developed by PSCo Engineering.
- Estimates are based on 2015 dollars (appropriate contingency and escalation applied).
- AFUDC has been excluded.
- Labor is estimated for straight time only – no overtime included.
- Lead times for materials were considered for the schedule.
- The Solar Generation Facility is not in PSCo's retail service territory. Therefore, no costs for retail load metering are included in these estimates.
- PSCo (or it's Contractor) crews will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities.
- The estimated time to design, procure and construct the interconnection facilities is approximately 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.
- Customer will string OPGW fiber into substation as part of the transmission line construction scope.
- Breaker duty study determined that no breaker replacements are needed in neighboring substations.
- Line and substation bus outages will be authorized during the construction period to meet backfeed. Could potentially be problematic and extend requested backfeed date due to summer construction window.
- Power Quality Metering (PQM) will be required on the Customer's 115 kV line terminating into Boone Substation.

Figure – 2: One-Line of Proposed GI-2014-12 - 53MW Solar PV Generation Facility at Boone 115 kV POI

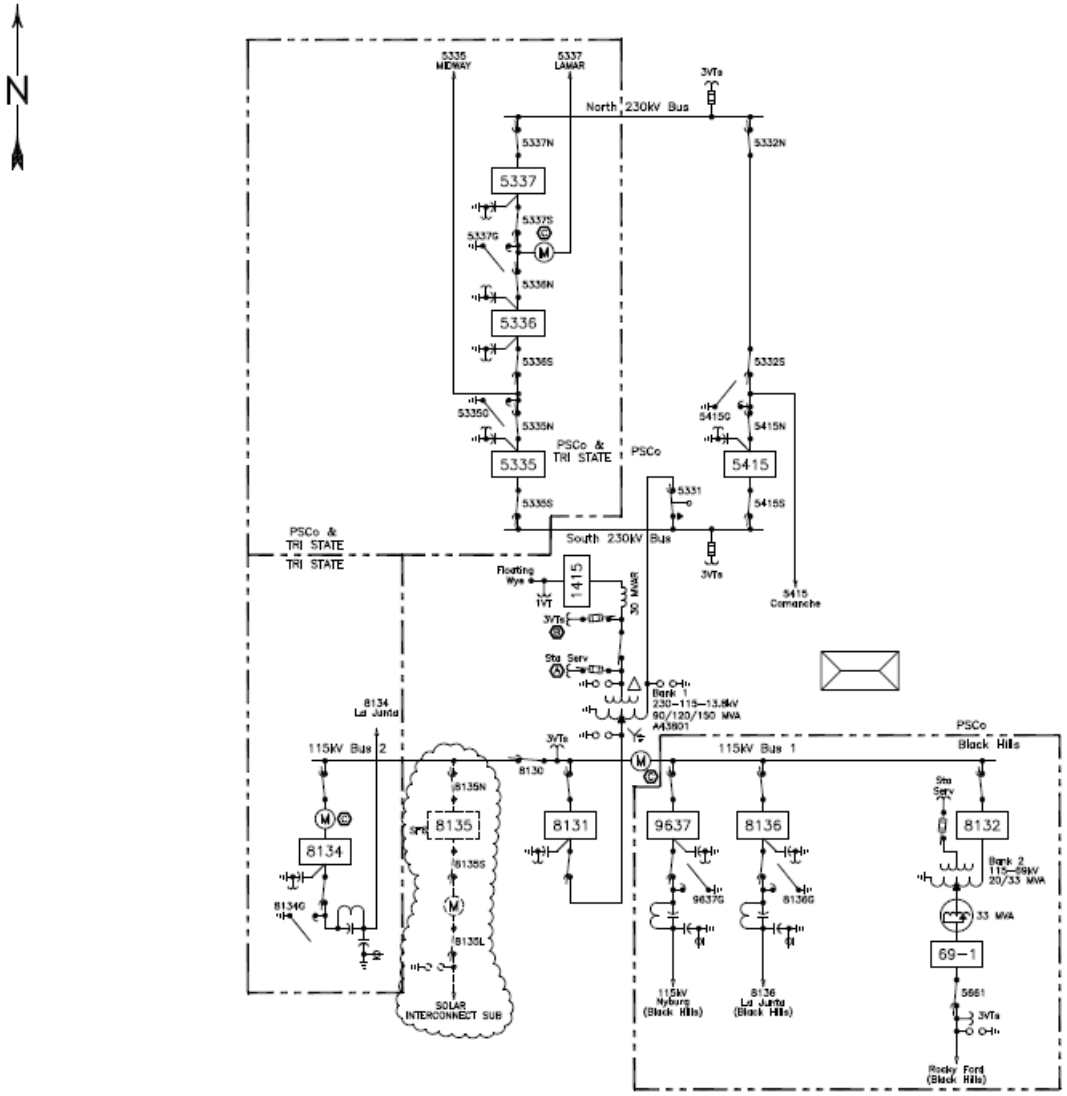

Table 5 – Summary of thermal violations from single contingency analysis due to addition of GI-2014-12

% change calculated based on emergency loading

				Contingency Loading Without GI-2014-12		Contingency Loading With GI-2014-12			
Monitored Facility (Line or Transformer)	**Type**	**Owner**	**Branch Rating MVA (Norm/Emer)**	**N-1 Flow MVA**	**N-1 Flow % of Rating**	**N-1 Flow MVA**	**N-1 Flow % of Rating**	**% Change**	**NERC Cat B Contingency**
BrairgateS - CottonwoodS115 kV	Line	CSU	162/180	174.5	107.7%/96.3%	177	109.3%/98.4%	2.1%	Cottonwood N-Kettle Creek S 115 kV
CottonwoodN - KettleCreekS115 kV	Line	CSU	150/192	161	107.3%/83.8%	163.5	109.0%/85.1%	1.3%	BrairgateS - CottonwoodS 115 kV
Monument – Flyhorse 115 kV	Line	CSU	120/120	118	98.4%/98.4%	121.7	101.4%/101.4%	3%	BLK SQMV – Fuller 115 kV

Table 6 – Summary of thermal violations from single contingency analysis due to addition of GI-2014-12 with Palmer Lake – Monument 115 kV line operating procedure

% change calculated based on emergency loading

				Contingency Loading Without GI-2014-12		Contingency Loading With GI-2014-12			
Monitored Facility (Line or Transformer)	**Type**	**Owner**	**Branch Rating MVA (Norm/Emer)**	**N-1 Flow MVA**	**N-1 Flow % of Rating**	**N-1 Flow MVA**	**N-1 Flow % of Rating**	**% Change**	**NERC Cat B Contingency**
BrairgateS - CottonwoodS115 kV	Line	CSU	162/180	139	85.8%/77.2%	140	86.4%/77.8%	0.6%	Cottonwood N-Kettle Creek S 115 kV
CottonwoodN - KettleCreekS115 kV	Line	CSU	150/192	124.7	83.1%/64.9%	126	84%/65.6%	0.7%	BrairgateS - CottonwoodS 115 kV
Monument – FlyhorseN 115 kV	Line	CSU	120/120	74	61.7%/61.7%	75.6	63%/63%	1.3%	BLK SQMV – Fuller 115 kV

Xcel Energy

Table 7 – Summary of thermal violations from single contingency analysis due to addition of GI-2014-12

% change calculated based on emergency loading

				Branch N-2 Loading Without GI-2004-2 Restudy		Branch N-2 Loading With GI-2004-2 Restudy			
Monitored Facility (Line or Transformer)	**Type**	**Owner**	**Branch Rating MVA (Norm/Emer)**	**N-2 Flow MVA**	**N-2 Flow % of Rating**	**N-2 Flow MVA**	**N-2 Flow % of Rating**	**% Change**	**NERC Cat C Contingency**
Airport Park – Baculite 115 kV	Line	BHCE	195/195	195	100%/100%	201.2	103.2%/103.2%	3.2%	Baculite – West Station 115 kV#1 &2
Baculite – Northridge 115 kV	Line	BHCE	119/119	120.3	101.1%/101.1%	126.3	106.1%/106.1%	5%	Baculite – West Station 115 kV#1 &2
Fountain Valley – DesertCov 115 kV	Line	BHCE	115/115	121.7	105.8%/105.8%	128.6	111.8%/111.8%	6%	MidwayBR 230 kV breaker failure
Fountain Valley – MidwayBR 115 kV	Line	BHCE	115/115	120.3	104.6%/104.6%	127.0	110.5%/110.5%	5.9%	MidwayBR 230 kV breaker failure
DesertCov – West Station 115kV	Line	BHCE	120/120	144.2	120.2%/120.2%	151.2	126%/126%	5.8%	MidwayBR 230 kV breaker failure
Daniels Park – Fuller 230 kV	Line	PSCo	478/478	511.5	107%/107%	529	110.7%/110.7%	3.7%	Comanche – Daniels Park 345 kV #1&2
Midway 230/115 kV #T1	Xfmr	PSCo	97/97	101	104.1%/104.1%	107.5	110.8%/110.8%	6.7%	Comanche – Daniels Park 345 kV #1&2
MidwayPS-Midway BR 230 kV	Bus tie	WAPA/ PSCo	430/478	468.7	109%/98%	486.3	113.1%/101.7%	3.7%	Comanche – Daniels Park 345 kV #1&2
Palmer Lake – Monument 115 kV	Line	PSCo	120/120	148.9	124.1%/124.1%	154	128.4%/128.4%	4.3%	Comanche – Daniels Park 345 kV #1&2
Monument – FlyhorseN 115 kV	Line	CSU	120/120	156.6	130.5%/130.5%	161.9	134.9%/134.9%	4.4%	Comanche – Daniels Park 345 kV #1&2
Flyhorse – KettleCreekN115 kV	Line	CSU	162/180	167.2	103.2%/92.9%	172.4	106.4%/95.8%	2.9%	Comanche – Daniels Park 345 kV #1&2
BrairigateS-CottonwoodS 115 kV	Line	CSU	162/180	191.3	118.1%/106.3%	193.9	119.7%/107.7%	1.4%	Cottonwood North Bus outage
CottonwoodN-KettlecreekS 115 kV	Line	CSU	150/192	147.1	98.1%/76.6%	150	100%/78.1%	1.5%	Cottonwood South Bus outage
BlackForest Tap – BLK SQMV 115kV	Line	CSU	81/81	121.7	150.2%/150.2%	123.6	152.6%/152.6%	2.4%	Cottonwood 115 kV tie breaker outage
BLk SQMV – Fuller 115 kV	Line	CSU	143/143	144.1	100.8%/100.8%	146.1	102.2%/102.2%	1.4%	Cottonwood 115 kV tie breaker outage

				Branch N-2 Loading Without GI-2004-2 Restudy		Branch N-2 Loading With GI-2004-2 Restudy			
Monitored Facility (Line or Transformer)	**Type**	**Owner**	**Branch Rating MVA (Norm/Emer)**	**N-2 Flow MVA**	**N-2 Flow % of Rating**	**N-2 Flow MVA**	**N-2 Flow % of Rating**	**% Change**	**NERC Cat C Contingency**
Fountain S-RD_Nixon 115kV	Line	CSU	195/212	229.7	117.8%/108.3%	231.5	118.7%/109.2%	0.9%	Kelker 230 kV Tie breaker outage

Table 8- Generation Dispatch of Major Generating Units in the Study area (MW is Gross value)

PSCo:

Bus	LF ID	MW
Comanche PV	S1	102
Comanche	C1	360
Comanche	C2	365
Comanche	C3	805
Lamar DC Tie	DC	0
Fountain Valley	G1	36
Fountain Valley	G2	36
Fountain Valley	G3	36
Fountain Valley	G4	36
Fountain Valley	G5	36
Fountain Valley	G6	36
Colorado Green	1	81
Colorado Green	2	81
Twin Butte	1	75
Jackson Fuller	W1	200
Comanche PV	S1	120
Alamosa CT	G1	0
Alamosa CT	G2	0
Cogentrix	S1	25.5
Greater Sandhill	S1	14.5
Blanca Peak	S1	19.5
SLV Solar	S1	44.2
Fort Saint Vrain	G1	116.8
Fort Saint Vrain	G2	100.0
Fort Saint Vrain	G3	100.0
Fort Saint Vrain	G4	0
Fort Saint Vrain	G5	0
Fort Saint Vrain	G6	0
Fort Saint Vrain	G7	0

BHE:

Bus	LF ID	MW
BUSCHWRTG1	G1	3.6
BUSCHWRTG2	G2	3.6
E Canon	G1	0
PP_MINE	G1	0
Pueblo Diesels	G1	0
Pueblo Plant	G1	0
Pueblo Plant	G2	0.0
R.F. Diesels	G1	0.0
Airport Diesels	G1	0.0
Canyon City	C1	0
Canyon City	C1	0

Baculite 1	G1	90
Baculite 2	G1	90
Baculite 3	G1	40.0
Baculite 3	G2	40.0
Baculite 3	S1	20
Baculite 4	G1	40.0
Baculite 4	G2	40.0
Baculite 4	S1	20
Baculite 5	G1	90

CSU:

Bus	LF ID	MW
Birdsale1	1	0.0
Birdsale 2	1	0.0
Birdsale 3	1	0.0
RD_Nixon	1	225.39
Tesla	1	13.2
Drake 5	1	49.65
Drake 6	1	83.19
Drake 7	1	138.03
Nixon CT 1	1	0.0
Nixon CT 2	1	0.0
Front Range CC 1	1	120.4
Front Range CC 2	1	120.8
Front Range CC 3	1	120.0