

Addendum
System Impact Study Report
Generation Interconnection Request # GI-2015-1

250 MW Wind Generation Facility
Comanche – Daniels Park 345kV Line (L7015)
Elbert County, Colorado

Transmission Planning West
Xcel Energy
March 23, 2017

Revised Multiple Contingency Results

After posting the System Impact Study report, Colorado Springs Utilities has informed PSCo that their Transmission Planning criterion has been changed. The revised criterion requires that single contingency analysis is based on the normal rating of facilities and multiple contingency analysis is based on the emergency rating of the facilities. This addendum also clarifies the reactive power requirements at the POI.

Based on the new criteria, the SIS study did not find any single contingency thermal overloads on the CSU system that would be attributable to GI-2015-1.



Notes –

1. All thermal violations are identified in red.
2. For Double Contingency Analysis, thermal overloads on All facilities are calculated using applicable Emergency Rating of the facility

**Table 7 – Summary of thermal violations from Multiple Contingency Analysis
Without Palmer Lake– Monument 115kV Line Operating Procedure**

				Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1			
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 Multiple Contingency
Portland - Skala115kV	Line	BHCE	119/119	131.7	110.7%/110.7%	140.5	118.1%/118.1%	7.4%	Midway 230kV Breaker Outage
Canyon- Skala 115kV	Line	BHCE	119/119	117.4	98.7%/98.7%	125.5	105.5%/105.5%	6.8%	Midway 230kV Breaker Outage
West Canyon 230/115kV	Xfmr	BHCE	100/100	103.6	103.6%/103.6%	104.9	104.9%/104.9%	1.3%	Portland – West Station 115kV#1 &2
Arapahoe – SantaFe 230kV	Line	PSCo	300/330	300.6	100.2%/91.1%	346.2	115.4%/105.0%	13.9%	Greenwood- Prairie – Daniels Park 230kV # 1&2
Daniels Park - SantaFe 230kV	Line	PSCo	319/319	337.5	105.8%/105.8%	383.1	120.1%/120.1%	14.3%	Greenwood- Prairie – Daniels Park 230kV # 1&2
BlackForest Tap – BLK SQMV 115kV	Line	TSGT	81/81	132.4	163.4%/163.4%	136.4	168.4%/168.4%	5%	Cottonwood 115kV tie breaker outage
BLk SQMV – Fuller 115kV	Line	TSGT	143/143	153.4	107.3%/107.3%	157.6	110.2%/110.2%	2.9%	Cottonwood 115kV tie breaker outage
Fuller 230/115kV	Xfmr	TSGT	100/100	131.6	131.6%/131.6%	133.2	133.2%/133.2%	1.6%	Cottonwood 115kV tie breaker outage
Fountain S-RD_Nixon 115kV	Line	CSU	195/212	259.3	133.0%/122.3%	262.5	134.6%/123.8%	1.5%	Kelker 230kV Tie breaker outage
DanielsPark – Fuller 230kV	Line	PSCo	478/478	583.7	122.1%/122.1%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Fountain Valley – Desertcove 115kV	Line	BHCE	119/119	122.1	102.6%/102.6%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	120.9	101.6%/101.6%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Hydepark – West Station 115kV	Line	BHCE	120/120	105.6	88.0%/88.0%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
MidwayPS - MidwayBR 230kV	Line	PSCo/	430/478	422.2	98.2%/88.3%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2



**Table 7 – Summary of thermal violations from Multiple Contingency Analysis
Without Palmer Lake– Monument 115kV Line Operating Procedure**

				Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1			
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 Multiple Contingency
		WAPA							
Palmer Lake – Monument 115kV	Line	CSU	132/153	166.1	125.8%/108.6%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
DesertCove – West Station 115V	Line	BHCE	119/119	144.5	121.4%/121.4%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
FlyhorseS-KettlecreekN 115kV	Line	CSU	162/180	196.7	121.4%/109.3%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Monument – FlyhorseN 115kV	Line	CSU	142/156	185.1	130.4%/118.7%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Monument – Flyhorse N 115kV	Line	CSU	142/157	N/A	N/A	183.9	129.5%/117.1%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Flyhorse S – Kettlecreek N 115kV	Line	CSU	162/180	N/A	N/A	195.4	120.6%/108.6%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Palmer lake – Monument 115kV	Line	CSU/PS Co	132/153	N/A	N/A	164	124.2%/107.2%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
DanielsPark – Fuller 230kV	Line	PSCo	478/478	N/A	N/A	570.7	119.4%/119.4%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Fountain Valley – Desertcove 115kV	Line	BHCE	119/119	N/A	N/A	121.1	101.8%/101.8%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	N/A	N/A	119.9	100.7%/100.7%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
DesertCove – West Station 115V	Line	BHCE	119/119	N/A	N/A	143.3	120.4%/120.4%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Daniels Park – Fuller 230kV	Line	PSCo	478/478	N/A	N/A	670.1	140.2%/140.2%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Fountain Valley – DesertCove 115kV	Line	BHCE	119/119	N/A	N/A	144.7	121.6%/121.6%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1



**Table 7 – Summary of thermal violations from Multiple Contingency Analysis
Without Palmer Lake– Monument 115kV Line Operating Procedure**

				Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1			
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 Multiple Contingency
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	N/A	N/A	143.4	120.5%/120.5%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
HydePark – West Station 115kV	Line	BHCE	120/120	N/A	N/A	130.6	108.8%/108.8%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
MidwayPS - MidwayBR 230kV	Line	PSCo/WAPA	430/478	N/A	N/A	503.7	117.1%/105.4%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Palmer Lake – Monument 115kV	Line	CSU/PS Co	132/153	N/A	N/A	191.3	144.9%/125.0%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
DesertCove – West Station 115V	Line	BHCE	119/119	N/A	N/A	168.1	141.2%/141.2%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Cottonwood N – KettleCreekS 115kV	Line	CSU	150/192	N/A	N/A	189.8	117.1%/105.4%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Monument – Flyhorse N 115kV	Line	CSU	142/157	N/A	N/A	211.1	148.6%/134.4%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Flyhorse S – Kettlecreek N 115kV	Line	CSU	162/180	N/A	N/A	223	137.6%/123.9%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1

**Table 8 – Summary of thermal violations from Multiple Contingency Analysis
With Palmer Lake– Monument 115kV Line Operating Procedure**

				Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1			
--	--	--	--	--	--	---	--	--	--



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 Multiple Contingency
Portland - Skala115kV	Line	BHCE	119/119	131.8	110.7%/110.7%	140.5	118.1%/118.1%	7.3%	Midway 230kV Breaker Outage
Canyon- Skala 115kV	Line	BHCE	119/119	117.6	98.7%/98.7%	125.5	105.5%/105.5%	6.7%	Midway 230kV Breaker Outage
West Canyon 230/115kV	Xfmr	BHCE	100/100	104.2	104.2%/104.2%	105.5	105.5%/105.5%	1.3%	Portland – West Station 115kV#1 &2
Arapahoe – SantaFe 230kV	Line	PSCo	300/330	303	101.0%/91.8%	348.9	116.3%/105.7%	13.9%	Greenwood- Prairie – Daniels Park 230kV # 1&2
Daniels Park - SantaFe 230kV	Line	PSCo	319/319	339.7	106.5%/106.5%	386	121.0%/121.0%	14.5%	Greenwood- Prairie – Daniels Park 230kV # 1&2
Daniels Park – Surrey Ridge 230kV	Line	PSCo	478/478	428.1	89.6%/89.6%	490.9	102.7%/102.7%	13.1%	Greenwood- Prairie – Daniels Park 230kV # 1&2
BlackForest Tap – BLK SQMV 115kV	Line	TSGT	81/81	157.9	195.0%/195.0%	161.0	198.8%/198.8%	3.8%	Cottonwood 115kV tie breaker outage
BLk SQMV – Fuller 115kV	Line	CSU	143/143	179.2	125.3%/125.3%	182.3	127.5%/127.5%	2.2%	Cottonwood 115kV tie breaker outage
Fuller 230/115kV	Xfmr	CSU	100/100	150.8	150.8%/150.8%	151.8	151.8%/151.8%	1.0%	Cottonwood 115kV tie breaker outage
Monument – Gresham 115kV	Line	TSGT	145/145	148.9	102.7%/102.7%	152.1	104.9%/104.9%	2.2%	Cottonwood 115kV tie breaker outage
Fountain S-RD_Nixon 115kV	Line	CSU	195/212	252.1	129.3%/118.9%	254.7	130.6%/120.1%	1.2%	KelKer 230kV Tie breaker outage
DanielsPark – Fuller 230kV	Line	PSCo	478/478	660.1	138.1%/138.1%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Fountain Valley – Desertcove 115kV	Line	BHCE	119/119	117.2	98.5%/98.5%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	115.9	97.4%/97.4%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Hydepark – West Station 115kV	Line	BHCE	120/120	105.3	87.7%/87.7%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
MidwayPS - MidwayBR 230kV	Line	PSCo/ WAPA	430/478	397.2	92.4%/83.1%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Palmer Lake – Monument 115kV	Line	CSU	132/153	N/A	N/A	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
DesertCove – West Station 115V	Line	BHCE	119/119	139.6	117.3%/117.3%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
FlyhorseS-KettlecreekN 115kV	Line	CSU	162/180	91	56.2%/50.6%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2
Monument – FlyhorseN 115kV	Line	CSU	142/156	79.5	56%/50.6%	N/A	N/A	N/A	Comanche – Daniels Park 345kV # 1&2



**Table 8 – Summary of thermal violations from Multiple Contingency Analysis
With Palmer Lake– Monument 115kV Line Operating Procedure**

				Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1			
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 Multiple Contingency
Monument – Flyhorse N 115kV	Line	CSU	142/157	N/A	N/A	79.5	56.0%/50.7%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Flyhorse S – Kettlecreek N 115kV	Line	CSU	162/180	N/A	N/A	91	56.2%/50.6%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Palmer lake – Monument 115kV	Line	CSU	132/153	N/A	N/A	N/A	N/A	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
DanielsPark – Fuller 230kV	Line	PSCo	478/478	N/A	N/A	646	135.1%/135.1%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Fountain Valley – Desertcove 115kV	Line	BHCE	119/119	N/A	N/A	116.2	97.6%/97.6%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	N/A	N/A	114.9	96.6%/96.6%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
DesertCove – West Station 115V	Line	BHCE	119/119	N/A	N/A	138.4	116.3%/116.3%	N/A	Comanche – Daniels Park 345kV #1 & Comanche – GI-Tap 345kV #1
Daniels Park – Fuller 230kV	Line	PSCo	478/478	N/A	N/A	760.2	159%/159%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Fountain Valley – DesertCove 115kV	Line	BHCE	119/119	N/A	N/A	139.7	117.4%/117.4%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Fountain Valley – MidwayBR 115kV	Line	BHCE	119/119	N/A	N/A	138.4%	116.3%/116.3%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
HydePark – West Station 115kV	Line	BHCE	120/120	N/A	N/A	130.9	109.1%/109.1%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
MidwayPS - MidwayBR 230kV	Line	PSCo/WAPA	430/478	N/A	N/A	474.6	110.4%/99.3%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Palmer Lake – Monument 115kV	Line	CSU	132/153	N/A	N/A	N/A	N/A	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
DesertCove – West Station	Line	BHCE	119/119	N/A	N/A	163.3	137.2%/137.2%	N/A	Comanche – Daniels Park 345kV #1 &



**Table 8 – Summary of thermal violations from Multiple Contingency Analysis
With Palmer Lake– Monument 115kV Line Operating Procedure**

Monitored Facility (Line or Transformer)	Type	Owner	Branch Rating MVA (Norm/Emer)	Branch Contingency Loading Without GI-2015-1		Branch Contingency Loading With GI-2015-1		% Change	NERC Multiple Contingency
				N-2 Flow MVA	N-2 Flow % of Rating	N-2 Flow MVA	N-2 Flow % of Rating		
115V									Daniels Park – GI-Tap 345kV #1
Cottonwood N – KettleCreekS 115kV	Line	CSU	150/192	N/A	N/A	110.5	68.2%/61.4%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Monument – Flyhorse N 115kV	Line	CSU	142/157	N/A	N/A	89.9	63.3%/57.2%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1
Flyhorse S – Kettlecreek N 115kV	Line	CSU	162/180	N/A	N/A	101.8	62.9%/56.6%	N/A	Comanche – Daniels Park 345kV #1 & Daniels Park – GI-Tap 345kV #1

The incremental overloads on the following BHCE facilities are attributable to GI-2015-1 Interconnection

- Portland – Skala 115kV line loading increased from 110.7% to 118.1%
- Canyon City – Skala 115kV line loading increased from 98.7% to 105.5%
- West Canyon 230/115kV transformer loading increased from 104.2% to 105.5%
- Fountain Valley – Desertcove 115kV line loading increased from 102.6% to 121.6%
- Fountain Valley – MidwayBR 115kV line loading increased from 101.6% to 120.5%
- Hydepark – West Station 115kV line loading increased from 87.7% to 109.1%
- Desertcove – West Station 115kV line loading increased from 121.4% to 141.2%

The incremental overloads on the following TSGT facilities are attributable to GI-2015-1 Interconnection

- Black Forest Tap – BLK SQMV 115kV line loading increased from 195.0% to 198.8%
- BLK SQMV – Fuller 115kV line loading increased from 125.3% to 127.5%
- Fuller 230/115kV line loading increased from 150.8% to 151.8%
- Monument – Gresham 115kV line loading increased from 102.7T to 104.9%



The incremental overloads on the following WAPA facilities are attributable to GI-2015-1 Interconnection

- Midway PS – Midway BR 230kV tie line loading increased from 88.3% to 105.4%

The Palmer Lake – Monument 115kV line operating procedure was able to mitigate most of the overloads on the CSU facilities. The incremental overloads on the following CSU facility is attributable to GI-2015-1 Interconnection

- Fountain_S – RD_Nixon 115kV line loading increased from 122.3% to 123.8%

Since the study simulated heavy south – north flows with renewable resources dispatched at 85% of the nameplate capacity, the multiple contingency overloads on the PSCo facilities will be addressed by system readjustments (including generation curtailment) implemented via operating procedures. PSCo facility overloads due to multiple contingencies are not attributed to the GI-2015-1 interconnection.

Energy Resource Interconnection Service (ERIS): GI-2015-1 output for ERIS is 0 MW for the studied generation dispatch scenario due to the single contingency overload on the BHCE system and multiple contingency thermal overloads on the CSU, BHCE, TSGT and WAPA facilities listed above. However, higher output may become feasible on an as-available basis depending on the prevailing dispatch of existing generation resources located in the electrical vicinity of GI-2015-1 (Jackson Fuller, Comanche, Midway and Lamar areas, CSU system and BHCE system).

Network Resource Interconnection Service (NRIS): Implementing the Network Upgrades needed to mitigate the above mentioned thermal overloads on CSU, TSGT, WAPA and BHCE systems will allow GI-2015-1 to achieve full NRIS of 250MW. The Interconnection Customer has to work with the facility owner in order to identify mitigation measures to eliminate the above listed affected party facility overloads attributed to GI-2015-1 interconnection.

Voltage Regulation and Reactive Power Capability

Interconnection Customers are required to interconnect its Large Generating Facility with Public Service of Colorado's (PSCo) Transmission System in accordance with the *Xcel Energy Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW* (available at: <http://www.transmission.xcelenergy.com/staticfiles/microsites/Transmission/Files/PDF/Interconnection/Interconnections-POL->



[TransmissionInterconnectionGuidelineGreat20MW.pdf](#)).

In addition, wind generating plant interconnections must also fulfill the performance requirements specified 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 are expected to adhere to the Rocky Mountain Area Voltage Coordination Guidelines (RMAVCG). Accordingly, since the POI for this interconnection request is located within Southeast Colorado - Region 4 defined in the *RMAVCG*; 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 (Attachment N effective 10/14/2016) requires all non-synchronous Generator Interconnection (GI) Customers to provide dynamic reactive power within the power factor range of 0.95 leading to 0.95 lagging at the high side of the generator substation. Furthermore, Xcel Energy requires every Generating Facility to have dynamic voltage control capability to assist in maintaining the POI voltage schedule specified by the Transmission Operator as long as the Generating Facility does not have to operate outside its 0.95 lag – 0.95 lead dynamic power factor range capability.
- 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 (34.5 kV or 345 kV bus) of any additional static reactive power compensation needed within the generating plant in order to have adequate reactive capability to meet the +/- 0.95 power factor and the 1.02 – 1.03 per unit voltage range standards at the POI. Further, for wind generating plants to meet the LVRT (Low Voltage Ride Through) performance requirements specified in FERC Order 661-A, an appropriately sized and located dynamic reactive power device (DVAR, SVC, etc.) may also need to be installed within the generating plant. Finally, it is the responsibility of the Interconnection Customer to compensate their generation tie-line to ensure minimal reactive power flow under no load conditions.
- 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).