Holms Mesa Load Interconnection System Impact Study

Request # NQ-2011-2

August 28, 2012

I. Executive Summary

The objective of this Load Interconnection System Impact Study is to examine the reliability of the bulk transmission system to serve a load north of the Parachute Substation at a proposed substation called Holms Mesa. The Customer requested that PSCo study an ultimate demand of 28.0 MVA load (0.98 lagging power factor). The Customer proposed an in-service date of second quarter 2013, for the load interconnection project

Transmission reliability studies were conducted. The study assumed a Middle Fork (Bench) 230kV demand of 40.5 MW (with 19.2 MVAR), an Una Orchard 69kV demand of 18.9 MW (with 11.0 MVAR), and a Starkey Gulch 230kV demand of 47.5 MW (with 15.6 MVAR). The study assumed a 7.5 MVAR capacitor bank would be available at the Una Orchard 69kV bus, a 45 MVAR capacitor bank would be available at the Cameo 230kV bus, and a 45 MVAR capacitor bank would be available at the Parachute 230kV bus. The study considered a proposed 28.0 MVA load served from a substation called “Holms Mesa” located approximately six miles north of Parachute and approximately one-half mile from the RiflePS-Parachute 230kV line. The transmission portion of the project consists of an in-an-out connection to the RiflePS-Parachute 230kV line and a one-half mile double circuit 230kV transmission line (strung with 1-795 kcmil ACSR conductor) constructed from the tap point to the new Holms Mesa Substation. The new transmission substation would consist of a 230kV three breaker ring bus laid out for future breaker-and-a-half along with revenue metering. The approximate cost for this transmission substation project is $6.02 million and is PSCo’s cost responsibility. The 1-795 kcmil ACSR conductor for the double circuit 230kV line was selected to match the existing conductor of the RiflePS-Parachute 230kV line. PSCo may need to replace the 1-795 kcmil ACSR conductor on the RiflePS-Parachute 230kV line with 1-1272 kcmil ACSR conductor in the future if additional load-serving capacity is needed. Therefore, the use of 1-1272 kcmil ACSR conductor for the double circuit 230kV transmission line from the tap point to the new Holms Mesa Substation should be considered.

The 28.0 MVA Holms Mesa load will impact the bulk electric transmission system. The load will increase line flows and decrease bus voltages in the study area. The study determined the demand levels that can be served at Holms Mesa under high TOT2A power transfer levels (500 MW north-to-south) and on-peak summer demand conditions in the load-serving area. They are:

- A Homes Mesa demand of 6.0 MW (and 1.2 MVAR), with maximum TOT2A north-to-south power transfers of 500 MW, during the summer on-peak conditions, can be reliably served.
- A Holms Mesa demand of 15.0 MW (and 3.0 MVAR), with maximum TOT2A north-to-south power transfers of 500 MW, during summer on-peak conditions, and the RiflePS-Parachute 230kV rating increased to its thermal rating (439 MW), can be reliably served. The feasibility of achieving the thermal rating of 439 MVA has not been determined.
- A Holms Mesa demand of 28.0 MVA (27.4 MW and 5.6 MVAR), with maximum TOT2A north-to-south power transfers reduced to 450 MW, during summer on-peak conditions, can be reliably served.
- A Holms Mesa demand of 28.0 MVA (27.4 MW and 5.6 MVAR), with maximum TOT2A north-to-south power transfers of 500 MW, and a transmission addition (the RifleCu-Parachute 230kV line), during summer on-peak conditions, can be reliably served.

PSCo has transmission projects under consideration that will support load additions in the Rifle-Parachute load-serving area (including the proposed Holms Mesa 28.0 MVA load). These projects include the following:

- The RifleCu-Parachute 230kV line. The line will be constructed with 1-1272 kcmil ACSR conductor. (Proposed in-service date: December 2015).
- The RifleCu-RifleWA 230kV (Circuit No. 3007) line uprate. The line has a 574 MVA thermal rating but is presently limited to 478 MVA based on substation element limitations at the RifleCu Substation. The project supports the RifleCu-Parachute 230kV line. (Proposed in-service date: 2015).
- The Grand Junction 138-115kV transformer #2 (Proposed in-service date: 2015).

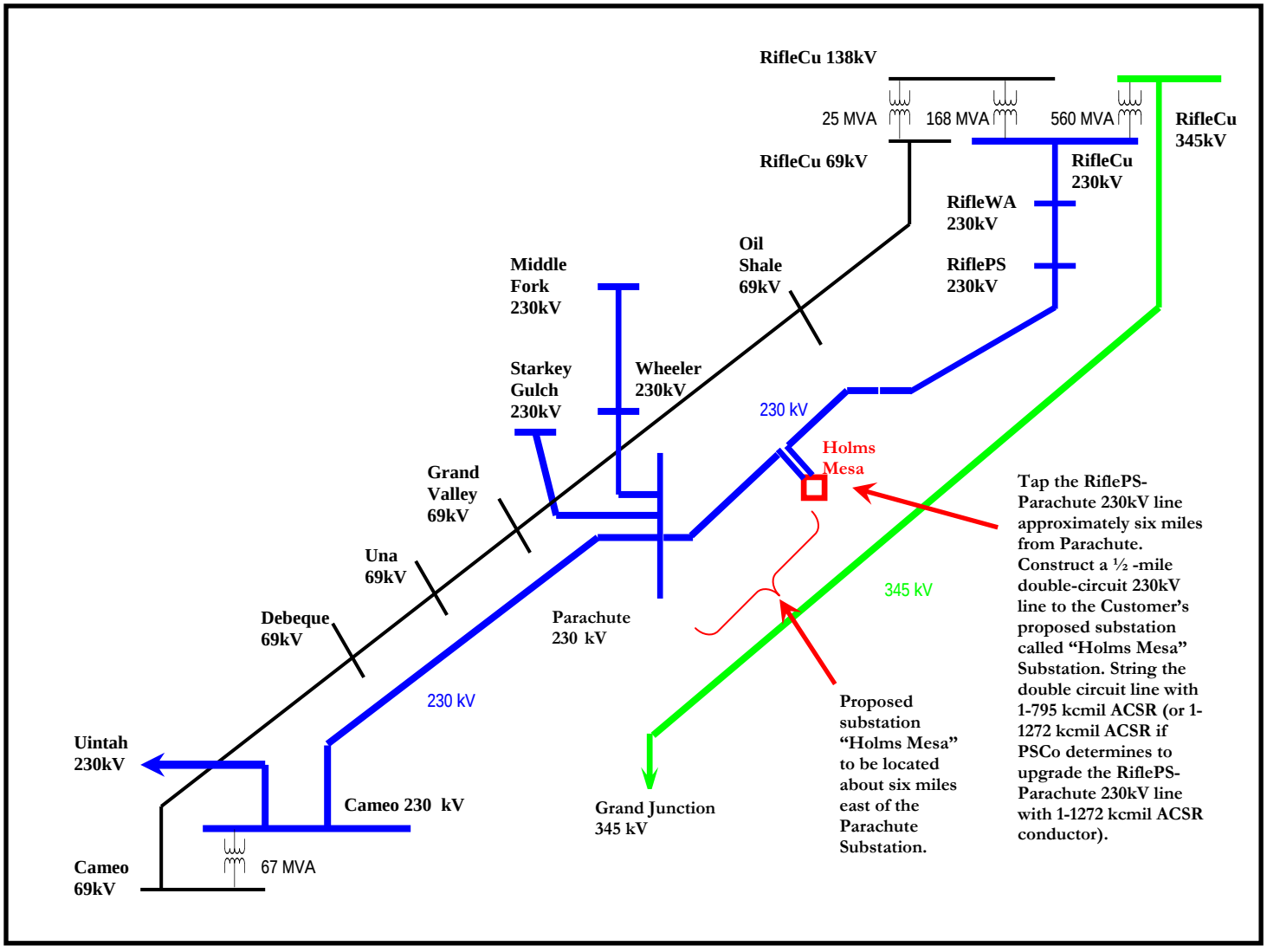
The proposed RifleCu-Parachute 230kV could be terminated at the RiflePS Substation creating a RiflePS-Parachute 230kV line #2 if PSCo finds it is not feasible to terminate the RifleCu-Parachute 230kV line at the RifleCu Substation. A RiflePS-Parachute 230kV line #2 would also support the Holms Mesa 28.0 MVA load addition. A RiflePS-Parachute 230kV line #2 would require the replacement of the existing RiflePS-RifleWA 230kV bus work at the Rifle Substation with bus work of higher capacity.

The study concludes that the Holms Mesa 28.0 MVA load addition can be served from the bulk transmission system under high TOT2A conditions (500 MW north-to-south) with the addition of the RifleCu-Parachute 230kV line (and other supporting projects). If the entire 28.0 MVA Holms Mesa load were to come on-line prior to the completion of the RifleCu-Parachute 230kV line, a mitigation measure could be developed for the few hours when the TOT2A flow is above 450 MW north-to-south combined with an outage of the RifleCu-Grand Junction 345kV line, an event that is highly unlikely.

II. Background

A Customer requested load interconnection service for a new load that would be located approximately six miles north of the Parachute Substation and approximately one-half mile from the RiflePS-Parachute 230kV transmission line. It is assumed that the load would be added in stages. The study considered the impact of a 28.0 MVA load (98% power factor or 27.4 MW and 5.6 MVAR). PSCo Transmission Planning conducted a System Impact Study and the results are included in this report.

Figure No. 1 Conceptual One-Line of the Study Area



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III. Methodology

A. Study Case Creation

The Western Electricity Coordinating Council (WECC) 2012 heavy summer operating case "12hs4ap" and the WECC 2013 heavy winter operating case "13hw2p" were used for the study. The cases were modified to reflect the present and the near term load additions in the area. The Middle Fork (Bench) 230kV load is represented as 40.5 MW (with 19.2 MVAR). The near term load additions include the Una Orchard 69kV load that will increase from 12.6 MW (with 7.3 MVAR) to 18.9 MW (with 11.0 MVAR) and the Starkey Gulch 230kV load that will increase from 12.5 MW (9.1 MVAR) to 47.5 MW (with 15.6 MVAR). A 7.5 MVAR capacitor bank is represented at the Una Orchard 69kV bus (In-Service Date: Summer 2012) and a 45 MVAR capacitor bank is represented at the Cameo 230kV bus (In-Service Date: Summer 2012) in both summer and winter cases. A 45 MVAR capacitor bank is represented at the Parachute 230kV bus (In-Service Date: Summer 2012) in the summer case; however, the bank was modeled out-of-service in the winter case as the voltage support is not needed in the winter case at the high TOT2A transfer limit.

PSCo adheres to the transmission standards established by the North American Electric Reliability Council (NERC). The FAC-009 standard ("Establish and Communicate Facility Ratings") requires transmission owners to ensure that facility ratings used in reliability planning and operation of the bulk transmission system is determined based on established methodologies. Section III.A of this report includes a table that lists facilities in the study area and their recently identified facility ratings for summer and winter conditions. These ratings were used in this load interconnection system impact study.

Two WECC power transfer paths are in the vicinity of the study area. The "TOT2A" transfer path is defined by three transmission lines that connect southwest Colorado with northwest New Mexico. The "TOT5" transfer path is defined by eight transmission lines that connect western Colorado and eastern Colorado across the Continental Divide. The study considered heavy north-to-south power transfers across TOT2A and their impact on the study area. The study also considered heavy west-to-east power transfers across TOT5 and their impact on the study area.

The 2012 heavy summer case and the 2013 heavy winter base were modified in the following ways:

a. Assumed a Starkey Gulch 230kV total demand of 50.0 MVA.
b. Assumed the Una Orchard 69kV total demand 21.7 MVA.
c. Assumed a Middle Fork 230kV (Bench) total demand of 44.8 MVA.
d. Assumed a Craig-RifleWA 230kV up-rate to 637 MVA (Western-RMR 2012 project).

e. Assumed a Curecanti-Montrose 115kV rating increase to 137 MVA (Western-RMR recent thermal review).
f. Assumed the Uintah-Adobe-Horizon 230kV de-rate to 239 MVA.
g. Added three capacitor banks at Una Orchard 69kV (7.5 MVAR capacitor bank), Cameo 230kV (45 MVAR capacitor bank) and Parachute 230kV (45 MVAR capacitor bank), all with summer 2012 in-service dates.
h. Modified the RiflePS-Parachute 230kV impedance data to reflect a 20.78 mile length.
i. Modified the Parachute-Cameo impedance data to reflect a 31.46 mile length.
j. Modified the summer and winter case to reflect a high TOT2A north-to-south flow of 500 MW. This was accomplished by increasing transfers between Western–RMR and New Mexico. The San Juan and Shiprock phase shifting transformers were used to more closely achieve the desired target level for TOT2A by changing inadvertent flow in the area. The Glade Tap-El Paso Tap 115kV line that is a TOT2A element and parallels the two phase-shifting transformers was represented out-of-service to reflect the proper operation whenever the phase-shifting transformers are scheduled.
k. Modified the summer case to reflect a high TOT5 west-to-east flow of 1300 MW. This was accomplished by increasing south-to-north transfers from New Mexico and Western-RMR (using the San Juan and Shiprock phase shifting transformers to achieve a south-to-north flow on TOT2A of 500 MW) to increase TOT5 west-to-east flows. Schedules from PacifiCorp East (PACE) to PSCo were increased until the 1300 MW level was achieved.
l. Modified the ratings of the transmission lines and transformers in the study area to reflect the current NERC FAC-009 Standard facility ratings.

Table 1 represents the 2012 heavy summer benchmark case (system conditions prior to the addition of the Holms Mesa load) loads. The summer season was selected for the table as the summer season represents the peak demand condition for the area.

Table 1. Benchmark Case "12hs4ap_TOT2A_500PS_BR_PL" – Loads

Bus Number	Bus Name	Id	Pload (MW)	Qload (Mvar)	Bus Number	Bus Name	Id	Pload (MW)	Qload (Mvar)
70268	ADOBE 230.0	GV	11.8	-1.2	70233	HORIZON 230.0	P1	18.5	0.0
70268	ADOBE 230.0	WA	0.4	0.0	70233	HORIZON 230.0	P2	26.9	14.0
70541	ASPEN_PS 115.0	AS	9.6	1.4	70288	MITCHLCR 69.0	GW	6.7	1.6
70541	ASPEN_PS 115.0	HC	20.9	0.3	70288	MITCHLCR 69.0	WM	0.4	0.1
70541	ASPEN_PS 115.0	WA	1.2	-0.1	70525	MTHARRIS 138.0	WA	1.2	0.0
70541	ASPEN_PS 115.0	WM	1.0	0.1	70525	MTHARRIS 138.0	YV	19.0	0.7
79092	AVON 115.0	HC	10.9	-0.1	70296	NEWCASTL 69.0	P1	1.4	0.5
79092	AVON 115.0	WA	0.6	0.0	70296	NEWCASTL 69.0	P2	4.7	1.7
70540	BASLTDST 115.0	HC	11.9	1.0	70309	PARACHUT 230.0	HC	4.7	0.6
70540	BASLTDST 115.0	WA	0.7	0.0	70309	PARACHUT 230.0	P1	12.4	7.8
79006	BEAVERCU 115.0	HC	25.4	1.4	70309	PARACHUT 230.0	WA	0.3	0.0
79006	BEAVERCU 115.0	WA	1.5	0.0	79056	RIFLE_CU 138.0	HC	4.5	0.8
70357	BENCH 230.0	IN	40.5	19.2	79056	RIFLE_CU 138.0	P1	8.6	0.7
70076	CAMEO 69.0	P4	0.8	0.3	79056	RIFLE_CU 138.0	P5	12.0	3.0
70089	CARBNDAL 115.0	P2	8.4	-2.2	79056	RIFLE_CU 138.0	TS	0.0	0.0
70113	CLIFTON 230.0	P1	14.2	3.8	79056	RIFLE_CU 138.0	WA	0.3	0.0
70113	CLIFTON 230.0	P2	14.8	6.2	70363	ROARNGFK 69.0	GW	8.1	0.0
79047	COLBRAN 138.0	GV	3.6	0.4	70363	ROARNGFK 69.0	WM	0.4	0.0
79047	COLBRAN 138.0	WA	0.1	0.0	70385	SHOSHA&B 4.0	P5	0.4	0.1
70535	COOLEYMA 230.0	HC	13.6	-1.6	70542	SNOWMASS 115.0	HC	10.9	-8.0
70535	COOLEYMA 230.0	WA	0.8	-0.2	70542	SNOWMASS 115.0	WA	0.6	-0.5
70009	CRAIG_YV 230.0	WA	1.4	0.0	79065	STEAMBT 230.0	NT	-0.8	-0.1
70009	CRAIG_YV 230.0	YV	21.8	0.7	79065	STEAMBT 230.0	WA	2.0	0.0
79018	CRYSTLPS 115.0	HC	9.1	3.8	79065	STEAMBT 230.0	YV	31.3	-0.6
79018	CRYSTLPS 115.0	WA	0.5	0.2	70299	STKGULCH 230.0	IN	47.5	15.6
70140	DEBEQUE 69.0	GV	1.6	0.6	70437	UINTAH 13.800	GV	1.2	0.7
70140	DEBEQUE 69.0	P1	0.5	0.2	70437	UINTAH 13.800	WA	0.0	0.0
70140	DEBEQUE 69.0	WA	0.0	0.0	70438	UINTAH 230.0	P1	8.2	3.1
70183	FRUITA 69.0	GV	1.2	0.4	70438	UINTAH 230.0	P3	6.1	2.1
70183	FRUITA 69.0	P1	6.9	2.6	70436	UINTAH 69.0	GV	7.4	3.7
70183	FRUITA 69.0	WA	0.0	0.0	70436	UINTAH 69.0	WA	0.2	0.1
70201	GLENNWD 69.0	GW	7.3	3.0	70109	UNA_ORCH 69.0	IN	18.9	11.0
70201	GLENNWD 69.0	WM	0.4	0.2	79066	VAIL 115.0	HC	16.5	-1.6
70214	GRANDJCT 69.0	GV	21.6	3.3	79066	VAIL 115.0	WA	1.0	-0.1
70214	GRANDJCT 69.0	WA	0.7	0.1	70454	VINELAND 69.0	NT	-3.2	-1.1
70206	GRANDJPS 230.0	NT	-1.4	1.5	70454	VINELAND 69.0	P1	8.7	4.1
70206	GRANDJPS 230.0	P1	32.0	7.4	70356	WEELERPS 230.0	IN	3.0	1.2
70206	GRANDJPS 230.0	P2	51.9	16.8	79069	WOLCOTT 230.0	HC	12.3	-6.8
					79069	WOLCOTT 230.0	WA	0.7	-0.4

Table 2 represents the generation in the study area for the 2012 on-peak summer conditions. The Fruita generating unit is represented on-line in the case. This is a reasonable dispatch for the high north-to-south TOT2A transfer conditions reflected in the study.

Table 2. Benchmark Case "12hs4ap_TOT2A_500PS_BR_PL" – Generation

Bus No.	Bus Name	Id	Cd	IS	Pgen (MW)	Pmax (MW)	Qgen (Mvar)	Qmax (Mvar)
79157	BMESA1-2 11.0	1	2	1	30.0	43.2	-7.1	19.0
79157	BMESA1-2 11.0	2	2	1	30.0	43.2	-7.1	19.0
79015	CRAIG 1 22.0	1	2	1	451.0	470.0	117.0	216.0
79016	CRAIG 2 22.0	1	2	1	451.0	470.0	117.0	216.0
79017	CRAIG 3 22.0	1	2	1	456.0	470.0	73.3	216.0
79162	CRYSTAL 12.5	1	2	1	15.0	27.5	-1.2	5.0
79154	FLGORG1 11.5	1	2	1	40.0	50.0	2.7	24.8
79155	FLGORG2 11.5	1	2	1	40.0	50.0	2.7	24.8
79156	FLGORG3 11.5	1	2	1	40.0	50.0	2.7	24.8
79123	FONTNLLE 4.160	1	2	1	7.0	10.0	-2.7	5.0
70180	FRUITA 13.8	G1	2	1	15.0	17.0	11.1	14.5
79040	HAYDEN1 18.0	1	2	1	175.0	212.0	-34.6	70.0
79041	HAYDEN2 22.0	1	2	1	250.0	286.0	-76.8	130.0
79176	MCPHEE 2.4	1	-2	1	1.0	1.3	0.0	0.0
79166	MOLINA-L 4.2	1	-2	1	2.0	4.9	2.3	2.3
79172	MOLINA-U 4.2	1	2	1	4.0	8.6	1.8	4.1
79019	MORRO1-2 12.5	1	2	1	60.0	82.0	22.9	45.0
79019	MORRO1-2 12.5	2	2	1	60.0	82.0	22.9	45.0
79158	NUCLA 1 13.8	1	2	1	14.0	14.0	0.3	13.8
79159	NUCLA 2 13.8	1	2	1	14.0	14.0	0.4	13.8
79160	NUCLA 3 13.8	1	2	1	14.0	14.0	0.4	13.8
79161	NUCLA 4 13.8	1	2	1	68.0	68.0	3.1	34.2
79251	QFATLAS1 13.8	1	2	1	0.0	31.2	9.7	22.0
79251	QFATLAS1 13.8	2	2	1	0.0	18.2	5.2	11.0
79252	QFATLAS2 13.8	3	2	1	0.0	18.2	0.4	11.0
79252	QFATLAS2 13.8	4	2	1	0.0	18.2	0.4	11.0
70385	SHOSHA&B 4.0	H1	-2	1	7.0	7.0	5.0	5.0
70385	SHOSHA&B 4.0	H2	-2	1	8.0	8.0	5.0	5.0
79164	TOWAOC 6.90	1	2	1	6.0	12.0	0.7	4.3

Table 3 lists the reactive devices in the study area for the summer season used for voltage control.

Table 3. Benchmark Case "12hs4ap_TOT2A_500PS_BR_PL" – Reactive Devices

Bus No.	Bus Name	IS	Control Mode	Vhi (pu)	Vlo (pu)	Binit (Mvar)	Blk 1 Steps	Blk 1 Bstep (Mvar)	Blk 2 Steps	Blk 2 Bstep (Mvar)	Blk 3 Steps	Blk 3 Bstep (Mvar)
70078	CAMEO 230.00	1	Locked (0)	1.0457	0.9957	45.0	1.0	-20.0	1.0	45.0	0.0	0.0
70109	UNA_ORCH 69.0	1	Discrete, cntr volt (1)	1.0076	0.9776	7.5	1.0	7.5	0.0	0.0	0.0	0.0
70309	PARACHUT 230.0	1	Locked (0)	1.0441	0.9941	45.0	1.0	45.0	0.0	0.0	0.0	0.0
70438	UINTAH 230.0	1	Locked (0)	1.0365	0.9865	45.0	1.0	45.0	0.0	0.0	0.0	0.0
79003	BASALT 115.00	0	Discrete, cntr volt (1)	1.0346	1.0046	30.0	1.0	30.0	1.0	30.0	0.0	0.0
79057	RIFLE_CU 230.00	1	Locked (0)	1.0449	0.9949	0.0	2.0	-30.0	0.0	0.0	0.0	0.0
79058	RIFLE_CU 345.00	1	Locked (0)	1.0423	0.9923	0.0	1.0	-30.0	1.0	-28.0	1.0	-25.0

Table 4 lists the line ratings assumed for the summer and winter seasons. The transmission lines and transformers in the study area were modeled with the current Facility Ratings (NERC FAC-009 Standard).

Table 4. Benchmark Case "12hs4ap_TOT2A_500PS_BR_PL" – Facility Ratings

Circuit Name	Ckt #	Summer Normal Rating (MVA)	Summer Emergency Rating (MVA)	Winter Normal Rating (MVA)	Winter Emergency Rating (MVA)
Cameo-Uintah 230kV	5607	239	239	239	239
Uintah-Adobe 230kV	5555	239	239	239	239
Adobe-Horizon 230kV	5555	239	239	239	239
Horizon-Grand Junction 230kV	5555	239	239	239	239
Grand Junction-Clifton 230kV	5557	273	314	273	319
Clifton-Grand Junction-Ute 230kV	5557	482	564	574	632
RiflePS-Parachute 230kV	5205	430	478	439	478
Parachute-Cameo 230kV	5509	430	478	439	482
RiflePS-RifleWA 230kV[1]	Tie	430	502	514	571
RifleWA-RifleCu 230kV	3007	478	478	478	478
RifleCu-Colbran 138kV	3014	96	96	96	96
Colbran-Grand Junction Ute	3015	55	56	55	56
Parachute-Wheeler 230kV	5507	159	159	159	159
Parachute-Starkey Gulch 230kV	5505	478	478	478	478
Wolcott-Cooley Mesa 230kV	5785	448	448	448	448
Cooley Mesa-Basalt 230kV	5787	531	531	531	531
Steamboat-Foidel Creek 230kV	5811	568	625	574	632
Foidel Creek-Wolcott 230kV[2]	5813	128	128	360	360
Hayden-Foidel Creek 230kV	5815	478	478	478	478
Foidel Creek-Steamboat 230kV	5817	568	625	574	632
Meeker-RifleUte 345kV	7300	598	598	621	621
RifleUte-Grand Junction 345kV	7302	598	598	621	621
Basalt-Malta 230kV	5149	359	359	359	359
RiflePS-Hopkins 230kV[3]	5207	57	57	307	307
Colbran 138-115kV #2	Xfmr	14	16	14	18
Grand Junction(Ute) 345-230 #1	Xfmr	273	314	273	319
Grand Junction(Ute) 138-115 #T2	Xfmr	55	56	55	56
Rifle(Ute) 230-138 #3	Xfmr	143	143	143	143
Rife(Ute) 345-230 #4	Xfmr	478	561	543	561

[1] The RiflePS-RifleWA 230kV bus joins two adjacent substations. The two substations are laid out in a main-and-transfer configuration. The bus conductor is 1033.5 ACSR (Ortolan) conductor. The conductor has a summer rating of 430.2 MVA (1080 amps, normal) and 501.5 MVA (1259 amps, emergency) and a winter rating of 513.9 MVA (1290 amps, normal) and 571.3 MVA (1434 amps, emergency).

[2] The Foidel Creek-Wolcott 230kV line (Circuit #5813) has a dynamic rating. The study assumed a summer ambient temperature during on-peak of 40º C (104º F) and an assumed winter ambient temperature during on-peak of 22º C (75º F). That results in a summer rating of 128 MVA (normal and emergency) and a winter rating of 360 MVA (normal and emergency).

[3] The RiflePS-Hopkins 230kV line (Circuit #5207) has a dynamic rating. The study assumed a summer ambient temperature during on-peak of 40º C (104º F) and an assumed winter ambient temperature during on-peak of 22º C (75º F). That results in a summer rating of 57 MVA (normal and emergency) and a winter rating of 307 MVA (normal and emergency). It should be noted, that this limitation is in the process of being corrected. The line has a summer rating of 430 MVA and a winter rating of 478 MVA.

The benchmark case was created with a high TOT2A north-to-south flow of 500 MW. The case was evaluated by simulating single element outages of lines and transformers in the study area. The results are listed in Table A1-1 and Table A1-2 in the Appendix. Table A1-1 and Table A1-2 list the criteria violations in the benchmark case (prior to the addition of the Holms Mesa load). The criteria violations in the tables are as follows:

- The Cameo-Uintah-Adobe-Horizon 230kV line (Ckt #5607 and Ckt #5555) criteria violations (for loss of the RifleCu-Grand Junction 345kV line) are due to a 600 amp rating (239 MVA) limitation imposed by agreement with the Union Pacific Railroad. PSCo will complete a Railroad Compatibility Study to ensure that electromagnetic interference caused by the Cameo-Uintah-Adobe-Horizon-Grand Junction 230kV high voltage power line sharing the same corridor with the parallel Union Pacific railway will not endanger the proper operating of the signal and protection system of the Union Pacific railway under both load and fault conditions. The study is expected to demonstrate that power flows at the thermal rating of the line (1440 amps or 573.7 MVA) will not induce interference in the parallel railway signal and protection system. Until the study is complete, the rating of the line will remain 239 MVA (600 amps) per an agreement between PSCo and the Union Pacific Railroad.
- The Grand Junction PS-Clifton-Grand Junction 230kV line (Circuit 5557) is rated at 254 MVA due to substation limitations.
- The Hopkins-Basalt contingency violation is mitigated with an operating practice that involves PSCo System Dispatch opening the line when overloaded.
- The RiflePS-Hopkins 230kV transmission line (Ckt # 5207) experienced a contingency overload of 242.5% of its 57 MVA rating. The line has a thermal rating of 439 MVA. The RiflePS-Hopkins 230kV line has a dynamic rating. The study assumed a summer ambient temperature during on-peak of 40º C (104º F) and an assumed winter ambient temperature during on-peak of 22º C (75º F). That results in a summer rating of 57 MVA (normal and emergency) and a winter rating of 307 MVA (normal and emergency). PSCo is presently working to mitigate these low ratings.
- The Cahone-Nucla 115kV, Nucla-Montrose 115kV, Lost Canyon-Mancos Tap 115kV and RifleCU-Meeker 138kV overloads are the responsibility of Tri-State G&T and do not impact this project.
- The Craig-RifleWA 230kV contingency overload of the 478 MVA rating is being mitigated by Western Area Power Administration – Rocky Mountain Region (Western-RMR). Western-RMR plans to up-rate the line to 637 MVA in 2012.
- The Grand Junction 138-115kV transformer overload of 113.2% of its 55 MVA rating will be mitigated by PSCo through the PSCo Capital Budget Study Process.

- The Grand Junction-Collbran 138kV contingency violation is due to the limitation imposed by the Grand Junction 138-115kV transformer. The transformer and line are in series. Resolving the Grand Junction 138-115kV transformer issue will mitigate this apparent overload.
- The Meeker-RifleCu 345kV line (Ckt # 7300) and the RifleCu-Grand Junction 345kV line overloads will be evaluated by the owners of the transmission line – PSCo, Tri-State and Platte River Power Authority. The Meeker-RifleCu 345kV line and the RifleCu-Grand Junction 345kV line are limited to 598 MVA due to a line trap at the RifleCu Substation.
- The Foidel Creek-Wolcott 230kV line (Circuit #5813) has a dynamic rating. The study assumed a summer ambient temperature during on-peak of 40º C (104º F) and an assumed winter ambient temperature during on-peak of 22º C (75º F). That results in a summer rating of 128 MVA (normal and emergency) and a winter rating of 360 MVA (normal and emergency).

The study results demonstrate that there are pre-existing conditions prior to the proposed Holms Mesa load addition that are being addressed by PSCo. It should be noted that these criteria violations occur at very high north-to-south flows (500 MW) on TOT2A. The results show that the Benchmark Case experiences contingency bus voltage violations at a TOT2A north-to-south flow of 500 MW. The capacitor banks at Una Orchard 69kV (7.5 MVAR), Cameo 230kV (45 MVAR), and Parachute 230kV (45 MVAR) are represented in-service in the summer case.

B. Study Scope and Assumptions

1. This study consisted of power flow analysis only. Angle or voltage stability studies were not conducted for this study. Short circuit studies were not conducted for this study.
2. Study cases were developed from the summer and winter base cases. The study cases reflected high TOT2A and high TOT5 transfer levels.

C. WECC Transfer Paths in the Study Area

Conditions on the transmission system can impact line flows and bus voltages in the study area. Demand and generation dispatch in the study area are two of these conditions. A third condition is the level of bulk power transfers that pass through the study area. The bulk power transfers that have the most significant impact on this study area are those that cross the WECC TOT2A power transfer path and the WECC TOT5 power transfer path. These paths are described as follows.

1. TOT2A – WECC-defined path represents the power transfers from southwest Colorado to northwest New Mexico and has a maximum north-to-south rating of 690 MW. The path owners include Western-RMR, Tri-State G&T and Public Service Co. of Colorado (PSCo).

Line/Transformer	Metered End
-Hesperus-San Juan 345 kV	San Juan
-Durango-Glade Tap 115 kV	Glade Tap
-Lost Canyon-Shiprock 230 kV	Shiprock

2. TOT5 – WECC-defined path represents the power transfers from western Colorado to western Colorado and has a maximum west-to-east rating of 1675 MW. The path owners include Western-RMR, Tri-State G&T, Platte River Power Authority (PRPA) and Public Service Co. of Colorado (PSCo).

Line/Transformer	Metered End
-North Park-Archer 230 kV	Archer
-Craig-Ault 345 kV	Craig
-Hayden-Gore Pass 230kV	Hayden
-Hayden-Gore Pass 138kV	Gore Pass
-Hopkins-Malta 230kV	Hopkins
-Basalt-Malta 230kV	Basalt
-Gunnison-Poncha 115kV	Poncha
-Curecanti-Poncha 230kV	Curecanti

Load flow studies that are conducted in this study area typically consider demand levels, dispatch scenarios and bulk power transfers across the TOT2A path and the TOT5 path.

D. Study Criteria

PSCo designs and constructs its system so transmission line flows, transformer flows and bus voltages remain within certain levels in order to reliably serve customers. The criteria that PSCo adheres to are as follows:

0. System Intact (All Facilities In-service)

Bus voltages are maintained between 0.95 and 1.05 p.u. (95% and 105% of the nominal voltage). The flow on transmission lines should not exceed 100% percent of the continuous rating of the line. Under system intact conditions, buses and branches in the study area are monitored with buses flagged for voltages outside the 0.95 p.u to 1.05 p.u. range and branch flagged for above 100% of the nominal rating of the branch. Manual or automatic system adjustments such as shunt capacitor or reactor switching, generator scheduling, or LTC tap adjustment are allowed. Area interchanges and phase shifter adjustments are allowed.

1. Single Contingency (One Facility Forced Out-of-service)

Bus voltages in the study are maintained between 0.90 and 1.10 p.u. (90% and 110% of the nominal voltage) and deviations from the pre-contingency voltages should be less than 0.05 p.u. The flow on transmission lines should not exceed 100% of the continuous rating of the line. Buses and branches in the study area are monitored with buses flagged for voltages outside the 0.90 p.u.-1.10 p.u. range and branch flows above 100% of nominal are flagged . Manual system adjustments such as generation dispatch are not allowed. Area interchange adjustments are not allowed. Adjustments to phase-shifting transformers and load tap changing (LTC) transformers are not allowed. Adjustments of shunt capacitors or inductors are allowed.

IV. Project Cost Estimates

Scoping level cost estimates (+/- 30%) were developed by PSCo Substation Engineering, PSCo Transmission Engineering, and PSCo Siting and Land Rights for the interconnection substation on the bulk transmission system and the transmission facilities required to serve the load. The approximate cost for the interconnection substation is $6.02 million. Please see Table 5 below.

Table 5 Interconnection Substation Cost Estimate

Element	Description	Cost Est. Millions
New 230kV Substation	**Siting and Land Rights**	**$0.15**
	Transmission Line Tap. Major equipment installation includes: • Holms Mesa Substation – A 230kV three breaker ring bus laid out for future breaker-and-a-half on five acre site. • Construct a one-half mile transmission line between the tap and the Holms Mesa Substation using 1-795 kcmil ACSR conductor strung on 230kV double circuit structures. This could change to 1-1272 kcmil ACSR conductor if PSCo anticipates upgrading the RiflePS-Parachute 230kV line to 1-1272 kcmil ACSR. • Customer Substation (Revenue metering)	**$5.36** **$0.35** **$0.16**
	Total Cost Estimate for Transmission Load Interconnection	**$6.02**
Time Frame	**Time required to site, design, procure and construct**	**18 months**

V. Motor Starting Requirements

For unrestricted motor starts, PSCo requires customers to adhere to a voltage dip requirement during motor starting that restricts voltage dips to 2% or less at any company transmission bus. The voltage dip percentage (%) is defined as:

$$\%\text{Voltage Dip} = (V_{prestart} - V_{start})/V_{prestart} * 100$$

where $V_{prestart}$ is the voltage at the bus before the motor is started and V_{start} is the voltage at the bus at the instant of maximum voltage drop during starting.

The customer is responsible to perform the motor start voltage dip studies and verify compliance with this voltage dip criteria. The Customer shall supply a copy of the voltage dip study results to PSCo Transmission Planning for review.

VI. Study Results

The purpose of the study was to verify that the bulk transmission system can serve the 28.0 MW load addition at a proposed Holms Mesa Substation in a reliable manner. Reliability for a transmission system involves the performance of transmission elements that deliver power to a proposed load within accepted standards at the desired level under normal and adverse conditions.

The summer and winter cases were modeled with a 230kV tap station called “Holms Mesa” located six miles north of Parachute assuming an in-and-out configuration. This created a RiflePS-Holms Mesa 230kV transmission line and a Holms Mesa-Parachute 230kV transmission line in the cases. A 28.0 MW (at a 98% power factor) load was modeled at the Holms Mesa 230kV bus. Reactive support equipment (capacitor banks) were placed at Una Orchard 69kV (7.5 MVAR), Cameo 230kV (45 MVAR) and Parachute 230kV (45 MVAR) in the summer cases. The Una Orchard and Cameo capacitor banks were placed in-service in the winter cases. To capture the range of normal and adverse conditions, the TOT2A and TOT5 transfer paths were adjusted to high levels creating high TOT2A cases and high TOT5 cases. Single contingencies were simulated with the transmission elements monitored and the results were recorded. The appendix contains the detailed study results.

A. High TOT2A Conditions (500 MW north-to-south)

1. Summer Season

The study determined that the 28.0 MVA Holms Mesa load will impact the bulk electric transmission system for a summer on-peak condition and a high TOT2A condition (500 MW north-to-south). The 2012 heavy summer study case with a high TOT2A flow (500 MW north-to-south) was obtained. The case did not include the

28.0 MVA Holms Mesa load. An outage of the RifleCu-Grand Junction 345kV line was simulated and this resulted in a contingency flow on the RiflePS-Parachute 230kV line of 98.5% of its 430 MVA rating. Adding the 28.0 MVA Holmes Mesa load increased the contingency flow on the RiflePS-Holms Mesa 230kV line to 105.0% of its 430 MVA rating for an outage of the RifleCu-Grand Junction 345kV line. The Grand Junction 345-230kV transformer experienced a 115.1% contingency flow of its 273 MVA rating. The Grand Junction 138-115kV transformer experienced a 119.6% flow of its 55 MVA rating. The RiflePS-Holms Mesa 230kV line flow violation can be mitigated if the Holms Mesa load is reduced to 6.0 MW (with a 1.2 MVAR reactive load). At that demand level and at a 500 MW TOT2A transfer level, an outage of the RifleCu-Grand Junction 345kV line causes the RiflePS-Holms Mesa 230kV contingency line flow to reach approximately 100.1% of its 430 MVA rating. Contingency bus voltages were at or above the 0.90 p.u. lower limit. Increasing the RiflePS-Holms Mesa 230kV line to 439 MVA (the line thermal rating) allows a larger Holms Mesa demand to be served at a 500 MW TOT2A transfer level. With the Holms Mesa load adjusted to15 MW with the TOT2A flow at 500 MW (north-to-south), the contingency flow on the RiflePS-Holms Mesa line reaches 100.0% of the 439 MVA line thermal rating for an outage of the RifleCu-Grand Junction 345kV line and bus voltages are just at the 0.90 p.u. criteria lower limit at Bench 230kV, Holms Mesa 230kV, Parachute 230kV, Starkey Gulch 230kV, and WheelerPS 230kV. The 2012 heavy summer case with the 28.0 MVA load at Holms Mesa 230kV was modified by reducing the TOT2A flow to 450 MVA. Outages were simulated and the results demonstrate that the entire Holms Mesa 28.0 MVA load can be served at this lower TOT2A level. PSCo plans to add a second Grand Junction 138-115kV transformer to mitigate the contingency overload. Sensitivity studies were conducted that considered the addition of transmission projects in the study area. The Debeque-Bluestone Valley 69kV line (with the Debeque-Cameo 69kV line removal) did not impact the Holms Mesa load addition significantly. The proposed RifleCu-Parachute 230kV line addition has a positive impact on the Holmes Mesa Project as it eliminates the RiflePS-Holms Mesa 230kV contingency overload and improves the Holms Mesa 230kV contingency bus voltages. The proposed RiflePS-Parachute 230kV line #2 also has a positive impact on the Holmes Mesa Project.

PSCo is planning to construct a RifleCu-Parachute 230kV line that has an expected in-service date of December 2015. The addition of this line will allow the 28.0 MW Holms Mesa load to be reliably served with the TOT2A north-to-south flow at 500 MW. In addition, PSCo will need to up-rate the RifleCu-RifleWA 230kV line (Circuit No. 3007) to at least 533 MVA. The line has a 574 MVA thermal rating but is presently limited to 478 MVA based on substation element limitations at the RifleCu Substation.

2. Winter Season

The 2013 heavy winter study case with a TOT2A flow of 500 MW (north-to-south) was obtained and the Holms Mesa 28.0 MVA load added. Outages were simulated. The RiflePS-Holms Mesa 230kV line contingency overload (for an outage of the RifleCu-Grand Junction 345kV line) does not occur. The Grand Junction 138-115kV transformer contingency flow reaches 118.2% of its 55 MVA rating. The study

concludes that the transmission system can reliably serve the proposed 28.0 MW load addition under winter on-peak demand conditions and a TOT2A north-to-south flow of 500 MW.

3. Historic TOT2A Transfer Levels

Historic TOT2A archive data for the last five years was obtained to determine the amount of time the TOT2A north-to-south flow exceeded 450 MW. In 2007, the TOT2A flow exceeded 450 MW for 112 hours and exceeded 500 hours nineteen hours for the entire year. In 2008, the TOT2A flow exceeded 450 MW for eighteen hours and exceeded 500 MW for one hour for the entire year. For 2009, 2010, and 2011, the TOT2A flow never exceeded 450 MW. The historical data suggests that flows above 450 MW rarely occur. The study allowed the TOT2A level to be decreased with the Holms Mesa Substation demand at 28.0 MVA until criteria violations were eliminated. At a TOT2A flow of 450 MW, the 28.0 MVA load at Holms Mesa can be reliably served.

B. High TOT5 Conditions (1300 MW west-to-east)

1. Summer Season

The 2012 heavy summer case with a high TOT5 flow (1300 MW west-to-east) and with the Holms Mesa 28.0 MVA load represented was obtained. Outages were simulated. The RifleWA-RiflePS 230kV bus tie outage was simulated; however, this outage is not possible because there are no bus sectionalizing circuit breakers at the Rifle Substation; therefore, the apparent overload of the Grand Junction 345-230kV transformer of 118.8% can be ignored. The RifleWA-RiflePS 230kV bus tie experiences a 117.0% overload of its 430 MVA rating for an outage of the Grand Junction-Clifton 230kV line. This overload condition is mitigated with the addition of the RifleCu-Parachute 230kV transmission line. If PSCo is not able to terminate the RifleCu-Parachute 230kV line at the RifleCu Substation and must terminate the transmission line at the RiflePS Substation, the RifleWA-RiflePS 230kV bus tie will need to be upgraded from 1-1033 kcmil ACSR conductor to bus work of a higher capacity in order to achieve a reliable system. Without this upgrade, an outage of the Grand Junction-Clifton 230kV line (with the RiflePS-Parachute 230kV line #2 added to the case) would result in an overload of the RifleWA-RiflePS 230kV bus tie of 118.0% of its 430 MVA rating.

2. Winter Season

The 2013 heavy winter case with a high TOT5 flow (1300 MW west-to-east) and with the Holms Mesa 28.0 MVA load represented was obtained. Outages were simulated. The study found that the transmission system can reliably serve the proposed 28.0 MW load addition under winter on-peak demand and with a high TOT5 flow (1300 MW west-to-east).

C. TOT5 Historic Transfer Levels

Historic TOT5 archive data for the last five years was obtained to determine the amount of time the TOT5 west-to-east flow exceeded 1300 MW. In 2007, the TOT5 flow exceeded 1300 MW a total of 10 hours for the year. In 2009, the TOT5 flow exceeded 1300 MW a total of sixteen hours for the year. In 2008, 2010 and 2011, the TOT2A flow never exceeded 1300 MW. The historical data suggests that flows above 1300 MW rarely occur.

Conclusion

The results show that the summer season is more limiting to the transmission system in the area around Holms Mesa than the winter season. In addition, high TOT2A north-to-south flows are more limiting to the transmission system that serves Holms Mesa than high TOT5 west-to-east flows. The results for the two transfer conditions and two seasonal conditions are listed below.

APPENDIX

A1. 2012 Heavy Summer Benchmark Case
Case Name: "12hs4ap_TOT2A_500PS_BR_PL"
High TOT2A Flow of 500 MW (north-to-south)
Holms Mesa Load = 0 MVA

The 2012 heavy summer benchmark case was obtained. Single contingencies were simulated and the results are the worst violations are listed in Table A1-1 and Table A1-2.

Table A1-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.00	104.40	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.00	115.50	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.00	316.00	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.00	112.80	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.00	118.30	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.00	131.20	79014 CRAIG 345 79266 MEEKER 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.00	119.00	79058 RIFLE_CU 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.00	112.00	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.00	118.80	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.00	113.20	70309 PARACHUT 230 70358 RIFLE_PS 230 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.00	105.20	79014 CRAIG 345 79266 MEEKER 345 1
79048 MONTROSE 115	79052 NUCLA 115	1	76.00	121.70	79011 CAHONE 115 79052 NUCLA 115 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.00	125.70	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.00	181.30	79014 CRAIG 345 79266 MEEKER 345 1

- The Grand Junction 345-230kV contingency flow of 104.4% of its 273 MVA rating is acceptable. The transformer has an emergency rating of 115% of 273 MVA or 314 MVA.
- The Hopkins Basalt 115kV contingency violation is presently mitigated with an operating practice.
- The RiflePS-Hopkins 230kV contingency violation will be eliminated when PSCo restores the line rating to an acceptable level.
- The Cameo-Uintah-Adobe-Horizon-Grand Junction 230kV contingency violation is under investigation.
- The Craig-RifleWA 230kV contingency flow will no longer be an issue after Western up-rates the line to 637 MVA in 2012.
- The Grand Junction 138-115kV contingency violation will be mitigated by PSCo through its annual capital budget process and the addition of a second transformer.

- The Grand Junction-Colbran 138kV line is limited by the Grand Junction 138-115kV transformer that it is in serial with the line and this will be mitigated with the second Grand Junction 138-115kV transformer.
- The Meeker-RifleCu 345kV contingency violation will be mitigated by the project owners – PSCo, Tri-State and Platte River Power Authority. The Montrose-Nucla 115kV criteria violation will be resolved by Tri-State
- The Foidel Creek-Wolcott 230kV criteria violation will be addressed by PSCo.

It should be noted that an outage of the RifleCu-Grand Junction 345kV line results in a contingency flow of the RiflePS-Parachute 230kV line of 99% of its 430 MVA rating.

Table A1-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	***0.9053***	0.9717	70268 ADOBE 230 70438 UINTAH 230 1
70357	BENCH	230.0	***0.9233***	0.9870	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70078	CAMEO	230.0	***0.9249***	0.9903	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70076	CAMEO	69.0	***0.9418***	1.0186	70076 CAMEO 69.0 70078 CAMEO 230 T5
70082	CAMP	69.0	***0.9248***	0.9834	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70140	DEBEQUE	69.0	***0.9045***	0.9876	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9506***	1.0082	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036	GRANDJCT	345.0	***1.0291***	0.9798	79049 MONTROSE 345 79072 HESPERUS 345 1
70206	GRANDJPS	230.0	***0.9066***	0.9619	70268 ADOBE 230 70438 UINTAH 230 1
70207	GRANDVLY	69.0	***0.9247***	0.9833	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70233	HORIZON	230.0	***0.9052***	0.9656	70233 HORIZON 230 70268 ADOBE 230 1
70302	OILSHALE	69.0	***0.9364***	0.9908	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	***0.9277***	0.9911	70309 PARACHUT 230 70358 RIFLE_PS 230 1
79056	RIFLE_CU	138.0	***0.9397***	0.9943	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	***0.9464***	1.0010	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	***0.9264***	0.9899	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70438	UINTAH	230.0	***0.9165***	0.9776	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70436	UINTAH	69.0	***0.9563***	1.0106	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70109	UNA_ORCH	69.0	***0.9066***	0.9785	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1

The study area contingency voltages are within criteria for the Benchmark Case.

A2. 2012 Heavy Summer Study Case

Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM"
High TOT2A Flow of 500 MW (north-to-south)
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

The 2012 Heavy Summer Benchmark (TOT2A at 500 MW north-to-south) case was obtained. The case was modified by tapping the RiflePS-Parachute 230kV approximately six miles from the Parachute Substation at a location called "Holms Mesa". A 28.0 MVA load (at a 0.98 power factor[4]) was represented at the tap point.

Table A2-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	126.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	107.9	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	115.1	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	106.1	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.8	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	334.9	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	111.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	117.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	70365 HOLMMESA 230	1	430.0	105.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79011 CAHONE 115	79052 NUCLA 115	1	76.0	179.7	79049 MONTROSE 345 79072 HESPERUS 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	133.5	79014 CRAIG 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	112.3	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	119.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.0	117.3	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79044 LOSTCANY 115	79111 MANCOSTP 115	1	115.0	132.0	79049 MONTROSE 345 79072 HESPERUS 345 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	107.6	79014 CRAIG 345 79266 MEEKER 345 1
79048 MONTROSE 115	79052 NUCLA 115	1	76.0	121.7	79011 CAHONE 115 79052 NUCLA 115 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	127.9	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.9	79014 CRAIG 345 79266 MEEKER 345 1

[4] The Xcel Energy Interconnection Guidelines For Transmission Interconnected Customer Loads indicates that at a new Point of Interconnection (POI), transformer additions, and planned transformer capacity upgrades to support load additions are expected to provide sufficient reactive power (leading or lagging) such that the power factor is between 98% lagging or leading at the POI.

Single contingency simulations were applied to the new case and the results are listed in Table A2-1 above and Table A2-2 below.

Table A2-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	0.8946	0.9690	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70357	BENCH	230.0	0.8674	0.9824	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70078	CAMEO	230.0	0.8912	0.9867	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113	CLIFTON	230.0	0.8966	0.9574	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70140	DEBEQUE	69.0	0.8934	0.9842	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70206	GRANDJPS	230.0	0.8920	0.9593	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70365	HOLMMESA	230.0	0.8713	0.9878	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70233	HORIZON	230.0	0.8923	0.9630	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70309	PARACHUT	230.0	0.8722	0.9866	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70299	STKGULCH	230.0	0.8708	0.9853	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70438	UINTAH	230.0	0.8970	0.9748	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	0.8913	0.9751	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70356	WEELERPS	230.0	0.8707	0.9852	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

- The RiflePS-Hood Mesa 230kV line (Ckt # 5205) contingency flow increased to 105.0% of the 430.0 MVA rating after adding the 28.0 MVA load addition at Holms Mesa.
- An outage of the RiflePS-Holms Mesa 230kV line resulted in contingency bus voltages less than criteria at several locations with some buses reaching 0.87 p.u. (Holms Mesa 69kV, Parachute 230kV, WheelerPS 230kV, Starkey Gulch 230kV and Bench 230kV).
- The Grand Junction 345-230kV 273 MVA transformer experiences a contingency flow of 115.1% of its 273 MVA rating (314 MVA). The transformer has an emergency rating of 115% or 314 MVA; therefore, the contingency flow on the transformer is just at the emergency limit. Emergency ratings for autotransformers can be used for a duration of four hours
- The Grand Junction 138-115kV transformer contingency flow reached 112.3% of its 55 MVA rating for an outage of the RifleCu-Grand Junction 345kV line. The transformer has an emergency rating of 56 MVA (102%).
- Foidel Creek-Wolcott 230kV line flow reached 181.9% of its 128 MVA rating for an outage of the Craig-Meeker 345kV line. The line is presently limited by a dynamic limit. PSCo is working to remove this limitation.
- The contingency flow of the RifleCu 345-230kV transformer reaches 97.2% of its 478 MVA rating for an outage of the Craig-Meeker 345kV line.
- The contingency flow of the RifleCu-RifleWA branch reaches 92.7% of its 478 MVA rating for an outage of the Craig-Meeker 345kV line.

A3. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM_6MW"
High TOT2A Flow of 500 MW (north-to-south)
Reduce Holms Mesa Load to 6.0 MW and 1.2 MVAR (98% PF)

The Holms Mesa load was reduced to 6.0 MW and 1.22 MVAR and the TOT2A north-to-south flow was left unchanged at 500 MW. Outages were simulated and the results are listed in the table below.

Table A3-1. Branch Flows for Single Contingency Outages

From bus	To bus	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	126.8	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	98.0	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	106.5	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	97.2	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.6	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	320.2	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	112.5	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	118.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70309 PARACHUT 230	70365 HOLMMESA 230	1	430.0	98.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	70365 HOLMMESA 230	1	430.0	100.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	430.0	95.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	131.7	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER 345	1	895.0	98.8	79013 CRAIG 230 79059 RIFLE WA 230 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	112.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	119.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.0	114.0	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	126.2	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.4	79014 CRAIG 345 79266 MEEKER 345 1

The reduction in the Holms Mesa 230kV load to 6.0 MW and 1.2 MVAR results in a contingency flow on the RiflePS-Holms Mesa 230kV line of 100.1% of its 430 MVA rating for an outage of the RifleCu-Grand Junction 345kV. The table below shows that bus voltages in the study are acceptable at a Holms Mesa load level of 60 MW and 1.2 MVAR and TOT2A at 500 MW north-to-south.

Table A3-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	***0.9048***	0.9710	70268 ADOBE 230 70438 UINTAH 230 1
70357	BENCH	230.0	***0.9154***	0.9859	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70076	CAMEO	69.0	***0.9413***	1.0178	70076 CAMEO 69.0 70078 CAMEO 230 T5
70078	CAMEO	230.0	***0.9239***	0.9895	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70082	CAMP	69.0	***0.9242***	0.9827	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70140	DEBEQUE	69.0	***0.9038***	0.9869	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9498***	1.0076	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036	GRANDJCT	345.0	***1.0286***	0.9793	79049 MONTROSE 345 79072 HESPERUS 345 1
70206	GRANDJPS	230.0	***0.9061***	0.9613	70268 ADOBE 230 70438 UINTAH 230 1
70207	GRANDVLY	69.0	***0.9240***	0.9825	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70365	HOLMMESA	230.0	***0.9198***	0.9915	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70233	HORIZON	230.0	***0.9048***	0.9650	70233 HORIZON 230 70268 ADOBE 230 1
70302	OILSHALE	69.0	***0.9348***	0.9902	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	***0.9199***	0.9901	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70359	RIFLE_CU	69.0	***0.9449***	1.0005	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	***0.9382***	0.9937	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	***0.9186***	0.9889	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70436	UINTAH	69.0	***0.9556***	1.0104	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70438	UINTAH	230.0	***0.9158***	0.9769	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70109	UNA_ORCH	69.0	***0.9059***	0.9777	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70440	UNIONOIL	69.0	***0.9243***	0.9828	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70454	VINELAND	69.0	***0.9445***	1.0123	70076 CAMEO 69.0 70078 CAMEO 230 T5
70356	WEELERPS	230.0	***0.9185***	0.9888	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

Contingency bus voltages in the study area are acceptable.

A4. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM_6MW"
High TOT2A Flow of 500 MW (north-to-south)
Adjust Holms Mesa Load to 15.0 MW and 3.0 MVAR (98% PF)
Increase the RiflePS-Holms Mesa 230kV Rating to 439 MVA

The RiflePS-Parachute 230kV line (Circuit #5205) has a rating of 430 MVA due to limitations at the RiflePS Substation. The RiflePS-Parachute 230kV is constructed with 1-795 kcmil ACSR conductor and the line has a thermal rating of 439 MVA (1102 amps). PSCo Substation Engineering will need to evaluate the RiflePS Substation to determine the requirements to achieve a 439 MVA summer normal rating. The study assumed that increase in the summer normal line rating to 439 MVA is possible.

The Holms Mesa demand was adjusted until a contingency resulted in a violation of the new rating and contingencies were simulated. The results are listed in the table below. At a Holms Mesa demand of 15 MW (and 3.0 MVAR), an outage of the RifleCu-Grand Junction 345kV line results in a contingency flow on the RiflePS-Holms Mesa of 100.0% of the 439 MVA rating. Contingency bus voltages for an outage of the RiflePs-Holms Mesa 230kV line are just at the 0.90 p.u. criteria lower limit at Bench 230kV, Holms Mesa 230kV, Parachute 230kV, Starkey Gulch 230kV, and WheelerPS 230kV. The results are listed in the tables below.

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Table A4-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	126.5	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	102.0	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	110.0	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	100.8	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.7	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	326.4	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	112.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	117.8	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70309 PARACHUT 230	70365 HOLMMESA 230	1	430.0	98.4	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	70365 HOLMMESA 230	1	439.0	100.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	430.0	96.5	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	132.5	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER 345	1	895.0	99.3	79013 CRAIG 230 79059 RIFLE WA 230 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	112.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	119.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.0	115.4	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	106.5	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	126.9	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.6	79014 CRAIG 345 79266 MEEKER 345 1

Table A4-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	***0.9041***	0.9701	70268 ADOBE 230 70438 UINTAH 230 1
70357	BENCH	230.0	***0.8952***	0.9844	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70076	CAMEO	69.0	***0.9280***	1.0166	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70078	CAMEO	230.0	***0.9139***	0.9883	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70082	CAMP	69.0	***0.9195***	0.9816	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113	CLIFTON	230.0	***0.9090***	0.9585	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70140	DEBEQUE	69.0	***0.9027***	0.9857	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9468***	1.0066	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79036	GRANDJCT	345.0	***1.0279***	0.9786	79049 MONTROSE 345 79072 HESPERUS 345 1
70206	GRANDJPS	230.0	***0.9054***	0.9604	70268 ADOBE 230 70438 UINTAH 230 1
70207	GRANDVLY	69.0	***0.9194***	0.9814	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70365	HOLMMESA	230.0	***0.8993***	0.9899	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70233	HORIZON	230.0	***0.9041***	0.9641	70233 HORIZON 230 70268 ADOBE 230 1
70302	OILSHALE	69.0	***0.9323***	0.9892	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	***0.8998***	0.9886	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70359	RIFLE_CU	69.0	***0.9426***	0.9996	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	***0.9360***	0.9929	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	***0.8984***	0.9873	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70436	UINTAH	69.0	***0.9542***	1.0101	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70438	UINTAH	230.0	***0.9144***	0.9760	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	***0.9049***	0.9766	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70440	UNIONOIL	69.0	***0.9196***	0.9817	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70356	WEELERPS	230.0	***0.8983***	0.9873	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

Contingency bus voltages at Bench 230kV, Holms Mesa 230kV, Parachute 230kV, Starkey Gulch 230kV and Wheeler PS 230kV are just at the 0.90 p.u. contingency bus voltage limit.

A5. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_450PS_BR_PL_HM"
Reduced TOT2A Flow to 450 MW (north-to-south)
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

The TOT2A north-to-south transfer level has a large impact on the line flows and bus voltages in the study area. The study case with Holms Mesa represented as a 28.0 MVA load and the TOT2A north-to-south transfer at 500 MW was obtained. The TOT2A north-to-south flow was reduced until the RiflePS-Holms Mesa 230kV contingency line overload was eliminated. With the flows reduced to 450 MW, contingencies were simulated and the results listed in the table below.

Table A5-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	119.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	104.8	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	113.7	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	104.1	70309 PARACHUT 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	105.7	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.9	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	305.3	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	105.3	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	110.8	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	70365 HOLMMESA 230	1	430.0	100.3	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	128.9	79014 CRAIG 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	106.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	112.4	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.0	111.0	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	102.0	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	122.8	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	179.3	79014 CRAIG 345 79266 MEEKER 345 1

The following observations were made from the table.

- The RiflePS-Holms Mesa 230kV contingency line flow decreased to 100.3% of its 430 MVA rating with the TOT2A flow reduced to 450 MW from 500 MW.
- The Grand Junction 345-230kV transformer contingency flow reached 113.7% of its 273 MVA rating for loss of the RiflePS-Holms Mesa 230kV line. This contingency flow is acceptable as the flow is within the emergency rating of the transformer.
- The Grand Junction 115-69kV transformer flow reached 105.7% of its 42 MVA rating for loss of the RiflePS-Holms Mesa 230kV line. This

transformer contingency flow will need to be investigated in more detail by PSCo.

- The Grand Junction 138-115kV transformer contingency flow reaches 106.2% of its 55.0 MVA rating. This is unacceptable but is an existing condition that PSCo is studying.
- The Grand Junction-Collbran 138kV line is limited by the Grand Junction 138-115kV transformer (a serial element). This limitation will be eliminated with the replacement of the Grand Junction 138-115kV transformer (or the addition of a second transformer).

Table A5-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	***0.9111***	0.9798	70268 ADOBE 230 70438 UINTAH 230 1
70357	BENCH	230.0	***0.9027***	0.9905	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79011	CAHONE	115.0	***0.9330***	0.9978	79049 MONTROSE 345 79072 HESPERUS 345 1
70076	CAMEO	69.0	***0.9167***	1.0036	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70078	CAMEO	230.0	***0.9236***	0.9981	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113	CLIFTON	230.0	***0.9185***	0.9671	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70140	DEBEQUE	69.0	***0.9039***	0.9786	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70214	GRANDJCT	69.0	***0.9414***	0.9990	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70206	GRANDJPS	230.0	***0.9124***	0.9695	70233 HORIZON 230 70268 ADOBE 230 1
70207	GRANDVLY	69.0	***0.9173***	0.9775	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70365	HOLMMESA	230.0	***0.9064***	0.9952	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70233	HORIZON	230.0	***0.9109***	0.9735	70233 HORIZON 230 70268 ADOBE 230 1
70302	OILSHALE	69.0	***0.9359***	0.9869	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	***0.9073***	0.9947	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79056	RIFLE_CU	138.0	***0.9439***	0.9952	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	***0.9476***	0.9989	79014 CRAIG 345 79266 MEEKER 345 1
70438	UINTAH	230.0	***0.9239***	0.9859	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70436	UINTAH	69.0	***0.9462***	1.0070	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	***0.9026***	0.9715	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	***0.9135***	0.9715	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70454	VINELAND	69.0	***0.9228***	1.0000	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

The reduction in the TOT2A flow from 500 MW to 450 MW reduced the contingency bus voltages to acceptable levels.

A6. 2012 Heavy Summer Study Case

Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM_S1"

Sensitivity #1: High TOT2A Flow of 500 MW with the Debeque-Bluestone Valley 69kV Project Added

Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

PSCo is considering the construction of a Bluestone Valley Substation that will tap the Parachute-Cameo 230kV line near Debeque, Colorado approximately half-way between Parachute Substation and Cameo Substation. A 230-69kV 75MVA transformer would be installed at the Bluestone Valley Substation along with protective equipment that includes a three-breaker ring bus laid out as a breaker-and-a-half configuration and a 69kV single bus single breaker layout. A two-mile 69kV transmission line from Bluestone Valley Substation to Debeque Substation would be constructed using 1-266 (Partridge) conductor on 6.211B towers. The portion of the RifleCu-Oil Shale-Grand Valley-Una-Debeque-Cameo 69kV line between Debeque and Cameo would be removed. The proposed project was modeled in the high transfer (TOT2A at 500 MW north-to-south) case with the Holms Mesa load added. Outages were simulated and the results are listed in the table below.

Table A6-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	125.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70109 UNA_ORCH 69.0	70207 GRANDVLY 69.0	1	55.9	109.7	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	102.4	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	109.8	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	100.2	70309 PARACHUT 230 70365 HOLMMESA 230 1
70207 GRANDVLY 69.0	70302 OILSHALE 69.0	1	55.9	109.8	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	110.4	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.8	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	335.6	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	111.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	116.8	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70302 OILSHALE 69.0	70359 RIFLE_CU 69.0	1	55.9	109.9	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70358 RIFLE_PS 230	70365 HOLMMESA 230	1	430.0	105.4	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	133.4	79014 CRAIG 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	117.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	124.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	598.0	115.4	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	107.1	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	127.9	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.8	79014 CRAIG 345 79266 MEEKER 345 1

Table A6-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	*0.8917*	0.9694	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70357	BENCH	230.0	*0.8551*	0.9811	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70393	BLUESTON	69.0	*0.8595*	1.0047	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70341	BLUESTON	230.0	*0.8692*	0.9849	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70078	CAMEO	230.0	*0.8847*	0.9874	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113	CLIFTON	230.0	*0.8949*	0.9577	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70140	DEBEQUE	69.0	*0.8578*	0.9985	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205	GRANDJCT	230.0	*0.8986*	0.9575	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70206	GRANDJPS	230.0	*0.8898*	0.9597	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70207	GRANDVLY	69.0	*0.8774*	0.9902	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70365	HOLMMESA	230.0	*0.8590*	0.9868	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70233	HORIZON	230.0	*0.8898*	0.9634	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70309	PARACHUT	230.0	*0.8600*	0.9852	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70438	UINTAH	230.0	*0.8937*	0.9752	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	*0.8576*	0.9876	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70356	WEELERPS	230.0	*0.8584*	0.9839	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

The Debeque-Bluestone Valley 69kV Project (including the removal of the Debeque-Cameo 69kV line) increases the contingency flow on the RiflePS-Holms Mesa 230kV line from 105.0 MVA to 105.4 MVA for loss of the RifleCu-Grand Junction 345kV line. The project decreases the contingency bus voltage at Holms Mesa from0.8713 p.u. to 0.8590 for loss of the RiflePS-Holms Mesa 230kV line. Several other transmission buses in the study area experience voltage reductions due to this proposed project. In addition, the project significantly increases contingency line flows on RifleCu-Grand Valley-Una-Debeque-Cameo 69kV line with the RifleCu-Oil Shale 69kV line experiencing a contingency flow of approximately 110% for loss of the RiflePS-Holms Mesa 69kV branch. PSCo is studying the impact of the proposed project on the system.

A7. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM_S2A"
Sensitivity #2A: High TOT2A Flow of 500 MW with the RifleCu-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

PSCo has proposed the construction of a RifleCu-Parachute 230kV transmission line. The line has an in-service date of December 2015. The line will constructed with 1-1272 kcmil ACSR conductor. The RifleCu-Parachute 230kV transmission project was modeled in the study case and outages were simulated. The results are listed below.

Table A7-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	136.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70206 GRANDJPS 230	70233 HORIZON 230	1	239.0	102.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.5	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	330.9	79014 CRAIG 345 79266 MEEKER 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	122.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	128.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	133.1	79014 CRAIG 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138 T2		55.0	105.3	79036 GRANDJCT 345 79049 MONTROSE 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	109.2	79036 GRANDJCT 345 79049 MONTROSE 345 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	107.7	79014 CRAIG 345 79266 MEEKER 345 1
79057 RIFLE_CU 230	79059 RIFLE WA 230	1	478.0	111.5	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	127.9	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.5	79014 CRAIG 345 79266 MEEKER 345 1

The addition of the RifleCu-Parachute 230kV transmission project eliminates the contingency overload of the RiflePS-Holms Mesa 230kV line. The RifleCu-Parachute 230kV transmission project eliminates the RifleCu 345-230kV contingency overload. The RifleCu-Parachute 230kV #2 transmission project does not eliminate the Grand Junction 138-115kV transformer contingency overload. This issue will need to be eliminated with the addition of a second transformer. The project increases the contingency flow of the Cameo-Uintah-Adobe-Horizon-Grand Junction 230kV transmission system. The project decreases the Grand Junction 138-115kV contingency flow. The RifleCu-RifleWA 230kV line (Circuit No. 3007) experiences a 111.5% contingency overload of its 478 MVA rating for an outage of the Craig-Meeker 345kV line. The RifleCu-RifleWA 230kV line is 1.59 miles in length, is constructed with 1-1272 kcmil ACSR conductor strung on 6.403R towers, and has a 574 MVA (1442 amps) thermal rating. The 478 MVA rating is based on substation elements at the RifleCu Substation. PSCo will need to upgrade the RifleCu-RifleWA 230kV line to at least 533 MVA to support the Holms load addition.

Table A7-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70078	CAMEO	230.0	***0.9367***	0.9910	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70076	CAMEO	69.0	***0.9420***	1.0207	70076 CAMEO 69.0 70078 CAMEO 230 T5
70140	DEBEQUE	69.0	***0.9041***	0.9891	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9579***	1.0088	70076 CAMEO 69.0 70078 CAMEO 230 T5
79036	GRANDJCT	345.0	***1.0310***	0.9805	10292 SAN_JUAN 345 79060 SANJN PS 345 1
70206	GRANDJPS	230.0	***0.9069***	0.9622	70268 ADOBE 230 70438 UINTAH 230 1
70207	GRANDVLY	69.0	***0.9242***	0.9842	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70233	HORIZON	230.0	***0.9055***	0.9659	70268 ADOBE 230 70438 UINTAH 230 1
70302	OILSHALE	69.0	***0.9340***	0.9911	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	***0.9368***	0.9939	79014 CRAIG 345 79266 MEEKER 345 1
70438	UINTAH	230.0	***0.9222***	0.9778	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70109	UNA_ORCH	69.0	***0.9062***	0.9798	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1

The studies demonstrate that the addition of the RifleCu-Parachute 230kV line results in contingency bus voltages within criteria.

A8. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_BR_PL_HM_S2B"
Sensitivity #2B: High TOT2A Flow of 500 MW with the RiflePS-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

PSCo is considering a second terminus for the RifleCu-Parachute 230kV line. That terminus would be the RiflePS Substation. The addition of the this line would result in a second RiflePS-Parachute 230kV transmission line. The RiflePS-Parachute 230kV line #2 was modeled in the study case. Outages were simulated and the results are listed below.

Table A8-1. Branch Flows for Single Contingency Outage

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	134.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	115.5	79003 BASALT 115 79004 BASALT 230 T2
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	333.3	79014 CRAIG 345 79266 MEEKER 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	126.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	430.0	103.1	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	133.4	79014 CRAIG 345 79266 MEEKER 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	121.1	79058 RIFLE_CU 345 79266 MEEKER 345 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	106.5	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	112.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	106.9	79014 CRAIG 345 79266 MEEKER 345 1
79048 MONTROSE 115	79052 NUCLA 115	1	76.0	121.7	79011 CAHONE 115 79052 NUCLA 115 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	598.0	127.4	79013 CRAIG 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	181.7	79014 CRAIG 345 79266 MEEKER 345 1

The addition of the RifleCu-Parachute 230kV transmission project eliminates the contingency overload of the RiflePS-Holms Mesa 230kV line. The RiflePS-Parachute 230kV #2 transmission project eliminates the RifleCu 345-230kV contingency overload. The RiflePS-Parachute 230kV #2 transmission project does not eliminate the Grand Junction 138-115kV transformer contingency overload. This issue will need to be eliminated with the addition of a second transformer. The project increases the contingency flow of the Cameo-Uintah-Adobe-Horizon-Grand Junction 230kV transmission system. The project decreases the Grand Junction 138-115kV contingency flow. The RiflePS-RifleWA 230kV bus tie experiences a 103.1% overload of its 430 MVA rating for an outage of the RifleCu-Grand Junction 345kV line. The 430.2 MVA (1080 amps) summer normal rating is based on the bus tie conductor limit for 1-1033.5 kcmil ACSR conductor. PSCo would need to replace the 1-1033.5 kcmil ACSR conductor with bus work with higher capacity. The upgrade of

the RiflePS-RifleWA 230kV bus tie would need to studied in more detail if the RiflePS 230kV terminus is selected.

Table A8-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	***0.9052***	0.9725	70268 ADOBE 230 70438 UINTAH 230 1
70078	CAMEO	230.0	***0.9358***	0.9920	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70076	CAMEO	69.0	***0.9421***	1.0211	70076 CAMEO 69.0 70078 CAMEO 230 T5
70140	DEBEQUE	69.0	***0.9045***	0.9895	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9579***	1.0093	70076 CAMEO 69.0 70078 CAMEO 230 T5
79036	GRANDJCT	345.0	***1.0309***	0.9806	10292 SAN_JUAN 345 79060 SANJN PS 345 1
70206	GRANDJPS	230.0	***0.9065***	0.9627	70268 ADOBE 230 70438 UINTAH 230 1
70206	GRANDJPS	230.0	***0.9067***	0.9627	70233 HORIZON 230 70268 ADOBE 230 1
70207	GRANDVLY	69.0	***0.9246***	0.9846	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70233	HORIZON	230.0	***0.9051***	0.9664	70268 ADOBE 230 70438 UINTAH 230 1
79056	RIFLE_CU	138.0	***0.9385***	0.9942	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	***0.9450***	1.0009	79014 CRAIG 345 79266 MEEKER 345 1
70438	UINTAH	230.0	***0.9224***	0.9785	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70109	UNA_ORCH	69.0	***0.9066***	0.9801	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70454	VINELAND	69.0	***0.9454***	1.0151	70076 CAMEO 69.0 70078 CAMEO 230 T5

The studies demonstrate that the addition of the RifleCu-Parachute 230kV line results in contingency bus voltages within criteria.

A9. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_-500PS_TOT5_1300_BR_PL_HM"
High TOT5 Flow of 1300 MW (west-to-east)
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

Heavy flows on the TOT5 power transfer path can have an impact on the study area. The study case that models Holms Mesa at 28.0 MVA was obtained. The TOT5 transfers were increased by scheduling power from PacifiCorp Electric Operations-East to PSCo. The TOT5 system intact flow was increased to 1300 MW west-to-east. Contingencies were simulated and the results are listed below.

Table A9-1. Branch Flows for Single Contingency Outages

** From bus ** ** To bus ** CKT	Rating	Loading%	Contingency Description
70113 CLIFTON 230 70206 GRANDJPS 230 1	273.0	102.9	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70205 GRANDJCT 230 79036 GRANDJCT 345 T1	273.0	118.8	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70205 GRANDJCT 230 79036 GRANDJCT 345 T1	273.0	117.3	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230 79036 GRANDJCT 345 T1	273.0	109.0	70309 PARACHUT 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1	42.0	105.7	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1	42.0	104.2	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115 79003 BASALT 115 1	60.0	222.7	79039 HAYDEN 230 79091 FOIDELCK 230 1
70232 HOPKINS 230 70358 RIFLE_PS 230 1	57.0	521.9	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230 79059 RIFLE WA 230 1	430.0	117.0	70113 CLIFTON 230 70205 GRANDJCT 230 1
70358 RIFLE_PS 230 79059 RIFLE WA 230 1	430.0	117.0	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70358 RIFLE_PS 230 79059 RIFLE WA 230 1	430.0	111.2	70113 CLIFTON 230 70206 GRANDJPS 230 1
70358 RIFLE_PS 230 79059 RIFLE WA 230 1	430.0	104.4	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230 79059 RIFLE WA 230 1	430.0	101.1	79069 WOLCOTT 230 79091 FOIDELCK 230 1
70359 RIFLE_CU 69.0 79056 RIFLE_CU 138 T2	75.0	94.1	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230 79091 FOIDELCK 230 1	128.0	200.0	79033 GOREPASS 230 79039 HAYDEN 230 1

The RiflePS-RifleWA 230kV bus tie has no sectionalizing breakers; therefore, outages involving the RiflePS-RifleWA 230kV bus tie can be ignored. The following contingency overloads are observed:

- The Grand Junction 345-230kV transformer experiences an overload (117.3% of its 273 MVA rating) for the loss of the RiflePS-Hood Mesa 230kV transmission line. This potential overload will need to be examined in more detail by PSCo.
- The Grand Junction 115-69kV transformer experiences an overload (104.2% of its 42 MVA rating) for the loss of the RiflePS-Hood Mesa 230kV transmission line. This contingency overload will be eliminated with the addition of a second Grand Junction 115-69kV transformer.

The contingency flow on the RiflePS-RifleWA bus tie reaches 117.0% of its 430 MVA rating for an outage of the Grand Junction-Clifton 230kV line. The 430.2 MVA (1080 amps) summer normal rating is based on the bus tie conductor limit for 1-1033.5 kcmil ACSR conductor. PSCo would need to replace the 1-1033.5 kcmil ACSR conductor with bus work of higher capacity. This would bring the bus tie rating to approximately 490 MVA (or higher with higher rated conductor). The upgrade of the RiflePS-RifleWA 230kV bus tie would need to studied in more detail if the RiflePS 230kV terminus is selected.

Table A9-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70140	DEBEQUE	69.0	***0.9447***	1.0009	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70214	GRANDJCT	69.0	***0.9700***	1.0246	70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1

Contingency bus voltages are within criteria for high TOT5 west-to-east transfer conditions.

A10. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_TOT5_1300_BR_PL_HM_S1"
Sensitivity #1: High TOT5 Flow of 1300 MW with the Debeque-Bluestone Valley 69kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

The Debeque-Bluestone Valley 69kV Project was added to the case. Outages were simulated and the results listed in the table below.

Table A10-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	101.4	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	117.2	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	114.3	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	106.6	70309 PARACHUT 230 70365 HOLMMESA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	105.3	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	103.4	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	222.8	79039 HAYDEN 230 79091 FOIDELCK 230 1
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	521.1	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	430.0	117.0	70113 CLIFTON 230 70205 GRANDJCT 230 1
70359 RIFLE_CU 69.0	79056 RIFLE_CU 138	T2	65.0	104.1	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	200.0	79033 GOREPASS 230 79039 HAYDEN 230 1

The criteria violations observed are very near the values obtained without the Debeque-Bluestone 230kV line added. This project does not improve the reliability of the system. The RiflePS-RifleWA 230kV bus tie has no sectionalizing breakers; therefore, outages involving the RiflePS-RifleWA 230kV bus tie can be ignored. The contingency bus voltages area listed below. No criteria violations were noted.

Table A10-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70393	BLUESTON	69.0	***0.9453***	1.0083	70341 BLUESTON 230 70393 BLUESTON 69.0 T1
70140	DEBEQUE	69.0	***0.9447***	1.0043	70140 DEBEQUE 69.0 70393 BLUESTON 69.0 1
70109	UNA_ORCH	69.0	***0.9465***	0.9979	70140 DEBEQUE 69.0 70393 BLUESTON 69.0 1

A11. 2012 Heavy Summer Study Case

Case Name: "12hs4ap_TOT2A_500PS_TOT5_1300_BR_PL_HM_S2A"

Sensitivity #2A: High TOT5 Flow of 1300 MW with the RifleCu-Parachute 230kV Project Added

Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

The RifleCu-Parachute 230kV project was added to the case. Simulations were conducted and the results listed below.

Table A11-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70231 HOPKINS 115	79003 BASALT 115	1	60.0	222.9	79039 HAYDEN 230 79091 FOIDELCK 230 1
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	523.2	79039 HAYDEN 230 79091 FOIDELCK 230 1
73072 GOREPASS 138	79038 HAYDEN 138	1	133.0	117.3	79033 GOREPASS 230 79039 HAYDEN 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	199.6	70232 HOPKINS 230 70358 RIFLE_PS 230 1

Table A11-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70140	DEBEQUE	69.0	*0.9461*	1.0042	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70109	UNA_ORCH	69.0	*0.9478*	0.9980	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1

The addition of the RifleCu-Parachute 230kV line eliminates transmission facility overloads under high west-to-east TOT5 flows for the following facilities:

- Grand Junction 345-230kV Transformer
- Grand Junction 115-69kV Transformer
- RiflePS-RifleWA 230kV Bus Tie
- Rifle 138-69kV Transformer

A12. 2012 Heavy Summer Study Case
Case Name: "12hs4ap_TOT2A_500PS_TOT5_1300_BR_PL_HM_S2B"
Sensitivity #2B: High TOT5 Flow of 1300 MW with the RiflePS-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

The RiflePS-Parachute 230kV line #2 was added to the case. Simulations were conducted and the results listed below.

Table A12-1. Branch Flows for Single Contingency Outages

** From bus	** ** To bus	** CKT	Rating	Loading%	Contingency Description
70113 CLIFTON 230	70206 GRANDJPS 230	1	273.0	103.2	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	119.1	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	105.9	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	222.4	79039 HAYDEN 230 79091 FOIDELCK 230 1
70232 HOPKINS 230	70358 RIFLE_PS 230	1	57.0	520.5	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	430.0	118.0	70113 CLIFTON 230 70205 GRANDJCT 230 1
70359 RIFLE_CU 69.0	79056 RIFLE_CU 138	T2	65.0	108.6	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
79069 WOLCOTT 230	79091 FOIDELCK 230	1	128.0	200.0	79033 GOREPASS 230 79039 HAYDEN 230 1

The RiflePS-RifleWA 230kV bus tie has no sectionalizing breakers; therefore, outages involving the RiflePS-RifleWA 230kV bus tie can be ignored. The following contingency overloads are observed:

- The contingency flow on the RiflePS-RifleWA bus tie reaches 118.0% of its 430 MVA rating for an outage of the Grand Junction-Clifton 230kV line. The 430.2 MVA (1080 amps) summer normal rating is based on the bus tie conductor limit for 1-1033.5 kcmil ACSR conductor. The addition of the RiflePS-Parachute 230kV Line #2 increases the contingency overload of the RiflePS-RifleWA 230kV Bus Tie from 117% of its 430 MVA rating to 118% of its 430 MVA rating. PSCo would need to replace the 1-1033.5 kcmil ACSR conductor with bus work of higher capacity. The upgrade of the RiflePS-RifleWA 230kV bus tie would need to studied in more detail if the RiflePS 230kV terminus is selected.

Table A12-2. Bus Voltages for Single Contingency Outages

No violations in the study area.

A13. 2013 Heavy Winter Study Case

Case Name: "13hw2p_TOT2A_500PS_BR_PL_HM"

High TOT2A Flow of 500 MW (north-to-south)

Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)

(Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Bank Off-Line)

The **winter season** was studied to determine the impact on the Holms Mesa load and transmission system that serves the load. The winter on-peak case was modified to reflect a high TOT2A flow of 500 MW. The Holms Mesa load was added to the case. Outages were simulated and the results listed below.

Table A13-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	120.0	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	187.2	79003 BASALT 115 79004 BASALT 230 T2
70233 HORIZON 230	70268 ADOBE 230	1	239.0	101.2	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	105.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	134.4	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER 345	1	895.0	100.9	79013 CRAIG 230 79059 RIFLE WA 230 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	118.2	79036 GRANDJCT 345 79049 MONTROSE 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	123.5	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79036 GRANDJCT 345	79058 RIFLE_CU 345	1	621.0	108.8	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	109.8	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	621.0	122.4	79013 CRAIG 230 79059 RIFLE WA 230 1

The results are similar, but not as severe, as the results obtained for the on-peak summer case with a high 500 MW north-to-south transfer across TOT2A. The RiflePS-Holms Mesa 230kV line contingency overload (for loss of the RifleCu-Grand Junction 345kV line) does not occur due to the lower demand during the winter. The Grand Junction 138-115kV overload (118.2% of its 55 MVA rating) occurs for both winter and summer season. PSCo will investigate adding a second Grand Junction 138-115kV transformer.

Table A13-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	0.9366	0.9912	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70357	BENCH	230.0	0.8899	0.9805	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70076	CAMEO	69.0	0.9265	1.0049	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70078	CAMEO	230.0	0.9260	0.9991	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70113	CLIFTON	230.0	1.0291	0.9790	70113 CLIFTON 230 70205 GRANDJCT 230 1
70140	DEBEQUE	69.0	0.9150	0.9811	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70205	GRANDJCT	230.0	1.0316	0.9768	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70207	GRANDVLY	69.0	0.9197	0.9796	79014 CRAIG 345 79266 MEEKER 345 1
70365	HOLMMESA	230.0	0.8937	0.9864	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70309	PARACHUT	230.0	0.8946	0.9847	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
79059	RIFLE WA	230.0	0.9390	0.9937	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	0.9388	1.0007	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	0.9347	0.9971	79014 CRAIG 345 79266 MEEKER 345 1
79057	RIFLE_CU	230.0	0.9397	0.9931	79014 CRAIG 345 79266 MEEKER 345 1
70358	RIFLE_PS	230.0	0.9391	0.9938	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	0.8932	0.9834	70358 RIFLE_PS 230 70365 HOLMMESA 230 1
70109	UNA_ORCH	69.0	0.9132	0.9739	70358 RIFLE_PS 230 70365 HOLMMESA 230 1

The low contingency bus voltages at Holms Mesa, Parachute, Starkey Gulch and Bench (for an outage of the RiflePS-Holms Mesa 230kV line) are eliminated by placing the Parachute 230kV 45MVAR capacitor bank in-service, as was done for the summer case.

A14. 2013 Heavy Winter Study Case
Case Name: "13hw2p_TOT2A_500PS_BR_PL_HM_S2A"
Sensitivity #2A: High TOT2A Flow of 500 MW with the RifleCu-Parachute 230kV Project Added
Holmes Mesa Load = 28.0 MVA (98% Power Factor Assumed (Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Off-Line)

The **winter** on-peak case was modified to include the Holms Mesa load, a high TOT5 flow (1300 MW west-to-east), and the RifleCu-Parachute 230kV transmission line represented. Outages were simulated and the results listed below.

Table A14-1. Branch Flows for Single Contingency Outages

From bus	To bus	CKT	Rating	Loading%	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	130.9	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70206 GRANDJPS 230	70233 HORIZON 230	1	239.0	100.3	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	186.9	79003 BASALT 115 79004 BASALT 230 T2
70233 HORIZON 230	70268 ADOBE 230	1	239.0	112.9	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	117.3	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	134.8	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER 345	1	895.0	101.5	79013 CRAIG 230 79059 RIFLE WA 230 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	116.9	79036 GRANDJCT 345 79049 MONTROSE 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	121.0	79036 GRANDJCT 345 79049 MONTROSE 345 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	110.4	79014 CRAIG 345 79266 MEEKER 345 1
79057 RIFLE_CU 230	79059 RIFLE WA 230	1	478.0	111.5	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	621.0	123.2	79013 CRAIG 230 79059 RIFLE WA 230 1

The contingency overload of the RifleCu-RifleWA 230kV line (for an outage of the Craig-Meeker 345kV line) is111.5% of its 478 MVA winter rating. The other criteria violations will be mitigated by the responsible entities. The studies demonstrate the need to add a second Grand Junction 138-115kV transformer. The RifleCu-RifleWA 230kV transmission line will need to uprated. PSCo is working on both of these projects.

Table A14-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	0.9405	0.9929	70268 ADOBE 230 70438 UINTAH 230 1
70140	DEBEQUE	69.0	0.9184	0.9843	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70302	OILSHALE	69.0	0.9290	0.9906	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	0.9382	0.9915	79014 CRAIG 345 79266 MEEKER 345 1
79059	RIFLE WA	230.0	0.9402	0.9954	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	0.9391	1.0012	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	0.9350	0.9979	79014 CRAIG 345 79266 MEEKER 345 1
79057	RIFLE_CU	230.0	0.9404	0.9942	79014 CRAIG 345 79266 MEEKER 345 1
70358	RIFLE_PS	230.0	0.9403	0.9955	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	0.9369	0.9903	79014 CRAIG 345 79266 MEEKER 345 1
70109	UNA_ORCH	69.0	0.9173	0.9767	79014 CRAIG 345 79266 MEEKER 345 1
70439	UNC	115.0	0.9285	1.0102	73012 AULT 345 73108 LAR.RIVR 345 1
70356	WEELERPS	230.0	0.9368	0.9902	79014 CRAIG 345 79266 MEEKER 345 1

Bus voltages in the study area are acceptable.

A15. 2013 Heavy Winter Study Case
Case Name: "13hw2p_TOT2A_500PS_BR_PL_HM_S2B"
Sensitivity #2B: High TOT2A Flow of 500 MW with the RiflePS-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)
(Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Bank Off-Line)

The **winter** on-peak case was modified to include the Holms Mesa load, a high TOT5 flow (1300 MW west-to-east), and the RiflePS-Parachute 230kV transmission line. Outages were simulated and the results listed below.

Table A15-1. Branch Flows for Single Contingency Outages

From bus	To bus	CKT	Rating	Loading%	Ncon	Contingency Description
70078 CAMEO 230	70438 UINTAH 230	1	239.0	129.0	1076	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70233 HORIZON 230	70268 ADOBE 230	1	239.0	110.9	1076	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
70268 ADOBE 230	70438 UINTAH 230	1	239.0	115.2	1076	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA 230	1	478.0	135.0	1055	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER 345	1	895.0	101.1	1054	79013 CRAIG 230 79059 RIFLE WA 230 1
79034 GRANDJCT 115	79035 GRANDJCT 138	T2	55.0	117.9	1075	79036 GRANDJCT 345 79049 MONTROSE 345 1
79035 GRANDJCT 138	79047 COLBRAN 138	1	55.0	122.1	1075	79036 GRANDJCT 345 79049 MONTROSE 345 1
79046 MEEKER 138	79056 RIFLE_CU 138	1	125.0	109.6	1055	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER 345	1	621.0	122.7	1054	79013 CRAIG 230 79059 RIFLE WA 230 1

The Grand Junction 138-115kV transformer flow reaches 117.9% of its 55 MVA rating for an outage of the Grand Junction-Montrose 345kV line. PSCo plans to add a second Grand Junction 138-115kV transformer to mitigate the violation.

Table A15-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	0.9408	0.9932	70268 ADOBE 230 70438 UINTAH 230 1
70357	BENCH	230.0	0.9352	0.9876	79014 CRAIG 345 79266 MEEKER 345 1
70140	DEBEQUE	69.0	0.9188	0.9845	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70140	DEBEQUE	69.0	0.9295	0.9845	79014 CRAIG 345 79266 MEEKER 345 1
70207	GRANDVLY	69.0	0.9236	0.9823	79014 CRAIG 345 79266 MEEKER 345 1
70365	HOLMMESA	230.0	0.9396	0.9922	79014 CRAIG 345 79266 MEEKER 345 1
70309	PARACHUT	230.0	0.9396	0.9917	79014 CRAIG 345 79266 MEEKER 345 1
79059	RIFLE WA	230.0	0.9416	0.9951	79014 CRAIG 345 79266 MEEKER 345 1
70359	RIFLE_CU	69.0	0.9409	1.0017	79014 CRAIG 345 79266 MEEKER 345 1
79056	RIFLE_CU	138.0	0.9369	0.9983	79014 CRAIG 345 79266 MEEKER 345 1
79057	RIFLE_CU	230.0	0.9423	0.9944	79014 CRAIG 345 79266 MEEKER 345 1
70358	RIFLE_PS	230.0	0.9417	0.9953	79014 CRAIG 345 79266 MEEKER 345 1
70299	STKGULCH	230.0	0.9383	0.9905	79014 CRAIG 345 79266 MEEKER 345 1
70109	UNA_ORCH	69.0	0.9193	0.9770	79014 CRAIG 345 79266 MEEKER 345 1
70109	UNA_ORCH	69.0	0.9202	0.9770	70076 CAMEO 69.0 70140 DEBEQUE 69.0 1
70109	UNA_ORCH	69.0	0.9275	0.9770	70109 UNA_ORCH 69.0 70140 DEBEQUE 69.0 1
70356	WEELERPS	230.0	0.9382	0.9904	79014 CRAIG 345 79266 MEEKER 345 1

Bus contingency voltages are acceptable.

A16. 2013 Heavy Winter Study Case
Case Name: "13hw2p_TOT2A_-500PS_TOT5_1300_BR_PL_HM"
High TOT5 Flow of 1300 MW (west-to-east)
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)
(Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Bank Off-Line)

The **winter** study case with a high TOT5 flow (1300 MW west-to-east) was obtained and the Holms Mesa Substation and 28.0MVA load added. Outages were simulated and the results listed in the tables below.

Table A16-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus **	CKT	Rating	Loading%	Contingency Description
70205 GRANDJCT 230	79036 GRANDJCT 345	T1	273.0	112.6	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115	T1	42.0	104.9	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70231 HOPKINS 115	70232 HOPKINS 230	T2	80.0	114.0	79039 HAYDEN 230 79091 FOIDELCK 230 1
70231 HOPKINS 115	79003 BASALT 115	1	60.0	320.6	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230	79059 RIFLE WA 230	1	514.0	100.4	79039 HAYDEN 230 79091 FOIDELCK 230 1
70359 RIFLE_CU 69.0	70388 SILTUSBR 69.0	1	55.9	103.6	70232 HOPKINS 230 70358 RIFLE_PS 230 1
70359 RIFLE_CU 69.0	79056 RIFLE_CU 138	T2	75.0	104.8	70358 RIFLE_PS 230 79059 RIFLE WA 230 1

Table A16-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	1.0877	1.0031	70113 CLIFTON 230 70206 GRANDJPS 230 1
70078	CAMEO	230.0	1.0703	1.0053	70113 CLIFTON 230 70206 GRANDJPS 230 1
70113	CLIFTON	230.0	1.0778	1.0036	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70214	GRANDJCT	69.0	0.9443	1.0123	70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1
70206	GRANDJPS	230.0	1.0866	1.0029	70113 CLIFTON 230 70206 GRANDJPS 230 1
70207	GRANDVLY	69.0	0.9282	0.9866	70302 OILSHALE 69.0 70359 RIFLE_CU 69.0 1
70233	HORIZON	230.0	1.0870	1.0028	70113 CLIFTON 230 70206 GRANDJPS 230 1
70436	UINTAH	69.0	1.0755	0.9902	70113 CLIFTON 230 70206 GRANDJPS 230 1
70438	UINTAH	230.0	1.0884	1.0032	70113 CLIFTON 230 70206 GRANDJPS 230 1
70109	UNA_ORCH	69.0	0.9279	0.9781	70302 OILSHALE 69.0 70359 RIFLE_CU 69.0 1

The RiflePS-RifleWA 230kV bus tie experiences a contingency flow of 100.4% of its 514 MVA winter rating. This flow is at the line rating limit. The RifleCu-SiltUSBR 69kV line overload of 103.6% of its 55.9 MVA rating for an outage of the Hopkins-RiflePS

230kV transmission line. This overload is mitigate by an operating practice that allows PSCo to open the Glenwood Springs-RifleCu 69kV line. PSCo has plans to upgrade the Glenwood Springs-RifleCu 69kV line to 115kV in the future and this project will eliminate that overload. Contingency bus voltage are acceptable in the study area.

A17. 2013 Heavy Winter Study Case
Case Name: "13hw2p_TOT2A_500PS__TOT5_1300_BR_PL_HM_S2A"
Sensitivity #2A: High TOT5 Flow of 1300 MW with the RifleCu-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)
(Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Bank Off-Line)

The winter case was obtained that includes the Holms Mesa 28.0 MVA load and reflects a high TOT5 flow (1300 MW west-to-east). The study case was modified to include the RifleCu-Parachute 230kV line. Outages were simulated and the results listed below.

Table A17-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus ** CKT	Rating	Loading%	Contingency Description
70231 HOPKINS 115	70232 HOPKINS 230 T2	80.0	114.3	79039 HAYDEN 230 79091 FOIDELCK 230 1
70231 HOPKINS 115	79003 BASALT 115 1	60.0	321.1	79039 HAYDEN 230 79091 FOIDELCK 230 1
70359 RIFLE_CU 69.0	70388 SILTUSBR 69.0 1	55.9	103.8	70232 HOPKINS 230 70358 RIFLE_PS 230 1

Table A17-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	1.0850	1.0078	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70078	CAMEO	230.0	1.0683	1.0124	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70113	CLIFTON	230.0	1.0839	1.0071	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70214	GRANDJCT	69.0	0.9534	1.0159	70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1
70205	GRANDJCT	230.0	1.0840	1.0074	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70206	GRANDJPS	230.0	1.0840	1.0069	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70207	GRANDVLY	69.0	0.9341	0.9898	70207 GRANDVLY 69.0 70302 OILSHALE 69.0 1
70207	GRANDVLY	69.0	0.9359	0.9898	70302 OILSHALE 69.0 70359 RIFLE_CU 69.0 1
70233	HORIZON	230.0	1.0843	1.0072	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70302	OILSHALE	69.0	0.9360	1.0015	70302 OILSHALE 69.0 70359 RIFLE_CU 69.0 1
70436	UINTAH	69.0	1.0727	0.9953	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70438	UINTAH	230.0	1.0857	1.0083	70205 GRANDJCT 230 79036 GRANDJCT 345 T1

The RifleCu-SiltUSBR 69kV contingency overload of 103.8% of its 55.9 MVA rating is mitigated with an operating practice. Contingency bus voltages are within criteria.

A18. 2013 Heavy Winter Study Case
Case Name: "13hw2p_TOT2A_500PS__TOT5_1300_BR_PL_HM_S2B"
Sensitivity #2B: High TOT5 Flow of 1300 MW with the RiflePS-Parachute 230kV Project Added
Holms Mesa Load = 28.0 MVA (98% Power Factor Assumed)
(Cameo 45 MVAR Capacitor On-Line, Una 7.5 MVAR Capacitor On-Line, Parachute 45 MVAR Capacitor Bank Off-Line)

The winter case was obtained that includes the Holms Mesa 28.0 MVA load and reflects a high TOT5 flow (1300 MW west-to-east). The study case was modified to include the RifleCu-Parachute 230kV line. Outages were simulated and the results listed below.

Table A18-1. Branch Flows for Single Contingency Outages

** From bus **	** To bus ** CKT	Rating	Loading%	Contingency Description
70205 GRANDJCT 230	79036 GRANDJCT 345 T1	273.0	113.6	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT 115 T1	42.0	105.4	70358 RIFLE_PS 230 79059 RIFLE WA 230 1
70231 HOPKINS 115	70232 HOPKINS 230 T2	80.0	113.9	79039 HAYDEN 230 79091 FOIDELCK 230 1
70231 HOPKINS 115	79003 BASALT 115 1	60.0	320.6	79039 HAYDEN 230 79091 FOIDELCK 230 1
70358 RIFLE_PS 230	79059 RIFLE WA 230 1	514.0	102.2	79039 HAYDEN 230 79091 FOIDELCK 230 1
70359 RIFLE_CU 69.0	70388 SILTUSBR 69.0 1	55.9	104.0	70232 HOPKINS 230 70358 RIFLE_PS 230 1
70359 RIFLE_CU 69.0	79056 RIFLE_CU 138 T2	75.0	104.7	70358 RIFLE_PS 230 79059 RIFLE WA 230 1

The RifleWA-RiflePS 230kV bus tie experiences a contingency overload of 102.2% of its 514 MVA winter rating. PSCo will need to upgrade the tie if the RifleCu-Parachute 230kV line is terminated at RifleCu Substation. The RifleCu-SiltUSBR 69kV contingency overload of 104.0% of its 55.9 MVA rating is mitigated with an operating practice. Contingency bus voltages are within criteria.

Table A18-2. Bus Voltages for Single Contingency Outages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description
70268	ADOBE	230.0	1.0847	1.0074	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70078	CAMEO	230.0	1.0680	1.0117	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70113	CLIFTON	230.0	1.0836	1.0069	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70214	GRANDJCT	69.0	0.9522	1.0156	70214 GRANDJCT 69.0 79034 GRANDJCT 115 T1
70205	GRANDJCT	230.0	1.0837	1.0072	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70206	GRANDJPS	230.0	1.0837	1.0066	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70207	GRANDVLY	69.0	0.9332	0.9897	70207 GRANDVLY 69.0 70302 OILSHALE 69.0 1
70233	HORIZON	230.0	1.0840	1.0068	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70359	RIFLE_CU	69.0	0.9559	1.0152	70359 RIFLE_CU 69.0 79056 RIFLE_CU 138 T2
70436	UINTAH	69.0	1.0724	0.9949	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70438	UINTAH	230.0	1.0854	1.0079	70205 GRANDJCT 230 79036 GRANDJCT 345 T1
70109	UNA_ORCH	69.0	0.9322	0.9817	70109 UNA_ORCH 69.0 70207 GRANDVLY 69.0 1