

Bluestone Valley Substation 230 kV Expansion

Reliability Study

Public Service Company of Colorado

12-4-2020

The Bluestone Valley 230kV Substation will connect to the Parachute-Cameo 230kV line by way of 0.6-mile double-circuit 230kV line to an in-and-out tap of the Parachute-Cameo 230kV line. The Bluestone Valley 230kV Substation will sectionalize the Parachute-Cameo 230kV line (Circuit #5509). The Parachute-Bluestone Valley 230kV line will be Circuit #5509. The Bluestone Valley-Cameo 230kV line will be Circuit #55123. The Bluestone Valley 230kV yard will consist of a three-breaker 230kV ring bus configuration to terminate the sectionalized Parachute-Cameo 230kV line and to terminate the primary of the Bluestone Valley 230-69kV 100 MVA transformer with load tap changer (LTC). The Bluestone Valley substation represents the new terminus of the RifleUte-Oil Shale-Una Orchard-DeBeque-Bluestone Valley 69kV line. This will allow the Bluestone Valley-Cameo 69kV line to be removed from the DeBeque Canyon.

The RifleUte-Bluestone Valley-Cameo 69kV Line (Circuit #6670) Refurbishment Project involves refurbishing (not rebuilding) the RifleUte-Oil Shale-Una Orchard-DeBeque-Bluestone Valley 69kV line so that it will remain a 69kV transmission line strung with 1-266 kcmil "Partridge" conductor with a thermal rating of 66 MVA. If the transmission line is re-strung with 1-477kcmil "Hawk" conductor, the thermal rating of the 69kV will increase to 96 MVA. The Bluestone Valley 230-69kV 100 MVA transformer will match that line rating. Transmission Planning West originally studied a RifleUte-Bluestone Valley-Cameo 69kV to 115kV rebuild project using 1-477 kcmil "Hawk" conductor; however, this may not represent a minimum viable project for the area.

The purpose of this study was to determine if the "RifleUte-Bluestone Valley-Cameo 69kV Line (Circuit #6670) Refurbishment Project (combined with the Bluestone Valley 230kV Substation Expansion Project)" represents the minimum viable project to serve reliably serve the existing and projected loads in the Rifle-Una Orchard-DeBeque-Bluestone Valley area.

a. Base Case - 2024 Heavy Summer (2024HS)

Power flow studies were conducted to determine the impact of the Bluestone Valley 230kV Substation Expansion Project on the transmission system reliability. The Western Electricity Coordinating Council (WECC) 2024 Heavy Summer 2 (2024 HS) case was selected for the study. The case has a TOT2A flow of 175 MW north-to-south. The Craig 1 generation is 400.0 MW out of 470.0 MW, the Craig 2 generation is 400.0 MW out of 470.0 MW, the Craig 3 generation is 478.0 MW out of 478.0 MW, the Hayden 1 generation is 175.0 MW out of 202.0 MW and the Hayden 2 generation is 250.0 MW out of 285.0 MW. The Cameo 45 MVAR capacitor bank and the Una Orchard 7.5 MVAR capacitor bank are represented in-service in the case as would be expected for a high demand, moderate TOT2A transfer case. The Parachute 45 MVAR capacitor bank and the Uintah 45 MVAR capacitor bank are out of service. The case loads are as follows:

Table 1. Area Loads – 2024 Heavy Summer

Bus Number	Bus Name	Id	Pload (MW)	Qload (Mvar)	Bus Number	Bus Name	Id	Pload (MW)	Qload (Mvar)
70009	CRAIG_YV 230.00	YV	17.0	-2.0	70357	BENCH 230.00	IN	53.9	19.2
70076	CAMEO 69.000	P4	0.8	0.3	70363	ROARNGFK 69.000	GW	9.2	2.4
70089	CARBNDAL 115.00	P2	8.1	-2.1	70385	SHOSHA&B 4.0000	P5	8.7	3.7
70109	UNA_ORCH 69.000	IN	18.0	11.0	70436	UINTAH 69.000	GV	1.4	0.4
70113	CLIFTON 230.00	P1	19.2	0.6	70438	UINTAH 230.00	P1	21.1	5.9
70113	CLIFTON 230.00	P2	14.7	0.7	70438	UINTAH 230.00	P3	12.1	0.4
70140	DEBEQUE 69.000	GV	1.8	0.6	70454	VINELAND 69.000	P1	6.7	2.9
70140	DEBEQUE 69.000	P1	2.0	0.8	70525	MTHARRIS 138.00	YV	15.8	3.3
70183	FRUITA 69.000	GV	2.3	0.7	70535	COOLEYMA 230.00	HC	13.7	2.6
70183	FRUITA 69.000	P1	7.4	2.8	70535	COOLEYMA 230.00	NT	-10.0	-3.3
70201	GLENNWD 69.000	GW	7.1	2.3	70540	BASLTDST 115.00	HC	11.2	1.3
70206	GRANDJPS 230.00	P1	34.1	1.6	70541	ASPEN_PS 115.00	AS	10.5	1.5
70206	GRANDJPS 230.00	P2	36.6	11.7	70541	ASPEN_PS 115.00	HC	23.3	7.7
70214	GRANDJCT 69.000	GV	28.4	4.4	70542	SNOWMASS 115.00	HC	10.3	7.4
70233	HORIZON 230.00	P1	17.2	0.3	79006	BEAVERCU 115.00	HC	23.6	3.2
70233	HORIZON 230.00	P2	17.4	6.0	79018	CRYSTLPS 115.00	HC	9.2	2.7
70264	CARDNELL 69.000	GW	3.2	0.8	79047	COLBRAN 138.00	GV	4.8	2.3
70268	ADOBE 230.00	GV	14.9	4.9	79056	RIFLE_CU 138.00	HC	2.0	0.0
70288	MITCHLCR 69.000	GW	5.8	1.4	79056	RIFLE_CU 138.00	P1	0.5	0.0
70296	NEWCASTL 69.000	P1	1.6	0.6	79056	RIFLE_CU 138.00	P5	9.2	-0.5
70296	NEWCASTL 69.000	P2	6.0	2.2	79056	RIFLE_CU 138.00	TS	0.0	0.0
70299	STKGULCH 230.00	IN	47.5	15.6	79065	STEAMBT 230.00	YV	24.0	-1.1
70309	PARACHUT 230.00	HC	3.9	-0.4	79066	VAIL 115.00	HC	20.2	5.7
70309	PARACHUT 230.00	P1	13.9	6.1	79069	WOLCOTT 230.00	HC	13.5	7.5
70356	WEELERPS 230.00	IN	3.2	1.5	79092	AVON 115.00	HC	11.5	1.0

The primary loads served by the Rifle(Ute)-Oil Shale-Una Orchard-DeBeque-Bluestone Valley 69kV line are the Una Orchard load and the DeBeque load. The Una Orchard demand is 18.0 MW and 11.0 MVAR in the case. The DeBeque load is 3.8 MW and 1.4 MVAR (Grand Valley Power and PSCo). The Grand Valley Power load served from DeBeque Substation was increased by 10 MW to 11.8 MW and 3.9 MVAR (a 95 lagging power factor) to reflect potential load growth for Grand Valley Power in the area. The total demand at DeBeque is 13.8 MW and 4.7 MVAR (14.6 MVA) in the study cases. The study case was created. The total demand at DeBeque (Grand Valley Power and PSCo) is 13.8 MW and 4.7 MVAR and the Una Orchard demand is 18.0 MW and 11.0 MVAR for a total of 31.8 MW and 15.7 MVAR. Table 2 below reflects the anticipated branch flows for system intact on-peak conditions for the summer of 2024.

Table 2. Existing System - System Intact, Branch Flows, 2024 Heavy Summer, TOT2A=175 MW (North-to-South), DeBeque Load Increased By 10 MW, Una 7.5 MVAR, Cameo 45 MVAR Caps and Bluestone Valley-Cameo 69kV In-Service

From Bus	To Bus	MW	MVAR	From Bus Voltage	Rating	Percent of Rating
BLUESTON 69.000	CAMEO 69.000	-7.8	-10.0	0.9697	56	23
BLUESTON 69.000	DEBEQUE 69.000	7.8	10.0	0.9697	56	23
PARACHUT 230.00	CAMEO 230.00	113.2	-39.8	1.0018	437	27
UNA_ORCH 69.000	DEBEQUE 69.000	6.1	-5.4	0.9608	56	15
UNA_ORCH 69.000	GRANDVLY 69.000	-24.0	1.3	0.9608	56	45
DEBEQUE 69.000	UNA_ORCH 69.000	-6.1	5.4	0.9629	56	15
DEBEQUE 69.000	BLUESTON 69.	-7.8	-10.0	0.9629	56	24
OILSHALE 69.000	GRANDVLY 69.000	24.7	-0.3	0.9831	56	45
OILSHALE 69.000	RIFLE_CU 69.000	-24.7	0.3	0.9831	56	45

The table shows that with a TOT2A north-to-south flow of 175 MVA, approximately three quarters of the power serving the combined Una Orchard/DeBeque load of 31.5 MW and 10.3 MVAR is coming from the RifleUte-Oil Shale 69kV line which is reflected in that flow reaching 45% of the 56 MVA rating of the line. The Una Orchard 7.5 MVAR capacitor supplies reactive requirements of the loads.

b. System Intact - Existing System - 2024 HS - High TOT5 Transfer – Increase Debeque Load

The TOT2A north-to-south schedule was increased to 525 MW north-to-south. The Craig/Hayden generation is near maximum as would be expected for a high TOT2A north-to-south scenario. The Cameo 45 MVAR capacitor bank, the Parachute 45 MVAR capacitor bank, the Uintah 45 MVAR capacitor bank, and the Una 7.5 MVAR capacitor bank are represented in-service in the case as would be expected for a high demand, high transfer case. As stated previously, the Grand Valley Power load at DeBeque Substation was increased by 10 MW to 11.8 MW and 3.9 MVAR to reflect potential load growth for Grand Valley Power in the area.

Table 3. Existing System - System Intact, Branch Flows, 2024 Heavy Summer, TOT2A=525 MW (North-to-South), GVP Debeque Load at 11.8 MW, Una, Cameo, Parachute, Uintah Caps In-Service, Bluestone Valley-Cameo 69kV In-Service

From Bus	To Bus	MW	MVAR	From Bus Voltage	Rating	Percent of Rating
BLUESTON 69.000	CAMEO 69.000	-6.0	-12.4	0.966	56	26
BLUESTON 69.000	DEBEQUE 69.000	6.0	12.4	0.966	56	26
BLUESTON 230.00	CAMEO 230.00	147.3	-57.3	1.013	437	36
BLUESTON 230.00	PARACHUT 230.00	-147.3	57.3	1.013	437	36
UNA_ORCH 69.000	DEBEQUE 69.000	8.0	-7.7	0.955	56	21
UNA_ORCH 69.000	GRANDVLY 69.000	-25.9	3.6	0.955	56	49
DEBEQUE 69.000	UNA_ORCH 69.000	-7.9	7.7	0.958	56	21
DEBEQUE 69.000	BLUESTON 69.	-5.9	-12.4	0.958	56	26
OILSHALE 69.000	GRANDVLY 69.000	26.7	-2.3	0.975	56	49
OILSHALE 69.000	RIFLE_CU 69.000	-26.7	2.3	0.975	56	49

The increase in TOT5 north-to-south flow from 175 MW to 525 MW increased the flow on the Parachute-Cameo 230kV line by 30% from 113.2 MW to 147.3 MW and increased the flow on the Rifle(Ute)-Oil Shale 69kV line by 8% from 24.7 MW to 26.7 MW. An outage of the Parachute-Cameo 230kV line shifts north-to-south flows across parallel branches and transformers in the system resulting in an increase of flow on the RifleUte-Oil Shale-Grand Valley-Una 69kV approximately 37% from about 27 MW to 37 MW. The 18 MW of load at Una and the 14 MW of load at Debeque are served from RifleUte. The Cameo to Bluestone Valley south-to-north 6 MW flow reverses direction to a 3 MW north-to-south flow. An outage of the RifleUte-Grand JunctionUte 345kV causes flow to increase significantly on the Parachute-Cameo 230kV line by 235% from 148 MW to 348 MW. There is little flow change on the RifleUte-Oil Shale-Grand Valley-Una-Debeque-Cameo 69kV line.

c. System Intact – Bluestone Valley Project - 2024HS – High TOT5 Transfer

The Bluestone Valley 230kV Substation Expansion Project was represented in the case. The Bluestone Valley 230-69 kV Transformer LTC was not regulating voltage. The Bluestone Valley-Cameo 69kV line was removed from the case. The following system intact flows were observed:

Table 4. System Intact, Branch Flows, 2024 Heavy Summer, TOT2A=525 MW (North-to-South), Bluestone Valley 230kV Expansion Added (Bluestone Valley 230-69kV Xfmr LTC not regulating voltage). Debeque Load at 11.8 MW, Una, Cameo, Parachute, Uintah Caps In-Service, Bluestone Valley-Cameo 69kV O/S

From Bus	To Bus	MW	MVAR	From Bus Voltage	Rating	Percent of Rating
BLUESTON 69.000	BLUESTON 230.00	-14.5	-12.1	0.994	100	19
BLUESTON 69.000	DEBEQUE 69.000	14.5	12.1	0.994	56	34
BLUESTON 230.00	CAMEO 230.00	140.7	-67.4	1.011	437	35
BLUESTON 230.00	PARACHUT 230.00	-155.2	54.8	1.011	437	37
UNA_ORCH 69.000	DEBEQUE 69.000	-0.6	-7.4	0.979	56	14
UNA_ORCH 69.000	GRANDVLY 69.000	-17.4	3.6	0.979	56	32
DEBEQUE 69.000	UNA_ORCH 69.000	0.6	7.3	0.984	56	13
DEBEQUE 69.000	BLUESTON 69.	-14.4	-12.0	0.984	56	34
OILSHALE 69.000	GRANDVLY 69.000	17.7	-3.3	0.988	56	33
OILSHALE 69.000	RIFLE_CU 69.000	-17.7	3.3	0.988	56	33

The table shows that the Bluestone Valley 230kV Substation Expansion project improves voltages on the RifleUte-Oil Shale-Una Orchard-DeBeque-Bluestone Valley 69kV systems and provides a better flow balance to serve the Una Orchard/DeBeque loads.

The Bluestone Valley 230kV Substation expansion project (connecting the RifleUte-Cameo 69kV system to the Parachute-Cameo 230kV system by way of the Bluestone Valley 230-69kV transformer and Bluestone Valley in-an-out tap of the Parachute-Cameo 230kV line significantly shifts flow from the RifleUte-Cameo 69kV system to the Parachute-Cameo 230kV line. The RifleUte-Oil Shale-Grand Valley-Una 69kV north-to-south flow decreases from 27 MW to 17 MW while the Parachute-Bluestone Valley 230kV line increases from about 12% 148 MW to 166 MW.

d. System Intact – Bluestone 230-69kV Transformer LTC Regulating Voltage

The impact of a Bluestone Valley 230-69kV 100 MVA transformer with a load tap changer (LTC) was studied and the results are listed in the table below.

Table 5. System Intact, Branch Flows, 2024 Heavy Summer, TOT2A=525 MW (North-to-South), Bluestone Valley 230kV Expansion Added (Bluestone Valley 230-69kV Xfmr LTC regulating voltage). Debeque Load at 11.8 MW, Una, Cameo, Parachute, Uintah Caps In-Service, Bluestone Valley-Cameo 69kV O/S

From Bus	To Bus	MW	MVAR	From Bus Voltage	Rating		Percent of Rating
BLUESTON 69.000	BLUESTON 230.00	-14.5	-12.1	1.023	100		19
BLUESTON 69.000	DEBEQUE 69.000	14.5	12.1	1.023	56		34
BLUESTON 230.00	CAMEO 230.00	140.3	-68.3	1.009	437		35
BLUESTON 230.00	PARACHUT 230.00	-155.7	51.4	1.009	437		37
UNA_ORCH 69.000	DEBEQUE 69.000	-1.4	-11.4	1.003	56		14
UNA_ORCH 69.000	GRANDVLY 69.000	-16.5	7.9	1.003	56		32
DEBEQUE 69.000	UNA_ORCH 69.000	1.5	11.4	1.012	56		13
DEBEQUE 69.000	BLUESTON 69.	-15.3	-16.0	1.012	56		34
OILSHALE 69.000	GRANDVLY 69.000	16.8	-7.6	1.002	56		33
OILSHALE 69.000	RIFLE_CU 69.000	-16.8	7.6	1.002	56		33

The Bluestone Valley 230-69kV 100 MVA load tap changing transformer dramatically improves the voltages on the RifleUte-Oil Shale-Una Orchard-DeBeque-Bluestone Valley 69kV system.

e. N-1 Outages – Bluestone Valley Project – 2024HS – High TOT5 Transfer

The 2024 Heavy Summer study case with the case re-dispatched to achieve a TOT2A north-to-south flow to 530 MW to reflect the most extreme condition for the study area was obtained. The study case included the Bluestone Valley 230kV bus with the Parachute-Cameo 230kV transmission line tapped (in-and-out tap) near the Town of DeBeque. The study assumed an in-and-out tap location on the Parachute-Cameo 230kV line approximately 60% of the distance from Parachute to Cameo. An 0.6-mile double circuit 230kV line from the in-and-out tap of the Parachute-Cameo 230kV line to the Bluestone Valley 230kV bus was modeled assuming 1-1272 kcmil conductor strung on 7.135R 230kV double-circuit towers. This created a Bluestone Valley-Parachute 230kV transmission line and a Bluestone Valley-Cameo 230kV transmission line. A Bluestone Valley 100 MVA 230-69kV transformer with a load tap changer was added. The Bluestone Valley-Cameo 69kV line was removed. The DeBeque 69kV demand was increased by 10 MW to reflect potential load growth in the area. Contingencies in the study area were simulated and the results provided in the following table.

Table 6. 2024 Heavy Summer with the Bluestone Valley 230kV Substation Expansion Project, TOT2A=530 MW (n -> s), Uintah, Cameo, Parachute, Una capacitor banks in-service, DeBeque Load Increased by 10 MW

BUS A		BUS B		ID	CONTINGENCY	MVAFLOW	AMPFLOW	RATE A/A	% FLOW
CAMEO	69	CAMEO	230	T5	COLLBRAN138-RIFLECU138 (1)	-35.8	35.8	66.7	53.7
CAMEO	69	CAMEO	230	T5	CAMEO 230-UINTAH 230 (1)	-34.2	34.2	66.7	51.2
CAMEO	69	VINELAND	69	1	GRANDJCT69-GRANDJCT115 (T1)	-36.4	36.5	64.8	56.3
CAMEO	69	VINELAND	69	1	GRANDJCT115-GRANDJCT138 (T2)	-34.3	34.2	64.8	52.7
CAMEO	69	VINELAND	69	1	GRANDJCT138-COLLBRAN138 (1)	-34.3	34.2	64.8	52.7
CAMEO	69	VINELAND	69	1	COLLBRAN138-RIFLECU138 (1)	-33.9	33.5	64.8	51.7
BLUESTON	230	CAMEO	230	1	RIFLECU 345-GRANDJCT345 (1)	343.8	367.0	437.0	84.0
BLUESTON	230	CAMEO	230	1	CLIFTON 230-GRANDJCT230 (1)	218.8	224.7	437.0	51.4
BLUESTON	230	CAMEO	230	1	GRANDJCT230-GRANDJCT345 (T1)	219.1	224.7	437.0	51.4
BLUESTON	230	PARACHUT	230	1	RIFLECU 345-GRANDJCT345 (1)	348.8	372.3	437.0	85.2
BLUESTON	230	PARACHUT	230	1	CLIFTON 230-GRANDJCT230 (1)	-229.8	234.3	437.0	53.6
BLUESTON	230	PARACHUT	230	1	GRANDJCT230-GRANDJCT345 (T1)	-229.8	234.2	437.0	53.6
BLUESTON	230	BLUESTON	69	1	UNA_ORCH69-GRANDVLY69 (1)	33.6	33.6	100.0	33.6
BLUESTON	230	BLUESTON	69	1	GRANDVLY69-OILSHALE69 (1)	33.6	33.6	100.0	33.6
BLUESTON	230	BLUESTON	69	1	OILSHALE69-RIFLE_CU69 (1)	33.5	33.5	100.0	33.5
BLUESTON	230	BLUESTON	69	1	BLUESTON230-PARACHUT230 (1)	33.1	33.1	100.0	33.1
UNA_ORCH	69	DEBEQUE	69	1	BLUESTON230-PARACHUT230 (1)	32.0	31.6	55.9	56.5
UNA_ORCH	69	DEBEQUE	69	1	UNA_ORCH69-GRANDVLY69 (1)	18.3	18.0	55.9	32.1
UNA_ORCH	69	DEBEQUE	69	1	GRANDVLY69-OILSHALE69 (1)	18.2	17.9	55.9	32.0
UNA_ORCH	69	DEBEQUE	69	1	OILSHALE69-RIFLE_CU69 (1)	18.2	17.9	55.9	31.9
UNA_ORCH	69	DEBEQUE	69	1	DEBEQUE 69-BLUESTON69 (1)	-14.6	17.4	55.9	31.2
UNA_ORCH	69	DEBEQUE	69	1	BLUESTON230-BLUESTON69 (1)	-14.6	17.4	55.9	31.1
UNA_ORCH	69	GRANDVLY	69	1	BLUESTON230-PARACHUT230 (1)	-43.2	42.8	55.9	76.5
UNA_ORCH	69	GRANDVLY	69	1	DEBEQUE 69-BLUESTON69 (1)	33.6	39.6	55.9	70.8
UNA_ORCH	69	GRANDVLY	69	1	BLUESTON230-BLUESTON69 (1)	33.5	39.5	55.9	70.7
UNA_ORCH	69	GRANDVLY	69	1	RIFLECU 345-GRANDJCT345 (1)	-27.0	28.7	55.9	51.3
DEBEQUE	69	BLUESTON	69	1	UNA_ORCH69-GRANDVLY69 (1)	32.9	32.1	55.9	57.5
DEBEQUE	69	BLUESTON	69	1	GRANDVLY69-OILSHALE69 (1)	32.8	32.0	55.9	57.3
DEBEQUE	69	BLUESTON	69	1	OILSHALE69-RIFLE_CU69 (1)	32.8	32.0	55.9	57.2
DEBEQUE	69	BLUESTON	69	1	BLUESTON230-PARACHUT230 (1)	31.4	30.6	55.9	54.7
GRANDVLY	69	OILSHALE	69	1	BLUESTON230-PARACHUT230 (1)	-43.1	42.9	55.9	76.8
GRANDVLY	69	OILSHALE	69	1	DEBEQUE 69-BLUESTON69 (1)	34.3	39.5	55.9	70.7
GRANDVLY	69	OILSHALE	69	1	BLUESTON230-BLUESTON69 (1)	34.3	39.5	55.9	70.6
GRANDVLY	69	OILSHALE	69	1	RIFLECU 345-GRANDJCT345 (1)	-27.3	28.7	55.9	51.4
OILSHALE	69	RIFLE_CU	69	1	BLUESTON230-PARACHUT230 (1)	-43.2	43.1	55.9	77.0
OILSHALE	69	RIFLE_CU	69	1	DEBEQUE 69-BLUESTON69 (1)	36.1	39.4	55.9	70.6
OILSHALE	69	RIFLE_CU	69	1	BLUESTON230-BLUESTON69 (1)	36.0	39.4	55.9	70.5
OILSHALE	69	RIFLE_CU	69	1	RIFLECU 345-GRANDJCT345 (1)	-27.8	28.7	55.9	51.4
RIFLE_CU	69	RIFLE_CU	138	T2	BLUESTON230-PARACHUT230 (1)	33.4	33.4	75.0	44.6
RIFLE_CU	69	RIFLE_CU	138	T2	DEBEQUE 69-BLUESTON69 (1)	-32.6	32.6	75.0	43.4
RIFLE_CU	69	RIFLE_CU	138	T2	BLUESTON230-BLUESTON69 (1)	-32.5	32.5	75.0	43.3

There are no branch violations in the study area around Bluestone Valley Substation.