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Grand Valley Power Near Term System Impact Study

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I. Executive Summary

The Grand Valley Power Near Term System Impact Study was conducted to examine the reliability of the transmission system that serves Grand Valley Power (GVP) loads in the near term (2015 through 2017). A 2017 heavy summer study case was developed from a WECC 2015 heavy summer base case. The summer on-peak demand condition was selected as the summer season reflects the highest GVP demands. A GVP 69kV detailed model was added to the study case. GVP's Uintah-Grand Junction(Ute) 69kV line is modeled with the FruitaGV-BookcliffGV 69kV branch open to simulate how the system is normally operated. The study also evaluated the system with the Uintah-LomaGV Tap 69kV open (with the FruitaGV-BookcliffGV 69kV branch closed) called "Maintenance Outage No. 1" to simulate the maintenance condition serving the LomaGV, FruitaGV, BookcliffGV, HighlineGV loads from Grand Junction(Ute) Substation. A maintenance outage of the Grand Junction(Ute)-HighlineGV 69kV line (with the FruitaGV-BookcliffGV 69kV branch closed) called "Maintenance Outage No. 2" to simulate the maintenance condition serving the LomaGV, FruitaGV, BookcliffGV, HighlineGV loads from the Uintah Substation was also considered. The latest GVP demand forecast was used for the study. The Fruita generation station was modeled off-line (normal condition). The TOT2A transfer path in southwest Colorado was modeled with a high north-to-south transfer condition of 500 MW. In addition, sensitivity cases were developed to represent three future PSCO projects – the Bluestone Valley Project, the Grand Junction(Ute) 138-115kV Transformer Replacement Project, and the Rifle(Ute)-Parachute 230kV Transmission Line Addition Project. A sensitivity case was also developed that represents future GVP load additions at Debeque Substation and Clear Creek Substation combined with the PSCO future transmission projects.

The study determined that the transmission system will be able to reliably serve the GVP loads in the near term (2015 through 2017). A contingency low voltage at the 0.90 p.u. criteria limit at the LomaGV 69kV load bus can occur with the Maintenance Outage No. 1 (Uintah-LomaGV Tap 69kV open with FruitaGV-BookcliffGV 69kV closed) and an outage of the Cameo 230-69kV transformer. Maintenance Outage No. 1 results in the GVP loads at LomaGV 69kV, FruitaGV 69kV, BookcliffGV 69kV and HighlineGV 69kV served radially from Grand Junction(Ute) Substation. The Grand Junction(Ute) 115-69kV transformer does not possess a load tap changer for voltage control. This configuration results in a bus voltage just at the low voltage limit. The LomaGV 69kV load bus voltage reaches 0.897 p.u. for an outage of the Cameo 230-69kV transformer.

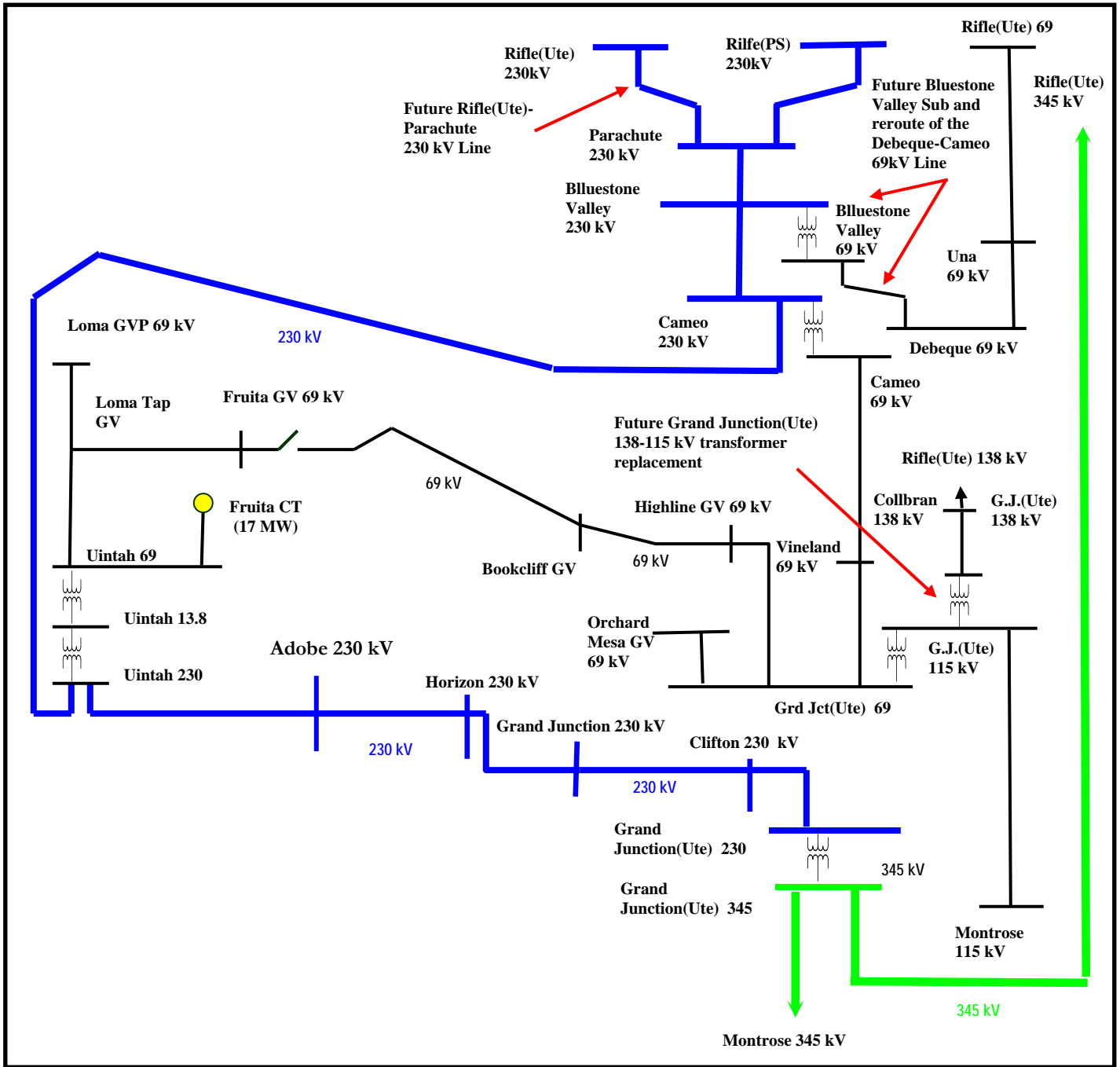
The planned PSCO transmission projects improve the overall reliability of the system and future long-term load additions that might be considered by GVP at Debeque Substation and Clear Creek Substation would be reliably served with the transmission system that includes PSCO's proposed transmission projects.

II. Background

This study was initiated with a GVP request for assistance from PSCO in the preparation of a near term transmission plan. To assist GVP, PSCO conducted a near term system impact study to assess the reliability of the bulk electric transmission system to serve GVP loads. The objective of this near term system impact study is to examine the reliability of the transmission system that serves the Grand Valley Power (GVP) loads and to identify system upgrades (if any) needed to achieve a reliable transmission system. The study assumed a 2015 system topology in the study area with 2017 peak summer loads and a 2017 system topology (PSCO transmission projects that are expected to be in-service in 2016 added to the 2015 topology). The summer season was selected because GVP loads are at their highest levels during the summer in the near term period.

A simplified one-line of the study area (Year 2017) can be seen in Figure No. 1 below. The diagram shows the system with PSCO proposed transmission projects.

Figure No. 1 Simplified Study Area One-Line (Year 2017)



III. Study Scope

A. Transfer Path Definitions

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. The path owners include Western-RMR, Tri-State G&T and Public Service Co. of Colorado (PSCO).

<u>Line/Transformer</u>	<u>Metered End</u>
-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. The path owners include Western-RMR, Tri-State G&T, Platte River Power Authority (PRPA) and Public Service Co. of Colorado (PSCO).

<u>Line/Transformer</u>	<u>Metered End</u>
-Terry Ranch-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.

B. Transfer Path Ratings

The TOT2A transfer path has a maximum north-to-south rating of 690 MW. The TOT5 transfer path has a maximum west-to-east rating of 1680 MW.

C. Reliability Criteria

Category A – System Normal

“N-0” System Performance Under Normal (No Contingency) Conditions
(Category A)
NERC Standard TPL-001-0

Voltage: 0.95 to 1.05 per unit
Line Loading: 100 percent of continuous rating
Transformer Loading: 100% of highest 65 °C rating

Category B – Loss of generator, line, or transformer (Forced Outage)

“N-1” System Performance Following Loss of a Single Element
(Category B) NERC Standard TPL-002-0

Voltage: 0.90 to 1.05¹ per unit
Line Loading: 100 percent of continuous rating
Transformer Loading: 100% of highest 65 °C rating

Category C – Loss of Bus or a Breaker Failure (Forced Outage)

“N-2 or More” System Performance Following Loss of Two or More
Elements (Category C) NERC Standard TPL-003-0

Voltage and Thermal: Allowable emergency limits will be considered as determined by the affected parties and the available emergency mitigation plan. Curtailment of firm transfers, generation re-dispatch and load shedding will be considered if necessary.

Category D – Extreme Events (Forced Outages)

“N-2 or More” System Performance Following Extreme Events
(Category D) NERC Standard TPL-004-0

Voltage and Thermal: Allowable emergency limits as determined by available emergency mitigation plan. Curtailment of firm transfers, generator re-dispatch and load shedding are permissible if necessary.

¹ The 1.05 p.u. maximum contingency bus voltage limit represents a recent change in the PSCO Planning Criteria from the 1.10 p.u. maximum contingency bus voltage limit.

D. Study Case Selection

Power flow study cases were developed to represent the 2017 summer on-peak demand conditions. The cases were created from the Western Electricity Coordinating Council (WECC) 2015 Heavy Summer base case “15hs3sa1p-r33” that was approved by WECC on October 4, 2013. This case represents the first year of the near term period (2015 through 2017). Since a WECC 2017 heavy summer base case was not available, two 2017 heavy summer cases were created from the 2015 heavy summer case – a case that represents the expected transmission system in 2017 without the proposed PSCO transmission projects planned for 2016 and a second case that represents the expected transmission system in 2017 with the proposed PSCO transmission projects planned for 2016. The demands in the study area for both cases were adjusted to reflect a summer 2017 on-peak season. These cases became the 2017 heavy summer study cases. Assumptions about the study process are listed below.

1. All GVP loads are calculated at the PSCO metering point.
2. Forecasted loads are at GVP’s peak, but can be assumed to be coincident since GVP and Xcel typically peak close to the same time.
3. GVP does power factor correction on circuits, so power factor can be assumed to be close to unity. The study assumed a 0.98 lagging power factor.
4. No new 69kV+ facilities have been constructed in the past two years.
5. A sensitivity study was conducted to examine the reliability of PSCO’s planned system to serve load additions at Clear Creek Substation and Debeque Substation. These load additions have been studied by PSCO in previous years and were investigated in this study although they are not presently in GVP’s near term load forecast.
6. No generation additions are anticipated on GVP’s system.
7. GVP anticipates it will continue receipt of approximately 1.5 MW from WAPA for the forecast period.
8. No significantly large load additions are anticipated in the near term forecast other than approximately one MW at Debeque Sub in early 2015. This load is expected to be higher in the summer months than in winter.
9. 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.
10. A transmission model of the GVP 69-kV transmission system developed by PSCO was used.
11. The study considered the impacts of high TOT2A north-to-south power system transfers (500 MW north-to-south) on the study area.
12. The switch between FruitaGVP and BookcliffGVP was represented open by opening the FruitaGV-BookcliffGV 69kV branch.
13. For every branch outage of the Uintah-Grand Junction(Ute) 69kV line, the normally open switch at Fruita GVP 69 kV was closed to restore load on the Uintah-Grand Junction(Ute) 69kV line.

14. In addition to the usual system intact and single contingency outages, the GVP 69-kV lines were taken out of service to simulate maintenance outages. The critical outages for the GVP 69 kV system simulated in the study are:

- An outage of the Grand Jct(Ute)-Highline GVP 69 kV line or
- An outage of the Uintah 69-Loma Tap GVP 69 kV line.

E. Study Assumptions

Solution methods for the study are as follows:

Table 1. Solution methods for the Study

	<u>Pre-contingency</u>	<u>Post-Contingency</u>
Area Interchange Control	On	Off
Phase-Shifter	Adjust	Lock
TFMR LTC	Adjust	Lock
Switched Shunt Reactor/Capacitor	Adjust	Lock (unless automatic in field)
DC Taps	Adjust	Adjust

F. Contingencies

Category A

No contingencies.

Category B

Category B contingencies consist of the outage of generators, lines, and transformers in the study area.

Category C

Table 2. Category C Disturbances in the Study Area

Fault Location	Tripped Facilities
Common Tower at Parachute 230kV	The Parachute-Cameo 230kV line and Parachute-RiflePS 230kV line.
Common Tower at Grand Junction (PS) 230kV	The Grand Junction(PS)-Uintah 230kV line and the Grand Junction (PS)-Clifton 230kV line.
Breaker Failure at Rifle(Ute) 345kV	The Rifle(Ute)-Meeker 345kV line and the Rifle(Ute)-Grand Junction(Ute) 345kV line.
Breaker Failure at Grand Junction(Ute) 345kV	The Grand Junction(Ute)-Rifle(Ute) 345kV line and the Grand Junction(Ute)-Montrose 345kV line.

G. Sensitivity Study – Impact of Planned Projects in the Study Area

A sensitivity study was conducted to assess the impact of PSCO planned projects and large GVP load additions in the study area in the far term. Three PSCO transmission projects in the study area and future potential GVP load additions have the potential to impact the system intact and contingency branch flows and bus voltages in the study area. The projects are described as follows:

1. The Bluestone Valley Substation will tap the Parachute-Cameo 230kV line approximately ten miles south of the Parachute Substation (approximately 1/3 the distance between the Parachute and Cameo substations). It will be constructed as an in-an-out tap of the Parachute-Cameo 230kV line with sectionalizing breakers. The new substation will include a 100 MVA 230-69kV transformer² and 230kV and 69kV circuit breakers. The Debeque-Cameo 69kV line will be re-routed to the Bluestone Valley Substation. This will require the construction of approximately 1.5 miles of 69kV transmission³. The project expected in-service date is June 2016.
2. The Grand Junction 50 MVA 138-115kV transformer will be replaced with a 100 MVA 138-115kV transformer⁴. The project expected in-service date is June 2016.
3. The Rifle(Ute)-Parachute 230kV line⁵ will be constructed. The project expected in-service date is May 2016.
4. A GVP 10 MW demand increase at the Debeque Substation could occur in the far term.
5. A GVP 80 MW load at a new Clear Creek Substation could occur in the far term. The Clear Creek Substation would connect to PSCO's future Bluestone Valley Substation by way of a 21-mile 230kV double circuit transmission line.

² The Lange 100 MVA 230-69kV transformer #1(WAPA-RMR) was selected as a typical equivalent transformer with the following characteristics: R = 0.0026 p.u., X=0.086 p.u. The transformer was selected to match the Debeque-Bluestone Valley 69kV line rating.

³ The Debeque-Bluestone Valley 69kV line model assumes 1.5 miles of 69kV transmission strung with 477 kcmil ACSR (Hawk) ACSR conductor on 69kV (6.211B) towers with transmission line modeling characteristics of R = 0.00608 p.u., X = 0.01999 p.u., B = 0.00048 p.u., and a rating = 95.7 MVA.

⁴ The Fraser 100MVA 138-115kV transformer (WAPA-RMR, also called "Mettler) was selected as a typical equivalent transformer with the following characteristics: R = 0.002 p.u., X = 0.040 p.u., and rating = 100 MVA.

⁵ The Rifle(Ute)-Parachute 230kV line model assumes 1272 kcmil (Bittern) ACSR conductor strung on 6.402R towers with transmission line modeling characteristics of R=0.00250 p.u., X = 0.02583 p.u., B = 0.05050, and a rating of 576.4 MVA.

All five projects were added to the 2017 heavy summer study case to create a sensitivity study case. The 10 MW Debeque demand increase assumed a 0.98 lagging power factor.

IV. Study Results

The 2017 heavy summer study case (with the TOT2A transfer path flow at 500 MW north-to-south) was studied with the FruitaGV-BookcliffGV 69kV branch open and Fruita generation off-line. The case did not include the future PSCO projects – the Bluestone Valley Project, the Grand Junction(Ute) 138-115kV Transformer Replacement Project, or the Rifle(Ute)-Parachute 230kV Transmission Line Addition Project that are scheduled to be in-service in 2016. This was done to consider the impact on GVP loads of these projects being delayed past 2017.

The 2017 Heavy Summer study case (system normal conditions with the FruitaGV-BookcliffGV 69kV branch open) represents a reliable system and no criteria violations on the GVP load-serving system were observed under system intact or outage conditions. Maintenance Outage No. 1 (Uintah-LomaGV Tap 69kV open with FruitaGV-BookcliffGV 69kV closed) resulted in the GVP loads at LomaGV 69kV, FruitaGV 69kV, BookcliffGV 69kV and HighlineGV 69kV served radially from Grand Junction(Ute) Substation and a slight low voltage was observed under contingency conditions. The LomaGV 69kV load bus voltage reached 0.897 p.u. (slightly less than the 0.90 p.u. minimum) for an outage of the Cameo 230-69kV transformer. The Grand Junction(Ute) 115-69kV transformer does not possess a load tap changer for voltage control at the Grand Junction(Ute) 69kV bus. Maintenance Outage No. 2 (The Grand Junction(Ute)-HighlineGV 69kV branch open and the FruitaGV-BookcliffGV 69kV line closed) results in the LomaGV 69kV, the FruitaGV 69kV, the BookcliffGV 69kV, and the HighlineGV 69kV loads served radially from the Uintah substation. Low voltages were observed at the BookcliffGV 69kV bus and the HighlineGV 69kV bus. However, the BookcliffGV 69kV and HighlineGV 69kV slight criteria violations can be eliminated by adjusting the Uintah 69kV voltage schedule that is maintained by the Uintah 230-69kV load tap changer.

PSCO's planned Bluestone Valley Project and the Grand Junction(Ute) 138-115kV Transformer Replacement Project were added individually to the study case. The Bluestone Valley Project will increase branch flows on the Rifle(Ute)-Una-Debeque-Bluestone Valley 69kV line; however, contingency flows are less than the 66.2 MVA rating. "Maintenance Outage No. 1" (Uintah-LomaGV Tap 69kV branch open and the FruitaGV-HighlineGV 69kV line closed) slightly decreases the contingency flow on the Rifle(Ute)-Una-Debeque-Bluestone Valley 69kV line. However, under this maintenance situation (with the GVP loads served radially from Grand Junction) some PSCO bus voltages in excess of 1.05 p.u. under contingency conditions occur that need to be studied by PSCO in more detail. The Grand Junction 50 MVA 138-115kV Transformer Replacement Project

(replacing the existing 50 MVA transformer with a 100 MVA transformer) results in contingency bus voltages within criteria. The slight voltage criteria violations that were observed in the study case prior to the addition of the Grand Junction(Ute) 100 MVA 138-115kV transformer are mitigated by the project. The Rifle(Ute)-Parachute 230kV Transmission Project will eliminate the contingency overload of the Rifle(PS)-Parachute 230kV line. The project will result in a Rifle(Ute)-Rifle(WA) 230kV contingency overload that has been observed by PSCO in other studies. This contingency overload will be mitigated by PSCO.

The GVP Debeque demand could increase an additional 10 MW (0.98 power factor assumed) in the far term (outside the near term scope of this study). A load increase of 10 MW was added to the Debeque 69kV bus to represent potential future load development in the Debeque area by Grand Valley Power. Also included is a second 7.5 MVAR capacitor bank at Una that has been considered by PSCO to support load additions. GVP could also add an additional 80 MW of load at a new substation called Clear Creek Substation that would connect to the Bluestone Valley Substation by way of an 21-mile 230kV double-circuit 230kV transmission line strung with 1272 kcmil conductor along with a 45 MVAR capacitor addition at Bluestone Valley Substation. The addition of 10 MW to the Debeque Substation results in a slight contingency bus voltage violation at the Debeque 69kV bus and the Bluestone 69kV bus for an outage of the Bluestone 230-69kV transformer. Contingency high bus voltages (greater than 1.05 p.u.) at some 230kV buses will be studied in more detail by PSCO. Contingency high bus voltages (greater than 1.05 p.u.) at some 69kV buses on the Uintah-LomaGVTap-FruitaGV-BookcliffGV-Highline-Grand Junction(Ute) 69kV load-serving system for an outage of the Parachute-Bluestone 230kV line will be studied in more detail by PSCO.

- APPENDIX A– Study Case Loads and Branches

Appendix A

System Case Loads and Branches

A. Loads in the Study Area – 2017 Heavy Summer – TOT2A at 500 MW

Table 3. Loads in the Study Area – 2017 Projected Demand

Bus Name	Bus No.	Id	PLoad (MW)	QLoad (Mvar)	Bus Name	Bus No.	Id	Pload (MW)	Qload (Mvar)		
ADOBE	230.00	70268	GV	14.08	2.86	HORIZON	230.00	70233	P2	18.45	6.52
ADOBE	230.00	70268	WA	0.31	-0.05	LOMA_GV	69.000	70462	GV	3.33	0.68
BENCH	230.00	70357	IN	45.60	15.60	ORCHMEGV	69.000	70433	GV	11.13	2.26
BOOKCFGV	69.000	70488	GV	6.58	1.34	PARACHUT	230.00	70309	HC	3.53	-0.24
CAMEO	69.000	70076	P4	0.81	0.27	PARACHUT	230.00	70309	P1	14.75	6.56
CLIFTON	230.00	70113	P1	19.62	0.65	PARACHUT	230.00	70309	WA	0.20	-0.04
CLIFTON	230.00	70113	P2	11.27	0.24	RIFLE_CU	138.00	79056	HC	2.18	0.00
COLBRAN	138.00	79047	GV	3.20	0.65	RIFLE_CU	138.00	79056	NT	-1.63	0.02
COLBRAN	138.00	79047	WA	0.07	0.02	RIFLE_CU	138.00	79056	P1	11.37	1.34
DEBEQUE	69.000	70140	GV	2.10	0.43	RIFLE_CU	138.00	79056	P5	10.90	-0.49
DEBEQUE	69.000	70140	P1	0.48	0.16	RIFLE_CU	138.00	79056	TS	0.00	0.00
DEBEQUE	69.000	70140	WA	0.02	0.00	RIFLE_CU	138.00	79056	WA	0.12	-0.01
FRUITA	69.000	70183	GV	1.37	0.28	STKGULCH	230.00	70299	IN	52.25	17.20
FRUITA	69.000	70183	P1	6.65	2.47	UINTAH	13.800	70437	GV	1.81	0.37
FRUITA	69.000	70183	WA	0.03	0.00	UINTAH	13.800	70437	WA	0.03	0.01
FRUITAGV	69.000	70492	GV	2.72	0.55	UINTAH	230.00	70438	P1	10.05	2.53
GRANDJCT	69.000	70214	GV	0.00	0.00	UINTAH	230.00	70438	P3	6.32	0.10
GRANDJCT	69.000	70214	WA	0.00	0.00	UINTAH	69.000	70436	GV	0.00	0.00
GRANDJPS	230.00	70206	NT	-1.60	1.73	UINTAH	69.000	70436	WA	0.00	0.00
GRANDJPS	230.00	70206	P1	32.15	1.26	UNA_ORCH	69.000	70109	IN	18.90	11.00
GRANDJPS	230.00	70206	P2	38.96	12.76	VINELAND	69.000	70454	NT	-3.18	-1.09
HIGHLNGV	69.000	70489	GV	7.76	1.58	VINELAND	69.000	70454	P1	8.53	3.99
HORIZON	230.00	70233	P1	16.53	0.22	WEELERPS	230.00	70356	IN	3.20	1.52

The WECC 2015 Heavy Summer base case “15hs3sa1p-r33” that was approved by WECC on October 4, 2013 was used for the study. The case was modified to represent the 2017 heavy summer coincident peak loads from the most recent demand forecast in the study area to 2017 levels using the PSCO load forecasting spreadsheet.⁶ The Grand Valley Power detailed 69kV model was added to the case. The detailed 69kV model was included in a new Zone 720 that included the BookcliffGV 69kV, FruitaGV 69kV, HighlineGV 69kV, LomaGV 69kV, and Orchard MesaGV 69kV busses and the 69kV transmission lines connecting them to the system. These GVP loads are lumped at the Uintah 69kV and Grand Junction 69kV buses in the original case; therefore, these lumped loads in the case were set to zero to avoid double counting the GVP 69kV loads. The remaining GVP loads were modified at the busses in the case to represent the “2017 Summer Peak Load Forecast by Substation” table that was provided to PSCO in January 2014. The Tri-State loads (Zone 790) for the 2017 heavy summer on-peak season were developed by averaging the load demand for each bus in the 2015 heavy summer case with the load demand for each bus in the 2019 heavy summer case.

⁶ Spreadsheet Name = “PSCO PTI-GE Out_A70_MSF_2013.xls”, Set year = “2017”, Tab = “PTI_Out_w-PSCO_Xfmr_loss”. The load demands include the distribution transformer losses reflected to the high side of the transformer.

B. Branches in the Study Area - 2017 Heavy Summer – TOT2A at 500 MW

Table 4. Branches Represented for the 2017 Heavy Summer Season

From Bus No.	From Bus Name	To Bus No.	To Bus Name	ID	Line R (pu)	Line X (pu)	Charging B (pu)	IS	Rate A
70076	CAMEO 69.0	70140	DEBEQUE 69.0	1	0.14219	0.24906	0.00524	1	55.9
70076	CAMEO 69.0	70454	VINELAND 69.0	1	0.02580	0.05580	0.00120	1	64.8
70078	CAMEO 230.0	70309	PARACHUT 230.0	1	0.00750	0.04730	0.08910	1	430.0
70078	CAMEO 230.0	70438	UINTAH 230.0	1	0.00545	0.04907	0.10088	1	239.0
70082	CAMP 69.0	70207	GRANDVLY 69.0	1	0.09127	0.07121	0.00106	1	32.3
70082	CAMP 69.0	70440	UNIONOIL 69.0	1	0.15573	0.12149	0.00180	1	30.0
70109	UNA_ORCH 69.0	70140	DEBEQUE 69.0	1	0.04878	0.08544	0.00180	1	55.9
70109	UNA_ORCH 69.0	70207	GRANDVLY 69.0	1	0.04878	0.08544	0.00180	1	55.9
70113	CLIFTON 230.0	70205	GRANDJCT 230.0	1	0.00064	0.00572	0.01175	1	273.0
70113	CLIFTON 230.0	70206	GRANDJPS 230.0	1	0.00134	0.01160	0.02568	1	482.0
70183	FRUITA 69.0	70436	UINTAH 69.0	1	0.05000	0.04626	0.00100	1	32.3
70206	GRANDJPS 230.0	70233	HORIZON 230.0	1	0.08200	0.00716	0.01576	1	239.0
70207	GRANDVLY 69.0	70302	OILSHALE 69.0	1	0.07358	0.12887	0.00272	1	55.9
70214	GRANDJCT 69.0	70433	ORCHMEGV 69.0	1	0.04925	0.09488	0.00146	1	44.0
70214	GRANDJCT 69.0	70454	VINELAND 69.0	1	0.05020	0.10856	0.00238	1	65.0
70214	GRANDJCT 69.0	70489	HIGHLNGV 69.0	1	0.08026	0.15462	0.00238	1	44.0
70268	ADOBE 230.0	70438	UINTAH 230.0	1	0.00097	0.00855	0.01882	1	239.0
70299	STKGULCH 230.0	70309	PARACHUT 230.0	1	0.00084	0.00551	0.01100	1	478.0
70302	OILSHALE 69.0	70359	RIFLE_CU 69.0	1	0.08530	0.14510	0.00350	1	55.9
70309	PARACHUT 230.0	70356	WEELERPS 230.0	1	0.00071	0.00551	0.01098	1	60.0
70309	PARACHUT 230.0	70358	RIFLE_PS 230.0	1	0.00490	0.03090	0.05960	1	430.0
70356	WEELERPS 230.0	70357	BENCH 230.0	1	0.00155	0.01212	0.02416	1	159.0
70358	RIFLE_PS 230.0	79059	RIFLE_WA 230.0	1	0.00000	0.00060	0.00000	1	500.0
70358	RIFLE_PS 230.0	79250	AMATLAS 230.0	1	0.00081	0.00536	0.01037	1	159.0
70359	RIFLE_CU 69.0	70388	SILTUSBR 69.0	1	0.05354	0.10670	0.00219	1	55.9
70436	UINTAH 69.0	70445	LOMATPGV 69.0	1	0.01642	0.03163	0.00049	1	44.0
70445	LOMATPGV 69.0	70462	LOMA_GV 69.0	1	0.04286	0.08258	0.00127	1	44.0
70445	LOMATPGV 69.0	70492	FRUITAGV 69.0	1	0.04469	0.08609	0.00132	1	44.0
70488	BOOKCFGV 69.0	70489	HIGHLNGV 69.0	1	0.04104	0.07907	0.00122	1	44.0
70488	BOOKCFGV 69.0	70492	FRUITAGV 69.0	0	0.09850	0.18976	0.00292	0	44.0
79033	GOREPASS 230.0	79039	HAYDEN 230.0	1	0.00410	0.06411	0.20395	1	478.0
79034	GRANDJCT 115.0	79183	STRNELSN 115.0	1	0.03901	0.14050	0.01733	1	95.0
79035	GRANDJCT 138.0	79047	COLBRAN 138.0	1	0.02431	0.08782	0.02322	1	55.0
79036	GRANDJCT 345.0	79058	RIFLE_CU 345.0	1	0.00199	0.02911	0.47001	1	621.0
79047	COLBRAN 138.0	79056	RIFLE_CU 138.0	1	0.04534	0.18330	0.04368	1	96.0
79057	RIFLE_CU 230.0	79059	RIFLE_WA 230.0	1	0.00053	0.00485	0.00998	1	478.0
79058	RIFLE_CU 345.0	79266	MEEKER 345.0	1	0.00149	0.01962	0.35505	1	598.0
79173	COLBRAN 115.0	79174	MOLINA-L 115.0	1	0.00670	0.01400	0.00266	1	85.0
79173	COLBRAN 115.0	79175	MOLINA-U 115.0	1	0.00670	0.01400	0.00266	1	85.0

The detailed 69kV model was included in a new Zone 720 that included the BookcliffGV 69kV, FruitaGV 69kV, HighlineGV 69kV, LomaGV 69kV, and Orchard MesaGV 69kV busses and the 69kV transmission lines connecting them to the system. The switch between FruitaGVP and BookcliffGVP is normally open; therefore, the FruitaGV-BookcliffGV 69kV branch was represented out-of-service in the case. For the maintenance outage of the Uintah-Grand Junction(Ute) 69kV line, the normally open switch at Fruita GVP 69 kV was closed to restore load on the Uintah-Grand Junction(Ute) 69kV line. In addition to the usual system intact and single contingency outages, the GVP 69-kV lines were taken out of service to simulate maintenance outages. System experience

and studies have shown that the critical outages for the GVP 69 kV system are a maintenance outage of the Grand Jct(Ute)-Highline GVP 69 kV line or a maintenance outage of the Uintah 69-Loma Tap GVP 69 kV line. The proposed Rifle(Ute)-Parachute 230kV line (ISD: 2016), the Grand Junction 138-115kV Transformer Replacement Project (ISD: 2016), the Bluestone Valley Project that includes the Debeque-Cameo 69kV re-route to the Bluestone Valley Substation (ISD: 2016) were not represented in the 2017 study case to study the impact of these projects being delayed. The projects were added individually to the study case to demonstrate the impact of the projects on the system assuming that they are placed in service prior to 2017.

C. Transformers in the Study Area – 2017 Heavy Summer - TOT2A at 500 MW

Table 5. Transformers in the Study Area

From Bus Number	From Bus Name	To Bus Number	To Bus Name	ID	Name	IS	R (pu)	X (pu)	Rate A
70076	CAMEO 69.000	70078	CAMEO 230.00	T5	CAMEO	1	0.00699	0.21714	66.7
70180	FRUITA 13.800	70183	FRUITA 69.000	U1	FRUITA	1	0.00350	0.06670	24.0
70205	GRANDJCT 230.00	79036	GRANDJCT 345.00	T1	GRANDJCT	1	0.00035	0.02760	273.0
70214	GRANDJCT 69.000	79034	GRANDJCT 115.00	T1	GRANDJCT	1	0.00000	0.18000	42.0
70359	RIFLE_CU 69.000	79056	RIFLE_CU 138.00	T2	RIFLE_CU	1	0.00000	0.10000	75.0
70436	UINTAH 69.000	70437	UINTAH 13.800	T2	UINTAH	0	0.02702	0.47523	28.0
70436	UINTAH 69.000	70438	UINTAH 230.00	T1	UINTAH	1	0.00699	0.21714	75.0
70437	UINTAH 13.800	70438	UINTAH 230.00	T1	UINTAH	1	0.00927	0.35655	56.0
79034	GRANDJCT 115.00	79035	GRANDJCT 138.00	T2	GRANDJCT	1	0.00000	0.14000	55.0
79056	RIFLE_CU 138.00	79057	RIFLE_CU 230.00	T3	RIFLE_CU	1	0.00000	0.05778	143.0
79057	RIFLE_CU 230.00	79058	RIFLE_CU 345.00	T4	Q50	1	0.00000	0.01283	478.0

Two transformers serve the GVP 69kV load-serving system between Uintah and Grand Junction. The Uintah 75 MVA 230-69kV transformer regulates the Uintah 69kV voltage over a range of +/- 10% in 32 steps (16 raise and 16 lower). The load tap-changer is set to maintain the Uintah 69kV voltage between 1.03 p.u. and 1.00 p.u. in the case. The Grand Junction(Ute) 42 MVA 115-69kV is set on the 2.5% no-load tap and has no voltage regulation capability. The Debeque 69kV load is served from the Rifle(Ute)-Una-Debeque-Cameo 69kV line. Two transformers serve that line – the Cameo 66.7 MVA 230-69kV transformer and the Rifle(Ute) 75 MVA 138-69kV transformer. The Cameo 66.7 MVA 230-69kV transformer regulates the Cameo 69kV voltage over a range of +/- 10% in 32 steps (16 raise and 16 lower). The load tap-changer is set to maintain the Cameo 69kV voltage between 1.03 p.u. and 1.00 p.u. in the case. The load tap changer for the new Rifle(Ute) 75 MVA 138-69kV transformer was added to the case.

D. Generation in the Study Area – 2017 Heavy Summer – TOT2A at 500 MW

Table 6. Generation in the Study Area

Bus Number	Bus Name	Id	IS	PGen (MW)	PMax (MW)
79157	BMESA1-2 11.000	1	1	34.0	43.2
79157	BMESA1-2 11.000	2	1	34.0	43.2
79015	CRAIG 1 22.000	1	1	470.0	470.0
79016	CRAIG 2 22.000	1	1	470.0	470.0
79017	CRAIG 3 22.000	1	1	470.0	470.0
79162	CRYSTAL 12.500	1	1	21.0	27.5
70180	FRUITA 13.800	G1	0	15.0	17.0
79040	HAYDEN1 18.000	1	1	212.0	212.0
79041	HAYDEN2 22.000	1	1	286.0	286.0
79176	MCPHEE 2.4000	1	1	1.0	1.3
79166	MOLINA-L 4.2000	1	1	3.0	4.9
79172	MOLINA-U 4.2000	1	1	6.0	8.6
79019	MORRO1-2 12.500	1	1	65.0	82.0
79019	MORRO1-2 12.500	2	1	65.0	82.0
79158	NUCLA 1 13.800	1	1	14.0	14.0
79159	NUCLA 2 13.800	1	1	14.0	14.0
79160	NUCLA 3 13.800	1	1	14.0	14.0
79161	NUCLA 4 13.800	1	1	36.4	68.0
79251	QFATLAS1 13.800	1	0	0.0	31.2
79251	QFATLAS1 13.800	2	0	0.0	18.2
79252	QFATLAS2 13.800	3	0	0.0	18.2
79252	QFATLAS2 13.800	4	0	0.0	18.2
79164	TOWAOC 6.9000	1	1	9.0	12.0

The generation in the 2017 heavy summer case reflects the Fruita generating station off-line (status = 0). The generation at the Craig generating station and the Hayden generating station were increased to their maximums in order to stress the TOT2A transfer path to 500 MW (north-to-south). The TOT2A path at present has a TOT2A transfer path limit of 500 MW.

F. Reactors in the Study Area – 2017 Heavy Summer – TOT2A at 500 MW

Table 7. Reactive Support in the Study Area

Bus Number	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)
70078	CAMEO 230.00	1	Discrete, cntr	1.0457	0.9957	45.0	1	-20.0	1	45.0
70309	PARACHUT 230.00	1	Discrete, cntr	1.0441	0.9941	45.0	1	45.0	0	0.0
79057	RIFLE_CU 230.00	1	Locked (0)	1.0449	0.9949	0.0	2	-30.0	0	0.0
70438	UINTAH 230.00	1	Discrete, cntr	1.0365	0.9865	45.0	1	45.0	0	0.0
70109	UNA_ORCH 69.000	1	Discrete, cntr	1.0076	0.9776	7.5	1	7.5	0	0.0

Table 7 lists the reactors in the study area that provide voltage support to the area.

- APPENDIX B– System Study Results–TOT2A 500 MW South-to-North Flow

Appendix B System Study Results

A. System Intact–2017HS–TOT2A = 500 MW-FruitaGV-Bookcliff69kV Open

Table 8. System Intact – GVP Bus Voltages under Maintenance Outages

Maintenance Outage	LomaGV 69kV Voltage (p.u.)	FruitaGV 69kV Voltage (p.u.)	BookcliffGV 69kV Voltage (p.u.)	HighlineGV 69kV Voltage (p.u.)	OrchrdMesGV 69kV Voltage (p.u.)
Uintah-LomaTap 69kV	0.965	0.969	0.977	0.984	0.999
Loma Tap-FruitaGV 69kV	1.026	0.982	0.986	0.991	1.002
FruitaGV-BookcliffGV 69kV	1.023	1.023	0.992	0.996	1.004
BookcliffGV-HighlineGV 69kV	1.017	1.014	1.005	1.008	1.009
HighlineGV-GrandJct(Ute) 69kV	1.007	0.998	0.978	0.973	1.014

Table No. 8 represents the system intact voltages at GVP load busses on the Uintah-Grand Junction(Ute) 69kV load-serving line under various maintenance outage scenarios. The GVP Uintah-Grand Junction(Ute) 69kV load-serving line can be opened at various places along the line to take sections of line out-of-service for maintenance. The system is normally open between FruitaGV 69kV and BookcliffGV 69kV and this line is closed to connect the loads radially to either the Grand Junction(Ute) 69kV bus or the Uintah 69kV bus for the applicable maintenance outages. The Uintah-Loma Tap 69kV maintenance outage results in the lowest voltages in the GVP Uintah-Grand Junction(Ute) 69kV load-serving system as it leaves the loads on a radial line from the Grand Junction(Ute) Substation with no voltage regulation available from the Grand Junction(Ute) 42 MVA 115-69kV transformer. With all transmission facilities in service, every maintenance condition results in bus voltages greater than 0.95 p.u. and less than 1.05 p.u. The lowest bus voltage occurs at the LomaGV 69kV load bus when it reaches 0.965 p.u. for system intact conditions with the Uintah-LomaTap 69kV branch open for maintenance (and the FruitaGV-BookcliffGV 69kV line closed).

B. Branch Flows for Outages - FruitaGV-BookcliffGV 69kV Open

Table 9. Branch Flows for Outages - FruitaGV-BookcliffGV 69kV Open

**	From bus	** **	To bus	** CKT	Rating	Loading%	Contingency Description
70205	GRANDJCT	230 79036	GRANDJCT	345 T1	273.0	102.8	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70214	GRANDJCT	69.0 79034	GRANDJCT	115 T1	42.0	103.0	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70309	PARACHUT	230 70358	RIFLE_PS	230 1	430.0	99.6	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013	CRAIG	230 79059	RIFLE WA	230 1	645.0	97.1	79014 CRAIG 345 79266 MEEKER 345 1
79014	CRAIG	345 79266	MEEKER	345 1	896.0	98.2	79013 CRAIG 230 79059 RIFLE WA 230 1
79034	GRANDJCT	115 79035	GRANDJCT	138 T2	55.0	115.8	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79034	GRANDJCT	115 79035	GRANDJCT	138 T2	55.0	113.3	79036 GRANDJCT 345 79049 MONTROSE 345 1
79036	GRANDJCT	345 79058	RIFLE_CU	345 1	621.0	107.8	70309 PARACHUT 230 70358 RIFLE_PS 230 1
79057	RIFLE_CU	230 79058	RIFLE_CU	345 T4	478.0	95.5	79014 CRAIG 345 79266 MEEKER 345 1
79058	RIFLE_CU	345 79266	MEEKER	345 1	598.0	124.3	79013 CRAIG 230 79059 RIFLE WA 230 1

Facility outages were simulated in the 2017 Heavy Summer study case (with TOT2A at 500 MW north-to-south) and the FruitaGV-BookcliffGV 69kV branch open. The Grand Junction(Ute) 273 MVA 345-230kV transformer contingency flow and the Grand Junction(Ute) 42 MVA 115-69kV transformer contingency flow are less than their respective emergency ratings. The Grand Junction(Ute) 55 MVA 138-115kV transformer contingency flow will be mitigated when the transformer is replaced with a 100 MVA transformer in 2016. The Meeker-Rifle(Ute) 345kV contingency overload is the responsibility of the transmission line owners. Category C contingencies were conducted with these results:

- For the common tower disturbance at the Parachute 230kV bus, the RifleUte-Grand Junction(Ute) 345kV branch flow reached 99.3% of its 621.0 MVA rating and contingency high voltages occurred at Cameo 230kV (1.061 p.u.) and Uintah 230kV (1.051 p.u.).
- For the common tower disturbance at the Grand Junction(PS) 230kV bus, contingency high voltages occurred at Cameo 69kV (1.056 p.u.), Cameo 230kV (1.064 p.u.), Fruita 69kV (1.079 p.u.), Uintah 69kV (1.084 p.u.), Uintah 230kV (1.085 p.u.), LomaGV Tap (1.083 p.u.), LomaGV 69kV (1.081 p.u.), and FruitaGV 69kV (1.081 p.u.).
- For the breaker failure disturbance at the Rifle(Ute) 345kV bus, the Grand Junction(Ute) 138-115kV transformer reached 103.4% of its 55 MVA rating and there were no branch flow violations, or voltage violations in the study area.
- For the breaker failure disturbance at the Grand Junction(Ute) 345kV bus, the Grand Junction(Ute) 138-115kV transformer reached 121.2% of its 55 MVA rating and there were no flow violations or voltage violations in the study area.

C. Bus Voltages for Outages - FruitaGV-BookcliffGV 69kV Open

Table 10. Bus Voltages for Outages - FruitaGV-BookcliffGV 69kV Open

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description			
70268	ADOBE	230.0	0.9669	1.0267	70113 CLIFTON	230	70205 GRANDJCT	230 1
70357	BENCH	230.0	0.9438	1.0017	79014 CRAIG	345	79266 MEEKER	345 1
70488	BOOKCFGV	69.0	0.9312	0.9918	70076 CAMEO	69.0	70078 CAMEO	230 T5
70078	CAMEO	230.0	0.9604	1.0236	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70076	CAMEO	69.0	0.9376	1.0261	70076 CAMEO	69.0	70078 CAMEO	230 T5
70113	CLIFTON	230.0	0.9615	1.0237	70113 CLIFTON	230	70205 GRANDJCT	230 1
79047	COLBRAN	138.0	0.9452	0.9967	79014 CRAIG	345	79266 MEEKER	345 1
70140	DEBEQUE	69.0	0.9147	0.9957	70076 CAMEO	69.0	70140 DEBEQUE	69.0 1
70155	DILLON	115.0	1.0556	1.0048	70155 DILLON	115	70156 DILLON	230 T1
70183	FRUITA	69.0	0.9615	1.0210	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70492	FRUITAGV	69.0	0.9634	1.0233	70113 CLIFTON	230	70205 GRANDJCT	230 1
70205	GRANDJCT	230.0	0.9641	1.0241	70205 GRANDJCT	230	79036 GRANDJCT	345 T1
70214	GRANDJCT	69.0	0.9523	1.0116	70076 CAMEO	69.0	70078 CAMEO	230 T5
70206	GRANDJPS	230.0	0.9619	1.0233	70113 CLIFTON	230	70205 GRANDJCT	230 1
70207	GRANDVLY	69.0	0.9256	0.9908	79014 CRAIG	345	79266 MEEKER	345 1
70489	HIGHLNGV	69.0	0.9352	0.9956	70076 CAMEO	69.0	70078 CAMEO	230 T5
70231	HOPKINS	115.0	0.9560	1.0072	79014 CRAIG	345	79266 MEEKER	345 1
70267	HOPKINS	69.0	0.9646	1.0179	79014 CRAIG	345	79266 MEEKER	345 1
70233	HORIZON	230.0	0.9638	1.0245	70113 CLIFTON	230	70205 GRANDJCT	230 1
70462	LOMA GV	69.0	0.9631	1.0230	70113 CLIFTON	230	70205 GRANDJCT	230 1
70445	LOMATPGV	69.0	0.9651	1.0249	70113 CLIFTON	230	70205 GRANDJCT	230 1
70302	OILSHALE	69.0	0.9317	0.9970	79014 CRAIG	345	79266 MEEKER	345 1
70309	PARACHUT	230.0	0.9488	1.0064	79014 CRAIG	345	79266 MEEKER	345 1
79059	RIFLE WA	230.0	0.9431	1.0010	79014 CRAIG	345	79266 MEEKER	345 1
79057	RIFLE_CU	230.0	0.9414	0.9988	79014 CRAIG	345	79266 MEEKER	345 1
79056	RIFLE_CU	138.0	0.9347	0.9997	79014 CRAIG	345	79266 MEEKER	345 1
70359	RIFLE_CU	69.0	0.9409	1.0057	79014 CRAIG	345	79266 MEEKER	345 1
70358	RIFLE_PS	230.0	0.9434	1.0014	79014 CRAIG	345	79266 MEEKER	345 1
70388	SILTUSER	69.0	0.9409	1.0033	79014 CRAIG	345	79266 MEEKER	345 1
70299	STKGULCH	230.0	0.9473	1.0050	79014 CRAIG	345	79266 MEEKER	345 1
70438	UINTAH	230.0	0.9705	1.0292	70113 CLIFTON	230	70205 GRANDJCT	230 1
70436	UINTAH	69.0	0.9664	1.0262	70113 CLIFTON	230	70205 GRANDJCT	230 1
70109	UNA_ORCH	69.0	0.9168	0.9869	70076 CAMEO	69.0	70140 DEBEQUE	69.0 1
70454	VINELAND	69.0	0.9405	1.0193	70076 CAMEO	69.0	70078 CAMEO	230 T5

Facility outages were simulated on the 2017 Heavy Summer study case with TOT2A at 500 MW north-to-south and the FruitaGV-BookcliffGV 69kV branch open (the normal configuration for the GVP Uintah-Grand Junction(Ute) 69kV load-serving system). All bus voltages were within criteria.

D. Branch Flows for Outages – Uintah-LomaGV Tap 69kV Open

Table 11. Branch Flows for Outages – Uintah-LomaGV Tap 69kV Open

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description				
70205	GRANDJCT	230 79036	GRANDJCT	345	T1	273.0	101.7	70309	PARACHUT	230 70358	RIFLE_PS	230 1
70214	GRANDJCT	69.0 79034	GRANDJCT	115	T1	42.0	109.8	70309	PARACHUT	230 70358	RIFLE_PS	230 1
70309	PARACHUT	230 70358	RIFLE_PS	230	1	430.0	99.3	79036	GRANDJCT	345 79058	RIFLE_CU	345 1
79013	CRAIG	230 79059	RIFLE_WA	230	1	645.0	97.1	79014	CRAIG	345 79266	MEEKER	345 1
79014	CRAIG	345 79266	MEEKER	345	1	896.0	98.2	79013	CRAIG	230 79059	RIFLE_WA	230 1
79034	GRANDJCT	115 79035	GRANDJCT	138	T2	55.0	117.1	79036	GRANDJCT	345 79058	RIFLE_CU	345 1
79034	GRANDJCT	115 79035	GRANDJCT	138	T2	55.0	115.0	79036	GRANDJCT	345 79049	MONTROSE	345 1
79036	GRANDJCT	345 79058	RIFLE_CU	345	1	621.0	107.5	70309	PARACHUT	230 70358	RIFLE_PS	230 1
79046	MEEKER	138 79056	RIFLE_CU	138	1	125.0	107.8	79014	CRAIG	345 79266	MEEKER	345 1
79057	RIFLE_CU	230 79058	RIFLE_CU	345	T4	478.0	95.3	79014	CRAIG	345 79266	MEEKER	345 1
79058	RIFLE_CU	345 79266	MEEKER	345	1	598.0	124.3	79013	CRAIG	230 79059	RIFLE_WA	230 1

Maintenance Outage No. 1 (opening the Uintah-LomaGV Tap 69kV and closing the FruitaGV-BookcliffGV 69kV line) results in the LomaGV 69kV, the FruitaGV 69kV, the BookcliffGV 69kV, and the HighlineGV 69kV loads served radially from the Grand Junction(Ute) substation. The Grand Junction 115-69kV contingency overload increases from 103.0% of its 42.0 MVA rating to 109.8% of its 42.0 MVA. This occurs because this configuration shifts the FruitaGV and LomaGV loads from the Uintah 230-69kV transformer to the Grand Junction(Ute) 115-69kV transformer. The contingency overload of the Grand Junction(Ute) 345-230kV transformer decreases from 102.8% to 101.7%.

E. Bus Voltages for Outages – Uintah-LomaGV Tap 69kV Open

Table 12. Bus Voltages for Outages – Uintah-LomaGV Tap 69kV Open

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70268	ADOBE	230.0	0.9720	1.0274	70113 CLIFTON	230	70205 GRANDJCT	230	1
70357	BENCH	230.0	0.9439	1.0018	79014 CRAIG	345	79266 MEEKER	345	1
70488	BOOKCFGV	69.0	0.9095	0.9766	70076 CAMEO	69.0	70078 CAMEO	230	T5
70078	CAMEO	230.0	0.9612	1.0238	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70076	CAMEO	69.0	0.9281	1.0243	70076 CAMEO	69.0	70078 CAMEO	230	T5
70113	CLIFTON	230.0	0.9666	1.0242	70113 CLIFTON	230	70205 GRANDJCT	230	1
70140	DEBEQUE	69.0	0.9143	0.9942	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70140	DEBEQUE	69.0	0.9208	0.9942	70076 CAMEO	69.0	70078 CAMEO	230	T5
70183	FRUITA	69.0	0.9598	1.0179	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70492	FRUITAGV	69.0	0.9008	0.9687	70076 CAMEO	69.0	70078 CAMEO	230	T5
70205	GRANDJCT	230.0	0.9692	1.0245	70205 GRANDJCT	230	79036 GRANDJCT	345	T1
70214	GRANDJCT	69.0	0.9420	1.0066	70076 CAMEO	69.0	70078 CAMEO	230	T5
70206	GRANDJPS	230.0	0.9669	1.0238	70113 CLIFTON	230	70205 GRANDJCT	230	1
70207	GRANDVLY	69.0	0.9242	0.9896	79014 CRAIG	345	79266 MEEKER	345	1
70489	HIGHLNGV	69.0	0.9171	0.9837	70076 CAMEO	69.0	70078 CAMEO	230	T5
70233	HORIZON	230.0	0.9688	1.0251	70113 CLIFTON	230	70205 GRANDJCT	230	1
70462	LOMA GV	69.0	0.8965	0.9647	70076 CAMEO	69.0	70078 CAMEO	230	T5
70445	LOMATPGV	69.0	0.8987	0.9667	70076 CAMEO	69.0	70078 CAMEO	230	T5
70302	OILSHALE	69.0	0.9307	0.9962	79014 CRAIG	345	79266 MEEKER	345	1
70433	ORCHMEGV	69.0	0.9338	0.9989	70076 CAMEO	69.0	70078 CAMEO	230	T5
70309	PARACHUT	230.0	0.9489	1.0064	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE WA	230.0	0.9431	1.0010	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9415	0.9988	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9343	0.9993	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9404	1.0054	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9434	1.0014	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9475	1.0051	79014 CRAIG	345	79266 MEEKER	345	1
70438	UINTAH	230.0	0.9725	1.0299	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70436	UINTAH	69.0	0.9653	1.0231	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70109	UNA_ORCH	69.0	0.9164	0.9855	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70109	UNA_ORCH	69.0	0.9203	0.9855	70076 CAMEO	69.0	70078 CAMEO	230	T5
70454	VINELAND	69.0	0.9307	1.0163	70076 CAMEO	69.0	70078 CAMEO	230	T5

Maintenance Outage No. 1 (Uintah-LomaGV Tap 69kV open with FruitaGV-BookcliffGV 69kV closed) results in the LomaGV 69kV, the FruitaGV 69kV, the BookcliffGV 69kV, and the HighlineGV 69kV loads served radially from the Grand Junction(Ute) substation and the LomaGV load experiences a slight voltage criteria violation. The LomaGV 69kV load bus voltage reached 0.897 p.u. (slightly less than the 0.90 p.u. minimum) for an outage of the Cameo 230-69kV transformer. The Grand Junction 42.0 115-69kV transformer does not have a load tap changer and cannot regulate the Grand Junction(Ute) 69kV bus voltage. The voltage violation is not significant as it is essentially at 0.90 p.u.

F. Branch Flows for Outages – Grand Junction-HighlineGV 69kV Open

Table 13. Branch Flows for Outages – Grand Junction-HighlineGV 69kV Open

**	From bus	** **	To bus	** CKT	Rating	Loading%	Contingency Description			
70205	GRANDJCT	230 79036	GRANDJCT	345 T1	273.0	105.3	70309	PARACHUT	230 70358	RIFLE_PS 230 1
70309	PARACHUT	230 70358	RIFLE_PS	230 1	430.0	100.3	79036	GRANDJCT	345 79058	RIFLE_CU 345 1
79013	CRAIG	230 79059	RIFLE_WA	230 1	645.0	97.2	79014	CRAIG	345 79266	MEEKER 345 1
79014	CRAIG	345 79266	MEEKER	345 1	896.0	98.3	79013	CRAIG	230 79059	RIFLE_WA 230 1
79034	GRANDJCT	115 79035	GRANDJCT	138 T2	55.0	112.5	79036	GRANDJCT	345 79058	RIFLE_CU 345 1
79034	GRANDJCT	115 79035	GRANDJCT	138 T2	55.0	109.3	79036	GRANDJCT	345 79049	MONTROSE 345 1
79036	GRANDJCT	345 79058	RIFLE_CU	345 1	621.0	108.6	70309	PARACHUT	230 70358	RIFLE_PS 230 1
79046	MEEKER	138 79056	RIFLE_CU	138 1	125.0	107.4	79014	CRAIG	345 79266	MEEKER 345 1
79057	RIFLE_CU	230 79058	RIFLE_CU	345 T4	478.0	96.0	79014	CRAIG	345 79266	MEEKER 345 1
79058	RIFLE_CU	345 79266	MEEKER	345 1	598.0	124.5	79013	CRAIG	230 79059	RIFLE_WA 230 1

Maintenance Outage No. 2 (Grand Junction(Ute)-HighlineGV 69kV branch open and FruitaGV-BookcliffGV 69kV branch closed) results in the LomaGV 69kV, the FruitaGV 69kV, the BookcliffGV 69kV, and the HighlineGV 69kV loads served radially from the Uintah substation. The Grand Junction(Ute) 115-69kV transformer contingency overload that occurs for Maintenance Outage No. 1 is eliminated (because the BookcliffGV and HighlineGV 69kV loads are shifted from Grand Junction(Ute) Substation to the Uintah Substation).

G. Bus Voltages for Outages – Grand Junction-HighlineGV 69kV Open

Table 14. Bus Voltages for Outages – Grand Junction-HighlineGV 69kV Open

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70268	ADOBE	230.0	0.9481	1.0234	70113 CLIFTON	230	70205 GRANDJCT	230	1
70357	BENCH	230.0	0.9415	1.0006	79014 CRAIG	345	79266 MEEKER	345	1
70488	BOOKCFGV	69.0	0.8969	0.9771	70113 CLIFTON	230	70205 GRANDJCT	230	1
70488	BOOKCFGV	69.0	0.8995	0.9771	70205 GRANDJCT	230	79036 GRANDJCT	345	T1
70078	CAMEO	230.0	0.9561	1.0218	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70076	CAMEO	69.0	0.9627	1.0288	70076 CAMEO	69.0	70078 CAMEO	230	T5
70082	CAMP	69.0	0.9340	0.9925	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70113	CLIFTON	230.0	0.9425	1.0213	70113 CLIFTON	230	70205 GRANDJCT	230	1
70140	DEBEQUE	69.0	0.9150	0.9979	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70183	FRUITA	69.0	0.9303	1.0075	70113 CLIFTON	230	70205 GRANDJCT	230	1
70492	FRUITAGV	69.0	0.9189	0.9972	70113 CLIFTON	230	70205 GRANDJCT	230	1
70205	GRANDJCT	230.0	0.9453	1.0219	70205 GRANDJCT	230	79036 GRANDJCT	345	T1
70214	GRANDJCT	69.0	0.9674	1.0215	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70206	GRANDJPS	230.0	0.9429	1.0205	70113 CLIFTON	230	70205 GRANDJCT	230	1
70207	GRANDVLY	69.0	0.9265	0.9924	79014 CRAIG	345	79266 MEEKER	345	1
70489	HIGHLNGV	69.0	0.8920	0.9726	70113 CLIFTON	230	70205 GRANDJCT	230	1
70489	HIGHLNGV	69.0	0.8945	0.9726	70205 GRANDJCT	230	79036 GRANDJCT	345	T1
70462	LOMA_GV	69.0	0.9287	1.0061	70113 CLIFTON	230	70205 GRANDJCT	230	1
70445	LOMATPGV	69.0	0.9308	1.0080	70113 CLIFTON	230	70205 GRANDJCT	230	1
79266	MEEKER	345.0	0.9429	0.9987	79014 CRAIG	345	79266 MEEKER	345	1
79046	MEEKER	138.0	0.9570	1.0083	79014 CRAIG	345	79266 MEEKER	345	1
70433	ORCHMEGV	69.0	0.9595	1.0140	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70309	PARACHUT	230.0	0.9465	1.0052	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE_WA	230.0	0.9416	1.0005	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9399	0.9983	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9343	0.9999	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9404	1.0060	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9419	1.0009	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9451	1.0039	79014 CRAIG	345	79266 MEEKER	345	1
70438	UINTAH	230.0	0.9518	1.0256	70113 CLIFTON	230	70205 GRANDJCT	230	1
70436	UINTAH	69.0	0.9360	1.0127	70113 CLIFTON	230	70205 GRANDJCT	230	1
70109	UNA_ORCH	69.0	0.9171	0.9888	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70440	UNIONOIL	69.0	0.9268	0.9926	79014 CRAIG	345	79266 MEEKER	345	1
70454	VINELAND	69.0	0.9641	1.0245	79036 GRANDJCT	345	79058 RIFLE_CU	345	1

Maintenance Outage No. 2 (Grand Junction(Ute)-HighlineGV 69kV branch open and FruitaGV-BookcliffGV 69kV branch closed) results in the LomaGV 69kV, the FruitaGV 69kV, the BookcliffGV 69kV, and the HighlineGV 69kV loads served radially from the Uintah substation. The BookcliffGV 69kV and HighlineGV 69kV slight low voltage criteria violations can be eliminated by adjusting the Uintah 69kV voltage schedule that is maintained by the Uintah 230-69kV load tap changer.

- APPENDIX C– Sensitivity Study Results – Future PSC and GVP Projects

Appendix C

Sensitivity Study Results

A. Sensitivity No. 1 – PSCO Bluestone Valley Project

The Bluestone Valley Substation will be constructed as an in-an-out tap of the Parachute-Cameo 230kV line with sectionalizing breakers. The substation will be located approximately ten miles south of the Parachute Substation (approximately 1/3 the distance between the Parachute and Cameo substations). The new substation will include a 100 MVA 230-69kV transformer and 230kV and 69kV circuit breakers. The Debeque-Cameo 69kV line will be re-routed to the Bluestone Valley Substation. This will require the construction of approximately 1.5 miles of 69kV line using 477 kcmil ACSR) (Hawk) conductor strung on 69kV towers (6.211B) and a rating=95.7 MVA.

Table 15. Sensitivity No. 1 - Add the Bluestone Valley Project – Branch Flows

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description							
70109	UNA_ORCH	69.0	70207	GRANDVLY	69.0	1	66.2	87.3	70309	PARACHUT	230	70358	RIFLE_PS	230	1
70205	GRANDJCT	230	79036	GRANDJCT	345	T1	273.0	97.4	70309	PARACHUT	230	70358	RIFLE_PS	230	1
70207	GRANDVLY	69.0	70302	OILSHALE	69.0	1	66.2	87.6	70309	PARACHUT	230	70358	RIFLE_PS	230	1
70214	GRANDJCT	69.0	79034	GRANDJCT	115	T1	42.0	108.0	70309	PARACHUT	230	70358	RIFLE_PS	230	1
70302	OILSHALE	69.0	70359	RIFLE_CU	69.0	1	66.2	87.8	70309	PARACHUT	230	70358	RIFLE_PS	230	1
70309	PARACHUT	230	70358	RIFLE_PS	230	1	430.0	100.3	79036	GRANDJCT	345	79058	RIFLE_CU	345	1
79013	CRAIG	230	79059	RIFLE_WA	230	1	645.0	97.1	79014	CRAIG	345	79266	MEEKER	345	1
79014	CRAIG	345	79266	MEEKER	345	1	896.0	98.2	79013	CRAIG	230	79059	RIFLE_WA	230	1
79034	GRANDJCT	115	79035	GRANDJCT	138	T2	55.0	120.0	79036	GRANDJCT	345	79058	RIFLE_CU	345	1
79036	GRANDJCT	345	79058	RIFLE_CU	345	1	621.0	106.1	70309	PARACHUT	230	70358	RIFLE_PS	230	1
79046	MEEKER	138	79056	RIFLE_CU	138	1	125.0	107.1	79014	CRAIG	345	79266	MEEKER	345	1
79057	RIFLE_CU	230	79058	RIFLE_CU	345	T4	478.0	95.8	79014	CRAIG	345	79266	MEEKER	345	1
79058	RIFLE_CU	345	79266	MEEKER	345	1	598.0	124.4	79013	CRAIG	230	79059	RIFLE_WA	230	1

The Bluestone Valley Project will increase branch flows on the Rifle(Ute)-Una-Debeque-Bluestone Valley 69kV line; however, contingency flows are less than the 66.2 MVA rating. The Grand Junction(Ute) 115-69kV transformer contingency overload (108.0 %) and the Rifle(Ute)-Parachute 230kV line contingency overload (100.3%) for an outage of the RiflePS-Parachute 230kV line will be mitigated after the addition of the Rifle(Ute)-Parachute 230kV line. The Grand Junction(Ute) 138-115kV transformer contingency overload (120.0%) will be mitigated when this transformer is replaced in 2016.

Table 16. Sensitivity No. 1 - Add the Bluestone Valley Project – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description			
70268	ADOBE	230.0	0.9729	1.0291	70113 CLIFTON	230	70205 GRANDJCT	230 1
70357	BENCH	230.0	0.9436	1.0018	79014 CRAIG	345	79266 MEEKER	345 1
70115	BLUESTON	230.0	0.9559	1.0123	79014 CRAIG	345	79266 MEEKER	345 1
70116	BLUESTON	69.0	0.9157	1.0040	70115 BLUESTON	230	70116 BLUESTON	69.0 1
70488	BOOKCFGV	69.0	0.9430	0.9928	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70078	CAMEO	230.0	0.9643	1.0272	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70076	CAMEO	69.0	0.9703	1.0272	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70082	CAMP	69.0	0.9302	0.9953	79014 CRAIG	345	79266 MEEKER	345 1
70113	CLIFTON	230.0	0.9675	1.0255	70113 CLIFTON	230	70205 GRANDJCT	230 1
70140	DEBEQUE	69.0	0.9154	1.0017	70116 BLUESTON	69.0	70140 DEBEQUE	69.0 1
70183	FRUITA	69.0	0.9608	1.0171	70113 CLIFTON	230	70205 GRANDJCT	230 1
70492	FRUITAGV	69.0	0.9612	1.0194	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70205	GRANDJCT	230.0	0.9702	1.0257	70205 GRANDJCT	230	79036 GRANDJCT	345 T1
70206	GRANDJPS	230.0	0.9679	1.0253	70113 CLIFTON	230	70205 GRANDJCT	230 1
70207	GRANDVLY	69.0	0.9301	0.9951	79014 CRAIG	345	79266 MEEKER	345 1
70233	HORIZON	230.0	0.9698	1.0267	70113 CLIFTON	230	70205 GRANDJCT	230 1
70462	LOMA GV	69.0	0.9609	1.0191	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70445	LOMATPGV	69.0	0.9629	1.0210	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
79266	MEEKER	345.0	0.9453	0.9992	79014 CRAIG	345	79266 MEEKER	345 1
79046	MEEKER	138.0	0.9576	1.0083	79014 CRAIG	345	79266 MEEKER	345 1
70302	OILSHALE	69.0	0.9345	0.9994	79014 CRAIG	345	79266 MEEKER	345 1
70309	PARACHUT	230.0	0.9485	1.0064	79014 CRAIG	345	79266 MEEKER	345 1
79059	RIFLE WA	230.0	0.9433	1.0012	79014 CRAIG	345	79266 MEEKER	345 1
79057	RIFLE_CU	230.0	0.9418	0.9990	79014 CRAIG	345	79266 MEEKER	345 1
79056	RIFLE_CU	138.0	0.9352	0.9997	79014 CRAIG	345	79266 MEEKER	345 1
70359	RIFLE_CU	69.0	0.9410	1.0049	79014 CRAIG	345	79266 MEEKER	345 1
70358	RIFLE_PS	230.0	0.9437	1.0016	79014 CRAIG	345	79266 MEEKER	345 1
70299	STKGULCH	230.0	0.9471	1.0051	79014 CRAIG	345	79266 MEEKER	345 1
70438	UINTAH	230.0	0.9745	1.0317	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70436	UINTAH	69.0	0.9643	1.0222	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70109	UNA_ORCH	69.0	0.9175	0.9922	70116 BLUESTON	69.0	70140 DEBEQUE	69.0 1
70440	UNIONOIL	69.0	0.9303	0.9954	79014 CRAIG	345	79266 MEEKER	345 1
70454	VINELAND	69.0	0.9661	1.0203	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70356	WEELERPS	230.0	0.9470	1.0050	79014 CRAIG	345	79266 MEEKER	345 1

The Bluestone Valley Project does not negatively impact transmission bus voltages and no contingency violations were observed.

Table 17. Sensitivity No. 1 - Add the Bluestone Valley Project with Maintenance Outage No. 1 (Open LomaGVTap-Uintah 69kV, Close FruitaGV-BookcliffGV 69kV) – Branch Flows

**	From bus	** **	To bus	** CKT	Rating	Loading%	Contingency Description			
70109	UNA_ORCH	69.0	70207 GRANDVLY	69.0 1	66.2	87.0	70309 PARACHUT	230	70358 RIFLE_PS	230 1
70205	GRANDJCT	230	79036 GRANDJCT	345 T1	273.0	96.5	70309 PARACHUT	230	70358 RIFLE_PS	230 1
70207	GRANDVLY	69.0	70302 OILSHALE	69.0 1	66.2	87.3	70309 PARACHUT	230	70358 RIFLE_PS	230 1
70214	GRANDJCT	69.0	79034 GRANDJCT	115 T1	42.0	114.9	70309 PARACHUT	230	70358 RIFLE_PS	230 1
70214	GRANDJCT	69.0	79034 GRANDJCT	115 T1	42.0	95.7	70076 CAMEO	69.0	70078 CAMEO	230 T5
70302	OILSHALE	69.0	70359 RIFLE_CU	69.0 1	66.2	87.4	70309 PARACHUT	230	70358 RIFLE_PS	230 1
70309	PARACHUT	230	70358 RIFLE_PS	230 1	430.0	100.2	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
79013	CRAIG	230	79059 RIFLE_WA	230 1	645.0	97.1	79014 CRAIG	345	79266 MEEKER	345 1
79014	CRAIG	345	79266 MEEKER	345 1	896.0	98.2	79013 CRAIG	230	79059 RIFLE_WA	230 1
79034	GRANDJCT	115	79035 GRANDJCT	138 T2	55.0	121.5	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
79034	GRANDJCT	115	79035 GRANDJCT	138 T2	55.0	117.0	79036 GRANDJCT	345	79049 MONTROSE	345 1
79034	GRANDJCT	115	79035 GRANDJCT	138 T2	55.0	96.5	70309 PARACHUT	230	70358 RIFLE_PS	230 1
79036	GRANDJCT	345	79058 RIFLE_CU	345 1	621.0	105.9	70309 PARACHUT	230	70358 RIFLE_PS	230 1
79036	GRANDJCT	345	79058 RIFLE_CU	345 1	621.0	95.1	70078 CAMEO	230	70115 BLUESTON	230 1
79046	MEEKER	138	79056 RIFLE_CU	138 1	125.0	107.2	79014 CRAIG	345	79266 MEEKER	345 1
79046	MEEKER	138	79056 RIFLE_CU	138 1	125.0	96.0	79058 RIFLE_CU	345	79266 MEEKER	345 1
79057	RIFLE_CU	230	79058 RIFLE_CU	345 T4	478.0	95.6	79014 CRAIG	345	79266 MEEKER	345 1
79058	RIFLE_CU	345	79266 MEEKER	345 1	598.0	124.3	79013 CRAIG	230	79059 RIFLE_WA	230 1

Maintenance Outage No. 1 (Uintah-LomaGVTap 69kV branch open and the FruitaGV-HighlineGV 69kV line closed) slightly decreases the contingency flow on the Rifle(Ute)-Una-Debeque-Bluestone Valley 69kV line. It increases the contingency flow (114.9%) on the Grand Junction(Ute) 115-69kV transformer (for an outage of the RiflePS-Parachute 230kV line because it shifts load to Grand Junction. The Grand Junction(Ute) 115-69kV transformer contingency overload 114.9%) and the Rifle(Ute)-Parachute 230kV line contingency overload (100.2%) for an outage of the RiflePS-Parachute 230kV line will be mitigated after the addition of the Rifle(Ute)-Parachute 230kV line. The Grand Junction(Ute) 138-115kV transformer contingency overload (121.5%) will be mitigated when this transformer is replaced in 2016.

Table 18. Sensitivity No. 1 - Add the Bluestone Valley Project with Maintenance Outage No. 1 (Open LomaGVTap-Uintah 69kV, Close FruitaGV-BookcliffGV 69kV) – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70268	ADOBE	230.0	0.9762	1.0297	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70268	ADOBE	230.0	1.0813	1.0297	70233 HORIZON	230	70268 ADOBE	230	1
70357	BENCH	230.0	0.9436	1.0018	79014 CRAIG	345	79266 MEEKER	345	1
70115	BLUESTON	230.0	0.9560	1.0123	79014 CRAIG	345	79266 MEEKER	345	1
70115	BLUESTON	230.0	1.0648	1.0123	70115 BLUESTON	230	70309 PARACHUT	230	1
70116	BLUESTON	69.0	0.9153	1.0040	70115 BLUESTON	230	70116 BLUESTON	69.0	1
70488	BOOKCFGV	69.0	0.9270	0.9778	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70078	CAMEO	230.0	0.9650	1.0273	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70078	CAMEO	230.0	1.0956	1.0273	70078 CAMEO	230	70115 BLUESTON	230	1
70076	CAMEO	69.0	0.9670	1.0255	70076 CAMEO	69.0	70078 CAMEO	230	T5
70113	CLIFTON	230.0	0.9725	1.0258	70113 CLIFTON	230	70205 GRANDJCT	230	1
79047	COLBRAN	138.0	0.9444	0.9950	79014 CRAIG	345	79266 MEEKER	345	1
70140	DEBEQUE	69.0	0.9150	1.0017	70116 BLUESTON	69.0	70140 DEBEQUE	69.0	1
70155	DILLON	115.0	1.0556	1.0048	70155 DILLON	115	70156 DILLON	230	T1
70183	FRUITA	69.0	0.9632	1.0205	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70183	FRUITA	69.0	1.0747	1.0205	70268 ADOBE	230	70438 UINTAH	230	1
70492	FRUITAGV	69.0	0.9185	0.9699	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70206	GRANDJPS	230.0	0.9729	1.0258	70113 CLIFTON	230	70205 GRANDJCT	230	1
70207	GRANDVLY	69.0	0.9300	0.9950	79014 CRAIG	345	79266 MEEKER	345	1
70489	HIGHLNGV	69.0	0.9345	0.9849	70214 GRANDJCT	69.0	79034 GRANDJCT	115	T1
70233	HORIZON	230.0	0.9747	1.0272	70113 CLIFTON	230	70205 GRANDJCT	230	1
70462	LOMA GV	69.0	0.9142	0.9659	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70445	LOMATPGV	69.0	0.9164	0.9679	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
79266	MEEKER	345.0	0.9453	0.9993	79014 CRAIG	345	79266 MEEKER	345	1
79046	MEEKER	138.0	0.9574	1.0081	79014 CRAIG	345	79266 MEEKER	345	1
70302	OILSHALE	69.0	0.9343	0.9992	79014 CRAIG	345	79266 MEEKER	345	1
70309	PARACHUT	230.0	0.9486	1.0065	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE WA	230.0	0.9433	1.0012	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9418	0.9990	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9349	0.9994	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9406	1.0047	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9436	1.0015	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9472	1.0051	79014 CRAIG	345	79266 MEEKER	345	1
70438	UINTAH	230.0	0.9758	1.0324	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70438	UINTAH	230.0	1.0860	1.0324	70268 ADOBE	230	70438 UINTAH	230	1
70436	UINTAH	69.0	0.9687	1.0257	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70109	UNA_ORCH	69.0	0.9171	0.9922	70116 BLUESTON	69.0	70140 DEBEQUE	69.0	1
70454	VINELAND	69.0	0.9634	1.0175	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70356	WEELERPS	230.0	0.9470	1.0050	79014 CRAIG	345	79266 MEEKER	345	1

The addition of the Bluestone Valley Project with Maintenance No. 1 (Uintah-LomaGV Tap 69kV branch open, FruitaGV-BookcliffGV 69kV branch closed) leaves the GVP loads served radially from Grand Junction improves the contingency voltages of the GVP buses; however, it also creates contingency high bus voltages at Adobe 230kV (1.081 p.u.), Bluestone 230kV (1.065 p.u.), Cameo 230kV (1.096 p.u.), Fruita 69kV (1.075 p.u.) and Uintah 230kV (1.086 p.u.) are all in excess of new 1.05 p.u. PSCO maximum contingency bus voltage limit criteria. This needs to be studied in more detail by PSCO.

B. Sensitivity No. 2 – PSCO Grand Junction 138-115 Transformer Replacement

The Grand Junction 50 MVA 138-115kV transformer will be replaced with a 100 MVA 138-115kV transformer.

Table 19. Sensitivity No. 2 - Replace the Grand Junction 138-115kV Transformer – Branch Flows

** From bus	** ** To bus	** CKT	Rating	Loading%	Contingency Description
70205 GRANDJCT 230	79036 GRANDJCT	345 T1	273.00	102.10	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70214 GRANDJCT 69.0	79034 GRANDJCT	115 T1	42.00	109.80	70309 PARACHUT 230 70358 RIFLE_PS 230 1
70309 PARACHUT 230	70358 RIFLE_PS	230 1	430.00	98.60	79036 GRANDJCT 345 79058 RIFLE_CU 345 1
79013 CRAIG 230	79059 RIFLE WA	230 1	645.00	97.10	79014 CRAIG 345 79266 MEEKER 345 1
79014 CRAIG 345	79266 MEEKER	345 1	896.00	98.10	79013 CRAIG 230 79059 RIFLE WA 230 1
79036 GRANDJCT 345	79058 RIFLE_CU	345 1	621.00	107.10	70309 PARACHUT 230 70358 RIFLE_PS 230 1
79046 MEEKER 138	79056 RIFLE_CU	138 1	125.00	108.40	79014 CRAIG 345 79266 MEEKER 345 1
79057 RIFLE_CU 230	79058 RIFLE_CU	345 T4	478.00	95.10	79014 CRAIG 345 79266 MEEKER 345 1
79058 RIFLE_CU 345	79266 MEEKER	345 1	598.00	124.30	79013 CRAIG 230 79059 RIFLE WA 230 1

The replacement of the Grand Junction 50 MVA 138-115kV transformer with a 100 MVA transformer removes the contingency overload of the Grand Junction(Ute) 138-115kV 55 MVA transformer. The contingency flow of the Grand Junction 115-69kV transformer increases to 109.8% of its 42.0 MVA rating for an outage of the RiflePS-Parachute 230kV line.

Table 20. Sensitivity No. 2 - Replace the Grand Junction 138-115kV Transformer – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70268	ADOBE	230.0	0.9679	1.0271	70113 CLIFTON	230	70205 GRANDJCT	230	1
70357	BENCH	230.0	0.9445	1.0021	79014 CRAIG	345	79266 MEEKER	345	1
70488	BOOKCFGV	69.0	0.9347	0.9925	70076 CAMEO	69.0	70078 CAMEO	230	T5
70078	CAMEO	230.0	0.9617	1.0241	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70076	CAMEO	69.0	0.9411	1.0263	70076 CAMEO	69.0	70078 CAMEO	230	T5
70113	CLIFTON	230.0	0.9624	1.0241	70113 CLIFTON	230	70205 GRANDJCT	230	1
70140	DEBEQUE	69.0	0.9156	0.9961	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70183	FRUITA	69.0	0.9619	1.0214	70113 CLIFTON	230	70205 GRANDJCT	230	1
70492	FRUITAGV	69.0	0.9644	1.0238	70113 CLIFTON	230	70205 GRANDJCT	230	1
70233	HORIZON	230.0	0.9647	1.0249	70113 CLIFTON	230	70205 GRANDJCT	230	1
70462	LOMA_GV	69.0	0.9640	1.0235	70113 CLIFTON	230	70205 GRANDJCT	230	1
70445	LOMATPGV	69.0	0.9661	1.0253	70113 CLIFTON	230	70205 GRANDJCT	230	1
79266	MEEKER	345.0	0.9454	0.9992	79014 CRAIG	345	79266 MEEKER	345	1
79046	MEEKER	138.0	0.9574	1.0082	79014 CRAIG	345	79266 MEEKER	345	1
70302	OILSHALE	69.0	0.9325	0.9974	79014 CRAIG	345	79266 MEEKER	345	1
70433	ORCHMEGV	69.0	0.9517	1.0047	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70309	PARACHUT	230.0	0.9495	1.0068	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE_WA	230.0	0.9437	1.0013	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9421	0.9991	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9360	1.0003	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9417	1.0060	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9440	1.0017	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9480	1.0054	79014 CRAIG	345	79266 MEEKER	345	1
70438	UINTAH	230.0	0.9714	1.0296	70113 CLIFTON	230	70205 GRANDJCT	230	1
70436	UINTAH	69.0	0.9674	1.0266	70113 CLIFTON	230	70205 GRANDJCT	230	1
70109	UNA_ORCH	69.0	0.9177	0.9874	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70440	UNIONOIL	69.0	0.9266	0.9915	79014 CRAIG	345	79266 MEEKER	345	1
70454	VINELAND	69.0	0.9440	1.0196	70076 CAMEO	69.0	70078 CAMEO	230	T5
70356	WEELERPS	230.0	0.9479	1.0053	79014 CRAIG	345	79266 MEEKER	345	1

The replacement of the Grand Junction 50 MVA 138-115kV transformer with a 100 MVA transformer results in contingency bus voltages within criteria. The slight voltage criteria violations that were observed in the study case prior to the addition of the Grand Junction 138-115kV Replacement Project are mitigated because the Grand Junction(Ute) 138-115kV transformer replacement adjusts branch flows in the area.

Table 21. Sensitivity No. 2 - Replace the Grand Junction 138-115kV Transformer with Maintenance Outage No. 1 (LomaGVTap-Uintah 69kV open, FruitaGV-BookcliffGV 69kV closed) – Branch Flows

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description							
70205	GRANDJCT	230	79036	GRANDJCT	345 T1	273.0	101.0	70309	PARACHUT	230	70358	RIFLE_PS	230	1	
70214	GRANDJCT	69.0	79034	GRANDJCT	115 T1	42.0	116.6	70309	PARACHUT	230	70358	RIFLE_PS	230	1	
70309	PARACHUT	230	70358	RIFLE_PS	230	1	430.0	98.4	79036	GRANDJCT	345	79058	RIFLE_CU	345	1
79013	CRAIG	230	79059	RIFLE_WA	230	1	645.0	97.1	79014	CRAIG	345	79266	MEEKER	345	1
79014	CRAIG	345	79266	MEEKER	345	1	896.0	98.1	79013	CRAIG	230	79059	RIFLE_WA	230	1
79036	GRANDJCT	345	79058	RIFLE_CU	345	1	621.0	106.8	70309	PARACHUT	230	70358	RIFLE_PS	230	1
79046	MEEKER	138	79056	RIFLE_CU	138	1	125.0	108.6	79014	CRAIG	345	79266	MEEKER	345	1
79058	RIFLE_CU	345	79266	MEEKER	345	1	598.0	124.3	79013	CRAIG	230	79059	RIFLE_WA	230	1

Maintenance Outage No. 1 (Uintah-LomaGVTap 69kV branch open and FruitaGV-HighlineGV 69kV branch closed) increases the contingency flow (116.6%) on the Grand Junction(Ute) 42.0 MVA 115-69kV transformer because it shifts GVP load to Grand Junction Substation.

Table 22. Sensitivity No. 2 - Replace the Grand Junction 138-115kV Transformer with Maintenance Outage No. 1 (LomaGVTap-Uintah 69kV open, FruitaGV-BookcliffGV 69kV closed) – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70268	ADOBE	230.0	0.9730	1.0278	70113 CLIFTON	230	70205 GRANDJCT	230	1
70357	BENCH	230.0	0.9446	1.0022	79014 CRAIG	345	79266 MEEKER	345	1
70488	BOOKCFGV	69.0	0.9138	0.9776	70076 CAMEO	69.0	70078 CAMEO	230	T5
70078	CAMEO	230.0	0.9626	1.0243	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70076	CAMEO	69.0	0.9322	1.0246	70076 CAMEO	69.0	70078 CAMEO	230	T5
70113	CLIFTON	230.0	0.9676	1.0246	70113 CLIFTON	230	70205 GRANDJCT	230	1
70140	DEBEQUE	69.0	0.9152	0.9947	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70183	FRUITA	69.0	0.9609	1.0184	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70492	FRUITAGV	69.0	0.9052	0.9696	70076 CAMEO	69.0	70078 CAMEO	230	T5
70205	GRANDJCT	230.0	0.9703	1.0249	70205 GRANDJCT	230	79036 GRANDJCT	345	T1
70214	GRANDJCT	69.0	0.9461	1.0074	70076 CAMEO	69.0	70078 CAMEO	230	T5
70206	GRANDJPS	230.0	0.9680	1.0242	70113 CLIFTON	230	70205 GRANDJCT	230	1
70207	GRANDVLY	69.0	0.9250	0.9901	79014 CRAIG	345	79266 MEEKER	345	1
70489	HIGHLNGV	69.0	0.9214	0.9846	70076 CAMEO	69.0	70078 CAMEO	230	T5
70233	HORIZON	230.0	0.9699	1.0255	70113 CLIFTON	230	70205 GRANDJCT	230	1
70462	LOMA GV	69.0	0.9008	0.9656	70076 CAMEO	69.0	70078 CAMEO	230	T5
70445	LOMATPGV	69.0	0.9030	0.9676	70076 CAMEO	69.0	70078 CAMEO	230	T5
70445	LOMATPGV	69.0	0.9121	0.9676	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
79266	MEEKER	345.0	0.9455	0.9993	79014 CRAIG	345	79266 MEEKER	345	1
70433	ORCHMEGV	69.0	0.9379	0.9998	70076 CAMEO	69.0	70078 CAMEO	230	T5
70309	PARACHUT	230.0	0.9496	1.0069	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE WA	230.0	0.9437	1.0013	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9421	0.9991	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9355	0.9999	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9412	1.0056	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9440	1.0017	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9482	1.0055	79014 CRAIG	345	79266 MEEKER	345	1
70438	UINTAH	230.0	0.9736	1.0304	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70436	UINTAH	69.0	0.9664	1.0236	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70109	UNA_ORCH	69.0	0.9173	0.9861	70076 CAMEO	69.0	70140 DEBEQUE	69.0	1
70454	VINELAND	69.0	0.9348	1.0168	70076 CAMEO	69.0	70078 CAMEO	230	T5
70356	WEELERPS	230.0	0.9480	1.0054	79014 CRAIG	345	79266 MEEKER	345	1

Maintenance Outage No. 1 (Uintah-LomaGVTap 69kV branch open and FruitaGV-HighlineGV 69kV branch closed) does not result in bus voltage criteria violations.

C. Sensitivity No. 3 – PSCO Rifle(Ute)-Parachute Line with Sensitivities 1 and 2

Table 23. Sensitivity No. 3 – Add the PSCO Rifle(Ute)-Parachute 230kV line to Sensitivity No. 1 (Bluestone Valley Project and Sensitivity No. 2 (Grand Junction 138-115kV Transformer Replacement Project) – Branch Flows

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description							
70078	CAMEO	230	70438	UINTAH	230	1	318.7	97.9	79036	GRANDJCT	345	79058	RIFLE_CU	345	1
79013	CRAIG	230	79059	RIFLE WA	230	1	645.0	96.9	79014	CRAIG	345	79266	MEEKER	345	1
79014	CRAIG	345	79266	MEEKER	345	1	896.0	98.2	79013	CRAIG	230	79059	RIFLE WA	230	1
79046	MEEKER	138	79056	RIFLE_CU	138	1	125.0	107.9	79014	CRAIG	345	79266	MEEKER	345	1
79057	RIFLE_CU	230	79059	RIFLE WA	230	1	478.0	108.9	79014	CRAIG	345	79266	MEEKER	345	1
79058	RIFLE_CU	345	79266	MEEKER	345	1	598.0	124.5	79013	CRAIG	230	79059	RIFLE WA	230	1

The PSCO Rifle(Ute)-Parachute 230kV line addition with the Bluestone Valley Project and Sensitivity No. 2 (Grand Junction 138-115kV Transformer Replacement) mitigates the Rifle(PS)-Parachute 230kV contingency overload and improves the reliability of the overall system because it eliminates the impact of the outage of the Rifle(PS)-Parachute 230kV outage (the critical outage for the load-serving area). The Rifle(Ute)-Rifle(WA) 230kV contingency overload is due to the addition of the Rifle(Ute)-Parachute 230kV line. This contingency overload has been observed by PSCO in other studies and is being mitigated by PSCO.

Table 24. Sensitivity No. 3 – Add the PSCO Rifle(Ute)-Parachute 230kV line addition to Sensitivity No. 1 (Bluestone Valley Project and Sensitivity No. 2 (Grand Junction 138-115kV Transformer Replacement Project) – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description			
70357	BENCH	230.0	0.9476	1.0032	79014 CRAIG	345	79266 MEEKER	345 1
70115	BLUESTON	230.0	0.9597	1.0135	79014 CRAIG	345	79266 MEEKER	345 1
70115	BLUESTON	230.0	1.0668	1.0135	70115 BLUESTON	230	70309 PARACHUT	230 1
70116	BLUESTON	69.0	0.9200	1.0082	70115 BLUESTON	230	70116 BLUESTON	69.0 1
70078	CAMEO	230.0	0.9763	1.0279	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70078	CAMEO	230.0	1.0967	1.0279	70078 CAMEO	230	70115 BLUESTON	230 1
70140	DEBEQUE	69.0	0.9197	1.0061	70116 BLUESTON	69.0	70140 DEBEQUE	69.0 1
70183	FRUITA	69.0	0.9651	1.0183	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70492	FRUITAGV	69.0	0.9676	1.0206	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70207	GRANDVLY	69.0	0.9365	0.9990	79014 CRAIG	345	79266 MEEKER	345 1
70462	LOMA_GV	69.0	0.9672	1.0203	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70445	LOMATPGV	69.0	0.9693	1.0222	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70309	PARACHUT	230.0	0.9525	1.0079	79014 CRAIG	345	79266 MEEKER	345 1
79059	RIFLE_WA	230.0	0.9488	1.0045	79014 CRAIG	345	79266 MEEKER	345 1
79057	RIFLE_CU	230.0	0.9481	1.0029	79014 CRAIG	345	79266 MEEKER	345 1
79056	RIFLE_CU	138.0	0.9408	1.0027	79014 CRAIG	345	79266 MEEKER	345 1
70359	RIFLE_CU	69.0	0.9454	1.0066	79014 CRAIG	345	79266 MEEKER	345 1
70358	RIFLE_PS	230.0	0.9491	1.0048	79014 CRAIG	345	79266 MEEKER	345 1
70299	STKGULCH	230.0	0.9511	1.0065	79014 CRAIG	345	79266 MEEKER	345 1
70438	UINTAH	230.0	0.9807	1.0330	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70436	UINTAH	69.0	0.9706	1.0235	79036 GRANDJCT	345	79058 RIFLE_CU	345 1
70109	UNA_ORCH	69.0	0.9216	0.9964	70116 BLUESTON	69.0	70140 DEBEQUE	69.0 1

Contingency criteria violations at PSCO busses in the study area (bus voltages in excess of 1.05 p.u.) were observed at the Bluestone 230kV bus (1.067 p.u.) for an outage of the Parachute-Bluestone 230kV line and the Cameo 230kV bus (1.097 p.u.) for an outage of the Bluestone-Cameo 230kV line) as listed in the table above. PSCO will study these voltage criteria violations in more detail.

Table 25. Sensitivity No. 3 – Add the PSCO Rifle(Ute)-Parachute 230kV line addition to Sensitivity No. 1 (Bluestone Valley Project and Sensitivity No. 2 (Grand Junction 138-115kV Transformer Replacement Project) with Maintenance Outage No. 1 (LomaGVTap-Uintah 69kV open, FruitaGV-BookcliffGV 69kV closed) – Branch Flows

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description								
70078	CAMEO	230	70438	UINTAH	230	1	318.7	96.6	79036	GRANDJCT	345	79058	RIFLE_CU	345	1	
70214	GRANDJCT	69.0	79034	GRANDJCT	115	T1	42.0	95.7	70076	CAMEO	69.0	70078	CAMEO	230	T5	
79013	CRAIG	230	79059	RIFLE	WA	230	1	645.0	96.9	79014	CRAIG	345	79266	MEEKER	345	1
79014	CRAIG	345	79266	MEEKER	345	1	896.0	98.2	79013	CRAIG	230	79059	RIFLE	WA	230	1
79057	RIFLE_CU	230	79059	RIFLE	WA	230	1	478.0	108.9	79014	CRAIG	345	79266	MEEKER	345	1
79058	RIFLE_CU	345	79266	MEEKER	345	1	598.0	124.5	79013	CRAIG	230	79059	RIFLE	WA	230	1

Maintenance Outage No. 1 (LomaGVTap-Uintah 69kV branch open and FruitaGV-BookcliffGV 69kV branch closed) does not result in contingency branch flow violations. The Rifle(Ute)-RifleWA 230kV contingency overload of 108.9% has been observed in other studies conducted by PSCO that could occur after the Rifle(Ute)-Parachute 230kV line is added in 2016. PSCO is working to mitigate this contingency overload.

Table 26. Sensitivity No. 3 – Add the PSCO Rifle(Ute)-Parachute 230kV line addition to Sensitivity No. 1 (Bluestone Valley Project and Sensitivity No. 2 (Grand Junction 138-115kV Transformer Replacement Project) with Maintenance Outage No. 1 (LomaGVTap-Uintah 69kV open, FruitaGV-BookcliffGV 69kV closed) – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description				
70357	BENCH	230.0	0.9477	1.0033	79014 CRAIG	345	79266 MEEKER	345	1
70115	BLUESTON	230.0	0.9599	1.0136	79014 CRAIG	345	79266 MEEKER	345	1
70115	BLUESTON	230.0	1.0674	1.0136	70115 BLUESTON	230	70309 PARACHUT	230	1
70116	BLUESTON	69.0	0.9196	1.0083	70115 BLUESTON	230	70116 BLUESTON	69.0	1
70488	BOOKCFGV	69.0	0.9295	0.9788	70214 GRANDJCT	69.0	79034 GRANDJCT	115	T1
70078	CAMEO	230.0	1.0973	1.0281	70078 CAMEO	230	70115 BLUESTON	230	1
70076	CAMEO	69.0	0.9707	1.0268	70076 CAMEO	69.0	70078 CAMEO	230	T5
70140	DEBEQUE	69.0	0.9193	1.0062	70116 BLUESTON	69.0	70140 DEBEQUE	69.0	1
70183	FRUITA	69.0	0.9696	1.0218	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70492	FRUITAGV	69.0	0.9211	0.9709	70214 GRANDJCT	69.0	79034 GRANDJCT	115	T1
70207	GRANDVLY	69.0	0.9365	0.9989	79014 CRAIG	345	79266 MEEKER	345	1
70462	LOMA GV	69.0	0.9169	0.9669	70214 GRANDJCT	69.0	79034 GRANDJCT	115	T1
70445	LOMATPGV	69.0	0.9190	0.9689	70214 GRANDJCT	69.0	79034 GRANDJCT	115	T1
70302	OILSHALE	69.0	0.9402	1.0023	79014 CRAIG	345	79266 MEEKER	345	1
70309	PARACHUT	230.0	0.9526	1.0079	79014 CRAIG	345	79266 MEEKER	345	1
79059	RIFLE WA	230.0	0.9489	1.0045	79014 CRAIG	345	79266 MEEKER	345	1
79057	RIFLE_CU	230.0	0.9481	1.0029	79014 CRAIG	345	79266 MEEKER	345	1
79056	RIFLE_CU	138.0	0.9405	1.0024	79014 CRAIG	345	79266 MEEKER	345	1
70359	RIFLE_CU	69.0	0.9451	1.0063	79014 CRAIG	345	79266 MEEKER	345	1
70358	RIFLE_PS	230.0	0.9492	1.0048	79014 CRAIG	345	79266 MEEKER	345	1
70299	STKGULCH	230.0	0.9512	1.0066	79014 CRAIG	345	79266 MEEKER	345	1
70436	UINTAH	69.0	0.9750	1.0270	79036 GRANDJCT	345	79058 RIFLE_CU	345	1
70109	UNA_ORCH	69.0	0.9213	0.9964	70116 BLUESTON	69.0	70140 DEBEQUE	69.0	1
70356	WEELERPS	230.0	0.9511	1.0065	79014 CRAIG	345	79266 MEEKER	345	1

Contingency criteria violations at PSCO busses in the study area (bus voltages in excess of 1.05 p.u.) were observed at the Bluestone 230kV bus (1.067 p.u.) for an outage of the Parachute-Bluestone 230kV line and the Cameo 230kV bus (1.097 p.u.) for an outage of the Bluestone-Cameo 230kV line). PSCO will study these voltage criteria violations in more detail.

D. Sensitivity No. 4 – Sensitivity No. 3 with GVP Future Load Additions

The GVP Debeque demand could increase an additional 10 MW (0.98 power factor assumed) in the far term (outside the near term scope of this study). A load increase of 10 MW was added to the Debeque 69kV bus to represent potential future load development in the Debeque area by Grand Valley Power. Also included is a second 7.5 MVAR capacitor bank at Una. GVP could also add an additional 80 MW of load at a new substation called Clear Creek Substation that would connect to the Bluestone Valley Substation by way of an 21-mile 230kV double-circuit 230kV transmission line strung with 1272 kcmil conductor along with a 45 MVAR capacitor addition at Bluestone Valley Substation. The demand increases at Debeque 69kV (10 MW) and Clear Creek 230kV (80 MW) were served with generation in eastern Colorado.

Table 27. Sensitivity No. 4 – Add a Proposed GVP 10 MW Load Addition at Debeque and an 80 MW Load Addition at Clear Creek with the Future PSCO Transmission Projects – Branch Flows

**	From bus	** **	To bus	**	CKT	Rating	Loading%	Contingency Description							
70109	UNA_ORCH	69.0	70207	GRANDVLY	69.0	1	66.2	84.9	70115	BLUESTON	230	70309	PARACHUT	230	1
70115	BLUESTON	230	70309	PARACHUT	230	1	430.0	97.2	79036	GRANDJCT	345	79058	RIFLE_CU	345	1
70207	GRANDVLY	69.0	70302	OILSHALE	69.0	1	66.2	85.3	70115	BLUESTON	230	70309	PARACHUT	230	1
70214	GRANDJCT	69.0	79034	GRANDJCT	115	T1	42.0	106.3	70115	BLUESTON	230	70309	PARACHUT	230	1
70302	OILSHALE	69.0	70359	RIFLE_CU	69.0	1	66.2	85.6	70115	BLUESTON	230	70309	PARACHUT	230	1
79013	CRAIG	230	79059	RIFLE_WA	230	1	645.0	102.3	79014	CRAIG	345	79266	MEEKER	345	1
79014	CRAIG	345	79266	MEEKER	345	1	896.0	103.3	79013	CRAIG	230	79059	RIFLE_WA	230	1
79036	GRANDJCT	345	79058	RIFLE_CU	345	1	621.0	101.7	70115	BLUESTON	230	70309	PARACHUT	230	1
79057	RIFLE_CU	230	79059	RIFLE_WA	230	1	478.0	116.8	79014	CRAIG	345	79266	MEEKER	345	1
79058	RIFLE_CU	345	79266	MEEKER	345	1	598.0	131.9	79013	CRAIG	230	79059	RIFLE_WA	230	1

The Rifle(Ute)-Rifle(WA) 230kV contingency overload (116.8%) is due to the addition of the Rifle(Ute)-Parachute 230kV line. This contingency overload is being mitigated by PSCO.

Table 28. Sensitivity No. 4 – Add a Proposed GVP 10 MW Load Addition at Debeque and an 80 MW Load Addition at Clear Creek with the Future PSCO Transmission Projects – Bus Voltages

Bus #	Bus Name	KV	ContVolt	BaseVolt	Contingency Description						
70268	ADOBE	230.0	1.0605	1.0017	70115	BLUESTON	230	70309	PARACHUT	230	1
70357	BENCH	230.0	0.9410	0.9956	79014	CRAIG	345	79266	MEEKER	345	1
70115	BLUESTON	230.0	1.0901	1.0057	70115	BLUESTON	230	70309	PARACHUT	230	1
70116	BLUESTON	69.0	0.8962	1.0134	70115	BLUESTON	230	70116	BLUESTON	69.0	1
70488	BOOKCFGV	69.0	0.9309	0.9801	70214	GRANDJCT	69.0	79034	GRANDJCT	115	T1
70078	CAMEO	230.0	1.0893	1.0120	70115	BLUESTON	230	70309	PARACHUT	230	1
70125	CLEARCRK	230.0	0.9530	1.0032	79014	CRAIG	345	79266	MEEKER	345	1
70125	CLEARCRK	230.0	1.0879	1.0032	70115	BLUESTON	230	70309	PARACHUT	230	1
70140	DEBEQUE	69.0	0.8959	1.0111	70116	BLUESTON	69.0	70140	DEBEQUE	69.0	1
70140	DEBEQUE	69.0	0.8962	1.0111	70115	BLUESTON	230	70116	BLUESTON	69.0	1
70183	FRUITA	69.0	1.0675	1.0005	70115	BLUESTON	230	70309	PARACHUT	230	1
70492	FRUITAGV	69.0	1.0697	1.0028	70115	BLUESTON	230	70309	PARACHUT	230	1
70207	GRANDVLY	69.0	0.9240	1.0066	70116	BLUESTON	69.0	70140	DEBEQUE	69.0	1
70207	GRANDVLY	69.0	0.9242	1.0066	70115	BLUESTON	230	70116	BLUESTON	69.0	1
70207	GRANDVLY	69.0	0.9426	1.0066	79014	CRAIG	345	79266	MEEKER	345	1
70233	HORIZON	230.0	1.0533	1.0010	70115	BLUESTON	230	70309	PARACHUT	230	1
70462	LOMA GV	69.0	1.0694	1.0025	70115	BLUESTON	230	70309	PARACHUT	230	1
70445	LOMATPGV	69.0	1.0712	1.0045	70115	BLUESTON	230	70309	PARACHUT	230	1
79266	MEEKER	345.0	0.9445	0.9959	79014	CRAIG	345	79266	MEEKER	345	1
79046	MEEKER	138.0	0.9515	1.0054	79014	CRAIG	345	79266	MEEKER	345	1
70302	OILSHALE	69.0	0.9429	1.0074	79014	CRAIG	345	79266	MEEKER	345	1
70302	OILSHALE	69.0	0.9533	1.0074	70116	BLUESTON	69.0	70140	DEBEQUE	69.0	1
70302	OILSHALE	69.0	0.9535	1.0074	70115	BLUESTON	230	70116	BLUESTON	69.0	1
70309	PARACHUT	230.0	0.9460	1.0003	79014	CRAIG	345	79266	MEEKER	345	1
79059	RIFLE WA	230.0	0.9405	0.9979	79014	CRAIG	345	79266	MEEKER	345	1
79057	RIFLE_CU	230.0	0.9402	0.9959	79014	CRAIG	345	79266	MEEKER	345	1
79056	RIFLE_CU	138.0	0.9318	0.9963	79014	CRAIG	345	79266	MEEKER	345	1
70359	RIFLE_CU	69.0	0.9450	1.0091	79014	CRAIG	345	79266	MEEKER	345	1
70358	RIFLE_PS	230.0	0.9408	0.9981	79014	CRAIG	345	79266	MEEKER	345	1
70299	STKGULCH	230.0	0.9445	0.9989	79014	CRAIG	345	79266	MEEKER	345	1
70438	UINTAH	230.0	1.0679	1.0027	70115	BLUESTON	230	70309	PARACHUT	230	1
70436	UINTAH	69.0	1.0724	1.0058	70115	BLUESTON	230	70309	PARACHUT	230	1
70109	UNA_ORCH	69.0	0.9053	1.0060	70116	BLUESTON	69.0	70140	DEBEQUE	69.0	1
70109	UNA_ORCH	69.0	0.9055	1.0060	70115	BLUESTON	230	70116	BLUESTON	69.0	1
70109	UNA_ORCH	69.0	0.9428	1.0060	79014	CRAIG	345	79266	MEEKER	345	1

The addition of 10 MW to the Debeque Substation results in a slight contingency bus voltage violation at the Debeque 69kV bus (0.896 p.u.) and the Bluestone 69kV bus (0.896 p.u.) for an outage of the Bluestone 230-69kV transformer. Contingency high bus voltages at Adobe 230kV (1.061 p.u.), Bluestone 230kV (1.090 p.u.), Cameo 230kV (1.083 p.u.), Clear Creek 230kV (1.088 p.u.), Horizon 230kV (1.053 p.u.) and Uintah 230kV (1.068 p.u.) for an outage of the Parachute-Bluestone 230kV line will be studied in more detail by PSCO. Contingency high bus voltages at some 69kV buses on the Uintah-LomaGVTap-FruitaGV-BookcliffGV-Highline-Grand Junction(Ute) 69kV load-serving system for an outage of the Parachute-Bluestone 230kV line will be studied in more detail by PSCO.