

Alternative 1 Contingency Analysis Summary

Load Level = 154 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 150/172 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV = 0.93 p.u.	San Luis 230-115 kV xfmr = 89%(100) 12 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.12 p.u. Ft Garland 69 kV Deviation = 0.14 p.u.	None
Alamosa Term 115-69 kV xfmr Outage	Ft Garland 69 kV Deviation = 0.05 p.u.	None
Alamosa Term-San Luis 115 kV Outage	Failed (Voltage Collapse)	Failed
Curecanti-Poncha 230 kV Line Outage	Creede 69 kV Deviation = 0.06 p.u. Highland 69 kV Deviation = 0.06 p.u. Ramon 69 kV Deviation = 0.06 p.u. South Fork 69 kV Deviation = 0.06 p.u. Wolf Creek 115 kV Deviation = 0.06 p.u.	Blue Mesa-Skito 115 kV = 114% (100) Gunnison-Skito 115 kV = 1011% (100)
Gunnison-Poncha 115 kV Line Outage	None	San Luis 230-115 kV xfmr = 102% (100) Blue Mesa-Curecanti 115 = 110% (72)
Midway-Poncha 230 kV Line Outage	None	San Luis 230-115 kV xfmr = 120% (100)
Poncha-San Luis 230 kV Line or San Luis 230-115 kV xfmr Outage	Failed (Voltage Collapse)	Failed
Poncha-Sargent 115 kV Line Outage	None	San Luis 230-115 kV xfmr = 110% (100)
Rio Grande Tap-Sargent 115 kV Outage	Alamosa Steam 69 kV Dev = 0.06 p.u. Alamosa Term 69 kV Dev = 0.06 p.u. Antonito 69 kV Deviation = 0.06 p.u. Del Norte 69 kV Deviation = 0.11 p.u. Ft Garland 69 kV Deviation = 0.06 p.u. Home Lake 69 kV Deviation = 0.09 p.u. Rio Grande 69 kV Deviation = 0.11 p.u. Romeo 69 kV Deviation = 0.06 p.u.	Alamosa Term 115-69 xfmr = 135% (25) Mosca-San Luis 69 kV Line = 107% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 117% (29) Sargent 115-69 kV xfmr = 101% (63)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 144% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed

Alternative 2 Contingency Analysis
Lake City-Ramon 115 kV Line Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 2, which adds a Lake City-Ramon 115 kV line to the high-voltage transmission system. The possibility of upgrading the existing Ramon-South Fork-Highland-Creede 69 kV line to complete the Lake City-Ramon 115 kV line exists, however, to assess the effectiveness of this option in improving the voltage stability of the San Luis Valley High Voltage Transmission System, a new line was simply added to the system representation. Alternative 2 was studied with no local San Luis Valley generation on-line. The following summary notes the results of these cases, which modeled constant MVA loads, at a power factor of 1.00. Power flow plots are in Appendix 2.

The results of these cases indicate that this alternative does not effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System, even though the power factor is 1.00. Since this alternative fails at an optimistic power factor of 1.00, it can be eliminated from further consideration.

Alternative 2 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 150/171 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV = 0.94 p.u.	12 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.12 p.u. Ft Garland 69 kV Deviation = 0.14 p.u.	None
Alamosa Term 115-69 kV xfmr Outage	Ft Garland 69 kV Deviation = 0.05 p.u.	None
Alamosa Term-San Luis 115 kV Outage	Failed (Voltage Collapse)	Failed
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 107% (100)
Gunnison-Poncha 115 kV Line Outage	None	None
Midway-Poncha 230 kV Line Outage	None	San Luis 230-115 kV xfmr = 109% (100)
Poncha-San Luis 230 kV Line or San Luis 230-115 kV xfmr Outage	Failed (Voltage Collapse)	Failed
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Alamosa Steam 69 kV Dev = 0.06 p.u. Alamosa Term 69 kV Dev = 0.05 p.u. Antonito 69 kV Deviation = 0.06 p.u. Del Norte 69 kV Deviation = 0.11 p.u. Ft Garland 69 kV Deviation = 0.06 p.u. Home Lake 69 kV Deviation = 0.09 p.u. Rio Grande 69 kV Deviation = 0.11 p.u. Romeo 69 kV Deviation = 0.06 p.u.	Alamosa Term 115-69 xfmr = 135% (25) Mosca-San Luis 69 kV Line = 106% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 117% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 144% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed

Alternative 3 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 3, which adds a Burro Canyon-San Luis 230 kV line and a second 230-115 kV San Luis transformer to the high-voltage transmission system. The possibility of adding generation at Burro Canyon Substation exists, however, this alternative assesses the feasibility of no generation at Burro Canyon Substation. In addition, Alternative 3 was studied with no local San Luis Valley generation on-line. The following summary exhibits the results of cases that modeled constant MVA loads, at unity power factor. Power flow plots are in Appendix 3.

The results of these cases indicate that this alternative does not effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System, even though the power factor is 1.00. Since this alternative fails at an optimistic power factor of 1.00, it can be eliminated from further consideration. Variations of this alternative, which include a generator at Burro Canyon of 120, 60, or 30 MW, is considered later in the report.

Alternative 3 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 151/172 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	10 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.11 p.u. Ft Garland 69 kV Deviation = 0.13 p.u.	Mosca-San Luis 69 kV Line = 108% (29)
Alamosa Term 115-69 kV xfmr Outage	Ft Garland 69 kV Deviation = 0.05 p.u.	None
Alamosa Term-San Luis 115 kV Outage	Alamosa St 69 kV Deviation = 0.16 p.u. Alamosa Tm 69 kV Deviation = 0.17 p.u. Antonito 69 kV Deviation = 0.17 p.u. Ft Garland 69 kV Deviation = 0.19 p.u. Home Lake 69 kV Deviation = 0.08 p.u. Mirage Jct 69 kV Deviation = 0.07 p.u. Moffat 69 kV Deviation = 0.07 p.u. Mosca 69 kV Deviation = 0.07 p.u. Romeo 69 kV Deviation = 0.17 p.u. Saguache 69 kV Deviation = 0.07 p.u.	Alamosa Term 115-69 xfmr = 113% (25) Mosca-San Luis 69 kV Line = 102% (29) RGrande Tap-Sargent 69 kV = 108% (44) San Luis 115-69 kV xfmr = 117% (42)
Comanche-Walsenburg 230 kV Line	None	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 107% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 110% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Deviation = 0.08 p.u. Home Lake 69 kV Deviation = 0.07 p.u. Rio Grande 69 kV Deviation = 0.08 p.u.	Alamosa Term 115-69 xfmr = 131% (25) Mosca-San Luis 69 kV Line = 103% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 115% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 140% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed

Alternative 4 Contingency Analysis
San Luis-Walsenburg 230 kV Line Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 4, which adds a San Luis-Walsenburg 230 kV line and a second 230-115 kV San Luis transformer to the high-voltage transmission system. The possibility of upgrading the existing ARCO-Walsenburg 115 kV line to complete the San Luis-Walsenburg 230 kV line exists. However, to assess the effectiveness of this alternative in improving the voltage stability of the San Luis Valley High Voltage System, a completely new line is simply added to the case. Alternative 4 was studied with no local San Luis Valley generation on-line. The following summary notes the results of cases that modeled constant MVA loads, at unity power factor. Power flow plots are in Appendix 4.

The results of these cases indicate that this alternative does effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System. However, further system additions are required to meet all requirements of the Reliability Criteria.

Alternative 4 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 151/172 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	10 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.12 p.u. Ft Garland 69 kV Deviation = 0.14 p.u.	None
Alamosa Term 115-69 kV xfmr Outage	Alamosa Term 69 kV Dev. = 0.05 p.u. Antonito 69 kV Deviation = 0.05 p.u. Ft. Garland 69 kV Deviation = 0.08 p.u. Romeo 69 kV Deviation = 0.05 p.u.	None
Alamosa Term-San Luis 115 kV Outage	Alamosa St 69 kV Deviation = 0.16 p.u. Alamosa Tm 69 kV Deviation = 0.17 p.u. Antonito 69 kV Deviation = 0.17 p.u. Ft Garland 69 kV Deviation = 0.19 p.u. Home Lake 69 kV Deviation = 0.08 p.u. Mirage Jct 69 kV Deviation = 0.07 p.u. Moffat 69 kV Deviation = 0.07 p.u. Mosca 69 kV Deviation = 0.06 p.u. Romeo 69 kV Deviation = 0.17 p.u. Saguache 69 kV Deviation = 0.07 p.u.	Alamosa Term 115-69 xfmr = 113% (25) Mosca-San Luis 69 kV Line = 102% (29) RGrande Tap-Sargent 69 kV = 109% (44) San Luis 115-69 kV xfmr = 117% (42)
Comanche-Walsenburg 230 kV Line	Burro Canyon Capacitor = 7.5 MVAR	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 118% (100) Gunnison-Skito 115 kV = 105% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 110% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	Burro Canyon Capacitor = 7.5 MVAR	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Deviation = 0.08 p.u. Home Lake 69 kV Deviation = 0.07 p.u. Rio Grande 69 kV Deviation = 0.08 p.u.	Alamosa Term 115-69 xfmr = 133% (25) Mosca-San Luis 69 kV Line = 103% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 114% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 141% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 120% (100) Gunnison-Skito 115 kV = 107% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 106% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 106% (100)

Alternative 5 Contingency Analysis Dispersed Static VAr Devices

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 5, which adds 100 MVar Static VAr Devices, holding local 69 kV voltages to 1.02 p.u.. The SVCs are added at Antonito, Fort Garland, Mosca, Ramon, San Luis, Sargent, and Waverly 69 kV buses. Alternative 5 is studied with no local San Luis Valley generation on-line. A summary of the results of Alternative 5 contingency analysis follows. Power flow plots are in Appendix 5.

The results of these cases indicate that this alternative does not effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System, even though the power factor is 1.00. Since this alternative fails at an optimistic power factor of 1.00, it can be eliminated from further consideration.

Alternative 5 Contingency Analysis Summary

Load Level = 144 MW

Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 153/172 MW

Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	San Luis 230-115 kV xfmr = 108% (100) 10 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	None	Alamosa St-Mosca 69 kV = 128% (26) Mosca-San Luis 69 kV Line= 134% (29) San Luis 230-115 kV xfmr = 113% (100)
Alamosa Term 115-69 kV xfmr Outage	None	San Luis 230-115 kV xfmr = 109% (100)
Alamosa Term-San Luis 115 kV Outage	None	Alamosa St-Mosca 69 kV = 109% (26) Home Lk-Rio Gr Tap 69 kV = 101% (44) Mosca-San Luis 69 kV Line= 118% (29) Rio Gr Tap-Sargent 69 kV=124% (44) San Luis 115-69 kV xfmr = 121% (42) San Luis 230-115 kV xfmr = 116% (100) Sargent 115-69 kV xfmr = 104% (63)
Comanche-Walsenburg 230 kV Line	Walsenburg 69 kV Deviation = 0.06 p.u.	San Luis 230-115 kV xfmr = 108% (100)
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 121% (100) Gunnison-Skito 115 kV = 108% (100)
Gunnison-Poncha 115 kV Line Outage	None	San Luis 230-115 kV xfmr = 125% (100) Blue Mesa-Curecanti 115 = 110% (100)
Midway-Poncha 230 kV Line Outage	None	San Luis 230-115 kV xfmr = 131% (100)
Poncha-San Luis 230 kV Line or San Luis 230-115 kV xfmr Outage	Failed (Voltage Collapse)	Failed
Poncha-Sargent 115 kV Line Outage	None	San Luis 230-115 kV xfmr = 139% (100)
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Deviation = 0.05 p.u. Rio Grande 69 kV Deviation = 0.05 p.u.	Alamosa Tm 115-69 kV xfmr=136% (25) Mosca-San Luis 69 kV Line= 103% (29) San Luis 230-115 kV xfmr = 112% (100)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 116% (29) San Luis 230-115 kV xfmr = 107% (100)
Sargent 115-69 kV Transformer Outage	None	Alamosa Tm 115-69 kV xfmr=108% (25) San Luis 115-69 kV xfmr = 141% (42) San Luis 230-115 kV xfmr = 109% (100)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Failed (Voltage Collapse)	Failed

Alternative 6 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
120 MW Burro Canyon Generation Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 6, which adds a Burro Canyon-San Luis 230 kV line and a second 230-115 kV San Luis transformer to the high-voltage transmission system. In addition, 120 MW of generation is added at Burro Canyon. Alternative 6 was studied with no local San Luis Valley generation on-line. Results of the Alternative 6 contingency analysis follows on the next page. Power flow plots are in Appendix 6.

The results of the these cases indicate that this alternative does effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System. However, further system additions are required to meet all requirements of the Reliability Criteria.

A previous report, the **Picketwire Project Preliminary Feasibility Study Report**, February 1994, documents that a 120 MW generator, with typical gas turbine generator, exciter, and governor data, is transiently stable with the system configuration of Alternative 6. Copies of this report are available upon request.

Alternative 6 Contingency Analysis Summary

Load Level = 144 MW

Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 156/170 MW

Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV Voltage = 0.95 p.u.	11 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.11 p.u. Ft Garland 69 kV Deviation = 0.12 p.u.	None
Alamosa Term 115-69 kV xfmr Outage	None	None
Alamosa Term-San Luis 115 kV Outage	Alamosa St 69 kV Deviation = 0.15 p.u. Alamosa Tm 69 kV Deviation = 0.16 p.u. Antonito 69 kV Deviation = 0.16 p.u. Ft Garland 69 kV Deviation = 0.18 p.u. Home Lake 69 kV Deviation = 0.07 p.u. Mirage Jct 69 kV Deviation = 0.06 p.u. Moffat 69 kV Deviation = 0.06 p.u. Mosca 69 kV Deviation = 0.06 p.u. Romeo 69 kV Deviation = 0.16 p.u. Saguache 69 kV Deviation = 0.06 p.u.	Alamosa Term 115-69 xfmr = 112% (25) Mosca-San Luis 69 kV Line = 102% (29) RGrande Tap-Sargent 69 kV = 108% (44) San Luis 115-69 kV xfmr = 121% (42)
Comanche-Walsenburg 230 kV Line	None	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 112% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 111% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	None	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Deviation = 0.07 p.u. Home Lake 69 kV Deviation = 0.06 p.u. Rio Grande 69 kV Deviation = 0.07 p.u.	Alamosa Term 115-69 xfmr = 127% (25)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 140% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 139% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 112% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 112% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 112% (100)

Alternative 7 Contingency Analysis
San Luis-Walsenburg 230 kV Line Addition
Alamosa Steam Capacitor Addition
Rio Grande Tap Capacitor Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 7, which adds a San Luis-Walsenburg 230 kV line and a second 230-115 kV San Luis transformer to the high-voltage transmission system, similar to Alternative 4. In addition, capacitors are modeled at Alamosa Steam and Rio Grande Tap 69 kV. Alternative 7 was studied with no local San Luis Valley generation on-line. The Alternative 7 contingency analysis is summarized on the following page. Power flow plots are in Appendix 7.

The results of these cases indicate that this alternative does effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System. Furthermore, the smaller scale voltage collapse associated with the Alamosa Terminal-San Luis 115 kV line outage, and the low voltages associated with the Rio Grande Tap-Sargent 69 kV line outage, are mitigated in this alternative. Some line upgrades are necessary to fully comply with the Reliability Criteria.

Alternative 7 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 151/172 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	10 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 20 MVar	Alamosa St-Mosca 69 kV = 115% (26) Mosca-San Luis 69 kV Line = 122% (29)
Alamosa Term 115-69 kV xfmr Outage	Alamosa St 69 kV Capacitor = 9 MVar	None
Alamosa Term-San Luis 115 kV Outage	Alamosa St 69 kV Capacitor = 38 MVar	Alamosa St-Mosca 69 kV = 106% (26) Mosca-San Luis 69 kV Line = 113% (29) RGrande Tap-Sargent 69 kV = 120% (44) San Luis 115-69 kV xfmr = 117% (42) Sargent 115-69 kV xfmr = 104% (63)
Comanche-Walsenburg 230 kV Line	Burro Canyon Capacitor = 7.5 MVar	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 118% (100) Gunnison-Skito 115 kV = 105% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 110% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	Rio Grande Tap Capacitor = 6 MVar	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Rio Grande Tap Capacitor = 8 MVar	Alamosa Term 115-69 xfmr = 124% (26) Mosca-San Luis 69 kV Line = 102% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 114% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 141% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 120% (100) Gunnison-Skito 115 kV = 107% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 107% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 107% (100)

Alternative 8 Contingency Analysis
San Luis-Walsenburg 230 kV Line Addition
Alamosa Terminal-Waverly 115 kV Line Addition
Rio Grande Tap Capacitor Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 8, which adds a San Luis-Walsenburg 230 kV line and a second 230-115 kV San Luis transformer to the high-voltage transmission system, similar to Alternative 4. In addition, an Alamosa Terminal-Waverly 115 kV line is added, to support the system during the Alamosa Terminal-San Luis 115 kV line outage. Capacitors are also modeled at Rio Grande Tap 69 kV. Alternative 8 was studied with no local San Luis Valley generation on-line. The results of the Alternative 8 contingency analysis is on the following page. Power flow plots are in Appendix 8.

The results of the these cases indicate that this alternative does not add any incremental benefits over Alternative 7. Although Alternative 8 adds support to the system for the Alamosa Terminal-San Luis 115 kV line outage, the need for capacitors at Alamosa Steam is not mitigated. The loss of the Alamosa Terminal-Alamosa Steam 69 kV line causes excessive voltage deviations at Alamosa Steam and Fort Garland. The low voltages associated with the Rio Grande Tap-Sargent 69 kV line outage, are mitigated in this alternative, by the addition of capacitors at Rio Grande Tap, similar to Alternative 7. This alternative is eliminated from further consideration in this report.

Alternative 8 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 151/172 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	10 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Deviation = 0.12 p.u. FL Garland 69 kV Deviation = 0.13 p.u.	None
Alamosa Term 115-69 kV xfmr Outage	Alamosa St. 69 kV Deviation = 0.05 p.u. Alamosa Term 69 kV Dev. = 0.05 p.u. Antonito 69 kV Deviation = 0.05 p.u. FL Garland 69 kV Deviation = 0.05 p.u. Romeo 69 kV Deviation = 0.05 p.u.	None
Alamosa Term-San Luis 115 kV Outage	None	None
Comanche-Walsenburg 230 kV Line	Burro Canyon Capacitor = 7.5 MVar	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 118% (100) Gunnison-Skito 115 kV = 105% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 110% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	Rio Grande Tap Capacitor = 8 MVar	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Rio Grande Tap Capacitor = 7 MVar	Alamosa Term 115-69 xfmr = 126% (25)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 112% (29)
San Luis-Waverly 115 kV Line Outage	None	None
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 137% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 120% (100) Gunnison-Skito 115 kV = 107% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 107% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 119% (100) Gunnison-Skito 115 kV = 107% (100)

Alternative 9 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 120 MW Generator Addition
Alamosa Steam Capacitor Addition
Rio Grande Tap Capacitor Addition

Load Level = 144 MW

SLV Generation = 0 MW

The following power flow summary is for Alternative 9, which adds a Burro Canyon-San Luis 230 kV line, a Burro Canyon 230-115 kV transformer, a Burro Canyon 120 MW generator, and a second 230-115 kV San Luis transformer to the high-voltage transmission system, similar to Alternative 6. In addition, capacitors are modeled at Alamosa Steam and Rio Grande Tap 69 kV. Alternative 9 was studied with no local San Luis Valley generation on-line. The results of the Alternative 9 contingency analysis are summarized on the following page. Power flow plots are in Appendix 9.

The results of these cases indicate that this alternative does effectively mitigate the voltage collapse concerns of the San Luis Valley High Voltage Transmission System, and improvement over Alternative 6 is gained, as the smaller scale voltage collapse associated with the Alamosa Terminal-San Luis 115 kV line outage, and the low voltages associated with the Rio Grande Tap-Sargent 69 kV line outage, are mitigated in this alternative. Some 69 kV line upgrades are necessary to fully comply with the Reliability Criteria.

Alternative 9 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 156/170 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	Ft. Garland 69 kV Voltage = 0.95 p.u.	11 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 19 MVar	Alamosa St-Mosca 69 kV = 111% (26) Mosca-San Luis 69 kV Line = 118% (29)
Alamosa Term 115-69 kV xfmr Outage	Alamosa St 69 kV Capacitor = 9 MVar	None
Alamosa Term-San Luis 115 kV Outage	Alamosa St 69 kV Capacitor = 37 MVar	Alamosa St-Mosca 69 kV = 104% (26) Mosca-San Luis 69 kV Line = 112% (29) RGrande Tap-Sargent 69 kV = 119% (44) San Luis 115-69 kV xfmr = 119% (42) Sargent 115-69 kV xfmr = 105% (63)
Comanche-Walsenburg 230 kV Line	None	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 112% (100)
Gunnison-Poncha 115 kV Line Outage	None	Blue Mesa-Curecanti 115 = 111% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	None	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Rio Grande Tap Capacitor = 9 MVar	Alamosa Term 115-69 xfmr = 120% (25)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 115% (29)
Sargent 115-69 kV Transformer Outage	None	San Luis 115-69 kV xfmr = 139% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Rio Grande Tap Capacitor = 8 MVar	Blue Mesa-Skito 115 kV = 112% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Rio Grande Tap Capacitor = 8 MVar	Blue Mesa-Skito 115 kV = 118% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 118% (100)