Alternative 10 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 60 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 10, which adds a Burro Canyon-San Luis 230 kV line, a Burro Canyon 230-115 kV transformer, Burro Canyon generation (60 MW), and a second 230-115 kV San Luis transformer to the high- voltage transmission system, similar to Alternative 9. The difference is in the size of the generator addition. At this point in the study, a 0 MW generation addition at Burro Canyon is known to be unacceptable, and a 120 MW generation addition at Burro Canyon is known to mitigate voltage collapse in the San Luis Valley. Therefore, knowledge of the effect of a 60 MW generation addition at Burro Canyon is valuable. In addition, capacitors are modeled at Alamosa Steam and Rio Grande Tap 69 kV. Alternative 10 was studied with no local San Luis Valley generation on-line. The results of the Alternative 10 contingency analysis are summarized on the following page. Power flow plots are in Appendix 10.

The results of the these cases indicate that a 60 MW generation addition at Burro Canyon is as effective in mitigating the voltage collapse concerns of the San Luis Valley High Voltage Transmission System at a load level of 144 MW. Further alternative development is required to fully comply with reliability criteria.

Alternative 10 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00

SLV Generation = 0 MW

PSCo/UC Losses = 153/171 MW
Load Model = Constant MVA

System State	High & Low Voltages	Overloads
System Normal	None	11 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 18 MVAr	Alamosa St-Mosca 69 kV = 110% (26) Mosca-San Luis 69 kV Line= 117% (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 = 36 MVAr	Alamosa St-Mosca 69 kV = 103% (26) Mosca-San Luis 69 kV Line= 112% (29) RGrande Tap-Sargent 69 kV=118% (44) San Luis 115-69 kV xfmr = 117% (42) Sargent 115-69 kV xfmr = 104% (63)
Comanche-Walsenburg 230 kV Line	None	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 116% (100) Gunnison-Skito 115 kV = 103% (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	Rio Grande Tap Capacitor = 9 MVAr	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 = 121% (25) Mosca-San Luis 69 kV Line= 104% (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 = 139% (42)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	Alamosa St 69 kV Capacitor = 6 MVAr Rio Grande Tap Capacitor = 14 MVAr	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	Alamosa St 69 kV Capacitor = 6 MVAr Rio Grande Tap Capacitor = 14 MVAr	Blue Mesa-Skito 115 kV = 120% (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 = 120% (100) Gunnison-Skito 115 kV = 107% (100)

Alternative 11 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 30 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 11, which adds a Burro Canyon-San Luis 230 kV line, a Burro Canyon 230-115 kV transformer, Burro Canyon generation (30 MW), and a second 230-115 kV San Luis transformer to the high-voltage transmission system, similar to Alternative 10. The size of the generator addition at Burro Canyon has been reduced from 60 MW to 30 MW. At this point in the study, a 0 MW generation addition at Burro Canyon is known to be unacceptable, and a 60 MW generation addition at Burro Canyon is known to mitigate voltage collapse in the San Luis Valley, at the studied load level. Therefore, knowledge of the effect of a 30 MW generation addition at Burro Canyon is valuable. In addition, capacitors are modeled at Alamosa Steam and Rio Grande Tap 69 kV. Alternative 11 was studied with no local San Luis Valley generation on-line. The results of the Alternative 11 contingency analysis are on the following page. Power flow plots are in Appendix 11.

The results of the these cases indicate that a 30 MW generation addition at Burro Canyon is as effective in mitigating the voltage collapse concerns of the San Luis Valley High Voltage Transmission System as a 120 MW or a 60 MW generation addition, at a regional load level of 144 MW. Further alternative development is required to fully satisfy reliability criteria.

Alternative 11 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = 1.00
SLV Generation = 0 MW
PSCo/UC Losses = 152/171 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 = 18 MVAr	Alamosa St-Mosca 69 kV = 109% (26) Mosca-San Luis 69 kV Line= 117% (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 = 35 MVAr	Alamosa St-Mosca 69 kV = 103% (26) Mosca-San Luis 69 kV Line= 111% (29) RGrande Tap-Sargent 69 kV=118% (44) San Luis 115-69 kV xfmr = 117% (42) Sargent 115-69 kV xfmr = 104% (63)
Comanche-Walsenburg 230 kV Line	None	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= 111% (100)
Midway-Poncha 230 kV Line Outage	None	None
Poncha-San Luis 230 kV Line Outage	Alamosa St 69 kV Capacitor = 7 MVAr Rio Grande Tap Capacitor = 17 MVAr	Blue Mesa-Skito 115 kV = 102% (100)
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 = 120% (25) Mosca-San Luis 69 kV Line= 104% (29)
San Luis 115-69 kV xfmr Outage	None	Ansel-San Luis 69 kV Line = 116% (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	Rio Grande Tap Capacitor = 9 MVAr	Blue Mesa-Skito 115 kV = 124% (100) Gunnison-Skito 115 kV = 111% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	Alamosa St 69 kV Capacitor = 9 MVAr Rio Grande Tap Capacitor = 25 MVAr	Blue Mesa-Skito 115 kV = 124% (100) Gunnison-Skito 115 kV = 111% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 124% (100) Gunnison-Skito 115 kV = 111% (100)

Alternative 12 Contingency Analysis
San Luis-Walsenburg 230 kV Line Addition
Regional 69 kV Line Uprates
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 12, which adds a San Luis-Walsenburg 230 kV line, a second 230-115 kV San Luis transformer, and capacitors at Alamosa Steam and Rio Grande Tap 69 kV, similar to Alternative 7. In addition, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. These lines were assumed to be reconductored with 397.5 MCM conductor. Alternative 12 was studied with no local San Luis Valley generation on-line. Alternative 12 modeled the worse of metered load power factors or 0.95. This resulted in system normal overloads that were not apparent when uniform power factors were modeled. The system normal power flow plot is in Appendix 12.

The system normal criteria violations were not revealed until the metered power factor data was made available. The system normal case indicates that additional capacitors are required for this alternative to fully satisfy reliability criteria.

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Alternative 12 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual

SLV Generation = 0 MW

PSCo/UC Losses = 153/172 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV Bus = 0.89 p.u. Mirage Junction 69 kV = 0.95 p.u. Saguache 69 kV Bus = 0.94 p.u. San Acacio 69 kV Bus = 0.95 p.u. Zinzer 69 kV Bus = 0.95 p.u.	Almsa Tm 115-13.2 xfmr 1 = 130% (8.9) Almsa Tm 115-13.2 xfmr 2 = 152% (8.9) Carmel N 69-12.5 kV xfmr = 90% (7.5) Center E 69-12.5 kV xfmr = 88% (7.5) Del Norte 69-25 kV xfmr = 95% (4.5) Ft. Garland 69-25 kV xfmr 3=113% (8.9) Ft Garland 69-25 kV xfmr 2=85% (4.1) Home Lake 69-25 kV xfmr = 86% (6.3) Hooper 69-12.5 kV xfmr = 93% (7.5) LaGarita 69-12.5 kV xfmr = 80% (10) Mosca 69-13.2 kV xfmr = 108% (1.1) Plaza 69-12.5 kV xfmr = 85% (2.5) Poncha 115-25 kV xfmr = 101% (12) Rio Grande 69-25 kV xfmr = 87% (5.0) Romeo 69-13.2 kV xfmr = 107% (5.0) Saguache 69-13.2 kV xfmr = 103%(3.0) Stanley 115-12.5 kV xfmr = 103% (10)
Outages cases were not run because of the inadequacies of the System Normal case. Further alternative development is required.		

Alternative 13 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 90-120 MW Generator
Regional 69 kV Line Uprates
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 13, which adds a San Luis-Walsenburg 230 kV line, a second 230-115 kV San Luis transformer, and capacitors at Alamosa Steam and Rio Grande Tap 69 kV, similar to Alternative 9. In addition, 120 MW of generator is added at Burro Canyon, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 13 was studied with no local San Luis Valley generation on-line. The loads utilized metered load power factors, although no load power factors better than 0.95 were modeled. The attached summary indicates the results of cases that modeled the actual load characteristic of the region's load, developed by LOADSYN, and at actual individual load power factors or 0.95 lagging power factors, whichever is worse. The system normal power flow plot is in Appendix 13.

The system normal criteria violations were not revealed until the metered power factor data was made available. The system normal case indicates that additional line uprates are required for this alternative to fully satisfy reliability criteria.

Alternative 13 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual

SLV Generation = 0 MW

PSCo/UC Losses = 158/170 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV Bus = 0.90 p.u. Saguache 69 kV Bus = 0.94 p.u.	Almsa Tm 115-13.2 xfmr 1 = 127% (8.9) Almsa Tm 115-13.2 xfmr 2 = 148% (8.9) Carmel N 69-12.5 kV xfmr = 88% (7.5) Center E 69-12.5 kV xfmr = 85% (7.5) Del Norte 69-25 kV xfmr = 95% (4.5) Ft Garland 69-25 kV xfmr 3=111% (8.9) Ft Garland 69-25 kV xfmr 2=83% (4.1) Home Lake 69-25 kV xfmr = 85% (6.3) Hooper 69-12.5 kV xfmr = 94% (7.5) Mosca 69-13.2 kV xfmr = 107% (1.1) Plaza 69-12.5 kV xfmr = 85% (2.5) Poncha 115-25 kV xfmr = 100% (12) Rio Grande 69-25 kV xfmr = 87% (5.0) Romeo 69-13.2 kV xfmr = 103% (5.0) Saguache 69-13.2 kV xfmr = 102%(3.0) Stanley 115-12.5 kV xfmr = 102% (10)
Outages cases were not run because of the inadequacies of the System Normal case. Further alternative development is required.		

Alternative 14 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 60 MW Generator
Regional 69 kV Line Uprates
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 14, which adds a Burro Canyon-San Luis 230 kV line, a second 230-115 kV San Luis transformer, and capacitors at Alamosa Steam and Rio Grande Tap 69 kV, similar to Alternative 10. In addition, 60 MW of generation is added at Burro Canyon, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 14 was studied with no local San Luis Valley generation on-line. The loads are modeled with metered power factors or 0.95 lagging power factors, whichever is worse. The system normal power flow plot is in Appendix 14.

The results of the these cases indicate that some additional capacitance is required on the 69 kV system, to fully comply with the reliability criteria. The system normal criteria violations were not revealed until metered power factor data became available. Contingencies were not simulated because of the inadequacies of the system normal case.

Alternative 14 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual

SLV Generation = 0 MW

PSCo/UC Losses = 155/171 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV Bus = 0.90 p.u. Saguache 69 kV Bus = 0.94 p.u.	Almsa Tm 115-13.2 xfmr 1 = 128% (8.9) Almsa Tm 115-13.2 xfmr 2 = 149% (8.9) Carmel N 69-12.5 kV xfmr = 88% (7.5) Center E 69-12.5 kV xfmr = 85% (7.5) Del Norte 69-25 kV xfmr = 95% (4.5) Ft Garland 69-25 kV xfmr 3=112% (8.9) Ft Garland 69-25 kV xfmr 2=84% (4.1) Home Lake 69-25 kV xfmr = 85% (6.3) Hooper 69-12.5 kV xfmr = 94% (7.5) Mosca 69-13.2 kV xfmr = 107% (1.1) Plaza 69-12.5 kV xfmr = 84% (2.5) Poncha 115-25 kV xfmr = 100% (12) Rio Grande 69-25 kV xfmr = 87% (5.0) Romeo 69-13.2 kV xfmr = 102% (5.0) Saguache 69-13.2 kV xfmr = 102%(3.0) Stanley 115-12.5 kV xfmr = 102% (10)
Outages cases were not run because of the inadequacies of the System Normal case. Further alternative development is required.		

Alternative 15 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 30 MW Generator
Regional 69 kV Line Uprates
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 15, which adds a San Luis-Walsenburg 230 kV line, a second 230-115 kV San Luis transformer, and capacitors at Alamosa Steam and Rio Grande Tap 69 kV, similar to Alternative 11. In addition, 30 MW of generation is added at Burro Canyon, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 15 was studied with no local San Luis Valley generation on-line. The loads are modeled with metered power factors or 0.95 lagging power factors, whichever is worse. The system normal power flow plot is in Appendix 15.

The results of the these cases indicate that some additional capacitance is required on the 69 kV system, to fully comply with the reliability criteria. The system normal criteria violations were not revealed until metered power factor data became available. Contingencies were not simulated because of the inadequacies of the system normal case.

Alternative 15 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual

SLV Generation = 0 MW

PSCo/UC Losses = 154/171 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal	Fort Garland 69 kV Bus = 0.92 p.u.	Almsa Tm 115-13.2 xfmr 1 = 130% (8.9) Almsa Tm 115-13.2 xfmr 2 = 151% (8.9) Carmel N 69-12.5 kV xfmr = 90% (7.5) Center E 69-12.5 kV xfmr = 86% (7.5) Del Norte 69-25 kV xfmr = 95% (4.5) Ft Garland 69-25 kV xfmr 3=113% (8.9) Ft Garland 69-25 kV xfmr 2=84% (4.1) Home Lake 69-25 kV xfmr = 85% (6.3) Hooper 69-12.5 kV xfmr = 95% (7.5) Mosca 69-13.2 kV xfmr = 108% (1.1) Plaza 69-12.5 kV xfmr = 85% (2.5) Poncha 115-25 kV xfmr = 101% (12) Rio Grande 69-25 kV xfmr = 87% (5.0) Romeo 69-13.2 kV xfmr = 105% (5.0) Saguache 69-13.2 kV xfmr = 103%(3.0) Stanley 115-12.5 kV xfmr = 103% (10)
Outages cases were not run because of the inadequacies of the System Normal case. Further alternative development is required.		

Alternative 16 Contingency Analysis
San Luis-Walsenburg 230 kV Line Addition
Regional 69 kV Line Uprates
Regional Capacitor Additions

Load Level = 144 MW SLV Generation = 0 MW

Alternative 16 models sufficient capacitor devices to meet reliability criteria with metered power factor data, and it is the preferred alternative of this report. This alternative meets all reliability criteria at the lowest overall cost, of those alternatives that were studied. The total cost of implementing this alternative is estimated to be $21,711,100. The cost estimate details are in Appendix T.

The system additions include a San Luis-Walsenburg 230 kV line, a second 230-115 kV San Luis transformer, a second Walsenburg 230-115 kV transformer, and capacitors at Alamosa Steam, Antonito, Del Norte, Fort Garland, and Home Lake. Except for more extensive capacitor additions, this alternative is similar to Alternative 12. In addition, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 16 was studied with metered power factors or 0.95 lagging power factor, whichever is worse, and no local San Luis Valley generation on-line. The results of the Alternative 16 contingency analysis are summarized on the following page. Power flow and voltage stability plots are in Appendix 16.

The results of the these cases indicate acceptable results at a regional load level of 144 MW, with an uprate of the Home Lake-Rio Grande Tap 69 kV line. This contingency analysis also demonstrates that the Home Lake capacitors are not necessary. The voltage stability criteria require a voltage collapse assessment without the availability of the single most critical VAr source. This assessment was made presuming that one 15 MVAr capacitor, recommended for addition, was unavailable. The results of the voltage stability analysis indicate that the nearest single contingency point-of-collapse is 163 MW, for an outage of the San Luis-Walsenburg 230 kV line. The study's voltage collapse criteria allows the region's load to be as high as 155 MW, with a 163 MW point-of-collapse.

Alternative 16 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual
SLV Generation = 0 MW
PSCo/UC Losses = 155/172 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal SLV Load @ Pt. of Collapse = 219 MW	Antonito 69 kV Capacitor = 6 MVAr Del Norte 69 kV Capacitor = 3 MVAr Ft Garland 69 kV Capacitor = 24 MVAr Saguache 69 kV Capacitor = 8 MVAr	17 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 16 MVAr Ft Garland 69 kV Capacitor = 30 MVAr	None
Alamosa Term 115-69 kV xfmr Outage	None	None
Alamosa Term-San Luis 115 kV Outage SLV Load @ Pt. of Collapse = 172 MW	Alamosa St 69 kV Capacitor = 29 MVAr Antonito 69 kV Capacitor = 13 MVAr Ft Garland 69 kV Capacitor = 30 MVAr	Home Lk-R Grande Tap 69 = 111% (44)
Comanche-Walsenburg 230 kV Line	None	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 SLV Load @ Pt. of Collapse = 175 MW	Del Norte 69 kV Capacitor = 9 MVAr	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Capacitor = 10 MVAr	None
San Luis 115-69 kV xfmr Outage	None	None
San Luis-Walsenburg 230 kV Outage SLV Load @ Pt. of Collapse = 163 MW*	None	None
Sargent 115-69 kV Transformer Outage	Del Norte 69 kV Capacitor = 8 MVAr	None
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 = 120% (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 = 120% (100) Gunnison-Skito 115 kV = 107% (100)

* . The system normal point-of-collapse, previously determined for the existing system, with the actual load model, & 0.95 power factor.

Alternative 17 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 120 MW Generator
Regional 69 kV Line Uprates
Regional Capacitor Additions

Load Level = 144 MW SLV Generation = 0 MW

Alternative 17 models sufficient capacitor devices to meet reliability criteria with metered power factor data, and, although not the preferred alternative of this report, it does meet reliability criteria. The primary reason that this alternative is not the preferred alternative is because the transmission costs are $640,000 higher, and the added uncertainty of the net costs relating to the generation. The generation must run to meet reliability criteria, but the need for another generation resource in the region does not exist, at this time. The total transmission cost of implementing this alternative is estimated to be $22,351,100. The cost estimate details are in Appendix T. Generation costs are detailed in Appendix B.

The system additions include a Burro Canyon-San Luis 230 kV line, a second 230-115 kV San Luis transformer, a Burro Canyon 230-115 kV transformer, and capacitors at Alamosa Steam, Antonito, Del Norte, Fort Garland, and Home Lake. Except for more extensive capacitor additions, this alternative is similar to Alternative 13. In addition, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 17 was studied with metered power factors or 0.95 lagging power factor, whichever is worse, and no local San Luis Valley generation on-line. The results of the Alternative 17 contingency analysis are summarized on the following page. Power flow and voltage stability plots are in Appendix 17.

The results of the these cases indicate acceptable results at a regional load level of 144 MW, with an uprate of the Home Lake-Rio Grande Tap 69 kV line. This contingency analysis also demonstrates that the Home Lake capacitors are not necessary. The voltage stability criteria require a voltage collapse assessment without the availability of the single most critical VAr source. This assessment was made presuming that one 15 MVAr capacitor, recommended for addition, was unavailable. The results of the voltage stability analysis indicate that the nearest single contingency point-of-collapse is 152 MW, for an outage of the Poncha-San Luis 230 kV line. The study's voltage collapse criteria allows the region's load to be as high as 144 MW, with a 152 MW point-of-collapse.

Alternative 18 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 60 MW Generator
Regional 69 kV Line Uprates
Regional Capacitor Additions

Load Level = 144 MW SLV Generation = 0 MW

Alternative 18 models sufficient capacitor devices to meet reliability criteria with metered power factor data. This alternative fails to meet single contingency voltage collapse criteria, with a 15 MVAr Fort Garland capacitor, recommended for addition, unavailable. The point-of-collapse for an outage of the Poncha-San Luis 230 kV line, with a 15 MVAr Fort Garland capacitor unavailable, is 136 MW. This is insufficient to meet the targeted 2006 regional load of 144 MW. As the power flow results indicate, if the recommended Fort Garland 15 MVAr capacitor were available, the 136 MW point-of-collapse would increase to a level above sufficient to support the 144 MW regional load level.

The fine details were not studied, since this is not the preferred alternative of the report. However, this is the basis for requiring a minimum of 60 MW to be on-line at Burro Canyon, and for specifying that the Burro Canyon generation needs to be between 90 and 120 MW, distributed in at least two units.

The system additions include a Burro Canyon-San Luis 230 kV line, a second 230-115 kV San Luis transformer, a Burro Canyon 230-115 kV transformer, and capacitors at Alamosa Steam, Antonito, Del Norte, Fort Garland, and Home Lake. Except for more extensive capacitor additions, this alternative is similar to Alternative 14. In addition, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 18 was studied with metered power factors or 0.95 lagging power factor, whichever is worse, and no local San Luis Valley generation on-line. The results of the Alternative 18 contingency analysis are summarized on the following page. Power flow and voltage stability plots are in Appendix 18.

Alternative 18 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual
SLV Generation = 0 MW
PSCo/UC Losses = 156/171 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal SLV Load @ Pt. of Collapse = 209 MW	Antonito 69 kV Capacitor = 5 MVAr Del Norte 69 kV Capacitor = 3 MVAr Ft Garland 69 kV Capacitor = 23 MVAr	15 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 14 MVAr Ft Garland 69 kV Capacitor = 29 MVAr	None
Alamosa Term 115-69 kV xfmr Outage	None	None
Alamosa Term-San Luis 115 kV Outage SLV Load @ Pt. of Collapse = 170 MW	Alamosa St 69 kV Capacitor = 27 MVAr Antonito 69 kV Capacitor = 13 MVAr Ft. Garland 69 kV Capacitor = 29 MVAr	Home Lk-R Grande Tap 69 = 108% (44)
Comanche-Walsenburg 230 kV Line	None	None
Curecanti-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 116% (100) Gunnison-Skito 115 kV = 103% (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 SLV Load @ Pt. of Collapse = 136 MW	Del Norte 69 kV Capacitor = 10 MVAr	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Capacitor = 10 MVAr	None
San Luis 115-69 kV xfmr Outage	None	None
Sargent 115-69 kV Transformer Outage	Del Norte 69 kV Capacitor = 8 MVAr	None
Burro Canyon-San Luis 230 kV Outage SLV Load @ Pt. of Collapse = 163 MW*	None	Burro Canyon 230-115 kV = 118% (100)
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 = 108% (100)
Stuck Poncha CB 586 Curecanti-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 120% (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 = 120% (100) Gunnison-Skito 115 kV = 107% (100)

* The system normal point-of-collapse, previously determined for the existing system, with the actual load model, & 0.95 power factor.

Alternative 19 Contingency Analysis
Burro Canyon-San Luis 230 kV Line Addition
Burro Canyon 30 MW Generator
Regional 69 kV Line Uprates
Regional Capacitor Additions

Load Level = 144 MW SLV Generation = 0 MW

Alternative 19 models sufficient capacitor devices to meet reliability criteria with metered power factor data. This alternative fails to meet single contingency voltage collapse criteria, with a 15 MVAr Fort Garland capacitor, recommended for addition, unavailable. The point-of-collapse for an outage of the Poncha-San Luis 230 kV line, with a 15 MVAr Fort Garland capacitor unavailable, is 126 MW. This is insufficient to meet the targeted 2006 regional load of 144 MW. As the power flow results indicate, if the recommended Fort Garland 15 MVAr capacitor were available, the 136 MW point-of-collapse would increase to a level above sufficient to support the 144 MW regional load level.

The system additions include a Burro Canyon-San Luis 230 kV line, a second 230-115 kV San Luis transformer, a Burro Canyon 230-115 kV transformer, and capacitors at Alamosa Steam, Antonito, Del Norte, Fort Garland, and Home Lake. Except for more extensive capacitor additions, this alternative is similar to Alternative 15. In addition, a second San Luis 115-69 kV transformer and a second Alamosa Terminal 115-69 kV transformer are modeled, as well as line uprates of the Ansel-San Luis, Alamosa Steam-Mosca, and Rio Grande Tap-Sargent 69 kV lines. Alternative 19 was studied with metered power factors or 0.95 lagging power factor, whichever is worse, and no local San Luis Valley generation on-line. The results of the Alternative 19 contingency analysis are summarized on the following page. Power flow and voltage stability plots are in Appendix 19.

Alternative 19 Contingency Analysis Summary

Load Level = 144 MW
Power Factor = Actual
SLV Generation = 0 MW
PSCo/UC Losses = 155/171 MW
Load Model = Actual

System State	High & Low Voltages	Overloads
System Normal SLV Load @ Pt. of Collapse = 205 MW	Antonito 69 kV Capacitor = 6 MVAr Del Norte 69 kV Capacitor = 3 MVAr Ft Garland 69 kV Capacitor = 23 MVAr	17 Load transformers > 80% of rating
Alamosa Steam-Alamosa Terminal 69 kV Line Outage	Alamosa St 69 kV Capacitor = 16 MVAr Ft Garland 69 kV Capacitor = 29 MVAr	None
Alamosa Term 115-69 kV xfmr Outage	None	None
Alamosa Term-San Luis 115 kV Outage SLV Load @ Pt. of Collapse = 167 MW	Alamosa St 69 kV Capacitor = 28 MVAr Antonito 69 kV Capacitor = 13 MVAr Ft. Garland 69 kV Capacitor = 29 MVAr	Home Lk-R Grande Tap 69 = 110% (44)
Comanche-Walsenburg 230 kV Line	None	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 SLV Load @ Pt. of Collapse = 126 MW	Burro Canyon Capacitor = 15 MVAr Del Norte 69 kV Capacitor = 13 MVAr Ft Garland 69 kV Capacitor = 28 MVAr Home Lake 69 kV Capacitor = 8 MVAr	None
Poncha-Sargent 115 kV Line Outage	None	None
Rio Grande Tap-Sargent 115 kV Outage	Del Norte 69 kV Capacitor = 10 MVAr	None
San Luis 115-69 kV xfmr Outage	None	None
Sargent 115-69 kV Transformer Outage	Del Norte 69 kV Capacitor = 8 MVAr	None
Burro Canyon-San Luis 230 kV Outage SLV Load @ Pt. of Collapse = 163 MW*	Del Norte 69 kV Capacitor = 8 MVAr	Burro Canyon 230-115 kV = 118% (100)
Stuck Poncha CB 386 Curecanti-Poncha 230 kV Line & Midway-Poncha 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 125% (100) Gunnison-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 = 124% (100) Gunnison-Skito 115 kV = 111% (100)
Stuck Poncha CB 1186 Midway-Poncha 230 kV Line & Poncha-San Luis 230 kV Line Outage	None	Blue Mesa-Skito 115 kV = 124% (100) Gunnison-Skito 115 kV = 111% (100)

* The system normal point-of-collapse, previously determined for the existing system, with the actual load model, & 0.95 power factor.