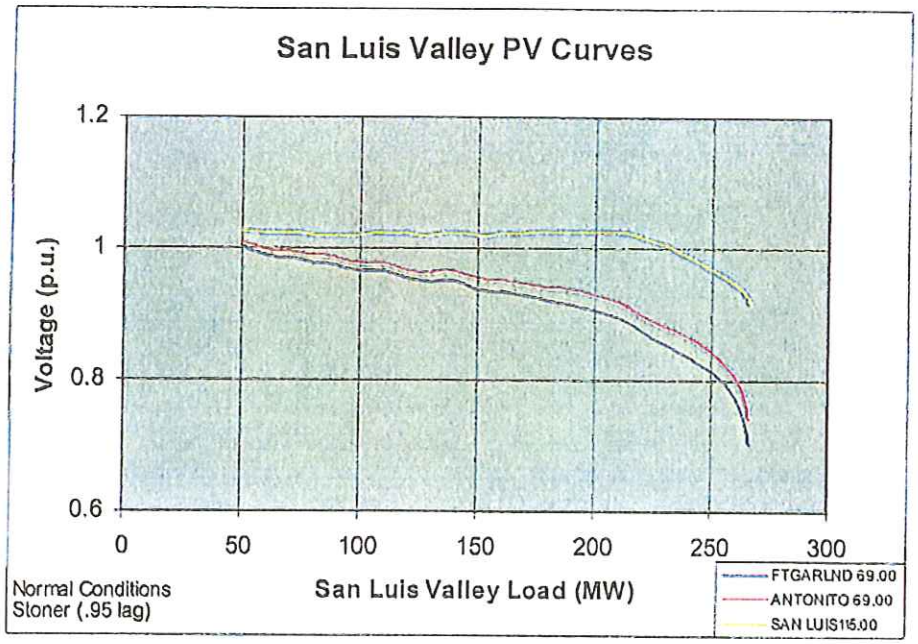
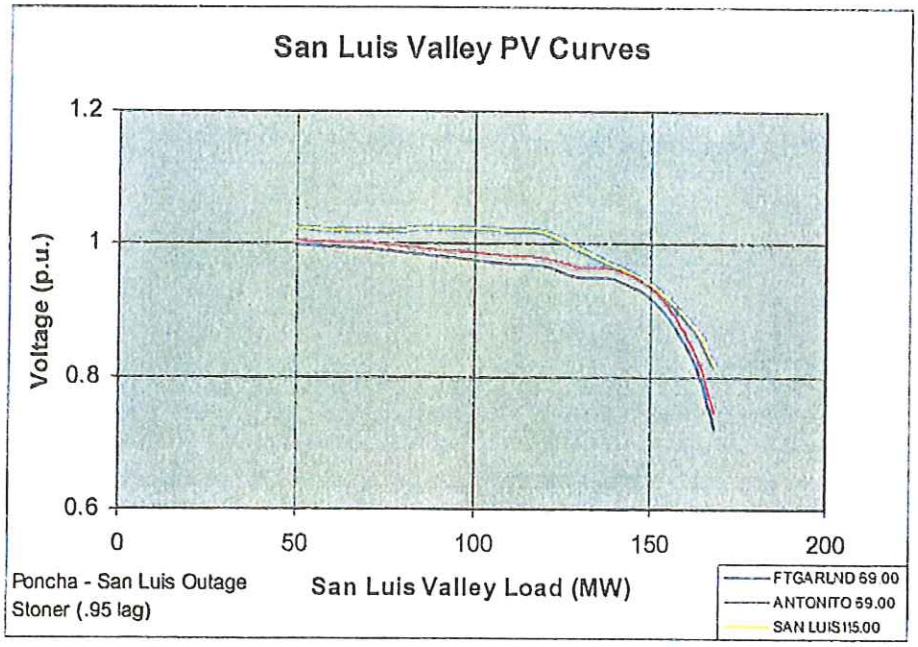
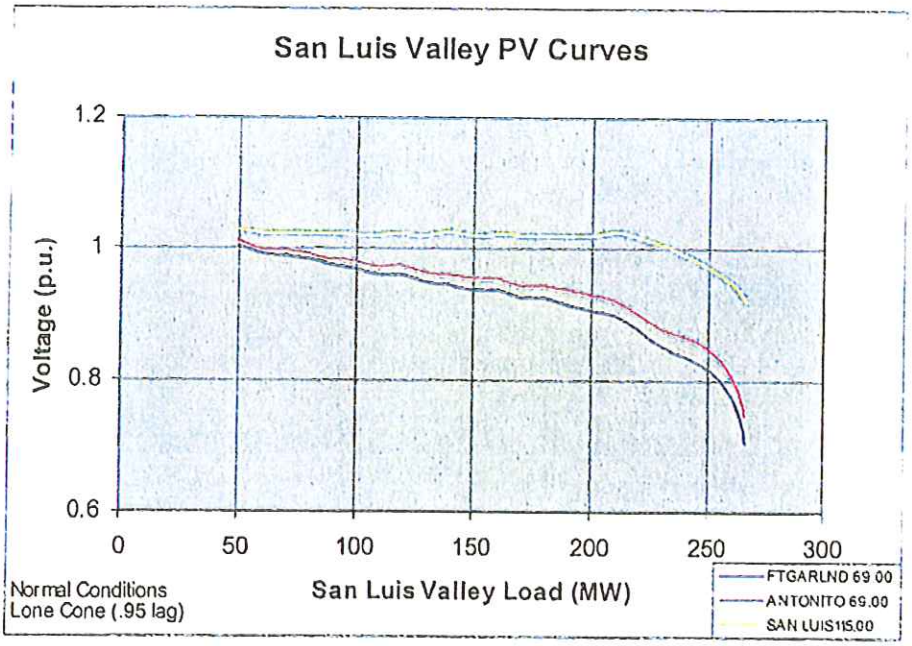
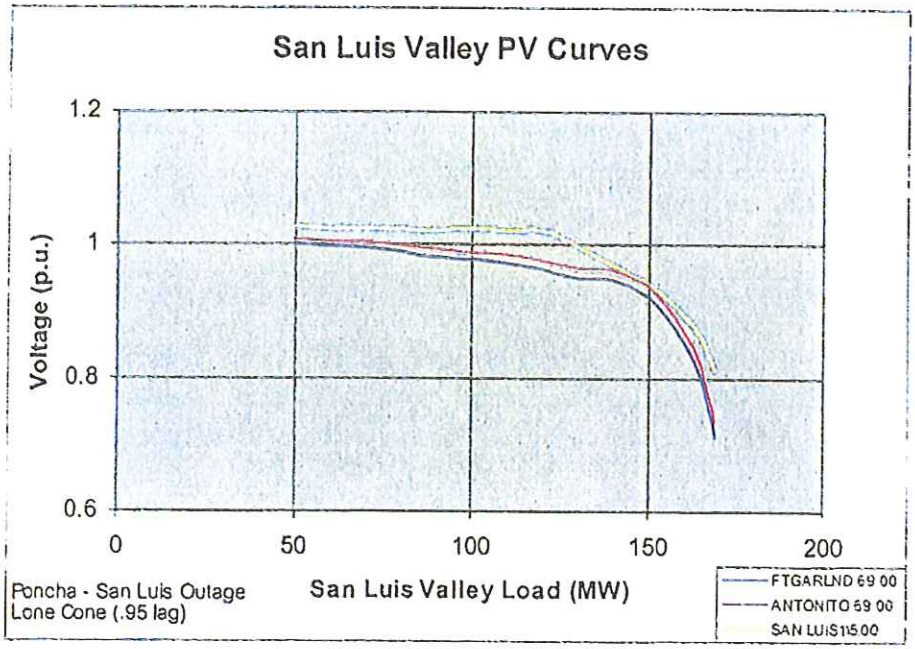
Alternative: San Luis Valley – Stoner 230 kV
System Normal Voltage Collapse Limit: 267 MW
Single Contingency Voltage Collapse Limit: 168 MW
Estimated Capital Cost (2003 Dollars): $68,116,000



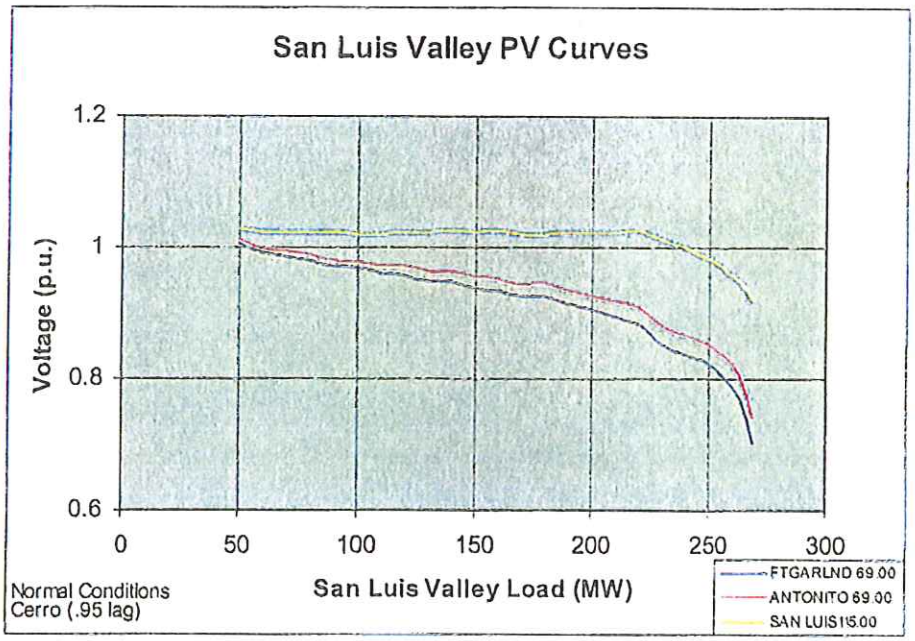



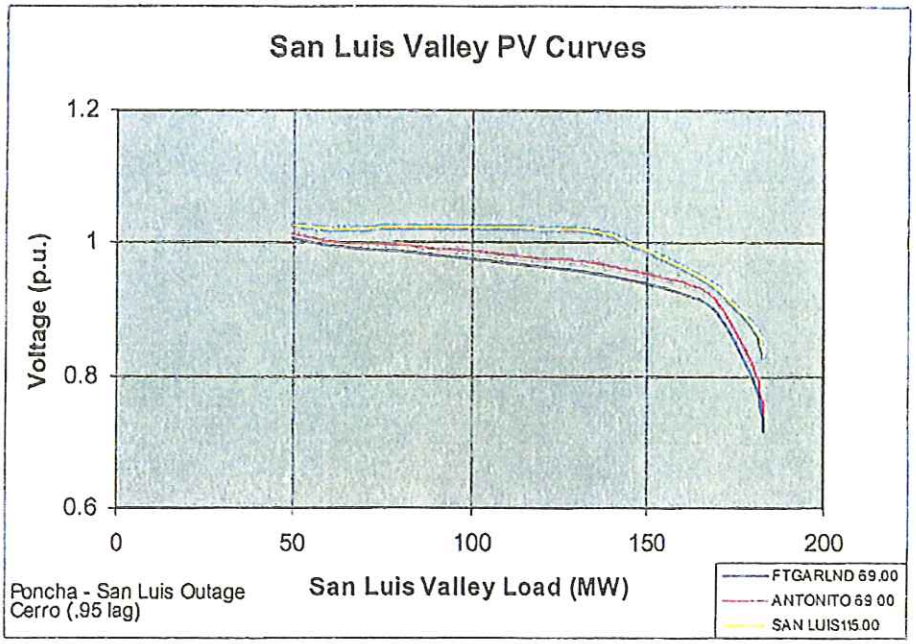
Alternative: Lone Cone – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 267 MW
Single Contingency Voltage Collapse Limit: 169 MW
Estimated Capital Cost (2003 Dollars): $68,116,000



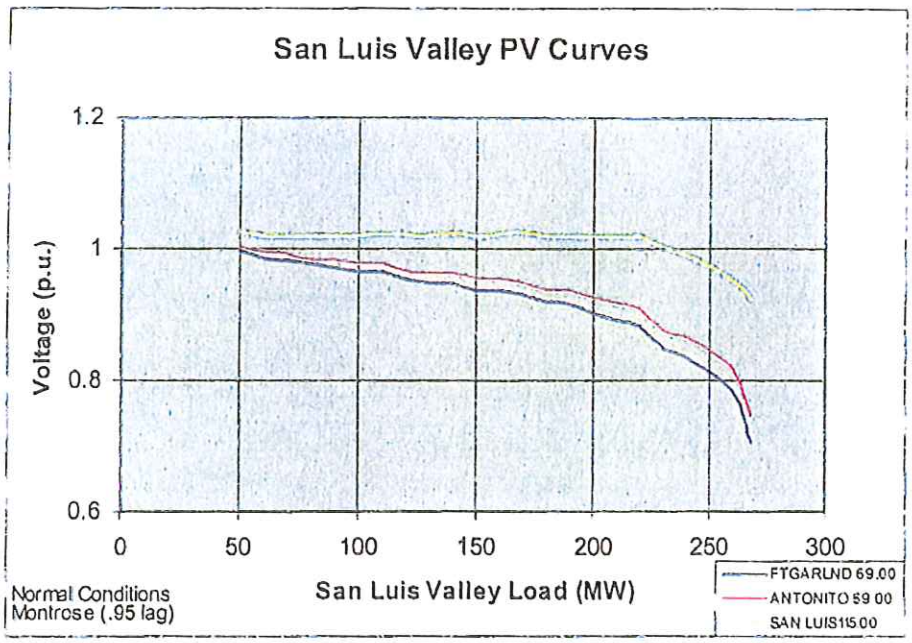



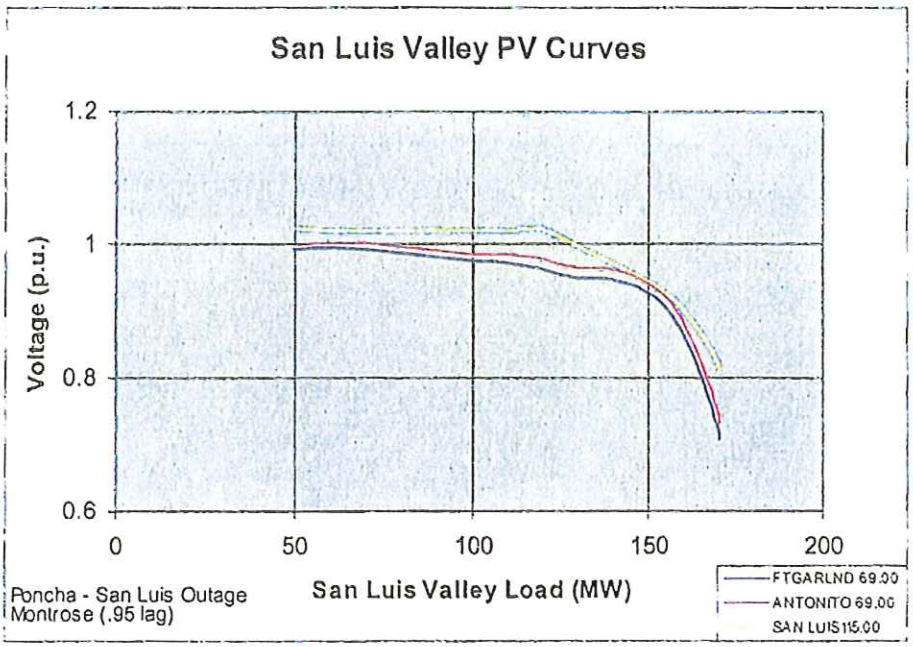
Alternative: Cerro – San Luis Valley 230kV
System Normal Voltage Collapse Limit: 269 MW
Single Contingency Voltage Collapse Limit: 183 MW
Estimated Capital Cost (2003 Dollars): $51,876,000



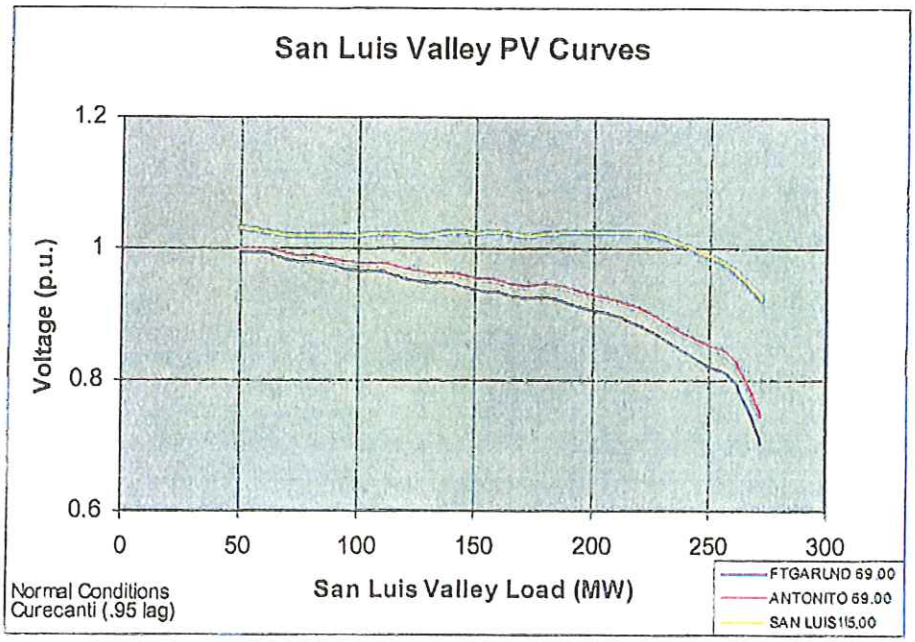



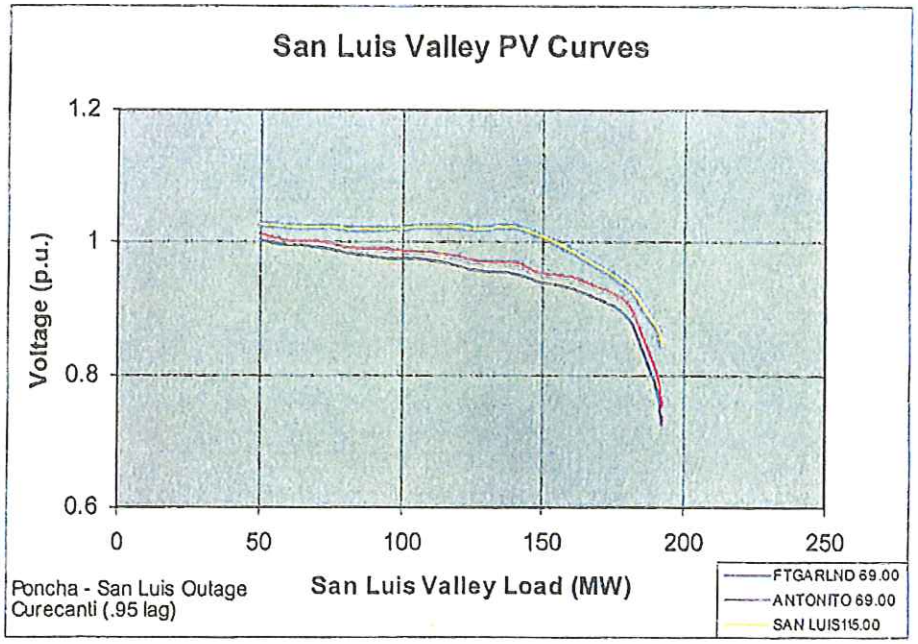
Alternative: Montrose – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 268 MW
Single Contingency Voltage Collapse Limit: 171 MW
Estimated Capital Cost (2003 Dollars): $58,027,000



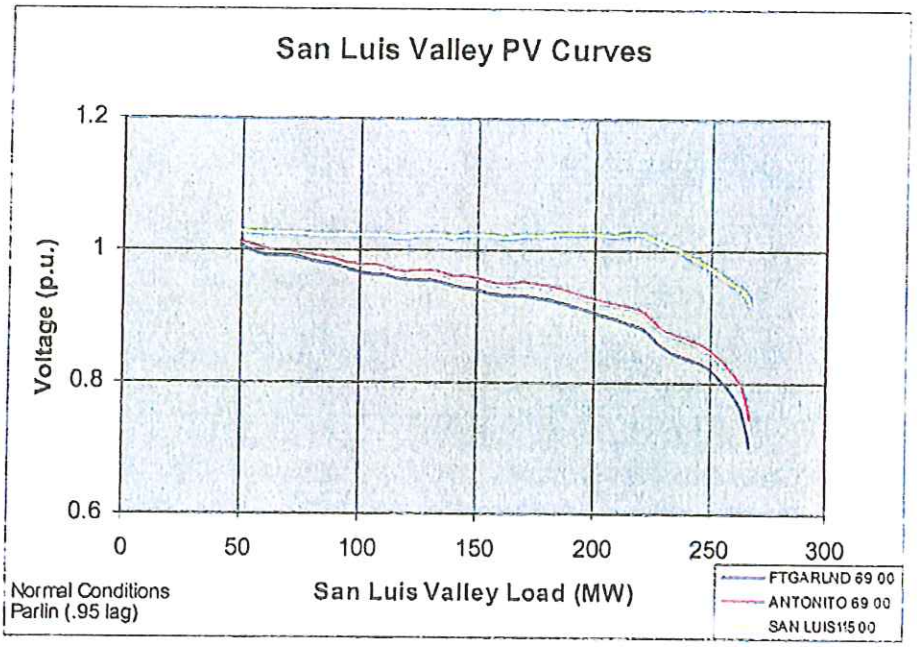



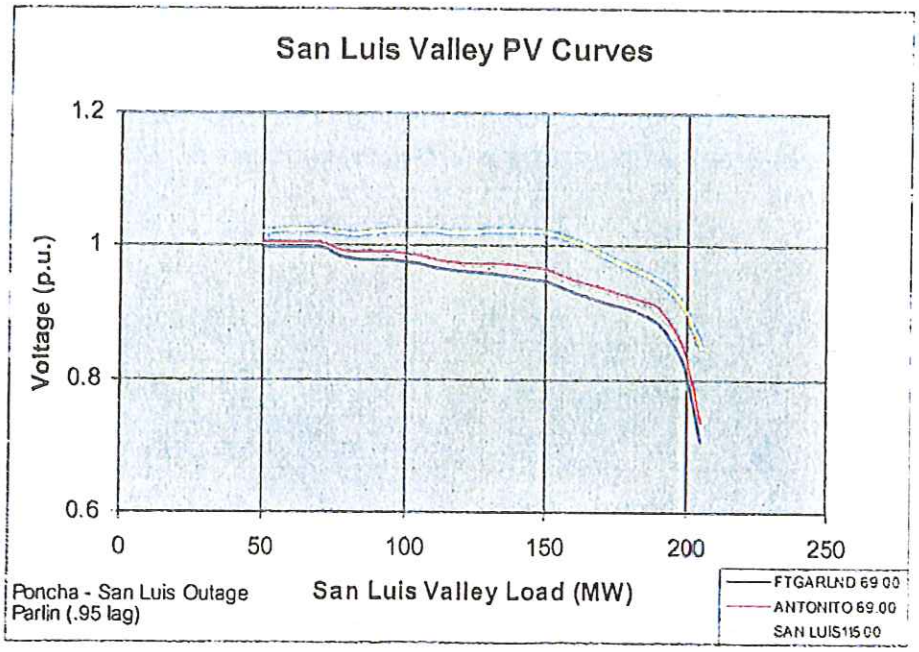
Alternative: Curecanti – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 272 MW
Single Contingency Voltage Collapse Limit: 192 MW
Estimated Capital Cost (2003 Dollars): $45,438,000



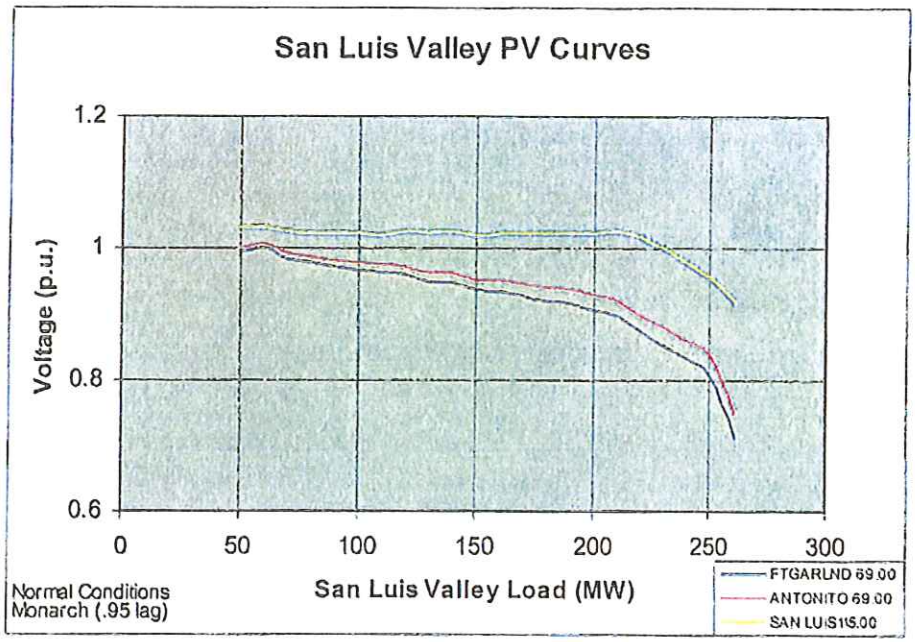



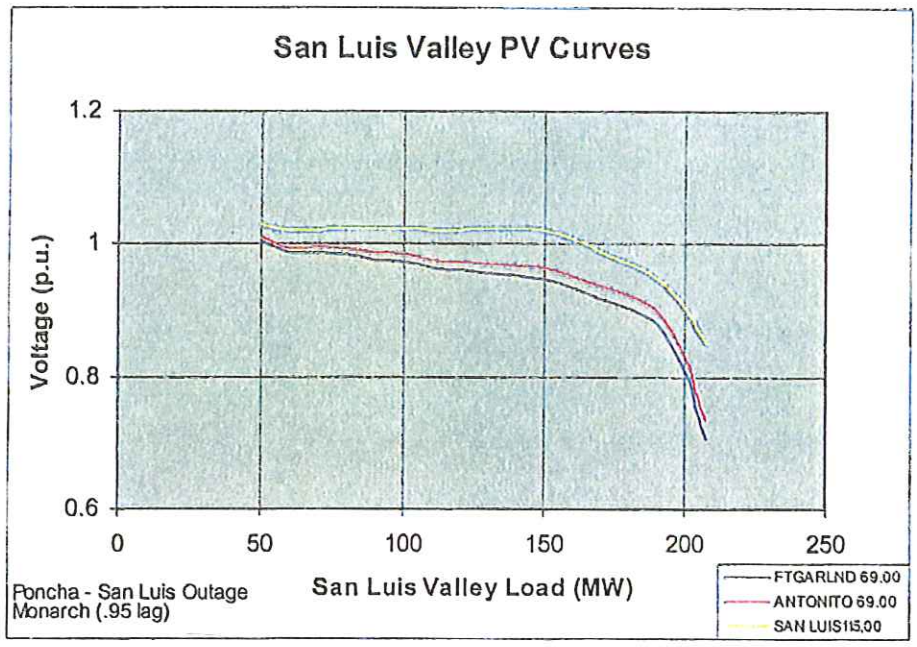
Alternative: Parlin – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 268 MW
Single Contingency Voltage Collapse Limit: 205 MW
Estimated Capital Cost (2003 Dollars): $36,920,000



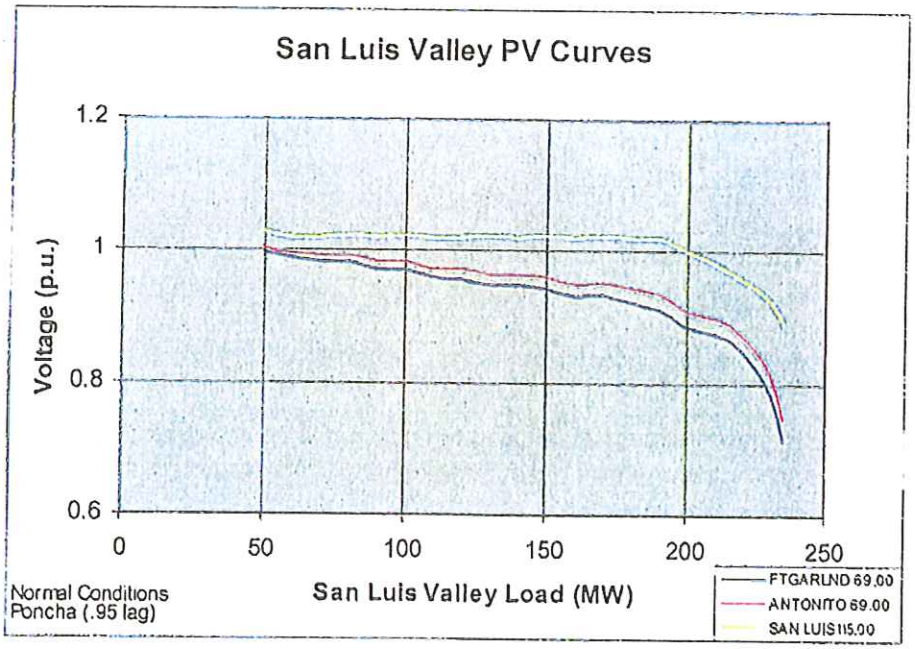



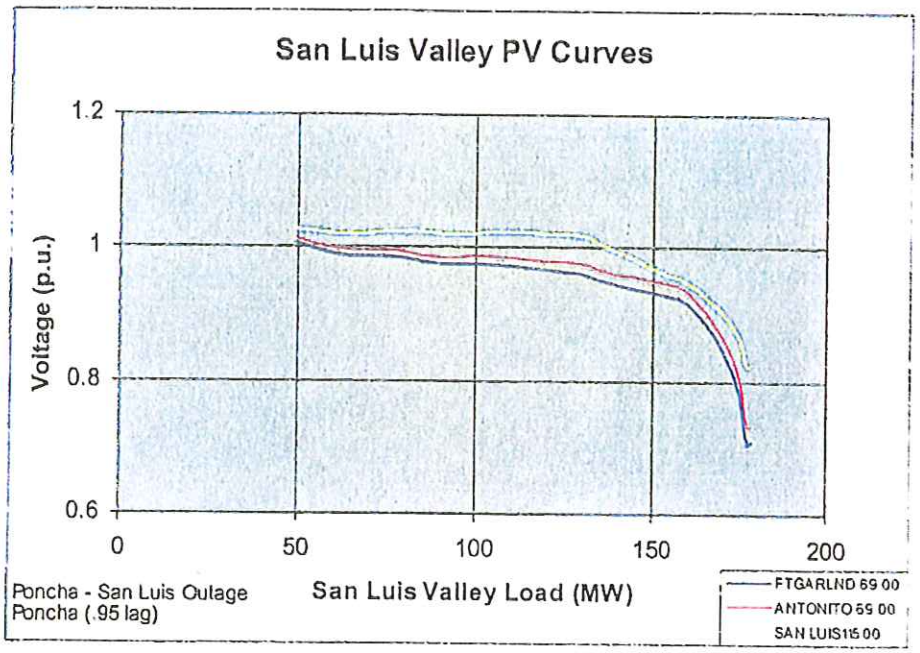
Alternative: Monarch – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 261 MW
Single Contingency Voltage Collapse Limit: 208 MW
Estimated Capital Cost (2003 Dollars): $34,920,000



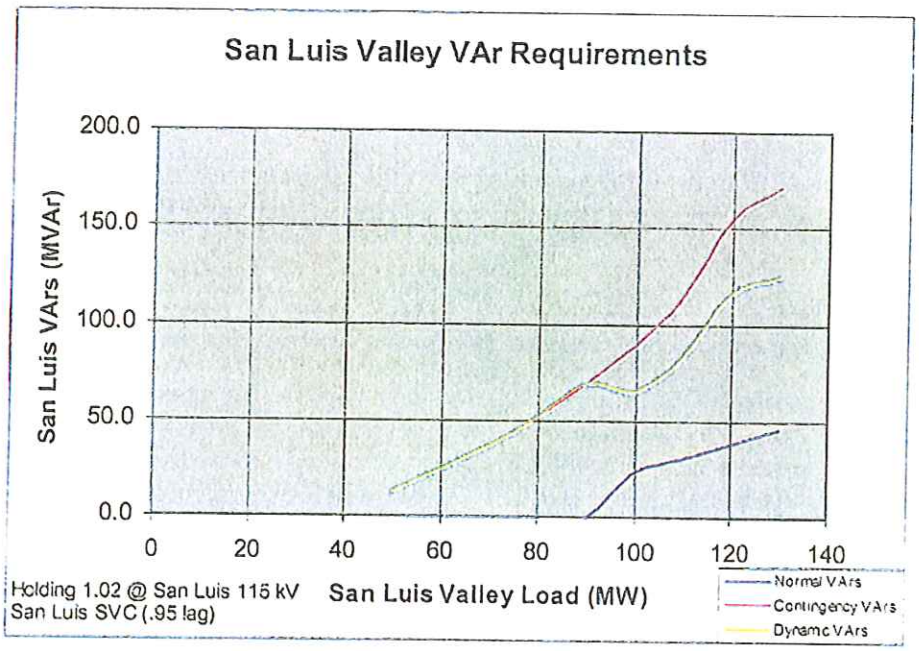



Alternative: Poncha – Sargent – San Luis Valley 230 kV
System Normal Voltage Collapse Limit: 235 MW
Single Contingency Voltage Collapse Limit: 178 MW
Estimated Capital Cost (2003 Dollars): $33,632,000



Alternative: San Luis Valley Static VAr Compensator
System Normal Voltage Collapse Limit: 280 MW
Single Contingency Voltage Collapse Limit: 129 MW[13]
Estimated Capital Cost (2003 Dollars): $9,306,000




[13] This is insufficient to serve existing peak loads in the valley.

# Appendix B

## Cost Estimates

Each Studied Alternative

| | |
|---|---|
| 230 kV Cost (per mile): | $400,000 |
| 345 kV Cost (per mile): | $500,000 |
| 230 kV Circuit Breaker Cost: | $719,000 |
| 345 kV Circuit Breaker Cost: | $1,133,000 |
| 115 kV Circuit Breaker Cost: | $466,000 |
| 345/230 kV Transformer Cost: | $2,123,000 |
| 230/115 kV Transformer Cost: | $927,000 |
| New Sub Fixed Cost: | $1,000,000 |
| 115 kV Removal (per mile): | $10,000 |
| SVC Fixed Cost: | $1,000,000 |
| SVC Variable Cost (per MVAr): | $40,000 |
| Capacitor Costs (per MVAr): | $40,000 |

| | | |
|---|---|---|
| **Monarch - San Luis Valley 230 kV** | | **$34,920,000** |
| Transmission Line | 70.0 | $28,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Monarch 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Monarch 115 kV Circuit Breaker | 3.0 | $1,398,000 |
| Monarch 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| | | |
| **San Luis Valley - Walsenburg 230 kV** | | **$33,550,000** |
| Transmission Line | 75.0 | $30,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Walsenburg 230 kV Circuit Breaker | 2.0 | $1,438,000 |
| Walsenburg 115 kV Circuit Breaker | 1.0 | $466,000 |
| Walsenburg 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 0.0 | $0 |
| | | |
| **Parlin - San Luis Valley 230 kV** | | **$36,920,000** |
| Transmission Line | 75.0 | $30,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Parlin 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Parlin 115 kV Circuit Breaker | 3.0 | $1,398,000 |
| Parlin 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| | | |
| **Cotopaxi - San Luis Valley 230 kV** | | **$36,920,000** |
| Transmission Line | 75.0 | $30,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Cotopaxi 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Cotopaxi 115 kV Circuit Breaker | 3.0 | $1,398,000 |
| Cotopaxi 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |

| | | |
|---|---|---|
| **Comanche - San Luis Valley 230 kV** | | **$39,438,000** |
| Transmission Line | 95.0 | $38,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Comanche 230 kV Circuit Breaker | 1.0 | $719,000 |
| Comanche 115 kV Circuit Breaker | 0.0 | $0 |
| Comanche Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Penrose - San Luis Valley 230 kV** | | **$44,920,000** |
| Transmission Line | 95.0 | $38,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Penrose 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Penrose 115 kV Circuit Breaker | 3.0 | $1,398,000 |
| Penrose 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| **San Luis Valley - Taos 230 kV** | | **$46,960,000** |
| Transmission Line | 100.0 | $40,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Taos 230 kV Circuit Breaker | 1.0 | $719,000 |
| Taos 345 kV Circuit Breaker | 3.0 | $3,399,000 |
| Taos 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Midway - San Luis Valley 230 kV** | | **$45,438,000** |
| Transmission Line | 110.0 | $44,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Midway 230 kV Circuit Breaker | 1.0 | $719,000 |
| Midway 115 kV Circuit Breaker | 0.0 | $0 |
| Midway 230/115 kV Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 0.0 | $0 |

| | | |
|---|---|---|
| **Curecanti - San Luis Valley 230 kV** | | **$45,438,000** |
| Transmission Line | 110.0 | $44,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Curecanti 230 kV Circuit Breaker | 1.0 | $719,000 |
| Curecanti 115 kV Circuit Breaker | 0.0 | $0 |
| Curecanti 230/115 kV Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Cerro - San Luis Valley 230 kV** | | **$51,876,000** |
| Transmission Line | 120.0 | $48,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Cerro 230 kV Circuit Breaker | 3.0 | $2,157,000 |
| Cerro 115 kV Circuit Breaker | 0.0 | $0 |
| Cerro Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| **Llaves - San Luis Valley 230 kV** | | **$55,959,000** |
| Transmission Line | 125.0 | $50,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Llaves 230 kV Circuit Breaker | 1.0 | $719,000 |
| Llaves 345 kV Circuit Breaker | 3.0 | $1,398,000 |
| Llaves 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| **Hesperus - San Luis Valley 230 kV** | | **$56,027,000** |
| Transmission Line | 130.0 | $52,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Hesperus 230 kV Circuit Breaker | 1.0 | $719,000 |
| Hesperus 345 kV Circuit Breaker | 1.0 | $466,000 |
| Hesperus 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 0.0 | $0 |

| | | |
|---|---|---|
| **Montrose - San Luis Valley 230 kV** | | **$58,027,000** |
| Transmission Line | 135.0 | $54,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Montrose 230 kV Circuit Breaker | 1.0 | $719,000 |
| Montrose 345 kV Circuit Breaker | 1.0 | $466,000 |
| Montrose 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Lone Cone - San Luis Valley 230 kV** | | **$68,116,000** |
| Transmission Line | 150.0 | $60,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Lone Cone 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Lone Cone 345 kV Circuit Breaker | 3.0 | $1,398,000 |
| Lone Cone 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| **San Luis Valley - Stoner 230 kV** | | **$68,116,000** |
| Transmission Line | 150.0 | $60,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Stoner 230 kV Circuit Breaker | 4.0 | $2,876,000 |
| Stoner 345 kV Circuit Breaker | 3.0 | $1,398,000 |
| Stoner 345/230 kV Transformer | 1.0 | $2,123,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |
| **Lost Canyon - San Luis Valley 230 kV** | | **$63,438,000** |
| Transmission Line | 155.0 | $62,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Lost Canyon 230 kV Circuit Breaker | 1.0 | $719,000 |
| Lost Canyon 115 kV Circuit Breaker | 0.0 | $0 |
| Lost Canyon 230/115 kV Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 0.0 | $0 |

| | | |
|---|---|---|
| **San Juan - San Luis Valley 230 kV** | | **$69,438,000** |
| Transmission Line | 170.0 | $68,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| San Juan 230 kV Circuit Breaker | 1.0 | $719,000 |
| San Juan 115 kV Circuit Breaker | 0.0 | $0 |
| San Juan Transformer | 0.0 | $0 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Gladstone - San Luis Valley 230 kV** | | **$75,550,000** |
| Transmission Line | 180.0 | $72,000,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Gladstone 230 kV Circuit Breaker | 2.0 | $1,438,000 |
| Gladstone 115 kV Circuit Breaker | 1.0 | $466,000 |
| Gladstone 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 0.0 | $0 |
| **Poncha - Sargent (SLV) 230 kV** | | **$33,632,000** |
| Transmission Line | 71.0 | $28,400,000 |
| San Luis 230 kV Circuit Breaker | 1.0 | $719,000 |
| Poncha 230 kV Circuit Breaker | 1.0 | $719,000 |
| Sargent 230 kV Circuit Breaker | 3.0 | $2,157,000 |
| Sargent 230/115 kV Transformer | 1.0 | $927,000 |
| New Substation Fixed Costs | 0.0 | $0 |
| 115 kV Removal | 71.0 | $710,000 |
| **San Luis Valley SVC** | | **$9,306,000** |
| Transmission Line | 0.0 | $0 |
| San Luis 115 kV Circuit Breaker | 1.0 | $466,000 |
| SVC Fixed Costs | 1.0 | $1,000,000 |
| SVC Variable Costs | 125.0 | $5,000,000 |
| Capacitor Costs | 46.0 | $1,840,000 |
| New Substation Fixed Costs | 1.0 | $1,000,000 |

# Appendix C

## Power Flow Data Listing

Base Case
Each Studied Alternative

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, DEC 09 2003  12:05
SAN LUIS VALLEY SECOND SOURCE STUDY * 03SLV0000HS                SYSTEM SUMMARY
EXISTING SYSTEM

------------------BUSES-----------------          GENERATION AREAS ZONES OWNERS AREA
TOTAL PQ<>0. PQ=0. PE/E  PE/Q SWING OTHER  LOADS PLANTS MACHS USED  USED  USED TRANS
13797  5474  6077  1203   776     1   266   6909  2030  2640   21   333   189    45
----------------AC BRANCHES----------------- 3WND MULTI-SECTION X---DC LINES--X FACTS
 TOTAL    RXB     RX    RXT   RX=0.  IN    OUT XFRM LINES SECTNS 2-TRM N-TRM VSC DEVS
 17680  11034    914   5552    180  16702  978   92   224   550    1     2     0    0

TOTAL GENERATION PQLOAD   I LOAD   Y LOAD   SHUNTS  CHARGING  LOSSES    SWING
MW     144784.0 139300.2      0.0      0.0    216.5       0.0  5267.4    526.1
MVAR    19553.0  30486.7      0.0   -135.7 -24635.8   55855.9 69693.6     79.6

TOTAL MISMATCH =     0.58 MVA X-----AT BUS-----X    SYSTEM   X------SWING-----X
 MAX. MISMATCH =     0.01 MVA 31588 WHITMORE60.0      BASE   30000 PTSB  7 20.0
  HIGH VOLTAGE = 1.29612 PU  50619 MFE 25  25.2      100.0
  LOW  VOLTAGE = 0.90000 PU  15981 NAVAJO 126.0  ADJTHR ACCTAP TAPLIM  THRSHZ  PQBRAK
                                                 0.0050 1.0000 0.0500 0.000290  0.700
X-------SOLV AND MSLV-------X  X----------NEWTON----------X  X------TYSL------X
 ACCP  ACCQ  ACCM   TOL  ITER  ACCN  TOL ITER  DVLIM NDVFCT  ACCTY   TOL  ITER BLOWUP
1.600 1.600 1.000 0.00010 100  1.00 0.100  50 0.9900 0.9900  1.000 .000010  20  5.00
```

```
     PTI INTERACTIVE POWER SYSTEM SIMULATOR--PSS/E      TUE, DEC 09 2003  12:05
SAN LUIS VALLEY SECOND SOURCE STUDY * 03SLV0000HS                  WORST
EXISTING SYSTEM                                                MISMATCHES
 BUS#    NAME  BSKV       MW        MVAR        MVA
31588 WHITMORE60.0       0.01        0.00       0.01
70376 SAN LUIS69.0       0.01        0.00       0.01
70024 ALMSA ST69.0      -0.01        0.00       0.01
31592 DESCHUTS60.0      -0.01        0.00       0.01
70026 ALMSA TM69.0      -0.01        0.00       0.01
70292 MOSCA   69.0       0.01        0.00       0.01
70374 SAN LUIS 115      -0.01        0.00       0.01
```