

System Impact Study Report For Xcel Energy OASIS Request 74515

Firm Point-to-Point Transmission Service for 176 MW From Craig/Hayden to Four Corners

Xcel Energy Transmission Planning
November 6, 2003

A. Introduction

On April 10, 2003 an organization submitted a request for long-term firm point-to-point transmission service to Public Service Company of Colorado (PSCo) under the Xcel Energy OATT. The request was for firm point-to-point transmission service for 35 MW starting in 2008 and increasing to 176 MW in 2012. The duration of the service has not been determined. The point of receipt will be at the Craig/Hayden generation station in northwest Colorado to a point of delivery at Four Corners in northern New Mexico.

The transmission system in western Colorado is defined as the system in western Colorado that is bounded by TOT1A on the northwest, TOT5 on the west, and TOT2A on the southwest. The facilities are owned primarily by three utilities – Western Area Power Administration (Western), Tri-State G&T (Tri-State) and PSCo. The system contains generation resources that serve the loads within the area and outside the area. Power at generation resources in the area is typically scheduled from east-to-west across TOT1A to Utah, from west-to-east across TOT5 to eastern Colorado, and north-to-south across TOT2A to New Mexico. TOT1A, TOT2A, and TOT5 represent power transfer paths that are recognized by the Western Electricity Coordinating Council (WECC). During the winter season, schedules across TOT2A can be from south-to-north to serve the heavy winter loads in Colorado.

The TOT2A path flows are measured across three lines – the Hesperus-San Juan 345 kV line, the Lost Canyon-Shiprock 230 kV line and the Durango-Shiprock 115 kV line and the path has a 690 MW transfer limit. The TOT2A path is owned by three utilities – Western, Tri-State, and PSCo. In order to accommodate the 176-MW transfer increase from Craig/Hayden to Four Corners, the transfer limit of the path must be increased from 690 MW to 866 MW.

The PSCo system in western Colorado lacks the capacity by itself to support the organization's request. Therefore, transmission enhancements would be required to accommodate this transmission service request. The enhancements considered in this study involve the addition of new facilities and upgrades on existing facilities owned by neighboring utilities and PSCo.

The results of this study indicated that there are not any PSCo-only alternatives that would be practical or cost-effective to achieve. The study did identify alternatives on neighboring systems that could accommodate the 176 MW request.

The potential system improvements identified in the study, the associated planning costs, and the tentative schedule need to be verified with Western and Tri-State as they are highly speculative and are based on PSCo's best knowledge at the time of this study. Should the organization's request be taken beyond this study, a joint area facilities study with all area utilities will be required to identify the total system upgrades necessary to support this transaction.

B. System Impact Study Approach

PSCo adheres to the WECC Reliability Criteria for planning studies. For example, during system intact conditions, criteria are to maintain system bus voltages between 0.95 and 1.05 per unit. Operationally, PSCo tries to maintain a system voltage profile ranging from 1.02 at generators to 1.0 or higher at load buses. Following a single contingency, voltages must be within 0.90 and 1.10 per unit and facility loadings must remain within 100% of their nominal steady state ratings for system intact conditions. Contingency analyses examined the existing system's weaknesses and determined the minimal required system reinforcements.

Figure No. 1 in Appendix A illustrates the existing western Colorado system north of TOT2A'. Figure No. 2 in Appendix A displays the existing western Colorado system south of TOT2A'. TOT2A' is a path that consists of the Montrose-Hesperus 345 kV line, the Curecanti-Lost Canyon 230 kV line and the Montrose-Nucla 115 kV line. The path is not a WECC-defined path but is a measure of the power flowing out of the Montrose and Curecanti substations to serve the demand in southwest Colorado and the power flowing from southwest Colorado to northwest New Mexico.

In order to determine if the western Colorado transmission system from Craig/Hayden to Four Corners can accommodate the 176 MW transmission reservation as requested by the organization, a WECC 2012

heavy summer power flow case was selected. This case reflects the expected demand conditions and planned upgrades in the study area for the year 2012. The case was used to determine a possible set of enhancements in the study area that would preserve the TOT2A path rating at 690 MW. The TOT2A path owners will need to study the suggested enhancements in more detail. This study assumes that the identified improvements listed in Appendix B are in place by the year 2008.

The purpose of study was to determine the enhancements needed to accommodate a 176-MW transfer from Craig/Hayden to Four Corners above the TOT2A path rating of 690 MW in the year 2012. The study also considered the improvements that would be required to accommodate a 35-MW increase on TOT2A in 2008, a 70-MW increase in 2009, a 105-MW increase in 2010, and a 140-MW increase in 2011. These improvements were identified using the 2012 heavy summer case by increasing the schedules from Craig/Hayden to Four Corners in 35-MW increments up to the 176-MW level. This approach is a conservative approach that assumes that load levels in 2008, 2009, 2010, and 2011 are at 2012 levels.

The cost estimates provided for the enhancements scheduled in 2008, 2009, 2010, 2011, and 2012 are based on a Western cost estimating guide that lists typical costs for facilities. These include estimates for engineering and surveying, land acquisition, permitting and environmental, administration and general, etc. that are based on Tri-State estimates.

These estimates are indicative planning estimates in 2003 dollars and should not be considered detailed engineering estimates.

The schedule estimate is based on a conservative assumption from Xcel Project Management without input from Western and Tri-State whose facilities are affected. Any schedule will require input from both Western and Tri-State to be valid. The construction sequence will also require a detailed joint study among the area utilities.

C. Transmission Improvements for Deliveries at Four Corners

The Study determined that the following transmission system improvements on PSCo's and neighboring systems are required to accommodate a 176-MW flow increase on TOT2A scheduled from Craig/Hayden to Four Corners in addition to a flow of 690-MW. In addition, cost estimates are provided for the enhancements.

1. Alternative No. 1

Uprate Western’s Shiprock-Lost Canyon-Curecanti 230 kV line to 345-kV, convert the Shiprock 230 kV phase-shifting transformer to 345-kV operation, add a third San Juan 300-MVA 345-kV phase-shifting transformer bank, add a third Shiprock 300-MVA 345-kV phase-shifting transformer bank, and other minor modifications.

Estimated Planning Cost (2003 \$) - \$141.3 million for a 176 MW Delivery

**Estimated Time Frame for Completion of Improvements:
84 Months**

Alternative No. 1 assumes that the TOT2A path flow is increased to a 690 MW level using a combination of schedules from eastern Colorado to Arizona, Idaho to Arizona, and Montana to Arizona. The study assumes prior enhancements identified in Appendix B have been made to the system by the TOT2A owners to achieve a level of 690 MW. The 176 MW transfer increase is scheduled from Craig/Hayden to Four Corners. The results are listed in Table No. 1 below.

Table No. 1 Alternative No. 1 – Cost estimate breakdown by year and request

YEAR	Amount of the Request on TOT2A above 690 MW	Facility Enhancements	Affected Utility	Cost (in millions)
2008	35 MW	Convert the Shiprock-Lost Canyon 230 kV line to 345-kV Convert the Curecanti-Lost Canyon 230 kV line to 345-kV	Western Western	\$ 121.7
2009	70 MW	Install a third 75-MVA 230-115 kV transformer at Curecanti	Western	\$ 2.4
2010	105 MW	Install a third 300 MVA 345-kV phase-shifting transformer bank at San Juan and a third 300 MVA 345-kV phase-shifting transformer bank at Shiprock.	Western	\$ 17.2
2011	140 MW	No facility Additions		\$ 0
2012	176 MW	Minor modification to the Meeker-Rifle 138 kV line to increase its rating to its thermal limit of 124 MVA.	Tri-State	less than \$50 k
		TOTAL COST ESTIMATE FOR ALTERNATIVE NO. 1		\$ 141.3

The following is a detailed list of the enhancements that comprise Alternative No. 1:

- 1.1 Convert Western’s 92.4-mile Curecanti-Lost Canyon 230 kV line to 345-kV in 2008 to accommodate the 35-MW request. The planning cost estimate is \$83.1 million.

- The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - Two 560-MVA 345-230 kV transformers will be installed at Western's Curecanti Substation.
 - A 345-kV 3-breaker ring bus (laid out for a future breaker-and-a-half arrangement) is needed at Curecanti Substation to terminate the Curecanti-Lost Canyon 345 kV line and for two 560 MVA transformers at Curecanti Substation.
 - The 230-kV position at Curecanti Substation made vacant by the removal of the Curecanti-Lost Canyon 230 kV line will be used to terminate the first 345-230 kV Curecanti transformer.
 - Two-thirds of a 230-kV breaker-and-a-half section is needed to terminate the second 345-230 kV Curecanti transformer.
 - A 4-breaker 345-kV ring bus (laid out for two future breaker-and-a-half arrangements) is needed at Tri-State's Lost Canyon Substation to terminate the Curecanti-Lost Canyon 345 kV line, the Lost Canyon-Shiprock 345 kV line, and two 250-MVA 345-115 kV transformers at Lost Canyon to replace the two 230-115 kV transformers that will be removed from Lost Canyon.
 - Two 115 kV line bays made available with the removal of the two 230-115 kV transformers will be used to terminate the two new 345-115 kV transformers.
- 1.2 Convert Western's 58.8-mile Lost Canyon-Shiprock 230 kV line to 345-kV in 2008 to accommodate the 35-MW request. The planning cost estimate is \$38.6 million
- The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - Two 345-kV breakers in the breaker-and-a-half arrangement at Shiprock Substation that is owned by Western and others will be needed to terminate the Lost Canyon-Shiprock 345 kV line.
 - The Shiprock phase shifting transformer (actually two 300 MVA transformers that were constructed for 345-kV operation but operated at 230-kV) will be prepared for 345-kV operation.
- 1.3 Add a third 75-MVA 230-115 kV transformer at Western's Curecanti Substation in 2009 to accommodate the 70-MW request. The planning cost estimate is \$ 2.4 million
- One 115-kV line bay to terminate the 230-115 kV transformer in an existing main-transfer scheme.

- One-third of a 230-kV breaker-and-a-half arrangement in the existing 230-kV breaker-and-a-half substation.
- 1.4 Add a third 300-MVA 345-kV phase-shifting bank at San Juan Substation that is owned by Western and others and a third 300-MVA 345-kV phase-shifting bank and Shiprock Substation in the year 2010 to accommodate the 105-MW request and the 140-MW request. The planning cost estimate is \$ 17.2 million
 - 1.5 Make minor modifications to Tri-State's Meeker-Rifle 138-kV line to increase the rating to its thermal limit of 124 MVA in year 2012 to accommodate the 176-MW request. The planning cost estimate is less than \$ 50,000.

A diagram of the system is shown in Appendix A, Figures 1 and 2

2. Alternative No. 2

Upgrade Western's Craig-Rifle-North Fork-Curecanti-Lost Canyon-Shiprock 230-kV line to 345 kV, convert the Shiprock 230 kV phase-shifting transformer to 345-kV operation, add a third Shiprock 300-MVA 345-kV phase-shifting transformer bank, add a third San Juan 300-MVA 345-kV phase-shifting transformer bank, and other minor modifications.

Estimated Planning Cost (2003\$): \$202.6 million for a 176 MW Delivery

Estimated Time Frame for Completion of Improvements: 84 Months

This alternative assumes that the TOT2A path flow is increased to a 690 MW level using a combination of schedules from the Pacific Northwest to Arizona, Idaho to Arizona, and Montana to Arizona. The study assumes prior enhancements identified in Appendix B have been made to the system by the TOT2A owners to achieve a level of 690 MW. These proposed enhancements differ from those determined for Alternative No.1. The 176 MW schedule is assumed to be from Craig/Hayden to Four Corners.

Note: The 341.7-mile Craig-Rifle-Hesperus-San Juan 345 kV line that is owned by Tri-State and PSCo uses bundled 1272 conductor. This line essentially parallels Western's 326.8-mile Craig-Rifle-North Fork-Curecanti-Shiprock 230 kV line. The Craig-Rifle section of Western's line uses bundled 1272 MCM conductor and is spaced

for 345-kV operation. From Rifle to Shiprock, the line uses single 1272 MCM conductor. To balance the flow between the parallel 345-kV circuits (when Western's line is operating at 345-kV), Western's line will require bundled 1272 conductor from Rifle to Shiprock. New towers were assumed to carry the additional weight.

The following enhancements comprise Alternative No. 2:

- 2.1 Convert Western's 94.7-mile Craig-Rifle 230 kV to 345 kV.
 - The line was constructed with bundled 1272 MCM conductor and spaced for 345-kV.
 - There is an open jumper at the Craig Substation owned by the Yampa participants that allows the line to be cutover to the 345-kV yard at Bears Ears.
 - There is an open jumper at Western's Rifle Substation that allows the line to be cutover from the 230-kV yard to the 345-kV yard via a 0.05-mile 345 kV line.
 - The Rifle 345 kV yard has a breaker position in the 345-kV ring bus available with existing breakers.

- 2.2 Convert Western's 52.4-mile Rifle-North Fork 230 kV line to 345 kV.
 - The conversion assumes bundled 1272 MCM with new transmission towers to support the line weight.
 - A 345-kV breaker will be needed at Western's Rifle Substation to terminate the Rifle end of Western's Rifle-Northfork 345 kV line.
 - A 3-breaker 345-kV ring bus (laid out for a future breaker-and-a-half arrangement is needed at Northfork Substation to terminate Western's Rifle-North Fork 345 kV line and Western's Northfork-Curecanti 345 kV line.
 - Two 250-MVA 345-115 kV transformers will be installed at Tri-State's Northfork Substation to replace the two 230-115 kV transformers that will be removed.
 - The study assumes that the two 115-kV breaker positions that become available with the removal of the two 230-115 kV transformers will be used for the new 345-115 kV transformers.

- 2.3 Convert Western's 28.5-mile North Fork-Curecanti 230 kV line to 345-kV.
 - The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.

- A 3-breaker 345-kV ring bus (laid out for a future breaker-and-a-half arrangement) is needed at Western's Curecanti Substation to terminate the Western's North Fork-Curecanti 345 kV line and the Western's Curecanti-Lost Canyon 345 kV line.
 - A 560-MVA 345-230 kV transformer will be needed at Western's Curecanti Substation to connect the 345-kV, 230-kV and 115-kV yards.
 - The study assumes that the 230-kV side of the 345-230 kV transformer will be terminated at one of the 230-kV breaker positions made available with Western's North Fork-Curecanti 230 kV line and Western's Curecanti-Lost Canyon 230 kV lines are converted to 345-kV.
- 2.4 Convert Western's 92.4-mile Curecanti-Lost Canyon 230 kV line to 345-kV.
- The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - A 3-breaker 345-kV ring bus (laid out for a future breaker-and-a-half arrangement) is needed at Tri-State's Lost Canyon Substation to terminate Western's North Fork-Lost Canyon 345 kV line and Western's Lost Canyon-Shiprock 345 kV line.
 - Two 250-MVA 345-115 kV transformers will be installed at Tri-State's Lost Canyon Substation to replace the two 230-115 kV transformers that will be removed.
 - The study assumes that the two 115-kV breaker positions that become available with the removal of the two 230-115 kV transformers will be used for the new 345-115 kV transformers.
- 2.5 Convert Western's 58.8-mile Lost Canyon-Shiprock 230 kV line to 345-kV.
- The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - Two 345-kV breakers in the breaker-and-a-half arrangement at Shiprock Substation owned by Western and others will be needed to terminate Western's Lost Canyon-Shiprock 345 kV line.
 - The Shiprock phase shifting transformer (actually two 300 MVA transformers that were constructed for 345-kV operation but operated at 230-kV) will be prepared for 345-kV operation. A third 300-MVA phase-shifting transformer will be added at Shiprock Substation. A third 300-MVA phase-shifting transformer will be added at San Juan Substation.

- 2.6 Reconductor Tri-State's 17.1-mile Spring Creek Tap-North Mesa-Garnet Mesa Tap 115 kV line with 477 MCM conductor.
 - It is assumed that Tri-State's 12.3-mile Garnet Mesa Tap-Hotchkiss 115 kV line would already be uprated to allow a TOT2A 690 MW rating.
- 2.7 Reconductor Western's 25.0-mile Montrose-South Canal-Curecanti 115 kV line from 477 MCM conductor to 795 MCM conductor.
- 2.8 Add a second 250 MVA 345-115 kV transformer at Montrose Substation owned by PSCo and Tri-State.

A diagram of the system is shown in Appendix A, Figures 1 and 2.

3. **Alternative No. 3**

Uprate Western's Craig-Rifle 230 kV line to 345-kV, uprate PSCo's Rifle-Colbran-Grand Junction 138 kV line to 230-kV, uprate Tri-State's Grand Junction-Montrose 115 kV line to 230-kV, uprate Western's Curecanti-Lost Canyon-Shiprock 230-kV line to 345 kV, convert the Shiprock 230 kV phase-shifting transformer to 345-kV operation, add a third Shiprock 300-MVA 345-kV phase-shifting transformer bank, a third San Juan 300-MVA 345-kV phase-shifting transformer bank, and other minor modifications.

Estimated Planning Cost (2003\$): \$222.5 million for a 176 MW Delivery

Estimated Time Frame for Completion of Improvements: 84 Months

This alternative assumes that the TOT2A path flow is increased to a 690 MW level using a combination of schedules from the Pacific Northwest to Arizona, Idaho to Arizona, and Montana to Arizona. The study assumes prior enhancements identified in Appendix B have been made to the system by the TOT2A owners to achieve a level of 690 MW. These proposed enhancements differ from those determined for Alternative No.1. The 176 MW schedule is assumed to be from Craig/Hayden to Four Corners.

The following enhancements comprise Alternative No. 3.

- 3.1 Convert Western's 94.7-mile Craig-Rifle 230 kV to 345 kV.

- The line was constructed with bundled 1272 MCM conductor and spaced for 345-kV.
 - There is an open jumper at the Craig Substation owned by the Yampa participants that allows the line to be cutover to the 345-kV yard at Western's Bears Ears Substation.
 - There is an open jumper at Western's Rifle Substation that allows the line to be cutover from the 230-kV yard to the 345-kV yard via a 0.05-mile 345 kV line.
 - PSCo's Rifle 345 kV yard has a breaker position in the 345-kV ring bus available with existing breakers.
- 3.2 Convert PSCo's 64.1-mile Rifle-Colbran-Grand Junction 138 kV line to 230-kV.
- The conversion assumes 1272 MCM conductor with new transmission towers to support the line weight.
 - PSCo's Colbran Substation is laid out as a 230-kV three-breaker ring bus laid out for future breaker-and-a-half.
 - Add a 75 MVA 230-115 kV transformer.
- 3.3 Convert Tri-State's 50.77-mile Rifle-Grand Junction 115 kV line to 230-kV.
- The conversion assumes 1272 MCM conductor with new transmission towers.
 - PSCo's Grand Junction Substation is laid out as a 230-kV three-breaker ring bus laid out for future breaker-and-a-half configuration.
 - Add a 280 MVA 345-230 kV transformer.
- 3.4 Convert Western's 92.4-mile Curecanti-Lost Canyon 230 kV line to 345-kV.
- The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - A 3-breaker 345-kV ring bus (laid out for a future breaker-and-a-half arrangement is needed at Tri-State's Lost Canyon Substation to terminate Western's North Fork-Lost Canyon 345 kV line and Western's Lost Canyon-Shiprock 345 kV line.
 - Two 250-MVA 345-115 kV transformers will be installed at Tri-State's Lost Canyon Substation to replace the two 230-115 kV transformers that will be removed.
 - The study assumes that the two 115-kV breaker positions that become available with the removal of the two 230-115 kV transformers will be used for the new 345-115 kV transformers.

- 3.5 Convert Western's 58.8-mile Lost Canyon-Shiprock 230 kV line to 345-kV.
 - The conversion assumes bundled 1272 MCM conductor with new transmission towers to support the weight of the bundled 1272 MCM conductors.
 - Two 345-kV breakers in the breaker-and-a-half arrangement at Shiprock Substation owned by Western and others will be needed to terminate the Lost Canyon-Shiprock 345 kV line.
 - The Shiprock phase shifting transformer (actually two 300 MVA transformers that were constructed for 345-kV operation but operated at 230-kV) will be prepared for 345-kV operation.
 - Add a third 300MVA phase-shifting transformer at Shiprock Substation and a third 300-MVA phase-shifting transformer bank at San Juan.
- 3.6 Reconductor Tri-State's 17.1-mile Spring Creek Tap-North Mesa-Garnet Mesa Tap 115 kV line with 477 MCM conductor.
 - It is assumed that Tri-State's 12.3-mile Garnet Mesa Tap-Hotchkiss 115 kV line would already be updated.
- 3.7 Reconductor Western's 25.0-mile Montrose-South Canal-Curecanti 115 kV line from 477 MCM conductor to 795 MCM conductor.
- 3.8 Add a second 250 MVA 345-115 kV transformer at the Montrose Substation owned by PSCo and Tri-State.
- 3.9 Add a second 280-MVA 345-230 kV transformer at PSCo's Grand Junction Substation.
- 3.10 Add a second 560 MVA 345-230 kV transformer at Western's Curecanti Substation.
- 3.11 Add a 7.5-MVAR 69-kV capacitor bank at PSCo's Uintah Substation.

A diagram of the system is shown in Appendix A, Figures 1 and 2.

Alternative No. 1 –

Alternative No. 1 can accommodate the 690 MW TOT2A path transfer limit (including planned enhancements) and the 176 MW transmission service request for the dispatch scenario studied. The dispatch scenario employed to raise the level TOT2A flow to 690 MW relied on schedules from Idaho to Arizona, Montana to Arizona and eastern Colorado to Arizona. The 176-MW request was served from units at Craig and Hayden and delivered to Four Corners.

Alternative No. 2 –

Alternative No. 2 can accommodate the 690 MW TOT2A path transfer limit (including planned enhancements) and the 176 MW transmission service request for the dispatch scenario studied. The dispatch scenario employed to raise the level TOT2A flow to 690 MW relied on schedules from the Pacific Northwest to Arizona, Idaho to Arizona, and Montana to Arizona. The 176-MW request was served from units at Craig and Hayden and delivered to Four Corners. This alternative assumed that a different set of enhancements as described for Alternative No. 1 in Appendix B would be made to achieve a path rating of 690 MW. The length of time to construct this alternative is at least seven years. Western owns the Craig-Rifle-Northfork-Curecanti-Lost Canyon-Shiprock 230 kV transmission system.

Alternative No. 3 -

Alternative No. 3 can accommodate the 690 MW path transfer limit (including planned enhancements) and the 176 MW transmission service for the dispatch scenario studied. The dispatch scenario employed to raise the level TOT2A flow to 690 MW relied on schedules from the Pacific Northwest to Arizona, Idaho to Arizona, and Montana to Arizona. This alternative assumes that a different set of enhancements as described for Alternative No. 1 in Appendix B will be made to achieve a path rating of 690 MW. It differs from Alternative No. 2 in that the uprate of Western's Rifle-Curecanti 230 kV line is replaced with the uprate of PSCo's Rifle-Colbran-Grand Junction 138 kV line to 230-kV and the uprate of Tri-State's Grand Junction-Montrose 115 kV line to 230-kV. It requires additional substation improvements and costs significantly more than Alternative No. 2.

230-kV Alternatives

Given the high cost of the two 345-kV alternatives, efforts were made to identify 230 kV alternatives that would accommodate a 690 MW TOT2A flow level and the 176 MW service requests for 2012 summer peak demands using the same scheduling pattern as used for the second and third alternative. These efforts

were unsuccessful as these alternatives were not reliable at the 866 MW transfer level. Some of the alternatives studied included:

- A. Lost Canyon-Nucla-Montrose 115 kV uprate to 230 kV
Montrose-Grand Junction 115 kV uprate to 230 kV
Grand Junction-Cameo 230 kV line
- B. Lost Canyon-Nucla-Montrose 115 kV uprate to 230 kV
Montrose-Grand Junction 115 kV uprate to 230 kV
Grand Junction-Colbran-Rifle 138 kV uprate to 230 kV line
- C. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Montrose-Nucla-Cahone-Lost Canyon 115 kV uprated to 230 kV
- D. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Montrose-Nucla-Cahone-Lost Canyon 115 kV uprated to 230 kV
Burro Bridge-Montrose 115 kV line
- E. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Montrose-Nucla-Cahone-Lost Canyon 115 kV uprated to 230 kV
Burro Bridge-Curecanti 115 kV line
- F. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Montrose-Nucla-Cahone-Lost Canyon 115 kV uprated to 230 kV
Burro Bridge-Curecanti 115 kV line
Burro Bridge-Montrose 115 kV line
- G. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Montrose-Nucla-Cahone-Lost Canyon 115 kV uprated to 230 kV
Reactive support added in southwest and western Colorado
- H. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Shiprock-Lost Canyon 230 kV uprated to 345 kV
Shiprock 230 kV phase-shifting transformer converted to 345 kV
- I. Craig-Rifle-North Fork-Curecanti 230 kV uprate to 345 kV
Shiprock-Lost Canyon 230 kV uprated to 345 kV
Shiprock 230 kV phase-shifting transformer converted to 345 kV
Reactive support added in southwest and western Colorado

APPENDIX A

SYSTEM DRAWINGS

Figure No. 1 – Western Colorado Area North of TOT2A'

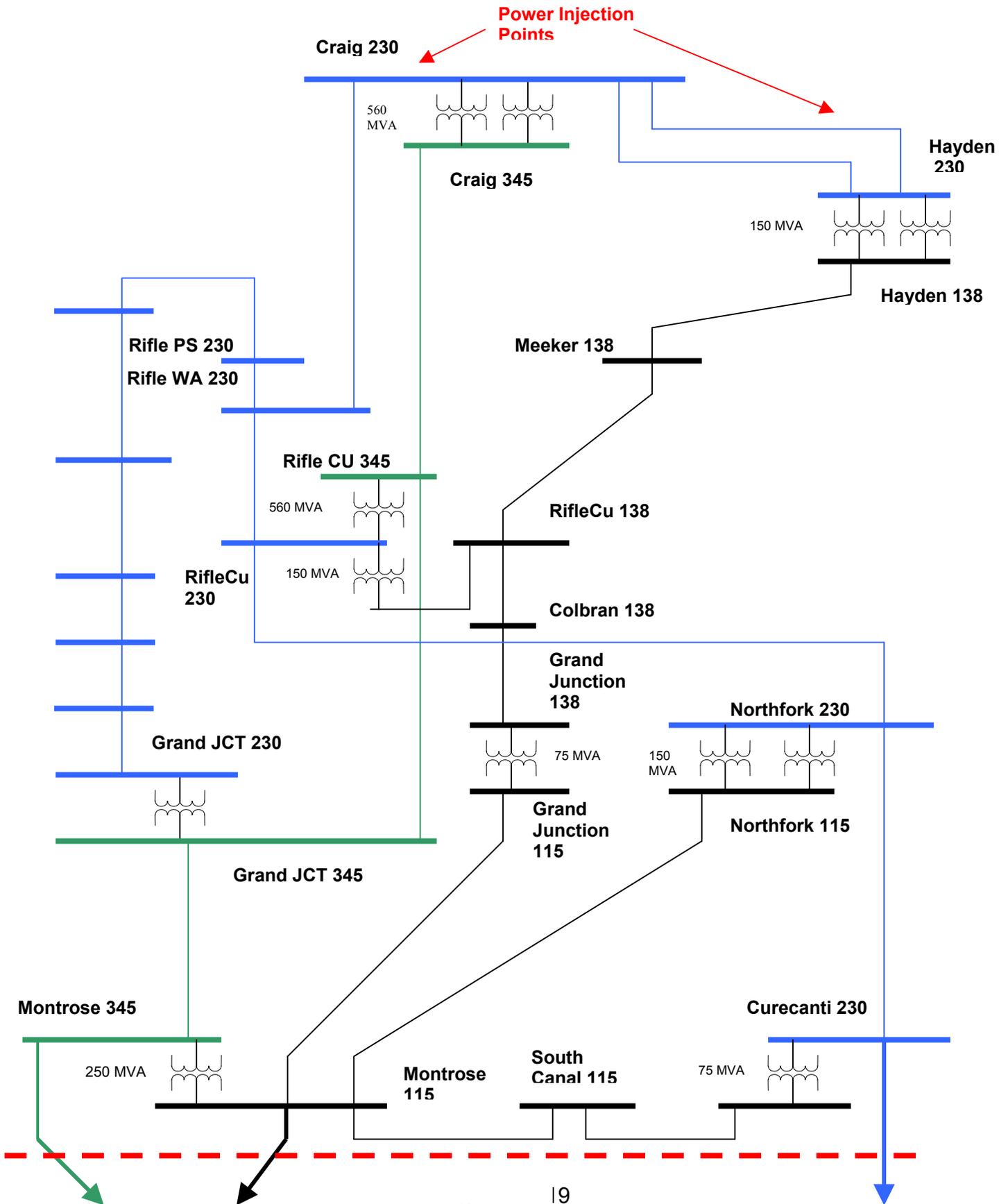
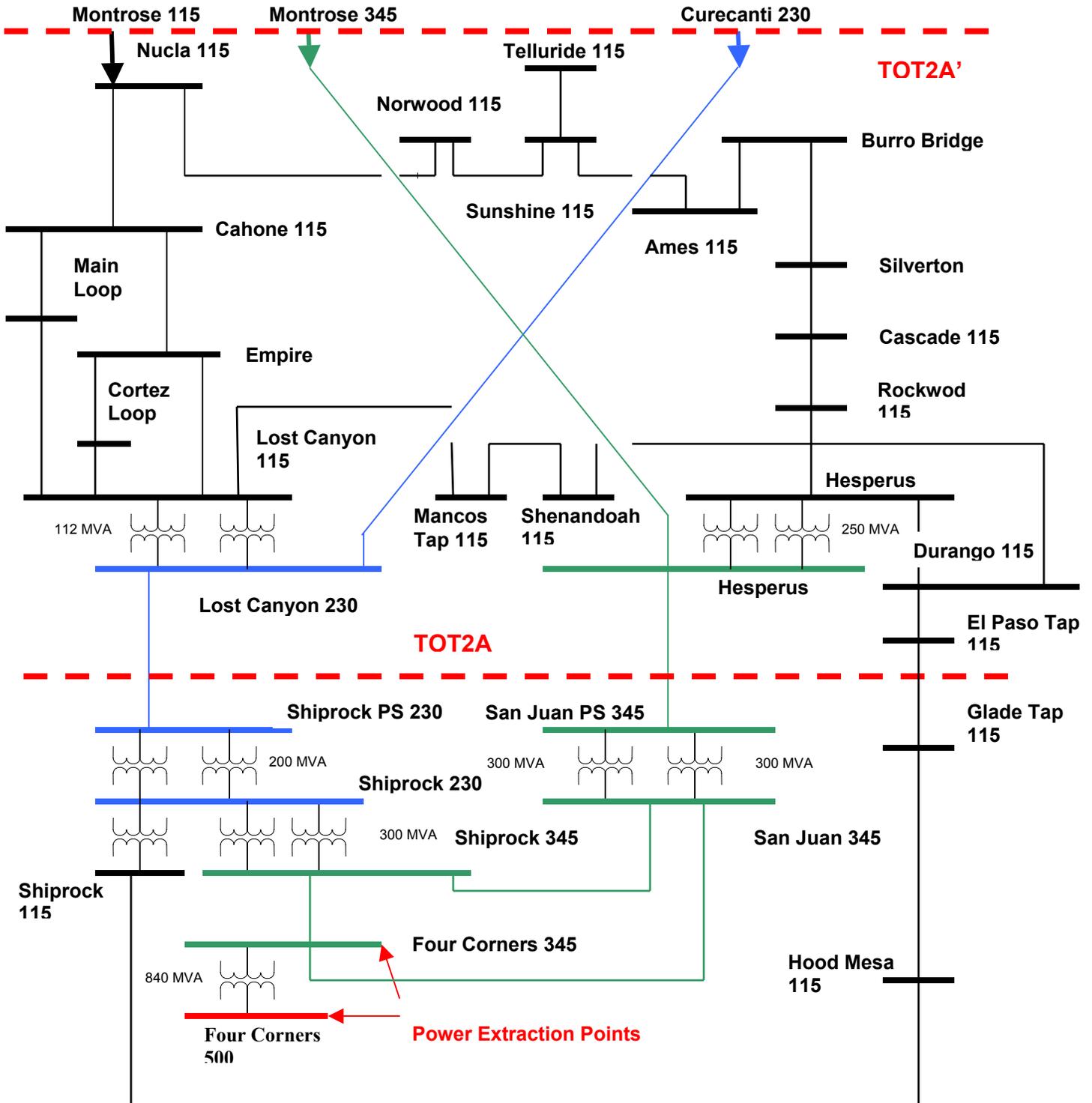


Figure No. 2 – Western Colorado System South of TOT2A'



APPENDIX B

WESTERN COLORADO AREA ENHANCEMENTS

The following facilities were added to the study case to remedy system problems in Western Colorado when the TOT2A flow is at a level of 690-MW in the years 2008 through 2012. These enhancements will require further study by Western Area Power Administration, Tri-State G&T and Public Service Company of Colorado.

Table No. 2 describes the facilities that were added to the study case to achieve a TOT2A level of 690 MW prior to adding the enhancements that comprise Alternative No.1 to accommodate the 176 MW request. These system improvements will need to be evaluated by the regional entities Western, Tri-State and PSCo in more detail.

Table No. 2. Facilities added to the study case to achieve a TOT2A rating of 690 MW (prior to the addition of Alternative No. 1)

Proposed Enhancement to Preserve the TOT2A Path Rating of 690 MW (2008 thru 2012)	Affected Facility Ownership		
	PSCo	TSGT	Western
1. Add a 400-MVAR 230 kV phase-shifting transformer at Gladstone 230 kV		X	
2. Add four 20-MVAR capacitor banks at Montrose 345 kV	X	X	
3. Add four 20-MVAR capacitor banks at Grand Junction 345 kV	X		
4. Add one 7.5-MVAR capacitor bank at Uintah 69	X		
5. Add two 20-MVAR capacitor banks at Hesperus 345 kV	X	X	X
6. Make minor modifications to increase the Craig-Rifle 230 kV line rating to its thermal limit of 956 MVA			X
7. Uprate the Curecanti-South Canal-Montrose 115 kV line from 120 MVA to 244 MVA by re-conductoring the 25.0-mile Montrose-South Canal-Curecanti 115 kV line to 795 MCM conductor from 477 MCM conductor.			X
8. Uprate the Hotchkiss-Garnet Tap 115 kV line rating of 95 MVA to 174.3 MVA by re-conductoring the line w/ 477 MVA at 100 degrees C.		X	
9. Uprate the Cameo-Vineland 69 kV line rating to 82 MVA by re-conductoring the line with 477 MCM conductor	X		
10. Uprate the Vineland-Grand Junction 69 kV line rating to 82 MVA by re-conductoring the line with 477 MCM conductor.	X		
11. Uprate the Grand Junction-Montrose 115 kV line rating to 146.4 MVA by increasing the design temperature to 75 degrees C.		X	
12. Uprate the Hotchkiss-North Fork 115 kV line rating to 174.3 MVA by increasing the design temperature to 100 degrees C.		X	
13. Uprate the North Mesa-Garnet Tap 115 kV line rating to 154.4 by increasing the design temperature to 100 degree C.		X	
14. Uprate the North Mesa-Spring Creek Tap 115 kV line rating to 130.5 MVA by increasing the design temperature to 75 degree C.		X	
15. Add a second Grand Junction 42-MVA 115-69 kV transformer	X		
16. Add a second Grand Junction 50-MVA 138-115 kV transformer	X		
17. Make minor modifications to increase the Curecanti-Lost Canyon 230 kV line rating to its thermal limit of 478 MVA.			X
18. Add a second Curecanti 75-MVA 230-115 kV transformer.			X
19. Add a second Montrose 250-MVA 345-115 kV transformer.	X	X	