

## Supplemental Study Report - Part B for Xcel Energy OASIS Request 74515 Xcel Energy Transmission Planning July 20, 2004

### A. Executive Summary

OASIS Request 74515 is a transmission request for 35 MW of firm north-to-south point-to-point transfer capability from Craig/Hayden to Four Corners starting in 2008 and increasing annually by 35 MW up to a total of 176 MW in 2012. In response to the this request, the following studies have resulted:

- T-2003-1 System Impact Study, posted on OASIS in November 2003, identified the system enhancements that would be needed on the western Colorado system in order to accommodate the 176-MW request in 2012. The results of this study indicated that the significant enhancements would be required at a total estimated planning level cost of \$141.3 million.
- T-2003-1 System Impact Supplement A, posted on OASIS in June 2004 determined that the firm point-to-point north-to-south transfer capability from Craig/Hayden to Four Corners would increase 14 MW in 2012 above the 176-MW request if the enhancements listed in Table No. 1 of the T-2003-1 System Impact Study were constructed. The study also identified that no additional transmission enhancements, above those necessary to achieve a 690 MW transfer capability, would be required to accommodate the Customer's initial 35 MW transmission service request.
- T-2003-1 System Impact Supplement B, this study, identified the enhancements needed to accommodate a 70-MW transfer in 2009, a 105-MW transfer in 2010, and a 140-MW transfer in 2011.

The following is a summary of transmission enhancements required by year:

Year	Accommodation	Enhancements Required to Support the Accommodation
2008	35 MW	None. Assumes enhancements to achieve 690 MW on TOT2A are completed by PSCo, Western-RMR and Tri-State. <b>\$0 Transmission Investment</b>
2009	70 MW	Increase the rating of Western-RMR's Curecanti-Lost Canyon-Shiprock 230 kV line to 345-kV. Modify the two Shiprock phase-shifting transformer banks for 345-kV operation. Add a third 300-MVA 345-kV phase-shifting transformer bank at San Juan. Add a third 300-MVA 345-kV phase shifting transformer bank at Shiprock. Add a third 75-MVA 230-115 kV transformer at Curecanti.  <b>Total 2009 Transmission Investment estimated at \$141.3 M</b>
2010	105 MW	Increase the rating of Western-RMR's Craig-Rifle WA 230 kV line rating to its thermal limit of 956 MVA. Replace the PSCo's Cameo-Vineland 69 kV conductor with 636 MCM conductor. Add a 20-MVAR capacitor at Tri-State's Lost Canyon Substation.  <b>TOTAL 2010 Transmission Investment estimated at \$0.9 M</b>

2011	140 MW	Replace the PSCo's Vineland-Grand Junction 69 kV line conductor with 636 MCM conductor. Add a 20-MVAR capacitor at PSCo's Grand Junction PS Substation.  <b>TOTAL 2011 Transmission Investment estimated at \$1.5 M</b>
2012	176 MW	Increase the rating of Tri-State's Meeker-Rifle 138 kV line to 124 MVA .  <b>Total 2012 Transmission Investment estimated at &lt; \$50K</b>

## B. Introduction

On April 30, 2004, the Customer and representatives from Public Service Company of Colorado (PSCo), Western Area Power Administration (Western-RMR) and Tri-State G&T (Tri-State) met to discuss the technical report that was completed by PSCo. The report provided justification for the system enhancements identified in OASIS Request 74515 for firm north-to-south point-to-point transmission service from Craig/Hayden in northwest Colorado to Four Corners in northwest New Mexico. The request was for 35 MW starting in 2008 and increasing to each year in 35-MW increments up to a total of 176 MW in 2012.

The representatives reviewed the technical study and requested that PSCo perform additional studies to answer questions from the report. The following additional studies were requested:

- Determine the amount of additional firm point-to-point north-to-south transfer capability from Craig/Hayden to Four Corners that would be possible with the transmission improvements listed in the report in Table No. 1 of the T-2003-1 System Impact Study. These improvements include the conversion of the Curecanti-Lost Canyon-Shiprock 230 kV line to 345 kV, the addition of a third 300-MVA 345-kV phase-shifting transformer at San Juan, a third 300-MVA 345-kV phase-shifting transformer at Shiprock, a third 75-MVA 230-115 kV transformer at Curecanti, and the increase in rating of the Meeker-Rifle 138 kV line to a higher rating. These enhancements are required to accommodate the 176 MW request. It was also requested that PSCo determine the minimum enhancements required in the 2008 heavy summer season to accommodate the initial 35 MW request from the customer. The completed study is called T-2003-1 System Impact Supplement A and was posted on OASIS in June 2004.
- Determine the minimum enhancements required to accommodate a 70 MW transfer in the year 2009, a 105 MW transfer in the year 2010, and a 140 MW transfer in the year 2011. The results of these analyses are summarized in this report, T-2003-1 System Impact Supplement B.

## C. System Impact Study Approach

### 1. Study Case Development

The WECC 2008 HS2-SA case (approved: February 11, 2004) was used as a starting point for developing the 2008, 2009, 2010 and 2011 heavy summer cases. The following adjustments were made to the cases:

#### a. Tri-State G&T

The loads in southwest Colorado in the 2008 heavy summer case were examined by Tri-State and the demands at the busses in the case were

adjusted to reflect TSGT's most up-to-date forecast by using actual 2003 summer load data and escalating the loads to the 2008 summer time frame assuming a 2% load growth factor. The Florida River 115 kV bus demand was decreased in the 2008 heavy summer case from 73.6 MW down to 29.3 MW as a result of the removal of a 40-MW project that has a new in-service date of 2012. The Cahone 115 kV bus demand was corrected in the 2008 heavy summer case to reflect the projected load at Empire's Cahone 46 kV distribution bus of 5.5 MW. This is consistent with the Cahone 115 kV demand in the 2004 heavy summer operating case of 4.3 MW.

b. Western-RMR

Western-RMR load data for the years 2009, 2010, and 2011 was approximated using the data in the 2008 case and the 2012 case. Each zone demand in the Western-RMR control area was determined by identifying the zone demand in the year 2008, the zone demand in 2012 and applying a constant growth rate to determine the 2009, 2010 and 2011 zone demands.

c. PSCo

The latest PSCo demand forecast (date: April 11, 2004) for the years 2008 through 2011 summer seasons was used in the cases. Detailed representations of the Grand Valley System with the proposed Adobe Substation and the Shoshone-Rifle 69 kV to 115 kV Uprate Project were added in western Colorado.

d. Generation Resources

The 2008, 2009, 2010 and 2011 heavy summer study cases were modified to reflect the current PSCo demand forecast. The 2010 and 2011 heavy summer study cases lacked sufficient resources to serve the projected PSCo demands in 2010 and 2011. To serve these demands, a second Pawnee generating station with a 750 MW maximum capability was added to the 2010 heavy summer study case. Transmission facilities needed to inject the Pawnee No. 2 plant output to the Ft. Lupton 230 kV and Smoky Hill 230 kV busses were added. A second Pawnee generating unit and associated transmission facilities were also added to the 2011 heavy summer study case. The T-2003-1 System Impact Study that was posted on OASIS in November 2003 identified the system enhancements that would be needed on the western Colorado system in order to accommodate the 176-MW request in 2012. The 2012 heavy summer study case that was used to determine the enhancements required in 2012 also included a second generating unit at Pawnee Substation as the Pawnee site was considered a likely location for new generation at the time the study case was created. In the spring of 2004, PSCo announced a proposal to construct a new 750-MW coal-fired plant at the Comanche Substation instead of the Pawnee Substation. This proposal included the addition of a Comanche-Daniels Park 345 kV double-circuit transmission line to deliver the Comanche plant output to the Daniels Park 230 kV bus. The selection of the Comanche site instead of the Pawnee site does not change the results of the studies that have been completed because the Daniels Park injection point for the Comanche unit output is located electrically near the Smoky Hill and Ft. Lupton injection points for the Pawnee unit output and therefore the flow patterns in western Colorado remain essentially unchanged no matter which of the two sites is selected.

## e. Other Modeling Considerations

For single contingencies, switchable shunt capacitors were allowed to adjust. The San Juan and Shiprock phase-shifting transformers were operated at zero degrees fixed phase for the 2008 through 2011 heavy summer cases. The Gladstone 230 kV phase-shifting transformer was not modeled in the 2008 through 2011 heavy summer cases. The study for the 2012 heavy summer season sufficiently demonstrated that the Gladstone PST is needed to prevent inadvertent flow through northern New Mexico during heavy transfers from eastern Colorado to Four Corners. The inadvertent flow through northern New Mexico was ignored in the 2008 through 2011 heavy summer cases because this problem is understood by Tri-State and is being studied as part of a long-range plan to serve customers in northern New Mexico. The Shiprock and San Juan phase-shifting transformers were allowed to load to 115% of their nominal rating under single contingency conditions. Western-RMR allows the 115% overload level as any overload can be removed quickly by operating the taps on the phase-shifting transformers to reduce the flow.

**D. Transmission Enhancements**

System studies were conducted for the years 2009 through 2011 at accommodation levels of 70 MW in 2009, 105 MW in 2010 and 140 MW in 2011. The results of the studies are contained in Table No. 1 below. The T-2003-1 System Impact Supplement A study concluded that no enhancements are required in 2008 provided PSCo, Tri-State and Western-RMR install the equipment that is listed in Table No. 2 of the System Impact Study that was posted on OASIS in November 2003

## 1. Enhancements Required in 2009

- Upgrade Western-RMR's Curecanti-Lost Canyon-Shiprock 230 kV line to 345-kV.
- Modify the two Shiprock 230 kV phase-shifting transformer banks for 345-kV operation.
- Add 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.
- Add a third 75-MVA 230-115 kV transformer at Curecanti.

Delaying the Curecanti-Lost Canyon-Shiprock 230 kV to 345-kV Upgrade Project until 2010 was attempted by adding 3-20 MVAR capacitors at Hesperus 345 kV and 2-20 MVAR capacitors at Lost Canyon in the 2010 study case. Even after the addition of these reactive sources, Tri-State's Hotchkiss-North Fork 115 kV line conductor would need to be replaced with 556.5 MCM conductor to increase its rating 174.3 MVA to 193.2 MVA. The cost of replacing the Hotchkiss-North Fork 115 kV line conductor and adding five capacitor banks is approximately \$2.4 million. At a line length of 7.12 miles, the total cost to replace the conductor would be \$890,000. Three 20-MVAR capacitor would be needed at the Hesperus 345 kV Substation and two 20-MVAR capacitors would be needed at the Lost Canyon 230 kV Substation at a cost of \$2,390,000. Please note that the above cost estimates are planning level estimates and would be refined in a future Facilities Study.

## 1. Enhancements Required in 2010

- Increase the rating of Western-RMR's Craig-Rifle WA 230 kV line to its thermal limit of 956 MVA.
- Replace PSCo's Cameo-Vineland 69 kV line conductor with 636 MCM conductor.
- Add a 20-MVAR capacitor at the Lost Canyon Substation.

This Craig-RifleWA 230 kV Uprate Project was listed in Table No. 2 of the System Impact Study and would be required in 2012 at a TOT2A level of 690 MW. This result reflects the higher California-Oregon Intertie (COI) flow in the 2012 HS case (COI=4495 MW) as compared with the 2010 HS case (COI=2670 MW). A higher the north-to-south (counter clockwise) COI flow tends to cause a higher north-to-south (clockwise) inadvertent flow from Craig to Four Corners

The Cameo-Vineland project was identified in the study T-2003-1 System Impact Supplement A as needed in 2012 to increase the Craig/Hayden to Four Corners transfers 14 MW above the accommodation level of 176 MW. The reason this project is needed in 2010 rather than in 2012 is due to the difference in the PSCo load forecast used to create the 2012 case and the PSCo load forecast used to create the 2010 case. Replacing the Cameo-Vineland 69 kV line conductor assumes a replacement cost per mile of \$150,000 and a line length of 4.1 miles for a total cost of \$615,000. The addition of a 20-MVAR capacitor bank at Lost Canyon Substation assumes a cost of \$15.00 per kVAR resulting in a project cost of \$300,000. Please note that the above estimates are planning level estimates and would be refined in a future Facilities Study.

2. Enhancements Required in 2011

- Replace the Vineland-Grand Junction 69 kV line conductor with 636 MCM conductor.
- Add a 20-MVAR capacitor at the Grand Junction PS Substation

The cost of replacing the Vineland-Grand Junction 69 kV line conductor with 636 MCM conductor assumes a replacement cost of \$150,000 per mile, at a line length of 7.8 miles, the project cost would be \$1,170,000. A 20 MVAR capacitor addition is needed at the Grand Junction PS Substation to provide voltage support for PSCo's Cameo-Adobe-GrandJPS-Grand JCT 230 kV loop for certain contingencies on the loop. Criteria violations occur due to higher demand on the loop because of the updated PSCo load forecast (date: April 11, 2004). The addition of a 20-MVAR (20,000 kVAR) capacitor bank at Grand Junction PS Substation assumes a cost of \$15.00 per kVAR resulting in a project cost of \$300,000. Please note that the above estimates are planning level estimates and would be refined in a future Facilities Study.

3. Enhancements Required in 2012

- Minor modifications to Tri-State's Meeker-Rifle 138 kV to increase the rating to its thermal limit of 124 MVA.

The cost of making minor modifications to Tri-State's Meeker-Rifle 138 kV line is less than \$50,000. This modification was identified in the T-2003-1 System Impact Study, posted on OASIS in November 2003. That study used a WECC 2012 heavy summer case. The PSCo control area demand in the 2012 heavy summer case is 8077 MW and is approximately 131 MW less than the PSCo control area demand in the 2011 heavy summer case that was developed for this study, the T-2003-1 System Impact Supplement B Study. The 2012 heavy summer case was developed from an earlier PSCo demand forecast than the 2011 heavy summer case; however, the impact of slightly smaller PSCo loads in western Colorado in the 2012 heavy summer case did not justify the creation of a second 2012 heavy summer case for the supplemental studies. This issue will be addressed in a facilities study. The enhancements recommended for each year of the study are listed in Table No. 1 below.

Table No. 1 Transmission enhancements required and planning level cost estimates by year.

YEAR	Amount of the Request on TOT2A above 690 MW	Facility Enhancements	Affected Utility	Cost (in millions)
2008	35 MW	<b>None</b>		<b>\$ 0</b>
2009	70 MW	Convert the Curecanit-Lost Canyon 230 kV line to 345-kV	Western-RMR	\$ 121.7
		Convert the Lost Canyon-Shiprock 230 kV line to 345-kV		
		Modify the two Shiprock 230 kV phase-shifting transformer banks for 345 kV operation	Western-RMR	less than \$50 k
		Install a third 300 MVA 345-kV phase-shifting transformer bank at San Juan	Western-RMR	\$ 17.2
		Install a third 300 MVA 345-kV phase-shifting transformer bank at Shiprock		
		Install a third 75-MVA 230-115 kV transformer at Curecanti	Western-RMR	\$ 2.4
		<b>TOTAL 2009 Transmission Investment</b>		<b>\$ 141.3</b>
2010	105 MW	Make minor modifications to increase the Craig-Rifle 230 kV line rating to its thermal limit of 956 MVA	Western-RMR	less than \$50 k
		Replace the Cameo-Vineland 69 kV conductor with 636 MCM conductor	PSCo	\$ 0.6
		Add 1-20 MVAR capacitor bank at the Lost Canyon 345kV bus	Tri-State	\$ 0.3
		<b>TOTAL 2010 Transmission Investment</b>		<b>\$ 0.9</b>
2011	140 MW	Replace the Vineland-Grand Junction 69 kV conductor with 636 MCM conductor	PSCo	\$ 1.2
		Add 1-20 MVAR capacitor bank at the GrandJPS 230 kV bus	PSCo	\$ 0.3
		<b>TOTAL 2011 Transmission Investment</b>		<b>\$ 1.5</b>
2012	176 MW	Make minor modification to the Meeker-Rifle 138 kV line to increase the rating to its thermal limit of 124 MVA.	Tri-State	less than \$50 k
		<b>TOTAL COST ESTIMATE FOR ALTERNATIVE NO. 1</b>		<b>\$ 143.7</b>