San Luis Valley - Calumet - Comanche Transmission Project

ALTERNATIVE EVALUATION

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TRI-STATE Generation and Transmission Association, Inc.

A Touchstone Energy® Cooperative

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1.0 Introduction

Tri-State Generation and Transmission Association, Inc. (Tri-State) and Xcel Energy's Colorado Operating Company Public Service Company of Colorado (Public Service) are proposing to participate in a joint project for the construction of a transmission project called the San Luis Valley–Calumet–Comanche Transmission Project (Project), which is comprised of four parts:

1. A new 345-230 kilovolt (kV) substation called Calumet, located approximately 6 miles north of Tri-State's existing Walsenburg Substation in Huerfano County, Colorado.
2. A double-circuit 230 kV line between San Luis Valley Substation and Calumet Substation.
3. A new (second) single-circuit 230 kV line between Calumet Substation and Tri-State's existing Walsenburg Substation.
4. A new double-circuit 345 kV transmission line connecting Calumet Substation to the existing Comanche Substation in Pueblo County, Colorado.

Parts 2 and 3, the 230 kV projects between San Luis Valley and Walsenburg to Calumet, are in lieu of Tri-State's proposed San Luis Valley Electric System Improvement Project.

Parts 3 and 4, taken together, fulfill the load-serving and reliability needs identified in Tri-State's proposed Boone–Stem Beach–Walsenburg 230 kV Project.

1.1 Description of Tri-State Generation and Transmission Association

Tri-State is a wholesale electric power supplier owned by the 44 electric member distribution systems that it serves. Tri-State generates and transports electricity to its member systems throughout a 250,000-square-mile service territory across Colorado, Nebraska, New Mexico, and Wyoming. Tri-State owns, operates, and maintains an extensive transmission system in these four states consisting of more than 5,200 miles of transmission lines, 135 substations, and switchyards.

Tri-State, founded in 1952 by its original member systems, today serves more than 1.4 million consumers in four states. Tri-State's mission is to provide its members a reliable, cost-based supply of electricity while maintaining a sound financial position through effective use of human, capital, and physical resources in accordance with cooperative principles.

1.2 Purpose of the Alternative Evaluation

The U.S. Department of Agriculture's (USDA) Rural Utilities Service (RUS) provides capital loans to electric cooperatives for the upgrade, expansion, maintenance, and replacement of the electric infrastructure in rural areas. Tri-State is pursuing financial support from the RUS for new 345 kV and 230 kV transmission lines in the Colorado Front Range and the associated 345 and 230 kV substations. The new transmission lines would connect the proposed 345-230 kV Calumet Substation in Huerfano County, Colorado to three existing substations: Tri-State's existing 230-115 kV Walsenburg Substation in Huerfano County, Colorado; the existing 230-115-69 kV San Luis Valley (SLV) Substation in Alamosa County, Colorado; and Public Service's 345 kV Comanche Substation in Pueblo County, Colorado.

The transmission lines will provide the power delivery infrastructure to increase the reliability and capacity of the existing transmission system and support proposed renewable energy development in the Walsenburg and San Luis Valley areas.

The RUS is required to evaluate environmental impacts of their actions under the National Environmental Policy Act (NEPA) and Council on Environmental Quality NEPA implementing regulations (40 Code of Federal Regulations 1500–1508). RUS guidance regarding NEPA implementation (RUS Bulletin 1794A-603) requires that a Macro Corridor Study (MCS) and Alternative Evaluation (AE) be prepared and accepted by RUS prior to the start of the official NEPA process. Tri-State has prepared this document to evaluate the system alternatives that best meet the purpose and need of the project. Potential corridor alternatives are discussed in the associated MCS reports.

1.3 Purpose for the Project

Tri-State provides wholesale power to its member-owned distribution systems, which in turn provide retail power to farms, homes, and businesses in their respective service areas. Four of Tri-State's members are directly affected by this project:

- San Luis Valley Rural Electric Cooperative (SLVREC)
- San Isabel Electric Association (SIEA)
- Southwestern Electrical Cooperative (SWEC)
- Springer Electric Cooperative (SEC)

SLVREC serves the bulk of the rural electric load in the San Luis Valley and Public Service serves the balance in the San Luis Valley and also around Alamosa, Colorado. SIEA serves more than 23,000 members in all or parts of seven counties in southern Colorado, including Pueblo and Huerfano counties. SWEC serves more than 897 members in all or parts of Harding, Quay, Union counties in New Mexico and Las Animas, Colorado. In addition, Tri-State depends on some of SWEC's 69 kV facilities to serve its Network Customer, Public Service of New Mexico (PNM), loads in Clayton, New Mexico. SEC serves approximately 1,950 consumers in the New Mexico counties of Colfax, Harding, Mora, San Miguel and Union.

As previously stated, Tri-State has partnered with Public Service on this Project. Tri-State's main interests are driven by a need to improve system reliability for its Members: SLVREC, SIEA, SWEC, and SEC. Public Service's desire to participate is based on a need to meet two objectives. First, similar to Tri-State, Public Service is interested in improving the reliability for its San Luis Valley customers. Public Service's second objective is to help meet the requirements of Colorado Senate Bill 07-100 (SB07-100), which requires Colorado's investor-owned utilities to designate Energy Resource Zones (ERZs) in Colorado and develop plans to construct or expand transmission to the ERZs to accommodate potential generation resources including renewable resources. The areas around the San Luis Valley and Walsenburg have been identified by Public Service to be in ERZs with high potential for solar generation development.

If successful, this project will help Tri-State and Public Service meet their respective transmission needs by utilizing one common transmission corridor instead of two separate corridors. This joint approach helps minimize potential impacts to property owners and the environment.

1.3.1 Reliability Improvement

Tri-State's primary purpose for the project is to solve a need to improve the electric service to SLVREC, SIEA, SWEC and SEC, and allow Tri-State and these members to more reliably serve their customers in southern Colorado and northeastern New Mexico. Two projects were developed by Tri-State to correct the reliability issues. The first project was the "San Luis Valley 230 kV Loop Project" or, alternatively, the "San Luis Valley Electric System Improvement Project" (SLVESIP). The SLVESIP consisted of a single-circuit 230 kV transmission line connecting the San Luis Valley and Walsenburg substations and was the subject of the "San Luis Valley Electric System Improvement Project" AE/MCS. The second project was the "Boone–Comanche–Stem Beach–Walsenburg 230 kV Line," which was developed to address reliability issues between Pueblo, Colorado, Walsenburg, Colorado, and northeastern New Mexico.

San Luis Valley Reliability

The reliability challenges in the San Luis Valley are documented in the original AE/MCS document prepared for the San Luis Valley Electric System Improvement Project. Study results indicated the Public Service Poncha–Sargent–San Luis 115 kV line could not adequately support peak loads during a single contingency outage of the jointly owned Poncha-San Luis Valley 230 kV line. Procedures have been implemented to shed Tri-State load in the area to avoid the risk of local voltage collapse. As a result, Tri-State had planned to construct a single 230 kV line between San Luis Valley and Walsenburg. The project would provide a second source to the San Luis Valley and mitigate contingency and voltage collapse concerns.

Pueblo, Walsenburg, and Northeastern New Mexico Reliability

Currently, if a single outage event occurs on Tri-State's existing Comanche–Walsenburg 230 kV transmission line, the 115 kV West Station–Stem Beach–Walsenburg line overloads. In order to stop the excessive flow on the 115 kV line between West Station and Walsenburg, a Remedial Action Scheme (RAS) is used. The RAS automatically opens (trips) the Walsenburg–Gladstone 230 kV line and unloads (mitigates) the 115 kV transmission line overload; however, tripping the Walsenburg–Gladstone 230 kV line reduces the load serving capability of the Springer–Gladstone–Clapham 115 kV line. Since the load serving capability is reduced, additional Tri-State member (SWEC and SEC) load must be shed in New Mexico. An additional path, electrically parallel to the existing Comanche–Walsenburg 230 kV line would decrease contingency loading on area transmission, eliminate the need for the RAS, and improve reliability for SIEA, SWEC, SEC and Tri-State's network customer, PNM.

In 2008, Tri-State's system planning engineers finalized the "Boone–Comanche–Stem Beach–Walsenburg 230 kV line report." [1] The study objectives considered transmission solutions capable of:

1. Supporting the SIEA projected 2012 peak load of 154.9 megawatts (MW) reliably and adequately. This forecast was subsequently reduced based on revised forecast values to 121 MW.
2. Eliminating the Walsenburg–Gladstone 230 kV line RAS for the loss of the Comanche–Walsenburg 230 kV line.

[1] Boone–Comanche–Stem Beach–Walsenburg 230 kV Line Report, TSGT, 2008.

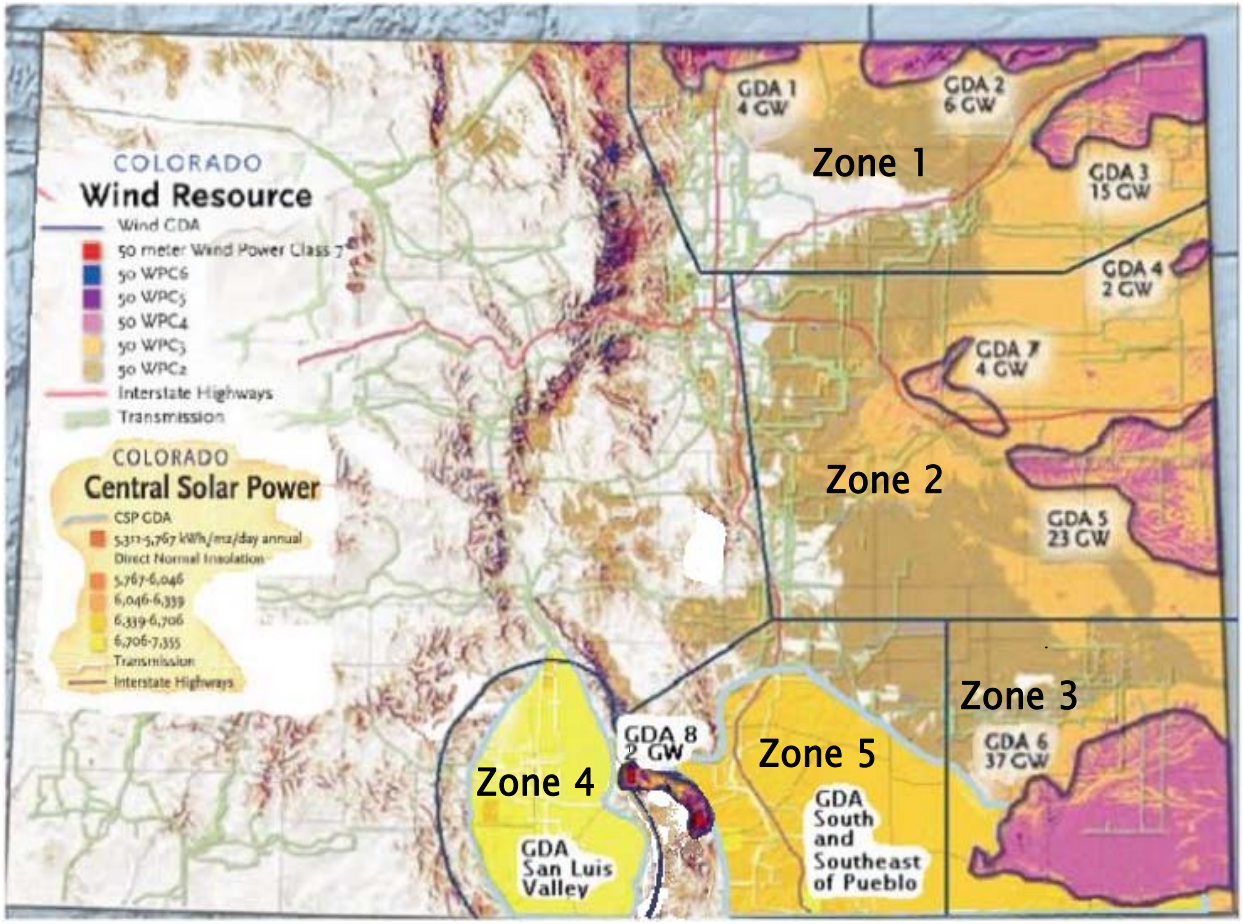
Within the study, seven transmission alternatives were considered. The final recommendation was for a new 230 kV Boone–Comanche–Stem Beach–Walsenburg line. The Comanche connection provided a minor benefit to Public Service and Black Hills Energy. Neither utility expressed an interest in the Comanche connection so Tri-State began to further define the 230 kV Boone–Stem Beach–Walsenburg project.

After reviewing the report, Public Service requested and Tri-State agreed to participate in a joint study of the region for SB07-100 purposes. The results of the alternatives evaluated jointly by Tri-State and Public Service are summarized in Section 3 of this Alternative Evaluation.

1.3.2 Public Service and SB07-100

On March 5, 2007, the General Assembly of Colorado passed SB07-100 upon recommendation by the 2006 Transmission Task Force on Reliable Electricity Infrastructure. SB07-100 directs Public Service to develop plans for the construction or expansion of transmission facilities as necessary to deliver electric power consistent with the timing of the development of beneficial energy resources, and to submit those plans for review and approval by the Colorado Public Utilities Commission for a Certificate of Public Convenience and Necessity (CPCN). Two of the transmission constrained areas that Public Service has identified are located in the south-central part of Colorado, and include the San Luis Valley and Walsenburg areas. As shown in Figure 1-1, these areas are referred to in SB07-100 filings as ERZs 4 and 5 or simply Zones 4 and 5. Public Service and Tri-State studies have verified that Zones 4 and 5 are constrained in terms of transmission. Based on analyses by the National Renewable Energy Laboratory (NREL), Zones 4 and 5 are prime locations for solar- and wind-generation development areas (GDA). Public Service's resource plan includes the development of solar-powered generation in the San Luis Valley region. In addition, Tri-State and Public Service have several wind powered interconnection requests in the Walsenburg/Calumet area.

Figure 1-1: Public Service Company of Colorado SB07-100 Energy Resource Zones[2]



[2] Figure from PSCo Report: "SB-100 Information report—Final", www.rmao.com/wtpp/SB100.

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2.0 Project Description

2.1 Proposed Action

The proposed project involves participating with Public Service to construct three new transmission line segments, each between an existing substation to the proposed Calumet Substation, to be located approximately 6 miles north of Walsenburg Substation on property already owned by Tri-State as shown on Figure 2-1.

The first segment includes a new double-circuit 230 kV line approximately 95 miles in length from San Luis Valley Substation to the new Calumet Substation. The conductor will be 1272 MCM ACSR with a maximum design temperature of 100^{o}C.

The second line segment includes a new double circuit 345 kV line, approximately 45 miles in length, from the new Calumet Substation to Public Service's Comanche Substation. The conductor will be two 1272 MCM ACSR conductors per phase with a maximum design temperature of 100^{o}C.

The third transmission line segment includes a new single-circuit 230 kV line on double-circuit structures between the new Calumet Substation and Walsenburg Substation. Similar to the 230 kV San Luis Valley to Calumet line segment, the conductor is planned to be 1272 MCM ACSR with a maximum design temperature of 100^{o}C. This also matches the conductor size of the existing Tri-State 230 kV Comanche-Walsenburg line that will be sectionalized at Calumet Substation as part of this Project. One side of the new 230 kV double circuit structures will be used for the new 230 kV Calumet-Walsenburg transmission circuit, while the other side is planned to be used for the existing 115 kV Stem Beach–Walsenburg line. This will utilize existing transmission corridors and allow the removal of the existing wood single circuit H-frame 115 kV Stem Beach–Walsenburg line for the section between Calumet and Walsenburg. There will be no 115 kV facilities planned at Calumet Substation, so the 115 kV Stem Beach–Walsenburg line will be routed around the station, as it currently passes through the Calumet property.

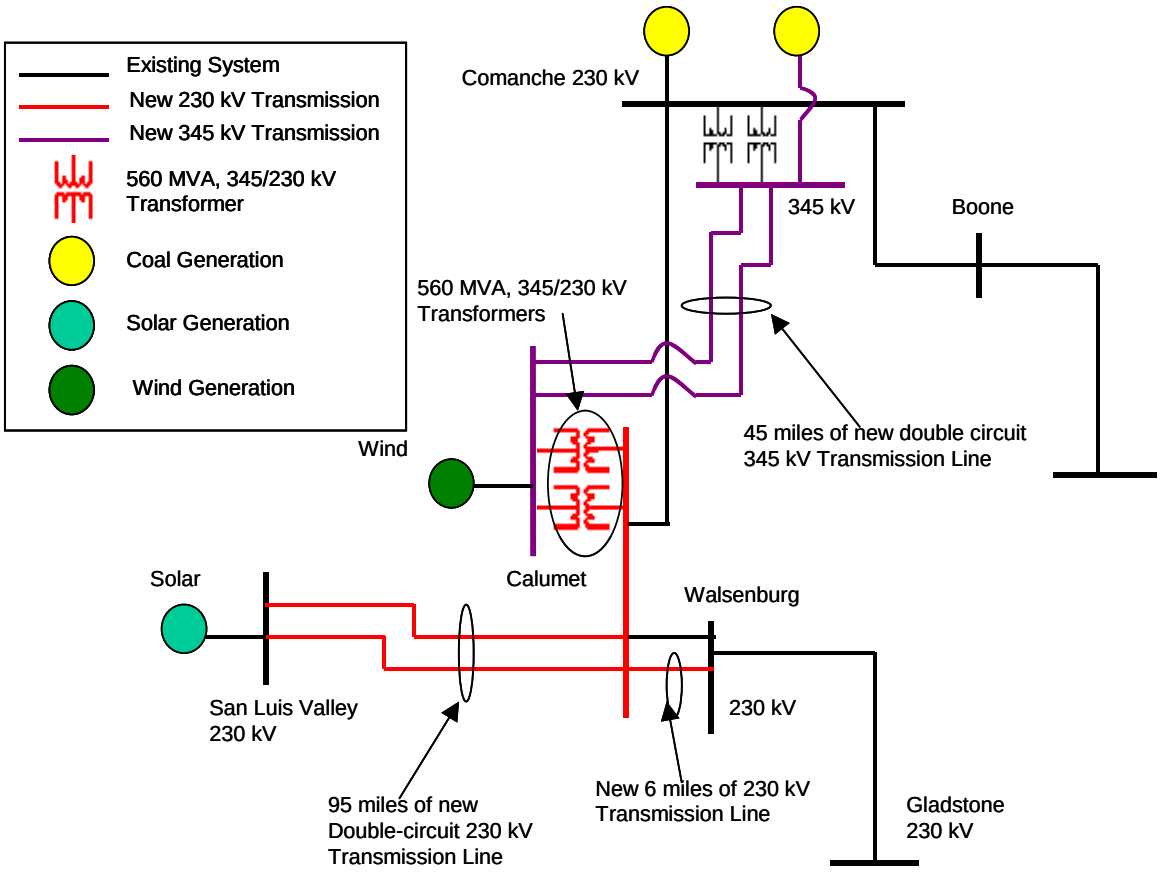
The new Calumet Substation will include two 345-230 kV 560 MVA autotransformers, eleven 230 kV breakers built in a breaker and a half arrangement, and four 345 kV breakers built in an initial ring bus arrangement with future expansion provisions to a breaker and a half arrangement. The eleven 230 kV breakers in a breaker and a half arrangement will allow for seven line or transformer positions, planned for five lines and two transformers. The five 230 kV lines consist of the two new 230 kV lines planned to San Luis Valley Substation, the new 230 kV line planned to Walsenburg Substation, and two lines to sectionalize the existing 230 kV Comanche-Walsenburg line into a 230 kV Comanche–Calumet line and a 230 kV Calumet–Walsenburg line. The four-breaker ring bus arrangement in the 345 kV section of the yard will allow for the two 345-230 kV transformer positions and two 345 kV lines to Comanche Substation.

The San Luis Valley Substation will be expanded from the existing three-breaker ring bus arrangement to a five-breaker ring to allow for the two new 230 kV line bays and future generator interconnections. The Walsenburg Substation will have one 230 kV breaker added in an existing bay of the main and transfer station arrangement to allow for the new 230 kV line from Calumet.

The Comanche Substation will require three 345 kV breakers to expand the station by one full breaker and a half bay in the existing breaker and a half arrangement to allow for two new 345 kV lines.

Tri-State and Public Service submitted companion CPCN applications to the Colorado Public Utilities Commission (CPUC) in May 2009. As part of the CPCN applications, Tri-State and Public Service submitted a joint report, titled "San Luis Valley-Calumet-Comanche Transmission Project."[3] The joint report discusses the alternatives studied in greater detail.

Figure 2-1: Project Area



[3] San Luis Valley–Calumet–Comanche Transmission Project, Transmission Study Report, Tri-State and Public Service Transmission Planning, May 2009.

3.0 Alternative Evaluation

3.1 Alternatives Considered

In the sections below, the "no action" alternative, and alternatives that address each aspect of the purpose and need described for the Project are discussed. As mentioned above, the most pressing need is to improve the reliability of the electrical service to Tri-State's Members. Each alternative that meets this purpose and need was also explored for its ability to support resource development in the San Luis Valley and Calumet areas. The energy requirements of the San Luis Valley to Walsenburg area were described in the June 2008 AE/MCS document for the original SLVESIP. This description is still valid.

3.1.1 No Action Alternative

Implementation of the "no action" alternative may not demonstrate compliance with the North American Electric Reliability Corporation (NERC) mandatory reliability standards.

If no action is taken to address the potential for voltage collapse in the San Luis Valley, the problem may become worse. If the loads in the San Luis Valley continue to grow, and the energy (megawatt hours [MWh]) of electrical use climbs, there will be more hours every year when the San Luis Valley is at risk of experiencing a voltage collapse.

Similarly, if no action is taken to remove the RAS and load shedding schemes in southern Colorado and north eastern New Mexico, Tri-State will not reliably meet its obligations to members and its network customer.

3.1.2 Additional Generation Capacity

Five different gas turbine generation alternatives, described as "emergency backup generation," were evaluated in the AE/MCS for the original SLVESIP. The report concluded the additional generation capacity for the San Luis Valley was not an effective or economic remedy to the reliability issues. The report states:

> Although the option of installing emergency backup generation would substantially reduce the risk of a voltage collapse, an allowance for forced outages must be considered. The "availability" of this type of generation is defined as the percentage of time a unit is available for operation, and not in "forced" or unplanned outage repair status. Based on information from the manufacturers, reliability and availability estimates of 98 percent and 95 percent, respectively, are reasonable for these units and represent best management practices. This implies that, even when properly operated and maintained, the emergency generation would not be available during approximately 400 hours per year because of unplanned events. In addition, this option would not improve the system for SIEA and surrounding areas.

Additional generation was not considered in the alternatives to eliminate the RAS and load-shedding schemes in southern Colorado and northeastern New Mexico.

Renewable energy sources like wind and solar are intermittent; therefore, additional renewable generation is not considered a viable mitigation option for the reliability issues described in Section 1.

3.1.3 Demand Side Management

Programs have already been implemented throughout Tri-State's member systems to promote energy conservation. They have been in place for more than 20 years and have been successful in helping to minimize the energy used and the maximum coincident peak load. However, as described in the June 2008 AE/MCS for the original project, it is unrealistic to expect that peak loads can be cost-effectively reduced enough to solve the voltage collapse issues in the SLVREC area. The San Luis Valley is subject to voltage collapse when the electrical demand exceeds 65 MW; this level of demand was exceeded more than 20 percent of the time (2,010 hours per year in 2007). Likewise, energy efficiency and demand side management (EE/DSM) techniques would not be effective in eliminating the reliability issues associated or caused by the Walsenburg–Gladstone RAS.

Since 1985, Tri-State (through their member cooperatives has been offering financial assistance toward the purchase of high-efficiency motors and pumps to reduce the electrical demand. The cooperatives have had the Energy Efficiency Credits (EEC) Program in place for more than 20 years. This program provides cash rebates to encourage and reward wise use of energy through energy-efficient purchases and practices. Through the EEC Program, Tri-State and the Tri-State member cooperatives have already reduced demand by over 73 MW (over the entire system) and saved more than 80,000 MWh of energy through the end of 2008. Tri-State and the members have expanded the EEC program to make it Energy Star based. In addition, additional measures and programs have been offered beginning at the first of 2009.

The Tri-State Members also have different EE/DSM programs they offer. All three of the members serving member-consumers in the San Luis Valley offer consumers appliance use information, energy use information, conservation guides, web-based conservation strategies and links, web-based energy calculators, free energy audits, and conservation programs, compact fluorescent lamp programs, and time-of-use rates. Each of them has line loss reduction strategies in place and participates through Tri-State in EPRI and CRN research into EE/DSM programs, measures and products.

Tri-State staff have conducted and participated in planning sessions with the members serving in the Valley to expand their programs to include additional demand response through which the load can be moved. For summer irrigation load, this will require installation of expensive communications and metering equipment to upgrade their current distribution infrastructures. These investments take time and planning that is well underway. Tri-State is working with one of the Members to support a smart grid expansion application under the American Recovery and Reinvestment Act of 2009 funding; this investment will support additional demand response. Tri-State is also evaluating whether to expand Economic Demand Response for summer 2010.

Finally, Tri-State has begun a comprehensive end-use EE/DSM study across the entire system. This study will examine the technical, economic, practical and actual energy and demand reduction potential. This study will focus on program and measure potential in discrete geographic regions, such as the San Luis Valley, and will identify those programs and measures that will have the most value to the member-consumers, the members, and Tri-State. This study will be completed in the first quarter of 2010 and implementation steps will be initiated later in the year.

An alternative to centralized generation and distribution of electrical energy is the installation of distributed generation. Distributed generation is built on the concept of installing generation at or near the point of

use. Solar, wind, or other alternative types of generation could be installed by the end user to meet specific needs. Residential loads, for example, can be reduced with the application of small solar or wind energy systems. These small systems would tend to reduce the loads in the San Luis Valley, and they would also reduce the maximum coincident peak (MCP) and result in reduced risk of voltage collapse (or subsequently less need for this Project). Irrigation loads, for example, represent a scheduled load and are not a good candidate for solar- or wind-generated power; however, this need could be met with some type of generator located near one or more of the irrigation pumps. Typically, this would need to be powered by gasoline or diesel engines to be available when irrigation was required. The owners and operators of irrigation systems currently have the option of installing local generation; however, the electric cooperative's obligation is to serve the member loads with the best option based on economic and environmental choices.

Tri-State has adopted several Board policies that enable and provide incentives to members and their member consumers to participate in and install local renewable projects that can count for renewable portfolio standard compliance in Colorado. These policies and the policies of the member boards will provide for net metering at the member-consumer premises and for small community-based projects. Each of the members offer net metering programs and are evaluating local renewable projects and participate through Tri-State in Electric Power Research Institute (EPRI) and Cooperative Research Network (CRN) research into distributed generation and distributed energy systems. Notwithstanding the attraction of such small projects, they remain costly.

In summary, programs have already been implemented that are designed to be compatible with the primary loads experienced on the member systems. These programs are effective in promoting energy conservation and local renewable energy development. They have been in place for more than 20 years, have already been successful in helping to minimize the energy used in the San Luis Valley and to minimize the MCP load, and should encourage more conservation in the future. However, it takes years to build out EE/DSM and distributed generation/local renewable projects that will have a material impact on local load and energy requirements. In addition, load growth in the area continues to be positive. The major factor contributing to the increasing summer MCP is the irrigation loads. Based on the growing residential loads combined with the amount of irrigation in the San Luis Valley, it is unrealistic to expect that peak loads can be cost-effectively reduced below 65 MW by either aggressive load management or through more aggressive energy conservation.

3.1.4 Additional Transmission Capacity

The Tri-State and Public Service joint studies were initiated with a power flow model that represented 2015 summer peak-loading conditions. The model was developed from Western Electricity Coordinating Council (WECC) case 2013HS1SA. Loads were adjusted throughout Colorado to 2015 peak summer levels based on Public Service, Tri-State, Colorado Spring Utilities, and Black Hills Energy forecasts. Additional detailed system representation data was included in some areas and a benchmark model was developed that did not include new proposed generation. The benchmark model did include Tri-State's proposed San Luis Valley Electric System Improvement Project (single circuit 230 kV) and the Boone-Stem Beach-Walsenburg 230 kV line. The benchmark case topology, which represents Tri-State's reliability driven projects, is shown in Figure 3-1. From the benchmark model, cases were developed to include new generation resources in the San Luis Valley, without additional transmission infrastructure alternatives.

The following is a list of alternatives considered:

Benchmark: San Luis Valley–Walsenburg single-circuit 230 kV; Walsenburg–Stem Beach–Boone single-circuit 230 kV (Benchmark)

Alternative 1: San Luis Valley–Calumet double-circuit 230 kV; Calumet–Comanche double-circuit 345 kV and Calumet–Walsenburg single-circuit 230 kV (proposed)

Alternative 2: San Luis Valley–Walsenburg double-circuit 230 kV; Walsenburg–Stem Beach–Comanche–Boone single-circuit 230 kV

Alternative 3: San Luis Valley–Walsenburg single-circuit 230 kV; Walsenburg–Stem Beach–Comanche single-circuit 230 kV; San Luis Valley–Comanche single-circuit 345 kV

Alternative 4: San Luis Valley–Calumet double-circuit 230 kV; Calumet–Walsenburg single-circuit 230 kV; Calumet–Comanche single-circuit 345 kV

Alternative 5: San Luis Valley–Calumet double-circuit 345 kV; Calumet–Comanche double-circuit 345 kV; Calumet–Walsenburg single-circuit 230 kV

3.1.4.1 Resource Injection Limiting Element Assumptions

The benchmark analysis indicated adding more than 450 MW of new resources at the San Luis Valley 230 kV bus overloaded some system elements. Overloaded elements included the underlying 69 and 115 kV transmission lines and some autotransformers (230-115 kV) in the San Luis Valley and at Midway Substation. Upon further review and discussion with potentially affected utilities (Western and Black Hills Energy), the following analysis assumptions were made to develop less restrictive limiting elements.

Overloads for the following items were not considered limiting elements:

1. Facilities overloaded in the benchmark case with zero generation injection.
2. Facilities with known overloads.
3. Short lengths of 69 or 115 kV line, typically less than 10–15 miles.
4. 230-115 kV autotransformers were allowed to reach 115 percent loading under contingency conditions.

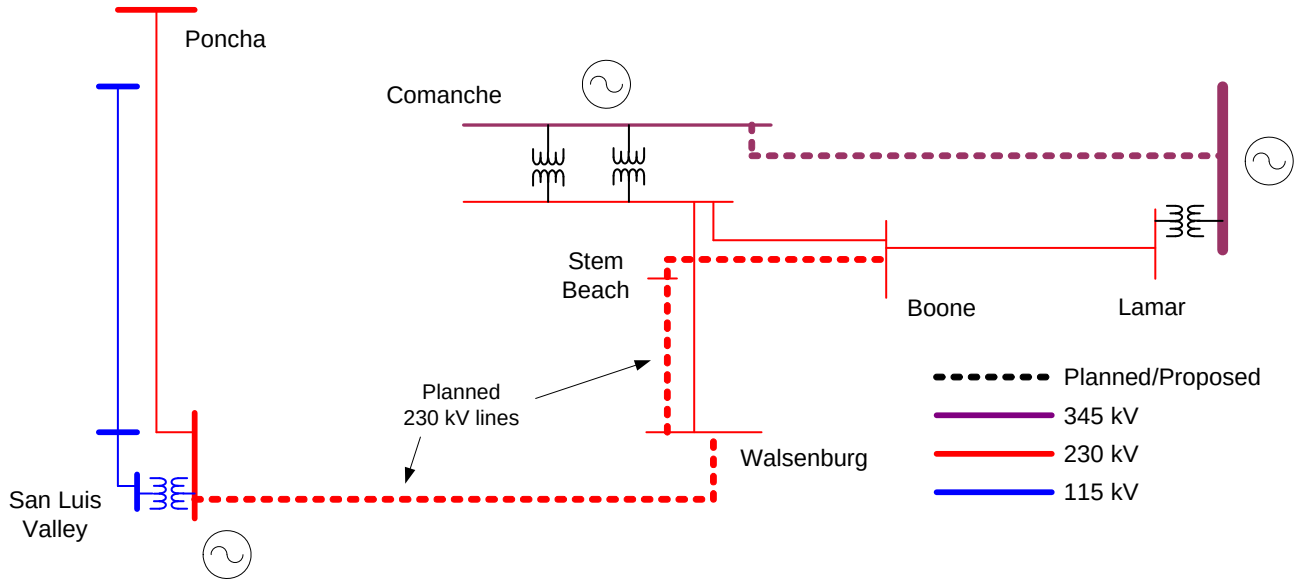
Besides employing the limiting element assumptions above, the following items will affect the actual injection level limits:

1. Load in the San Luis Valley was kept constant at approximately 155 MW. No lightly loaded cases were studied.
2. No transient or dynamic studies were performed. Proxy generators were used.
3. Potential effects on WECC-rated paths were not assessed.
4. All Calumet injections were modeled on the 345 kV bus. All Walsenburg injections were modeled on the 230 kV bus. All San Luis Valley injections were modeled on the 230 kV bus.

3.1.4.2 Transmission Alternative Summary

The following section describes the benchmark case and the five transmission alternatives and provides a results summary.

Figure 3-1: Benchmark



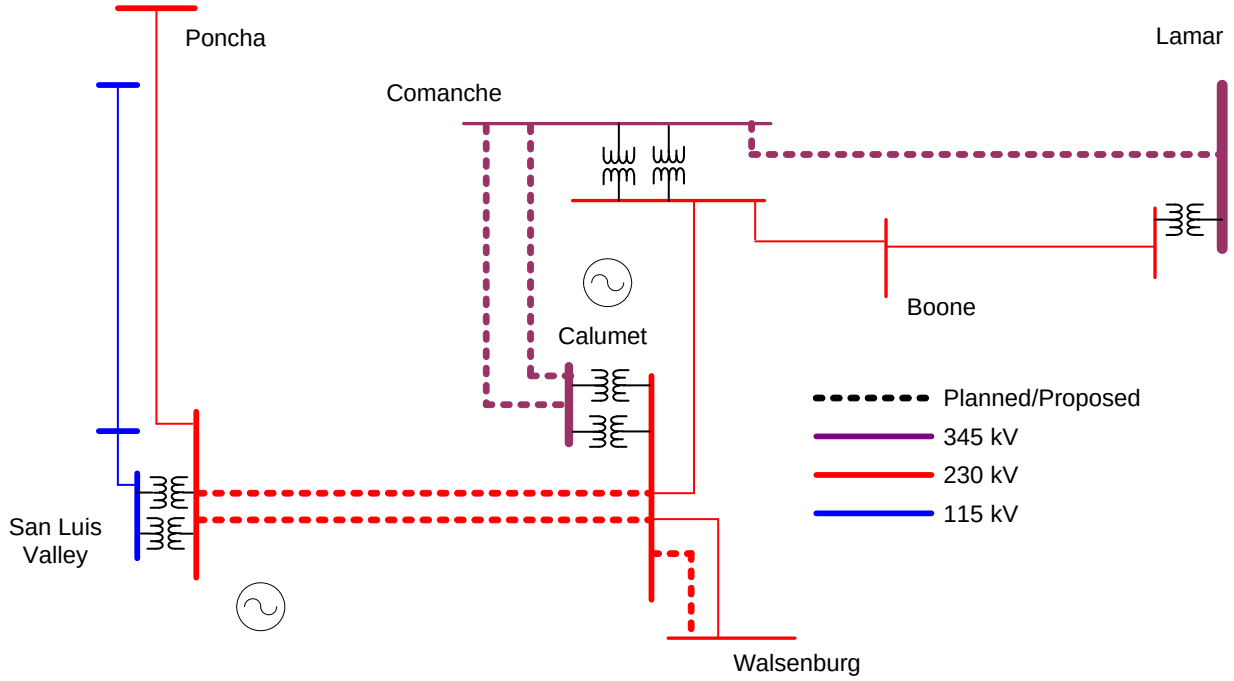
Benchmark includes the addition of the new San Luis Valley–Walsenburg single-circuit 230 kV and Walsenburg–Stem Beach–Boone single-circuit 230 kV transmission lines (Figure 3-1). These two projects represent Tri-State's originally proposed projects to correct reliability issues in the San Luis Valley and north east New Mexico areas.

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. Is capable of approximately 650 MW at the SLV substation if the 230-115 kV SLV autotransformers are allowed to load to 115 percent under contingency conditions. With SLV injections modeled at 600 MW, the alternative is capable of another 500 MW at Walsenburg, for a total simultaneous injection level of 1,100 MW.

Alternatives were evaluated to determine how new transmission between San Luis Valley and Comanche could be developed to allow higher levels of generation injection at San Luis Valley and provide for generation additions near Walsenburg.

Figure 3-2: Alternative 1 (Proposed)



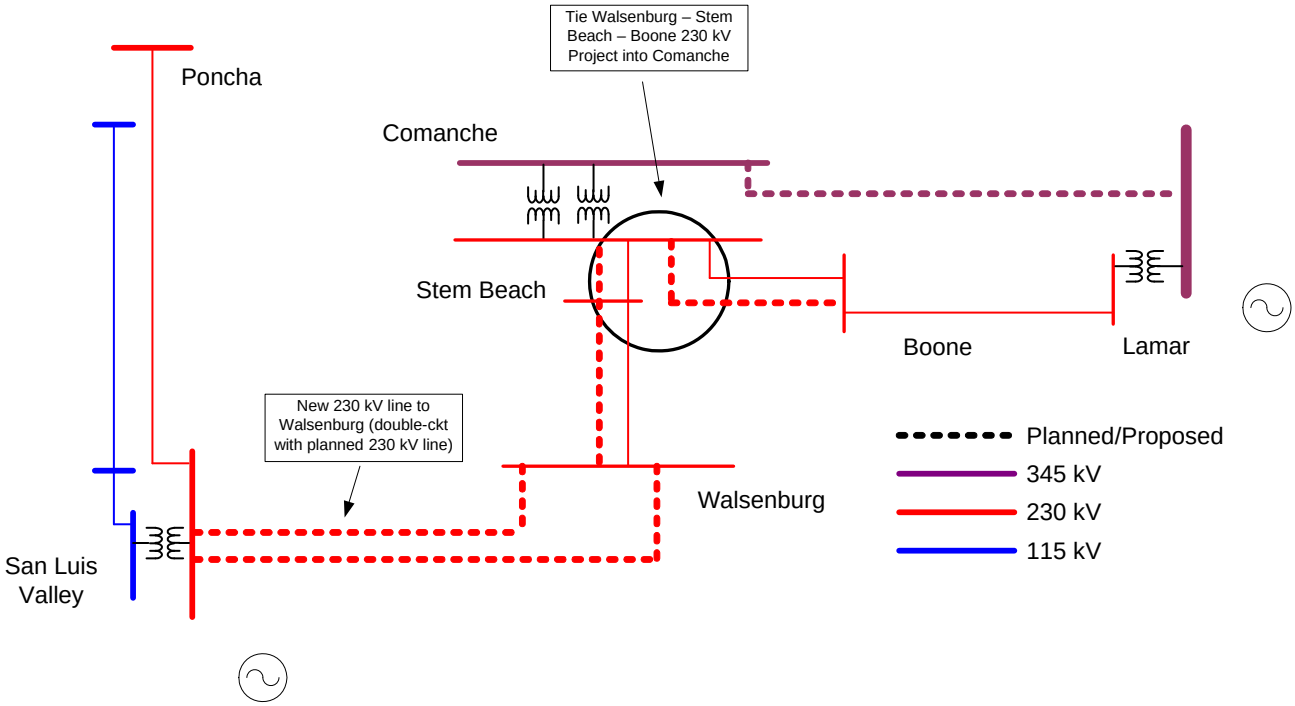
Alternative 1 includes the new Calumet Substation, San Luis Valley–Calumet double-circuit 230 kV line, Calumet–Comanche double-circuit 345 kV line, and the Calumet–Walsenburg 230 kV line (Figure 3-2). In addition, the existing Comanche–Walsenburg 230 kV line will be sectionalized at the Calumet Substation. The new Calumet Substation was added to serve as a point of interconnection for additional generation resources in the Walsenburg area. During the study process, it was determined the Walsenburg Substation could not be expanded to connect the required lines.

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. Non-simultaneous generation at the SLV substation is approximately 800 MW with the SLV transformer as a limit, and approximately 1,000 MW with the Poncha–Sargent 115 kV line as a limit.
3. Non-simultaneous generation at Calumet is approximately 1,400 MW with the Walsenburg 230-115 kV transformers as a limit.
4. The simultaneous generation limit varies between 800 MW and 1,600 MW with the San Luis Valley transformer as a limit.
5. The simultaneous generation limit is 1,500 MW. Above 1,500 MW, facilities outside the study area begin to overload.

For system intact conditions, 600 MW on the SLV 230 kV bus, and 800 MW on the Calumet 345 kV bus, the SLV–Calumet 230 kV lines are loaded approximately 14 percent of their thermal rating. In order to fully utilize the potential transfer capability afforded by the San Luis Valley–Calumet double-circuit 230 kV line, significant unplanned transmission additions in the San Luis Valley, Pueblo, Colorado Springs, Denver metropolitan area, and western Colorado areas are required.

Figure 3-3: Alternative 2



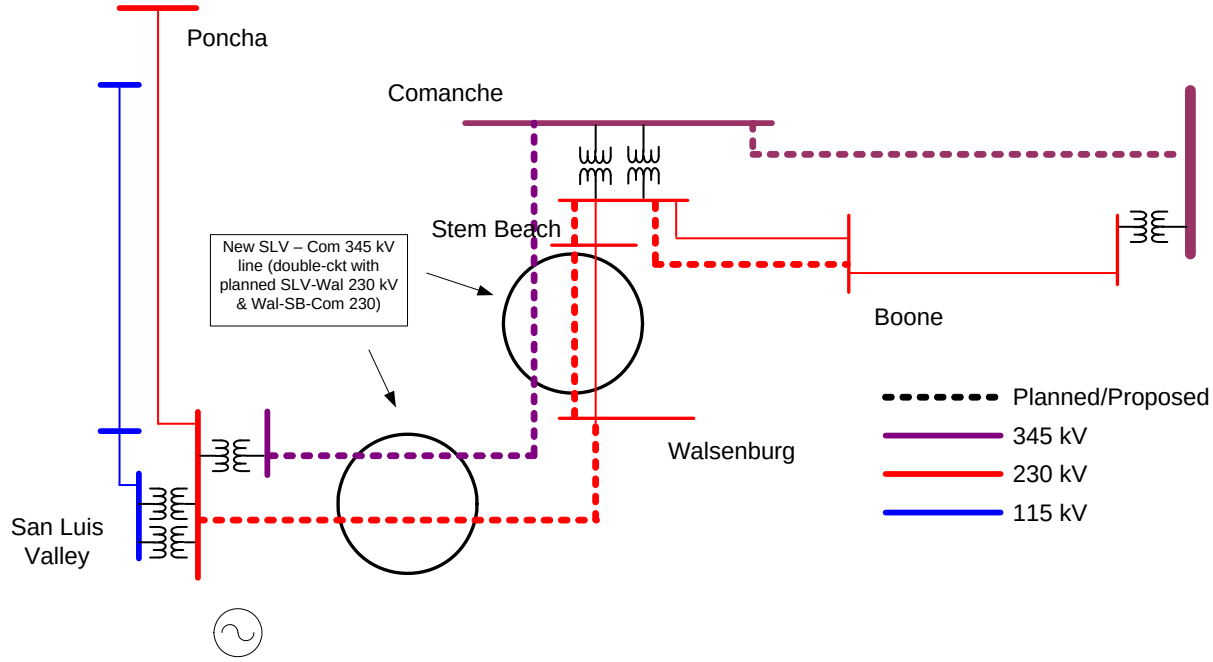
Alternative 2 includes the addition of the new San Luis Valley–Walsenburg double-circuit 230 kV line and Walsenburg–Stem Beach–Comanche–Boone single-circuit 230 kV line. This alternative meets Tri-State and Public Service reliability needs (Figure 3-3).

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. The San Luis Valley independent injection levels for this alternative were similar to Alternative 1.

No studies were performed to determine injection levels at Walsenburg. It was determined that expansion of the existing Walsenburg Substation would not be practical, and therefore would not readily accommodate many new line terminations or generator interconnections. Accordingly, this alternative was rejected by PSCo.

Figure 3-4: Alternative 3



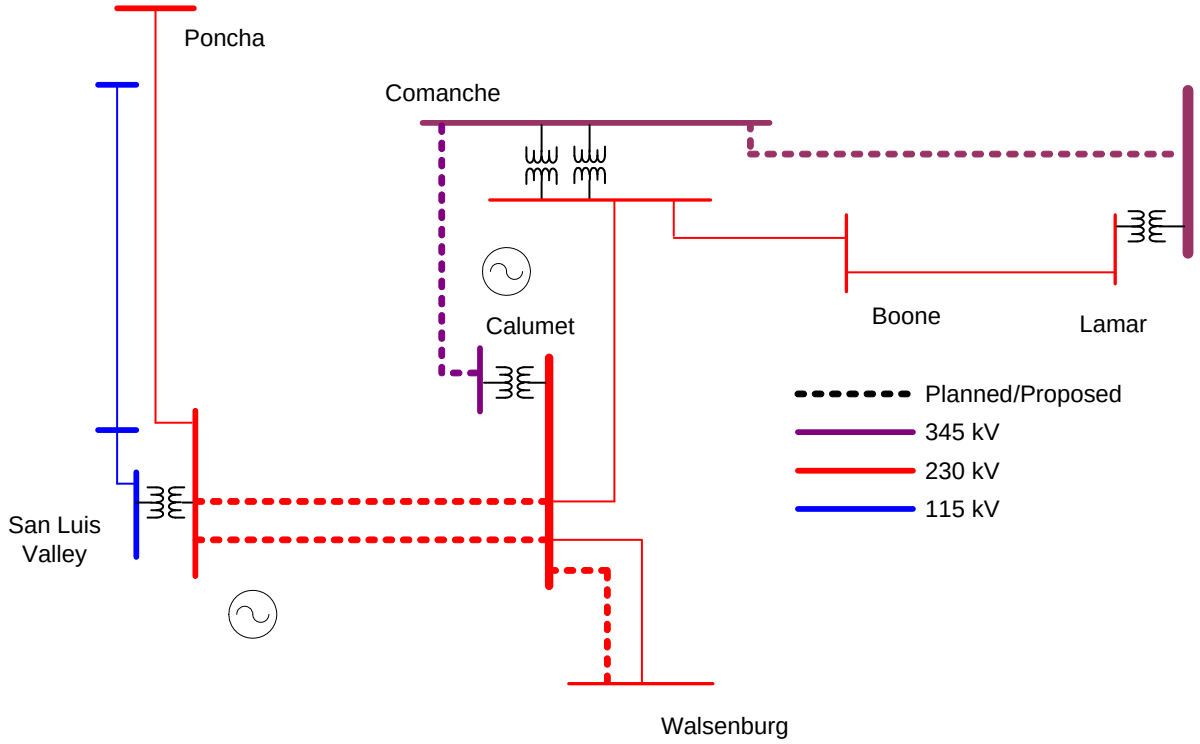
Alternative 3 additions include a San Luis Valley–Walsenburg single-circuit 230 kV line, Walsenburg–Stem Beach–Comanche–Boone single-circuit 230 kV line, and a San Luis Valley–Comanche single-circuit 345 kV line (Figure 3-4).

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. Is potentially capable of approximately 925 MW independent injections at SLV. Independent injections at Walsenburg were not studied for this alternative.

Under this alternative, the SLV–Comanche 345 kV outage limits the transfer capability of the system to the same levels as Alternative 2. In addition, connections at Walsenburg would be limited given site constraints. For these reasons, Alternative 3 was rejected.

Figure 3-5: Alternative 4

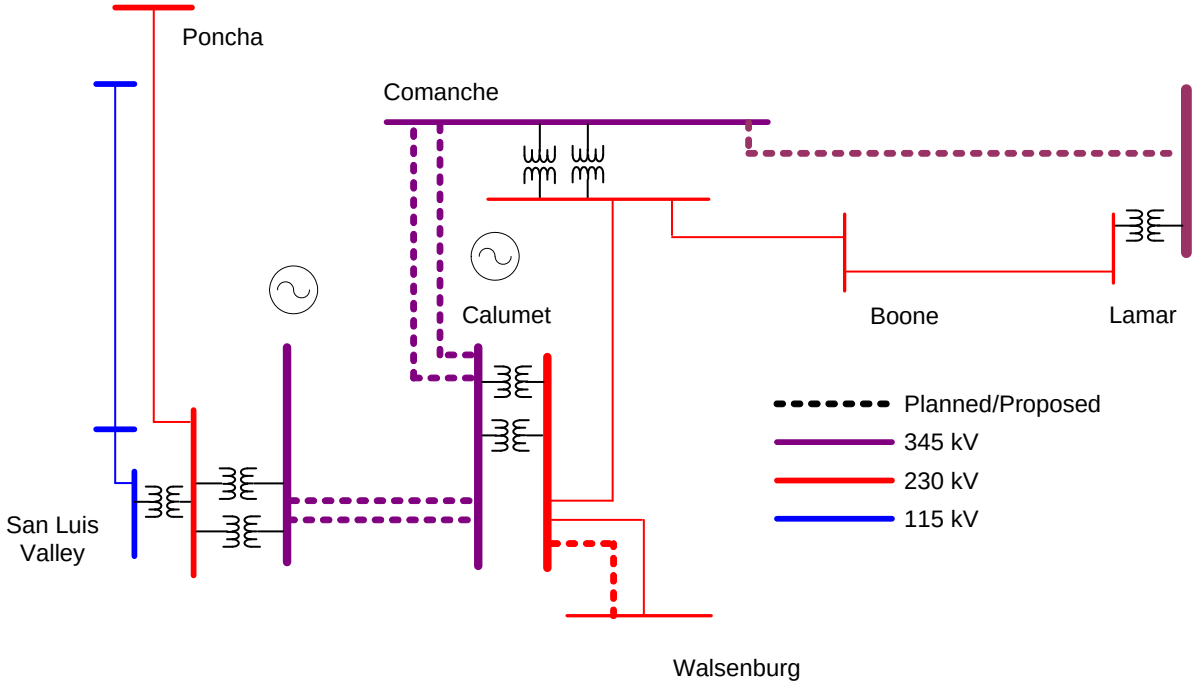


Alternative 4 includes the new Calumet Substation, San Luis Valley–Calumet double-circuit 230 kV line, Calumet–Walsenburg single-circuit 230 kV line, and a single Calumet–Comanche 345 kV line (Figure 3-4).

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. Under Alternative 4, injection capability is dependent on the outage of the single SLV–Comanche 345 kV line. Public Service decided to pursue building double-circuit 345 kV transmission to maintain firm capacity, required at higher levels of injection, and to allow for additional generation capability in both Zones 4 and 5. Therefore, Alternative 4 was rejected.

Figure 3-6: Alternative 5



Alternative 5 is the addition of the new Calumet Substation, a San Luis Valley–Calumet double-circuit 345 kV line, Calumet–Comanche double-circuit 345 kV line, and Calumet–Walsenburg single-circuit 230 kV line (Figure 3-5).

The power flow results indicate this alternative:

1. Corrects the reliability issues in the area.
2. If the San Luis Valley transformer loading issues are mitigated, then the simultaneous injection limits will primarily be based on the Walsenburg 230-115 kV transformer.
3. At simultaneous levels more than 1,500 MW, there are contingency issues outside the region that may have to be addressed. Therefore, the simultaneous limit was considered as approximately 1,500 MW.
4. For system intact conditions, 600 MW on the SLV 230 kV bus, and 800 MW on the Calumet 345 kV bus, the SLV-Calumet 345 kV lines are loaded approximately 7 percent of their thermal rating. Similar to Alternative 1, in order to utilize the potential transfer capability afforded by a San Luis Valley–Calumet double-circuit 345 kV line, significant unplanned transmission additions in the San Luis Valley, Pueblo, Colorado Springs, Denver metropolitan area, and western Colorado areas are required.

The overall performance of Alternative 5 is very similar to performance of Alternative 1 (proposed). Alternative 5 would require more right of way, larger structures, and is more expensive, and was rejected.

3.1.4.3 Transmission System Alternatives Discussion

Alternative 1 and Alternative 5 satisfy the needs of both utilities. These two alternatives are discussed further below and the results summarized in Table 3-1. Alternatives 2, 3, 4 met the reliability needs of the area, but these alternatives did not meet Public Service's needs. Alternatives 2 and 3 were rejected since the Walsenburg substation site is relatively constrained. Adding more terminations to facilitate generation interconnections will be difficult. In regards to Alternative 4, the injection capability is dependent on the outage of the single SLV–Comanche 345 kV line. Public Service decided to pursue building double-circuit 345 kV transmission to maintain firm capacity.

Table 3-1:
Alternative Assessment

	Tri-State share (Million $[1])	PSCo Share (Million $[2])	Estimated Maximum Level of injections[3] (MW)		
			SLV Only	Calumet Only	Simultaneous
Benchmark	102.6	0	650	Not Studied	1,000
Alternative 1 (proposed)	82.3	114.1	1,000	1,400	1,500
Alternative 5	82.3	172.1	1,400	1,400	1,500

[1] The cost estimates included in the proposed alternative are based on advanced negotiations regarding percentage participation between Tri-State and Public Service. Costs include Allowance for Funds Used During Construction (AFUDC).

[2] Totals include costs of building proposed project and does not include additional system upgrades (transformers, line and equipment upgrades), or generator interconnection costs.

[3] Injection levels are calculated based on injections in SLV on 230-kV bus and injections in Calumet on 345 kV bus. For the studies, the load in the SLV was held constant at approximately 155 MW.

Alternative 1 and Alternative 5 meet the needs of Tri-State and Public Service. Each alternative:

1. Corrects the reliability issues in the San Luis Valley.
2. Eliminates the Comanche-Walsenburg 230 kV RAS.
3. Complies with Colorado Senate Bill 07-100 (SB07-100).
4. Demonstrates the capability of supporting approximately 1,500 MW of simultaneous resource injections.

The transmission line segments in Alternatives 1 and 5 are identical with the exception of the San Luis Valley–Calumet line segment. Alternative 1 uses a double-circuit 230 kV line between San Luis Valley and Calumet, whereas Alternative 5 has a double-circuit 345 kV line between San Luis Valley and Calumet.

Alternative 1 is the proposed project. As discussed below, the additional cost of Alternative 5, additional right-of-way (ROW), increased operational complexity associated with a lightly loaded 345 kV double circuit line, and little difference in line losses for no simultaneous injection improvement is not justified.

Estimates indicate Alternative 5 will cost $58M (including AFUDC) more than Alternative 1. Alternative 5 will require modifications at the San Luis Valley and Calumet substations, the largest difference being the

inclusion of two 345-230 kV 560 MVA autotransformers at the San Luis Valley Substation. These substation changes are not necessary in Alternative 1.

Without significant transmission system improvements in the San Luis Valley, Walsenburg, Pueblo, Colorado Springs, Denver metropolitan area, and western Colorado areas, neither alternative is capable of fully utilizing the transmission lines' thermal capacity. The generation injection limits are not related to the transmission capability of the Project, but by elements outside the project area. Under the same peak resource injection conditions of 600 MW at SLV and 800 MW at Calumet, the 230 kV lines are loaded to 14 percent of thermal capacity, whereas the 345 kV option is loaded to approximately 7 percent.

Intermittent renewable resources such as wind, photo-voltaic solar, and concentrated solar with storage are anticipated in the SLV and Calumet areas. The resources may operate with capacity factors ranging from 0.15 to 0.3. Some of the resources will have minimal voltage control capability. Therefore, the 345 kV option will introduce operational issues such as high voltage. Studies indicate approximately 80 MVAR of switched reactors at both San Luis Valley and Calumet Substation are required to maintain voltage within limits for the 345 kV option. The addition of reactors increases initial capital cost, operational complexity, and maintenance cost, and could lead to an overall decrement in system availability.

Line losses are not a defining condition for two reasons. First, the losses between the 230 and 345 kV options are not significant because of the low capacity factors of the speculative resources and light line loading, irrespective of voltage level. Second, Public Service's need for the resources is low; therefore, it is not expected speculative resources capable of exceeding the power flow based limits will be in operation for several years beyond the in service date of the project.

Therefore, Alternative 5 is not the proposed project for the following reasons:

- Additional cost ($58 million, including AFUDC).
- No increase in simultaneous injection levels.
- Additional land use (additional 50-foot ROW).
- Potential visual impacts with taller structures.
- Operational complexity and associated potential decrement in reliability associated with a lightly loaded 345 kV double-circuit line.

3.1.5 Preferred Transmission System Alternative

The proposed project is the preferred transmission alternative. A new San Luis Valley–Calumet double-circuit 230 kV line, a Calumet–Comanche double-circuit 345 kV line, and the Calumet–Walsenburg single-circuit 230 kV line (Alternative 1) is the best alternative in order to cost-effectively:

1. Meet the reliability needs of the area by providing the necessary transmission infrastructure in the San Luis Valley to prevent voltage collapse and eliminating the RAS scheme for an outage of the Comanche–Walsenburg 230-kV line.
2. Meet the projected load growth in the area for Tri-State's affected members.
3. Meet Public Service's SB07-100 needs.
4. Maximize the capability of new transmission corridors.