08I-227E

Exhibit A

2008-2018 Transmission Planning Study

Colorado Long-Range Transmission Planning Group (CLRTPG)

Colorado Coordinated Planning Group (CCPG)

January 2009

Table of Contents

Appendixes

1. Executive Summary

The purpose of the Colorado Long Range Transmission Planning Group ("CLRTPG") is to provide a forum for electric load-serving entities ("LSE's") in the State of Colorado to jointly explore the potential for the development of a coordinated transmission network. The CLRTPG is a subcommittee of the Colorado Coordinated Planning Group ("CCPG"). CLRTPG was formed to jointly evaluate the development of coordinated long-range transmission plans for the CCPG footprint, including eastern Wyoming and Colorado. Previous CLRTPG studies have been performed approximately every two years and cover a ten-year planning horizon. This study represented a 2018 time frame.

This study was coordinated with other CCPG and LSE studies, primarily those associated with Colorado's Senate Bill 07-100 ("SB-100"). The overall transmission plans that resulted from this study includes the projects listed in the following table and are shown in Figure 1. The projects identified in this study are not necessarily recommendations or commitments by any particular party, but this study indicated that they have the potential to reliably accommodate additional resources, enhance transmission system performance, and have merit for long-range plans and additional study.

Table 1 CLRTPG 2008 Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)[1]	COST ($M)
Energy Center[2]-Burlington	500/345	70
Energy Center-Burlington-Big Sandy–Road 125-Missile Site	500/345	160
Energy Center-Comanche	500/345	80
Energy Center – Lamar	230	10
Lamar - Vilas	230/345	30
Pawnee-Daniels Park & Smoky Hill –Daniels Park	345	65
Ault – Cherokee	230	65
Wyoming – Colorado Intertie	345	[3]
San Luis Valley – Calumet	230	115
Calumet-Comanche	345	65
Calumet-Walsenburg	230	10
TOTAL		**670**

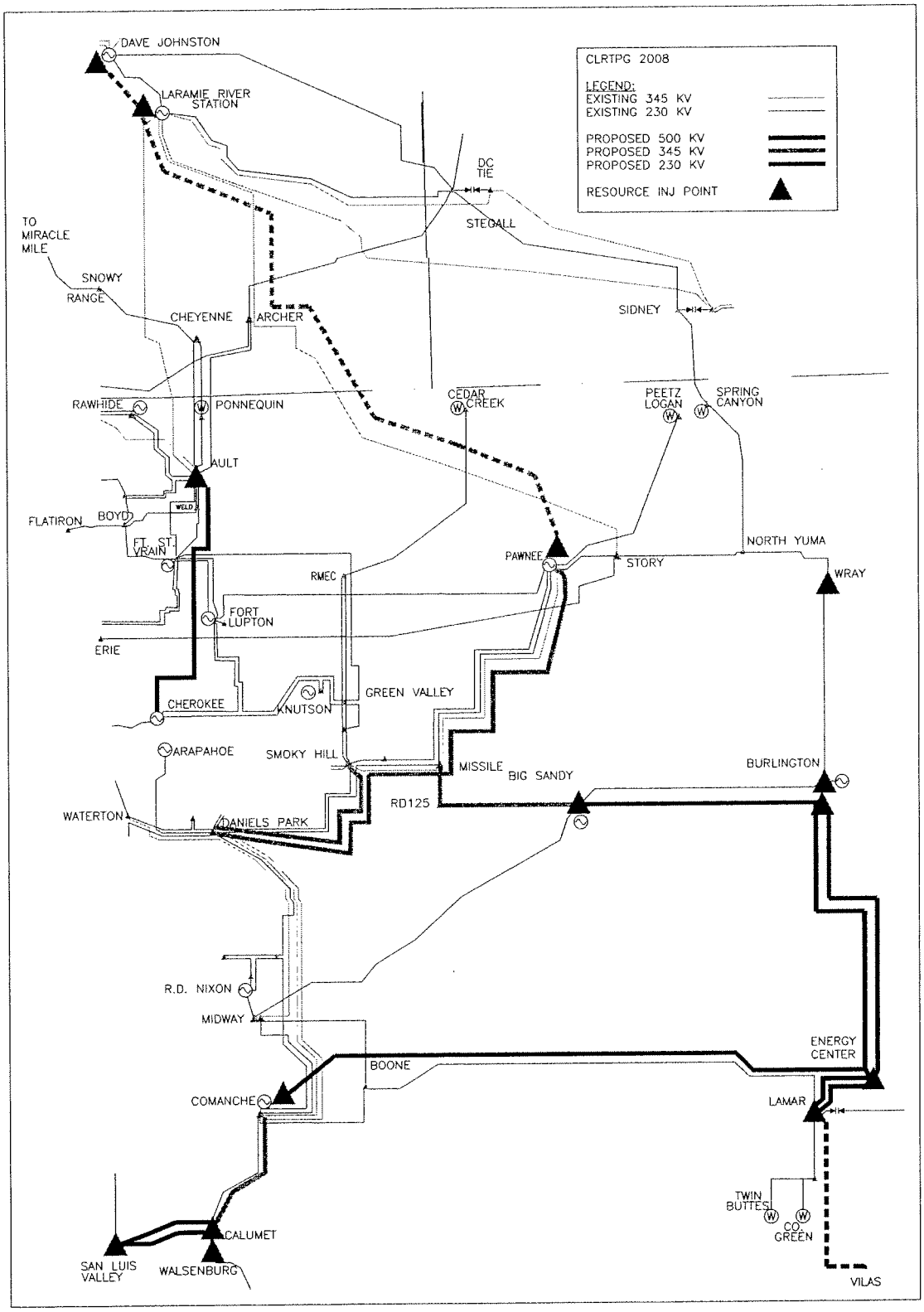
[1] Specific voltages have not been recommended. Preliminary studies show benefit to higher voltage operation, but for reasonable project implementation, some may need to be built at higher voltages, but initially operated at a lower voltage.
[2] Energy Center is in close proximity (within 20 miles) of Lamar Substation.
[3] Independent project; no costs provided

The projects listed in Table 1 are in addition to other planned transmission projects that have been identified in other planning forums, and are in various stages of implementation. Those projects are also considered to be part of the ten-year plan, and are listed in Table 2. The purpose for each project is provided under the Base Case Development section.

Table 2 Other CCPG Bulk Projects Planned for the 10 Year Horizon

TRANSMISSION PROJECT	ENTITY	IN-SERVICE DATE	COST ($M)
Comanche – Daniels Park 345 kV Transmission Project	PSCo	2009	150
Beaver Creek (Story) – Erie 230kV line	WAPA	2010	55
Miracle Mile – Ault 230kV line	WAPA	2010	90
Midway – Waterton 345kV Transmission Project	PSCo	2012	35
Pawnee – Smoky Hill 345kV Transmission Project	PSCo	2013	130
Burlington – Wray 230kV Transmission Project	TSGT	2015	30
Weld – Boyd – Flatiron 230kV Project	WAPA	2018	35
TOTAL			**525**

Figure 1 Overall Transmission Plan



2. Introduction

The CLRTPG was initiated in January 2004 as a subcommittee of the CCPG, whose purpose is to facilitate open discussion and joint planning efforts for the transmission system in the Rocky Mountain Region, which is primarily Colorado and southeastern Wyoming. CLRTPG study reports were issued in April 2004 and July 2006. As with previous studies, this study was performed by CCPG transmission planners. This study began on December 20, 2007. Regular meetings took place in 2008, and efforts were taken to adhere to FERC Rule 890 principles, including maintaining an open and transparent planning process.

Although the primary objective to develop coordinated long-range transmission plans remains consistent with previous studies, the methodology for modeling resources is somewhat different for this study. The previous CLRTPG studies modeled specific resource locations based on each utility's resource plans. The July 2006 study addressed Southern and Northern areas of Colorado and modeled scenarios that stressed those regions due to the nature of LSE projected resource plans, and the geographic locations of the studied resources.[4] Potential transmission plans were developed to serve forecasted load for the generation resource additions studied. Subsequent to the July 2006 study, the following new legislation and filings affected the 2008-2018 study objectives and methodology:

- Colorado Senate Bill 07-100 ("SB-100"), intended to enhance "energy-transmission capacity" for transmission-constrained resources, was signed in to law on March 27, 2007. The law requires rate-regulated utilities to designate Energy Resource Zones (ERZs) and develop plans to construct or expand transmission to the ERZs.

- Colorado House Bill 07-1281 ("HB1281"), also enacted on March 27, 2007, doubled Renewable Portfolio Standards (RPS) for investor owned utilities to 20%; established new standards for Cooperatives (10%); and Municipals serving over 40,000 customers (10%). The RPS needs to be met by 2020.

- In order to facilitate electric utility's compliance with SB-100, HB1281, and other legislation, the Colorado Public Utility Commission ("CPUC"), in decisions C07-0829 and C07-1101, abandoned requirements for "least-cost resource portfolios" for a "cost-effective" approach.

- On October 31, 2007, Public Service Company of Colorado ("PSCo") filed their response to SB-100, which identified four renewable resource zones[5]. References to "Zone" in this report means those shown on Figure 01 in Appendix 2 – Benchmark Case and were used to provide general injection locations for the study.

[4] http://www.rmao.com/wtpp/CO_Transmission_Planning_Group.html

[5] http://www.rmao.com/wtpp/SB100.html

- The Colorado Senate Bill 07-091, ("SB-91"), Renewable Resource Generation Development Area Task Force issued their report, "Connecting Colorado Renewable Resources to the Markets"[6]. The report labeled areas with wind and solar potential as Generation Development Areas (GDA). The Task Force defined a "Renewable Resource Generation Development Area (GDA) as a concentration of renewable resources within a specific geographic sub-region of Colorado . . ." with potential for 1,000 MW (nameplate) of generation capacity.

- FERC Order 890, which among other things set rules that describe how transmission provider's planning processes meet the principles of coordination, openness, transparency, information exchange, comparability, dispute resolution, regional coordination, economic planning studies, and cost allocation.

As a result, this study includes a determination of the transmission infrastructure required to accommodate a variety of resources to meet projected customer demand requirements for the 2018 period. The resources modeled may or may not represent the optimal "cost-effective" resource mix.

3. Principles

The following principles were employed to meet the study objectives:

1. Identify "Backbone" or "Bulk" transmission plans that will reliably meet forecast load requirements and accommodate a variety of potential resource plans.

2. Quantify the potential costs of the transmission plans.

3. Jointly perform studies and coordinate with other CCPG planning activities, including Senate Bill 07-100 studies and other LSE plans.

4. Adhere to the planning principles set forth in FERC Order 890, including conducting joint studies in a coordinated, open and transparent manner.

5. Comply with North American Electric Reliability Council (NERC) Standards and Western Electricity Coordinating Council (WECC) Criteria.

6. Efficiently use transmission corridors by proposing to use existing corridors where feasible, and reasonably sizing the capability of new corridors.

4. Participants

The 2018 study included participation and comments from a wide variety of stakeholders. The LSE planning participants included:

[6] http://www.colorado.gov/energy/in/uploaded_pdf/SB91TaskForceReport.pdf

- Black Hills Energy (BHE)
- Colorado Springs Utilities (CSU)
- Platte River Power Authority (PRPA)
- Public Service Company of Colorado (PSCo)
- Tri-State Generation and Transmission Association, Inc. (TSGT)
- Western Area Power Administration, Rocky Mountain Region (WAPA)

5. Case Development

The 2018HS1 WECC review case was used to form the benchmark models. The study participants reviewed and modified the case to accurately represent current load forecasts, regional transmission commitments, and generation projects. Appendix 2 – 2018 Benchmark - lists the case modifications and resulting topology.

The benchmark models included some transmission projects that have been identified through other planning forums. Some of the significant projects are shown in Table 3.

Table 3 Significant Projects Modeled in the Benchmark Case

TRANSMISSION PROJECT	PURPOSE	ENTITY	ISD
San Luis Valley – Walsenburg 230kV (single circuit)	Local Reliability	TSGT	2012
Wray – Burlington 230kV	Local Reliability	TSGT	2015
Beaver Creek(Story) – Erie 230kV	Serve native load	WAPA	2010
Miracle Mile – Ault 230kV line	Increase TOT 3	WAPA	2010
Comanche–Daniels Park 345kV	Accommodate 750 MW Comanche Unit #3	PSCo	2009
Midway – Waterton 345kV	Accommodate 500 MW generation near Midway	PSCo	2012
Weld – Boyd – Flatiron 230kV	Increase local load serving capability and reliability	WAPA	2018

6. Criteria and Methodology

6.1. *Study Criteria*

Power flow analysis was performed using Standards developed by the North American Electric Reliability Corporation (NERC), and Criteria developed by the Western Electricity Coordinating Council (WECC). Only steady state (powerflow) flow analysis was used to evaluate thermal and voltage performance of the transmission system. Studies evaluated system intact (NERC Category A), and single contingency (NERC Category B, or "N-1") conditions.

For this study, system intact (N-0) conditions were flagged if voltages were less than 0.95 or greater than 1.05 per unit. Element loadings were flagged if they exceeded 100% of their normal rating.

Single contingency (N-1) conditions were flagged if voltages were less than 0.90 or greater than 1.10 per unit. Element loadings were flagged if they exceeded 100% of applicable emergency ratings.

No transient or voltage stability studies were performed. Any project recommended by this study that proceeds with additional development may require additional detailed evaluation.

Studies did not consider contract path issues associated with the delivery of new resources to load.

6.2. *Study Methodology*

6.2.1. Loads

Every participating LSE evaluated their Load and Resource (L&R) requirements including forecasted loads, resource plans and reserve margins. All of the L&R analyses showed a need for additional resources in 2018. The total resource requirement, as shown in Table 4 was derived by adding together individual utility needs. According to the L&R data, approximately 1165 MW of additional generation resource, including capacity reserve margin, is needed by 2018 to meet the firm load obligation of 13,305 MW. Appendix 1 includes the L&R spreadsheet for the combined utilities, supporting Table 4.

Table 4 New Resource Need for 2018 Heavy Summer

LSE	FORECASTED LOAD (MW)	NEW RESOURCE NEED (MW)
BHE (Aquila)	462	74
CSU	1100	153
PRPA	862	7
PSCo	7643	716
TSGT	2968	215
WAPA	N/A	N/A
TOTAL	**13035**	**1165**

6.2.2. Transmission Upgrades

Studies focused on developing bulk transmission plans. Underlying or pre-existing transmission issues, such as overloads or voltage criteria violations, were not specifically addressed in this study unless a participant identified a remedy when results were reviewed.

6.2.3. Injection Zones

Study participants identified four injection zones to represent proposed generation locations. The zones are consistent with those identified in early SB07-100 studies and filings. Figure 02 in Appendix 2 indicates the zone boundaries, which can be described as:

Zone 1 – Northeast Colorado and Southern Wyoming
Zone 2 – East Central Colorado
Zone 3 – Southeast Colorado
Zone 4 – South Central Colorado

Subsequent SB07-100 studies have identified a 5th zone, which lies between Zones 3 and 4, and includes potential injection sites at Walsenburg and Boone.

6.2.4. Study Scenarios

Based on input from Transmission Planners and Stakeholders, four resource scenarios were developed to study transmission alternatives. The four resource study scenarios are described below. Table 5 lists the scenario injection magnitude and zone. Several factors were considered when developing these scenarios. One major factor was to maintain resource levels that would meet load requirements as defined by the L&R analysis. Based on the SB91 report and Stakeholder input, it is clear that the footprint of study has the potential for significantly large renewable resource development. However, when performing a study that models ten-year load growth, the resources modeled must reasonably match the forecasted loads. Since all potential resources could not be added simultaneously for the given forecast, scenarios were generally developed so that a reasonable level of resources could be added while stressing a particular region in the CCPG footprint. When a scenario proposed to inject excess capacity, i.e. more than required per the summary L&R as shown in Table 4, existing or proposed firm resource output was adjusted to maintain load and resource balance. Appendix 3 provides greater injection location detail for each scenario.

These levels were chosen with consideration of meeting or exceeding Colorado RPS requirements and resource planning requests in 2018. For this power flow study, the resource and technology type were not considered (thermal vs. renewable); therefore, resources were modeled at nameplate real power output, and given reactive power capabilities to meet power factor requirements.

Table 5 New Resources (MW) for Study Scenarios

SCENARIO	STRESS	ZONE 1	ZONE 2	ZONE 3	ZONE 4	TOTAL
A	South – North	965	0	1420	568	2953
B	North – South	765	200	1420	568	2953
C	East – West	740	740	1380	55	2915
D	Zone 4 – Front Range	105	0	730	2005	2840

Scenario A: Scenario A simulated a South to North stressed condition in which new Southeastern Colorado resources were analyzed while output of existing and proposed

resources north of Denver were reduced. The total new resource injection was 2953 MW. Utility resource planning departments suggested the injection locations.

Scenario B: This scenario simulated a North to South stressed condition in which proposed Northern resources were analyzed while output of existing and proposed resources south of Denver were reduced. The proposed Northern resources were modeled in two ways. First, the resources were injected at Pawnee, Peetz-Logan and Corner Point/Missile Site. Secondly, Northern resources were injected at Pawnee only via the proposed 345 kV project known as the Wyoming Colorado Intertie (WCI). The WCI project was used to simulate proposed Wyoming wind resources connected at Dave Johnston and Laramie River Station. Scenario B includes 2,953 MW of new resources.

Scenario C: This scenario models wind resources in proportion to the capability of each Generation Development Area (GDA) identified in the SB07-091 Task Force report. Original Stakeholder input asked for 5% of injection at each GDA. However, in order to meet the L&R requirements, the generation injections were scaled down from the 5%, or 5300 MW, to about 2915 MW to allow for a dispatch that could realistically be studied with the models available.

Scenario D: Scenario D models high resource output from the two GDA's in South Central Colorado. These GDA's are generally considered the regions that have the highest potential for solar generation development. A total of 2,840 MW of new resources were modeled.

6.2.5. Plan Verification

The four scenarios were studied in order (from A to D). As transmission plans were developed for a particular scenario, they were carried forth into subsequent scenario studies. That is, Scenario A stressed the system from the South to the North; Scenario B stressed North to South, Scenario C stressed East to West and Scenario D stressed South central to North. In summary, the following process was followed:

1. Perform a benchmark analysis of the system to provide a baseline of system performance.

2. Add Scenario A resource additions and compare system performance to the performance of the benchmark case.

3. Develop and evaluate transmission alternatives to alleviate any system intact and contingency performance issues.

4. Study Scenario B resource additions, keeping the transmission plans developed from Scenario A.

5. Develop and evaluate additional transmission alternatives to alleviate any system intact and contingency performance issues.

6. Study Scenario C resource additions, keeping the transmission plans developed from Scenarios A and B.

7. Develop and evaluate additional transmission alternatives to alleviate any system intact and contingency performance issues.

8. Study Scenario D resource additions, keeping transmission alternatives developed from previous scenarios.

The focus of the study was to develop bulk power system transmission plans and determine the segments' ability to deliver proposed resource output under steady state and single contingency conditions. Participants had the opportunity to review power flow results and propose specific system enhancements to remedy regional contingency violations as well as propose modifications and/or variations to proposed bulk system segments. Underlying or pre-existing transmission issues, such as overloads or voltage criteria violations, were not specifically addressed in this study unless a participant identified a remedy when results were reviewed. For example, with the Scenario D injections, several underlying facilities become overloaded under single contingency (N-1) conditions. This indicates additional injections are not feasible without costly upgrades of the lower level transmission system or implementing generation curtailment.

6.3. *Transmission Cost Estimates*

Projects contemplated through LSE's normal budgeting process are not included in the 2018 CLRTPG estimates. Only the cost associated with the new transmission additions were included. As most of the transmission plans identified in the CLRTPG study were reaffirmed through the SB100 studies, cost estimates for those projects have been provided where appropriate. Otherwise, common engineering unit costs were used to gain insight into the magnitude of transmission investment that could be expected in the ten-year timeframe to support the modeled level of generation. The costs represent 2008 dollars and are considered to have +/- 30% accuracy.

7. Results Summary

A summary of the proposed bulk system segments and estimated cost for each scenario is listed below. Appendix 3 – Scenario Summaries provides more detailed information.

7.1. *Scenario A*

Scenario A simulated a South to North stressed condition through the study footprint. The total new resource injection was 2953 MW. Table 6 summarizes how new resources were modeled and shows that the bulk of new resources were in the southern part of the study footprint. Table 7 shows the projects included in the Scenario A transmission plan.

Table 6 Scenario A New Resources

STUDY ZONE	INJECTION LOCATION	INJECTION AMOUNT (MW)
Zone 1	Ault	55
Zone 1	Pawnee	500
Zone 1	Peetz-Logan	410
Zone 3	**Energy Center**	**650**
Zone 3	**Lamar (new)**	**770**
Zone 4	SLV	445
Zone 4	Walsenburg	123
TOTAL		**2953**

Table 7 Scenario A Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
Energy Center-Burlington	500/345	70
Energy Center-Burlington – Big Sandy – Road 125-Missile Site	500/345	160
Energy Center-Comanche	500/345	80
Energy Center – Lamar	230	10
Lamar – Vilas	230/345	30
TOTAL		**350**

Study Results: The studies verified that the proposed Pawnee – Smoky Hill 345kV line would be sufficient to accommodate the additional resources modeled at Pawnee and Peetz-Logan. The San Luis – Walsenburg single-circuit 230kV line and the Midway – Waterton 345kV line, which were already in the benchmark models, appeared to be sufficient to accommodate the 575 MW of injection at San Luis Valley and Walsenburg. However, since there was over 1400 MW of new resource injection in the vicinity of Lamar and Energy Center, additional transmission had to be built from that region to the Front Range load centers. For the level of resources studied, three high-voltage lines provided optimum results, which is consistent with previous studies and the Eastern Plains Transmission Project (EPTP). Sensitivity studies showed that if the lines were operated at 500kV instead of 345kV, there was a potential for even higher resource additions in the region.

No resource additions were modeled at Vilas. However, SB07-100 studies have identified that project as having the potential to deliver resources from renewable development areas in Baca County. However, the high voltage transmission projects from Lamar/Energy Center would have to be built first.

7.2. *Scenario B*

Scenario B simulated a North to South stressed condition in the study footprint. As previously mentioned, the additional northern resources were modeled in two ways. The first method added new generation at Pawnee, Peetz-Logan and Missile Site substations. The second method added the proposed WCI. Scenario B includes 2,953 MW of new resources, which are shown in Table 8. Table 9 shows the projects included in the Scenario B transmission plan.

Table 8 Scenario B New Resources

STUDY ZONE	INJECTION LOCATION	INJECTION (MW)	INJECTION (MW) WCI
Zone 1	**Ault**	**55**	**55**
Zone 1	**Pawnee**	**500**	**0**
Zone 1	**Peetze-Logan**	**210**	**0**
Zone 2	**Corner Pt/Missile**	**200**	**0**
Z W1	**LRS**	**0**	**600**
Z W2	**DJ**	**0**	**310**
Zone 3	EC	650	650
Zone 3	Lamar (new)	770	770
Zone 4	SLV	445	445
Zone 4	Walsenburg	123	123
TOTAL		**2953**	**2953**

Table 9 Scenario B Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
Pawnee – Daniels Park 345kV line; Smoky Hill – Daniels Park 345kV line	345	65
Ault – Cherokee 230kV line	230	65
TOTAL		**130**

Study Results: Scenario B studies assumed that the projects identified from the Scenario A studies would be in place. This included the three high-voltage transmission lines out of Energy Center. As seen from Table 8, there was almost 1000 MW of new resources modeled northeast of the Denver-metro area. In order to accommodate those resources, these studies showed that additional transmission would be required from the Pawnee substation into the Denver-metro load center. Previous SB100 and WCI studies demonstrated a need for an Ault – Cherokee transmission project, and these studies of the WCI project with 910 MW of additional resources in Wyoming being scheduled to Colorado loads yielded similar results.

7.3. *Scenario C*

Scenario C simulated an East to West stressed condition through the study footprint. The total new resource injection was approximately 2915 MW. Table 10 summarizes

how new resources were modeled and shows that the bulk of new resources were in the southern part of the study footprint.

Table 10 Scenario C New Resources

STUDY ZONE	INJECTION LOCATION	INJECTION (MW)
Zone 1	Ault	110
Zone 1	Pawnee	410
Zone 1	Peetz-Logan	165
Zone 1	**Wray**	**55**
Zone 2	**Burlington**	**630**
Zone 2	**Big Sandy**	**110**
Zone 2	Corner Pt/Missile	0
Zone 3	EC	650
Zone 3	Lamar (new)	730
Zone 4	SLV	0
Zone 4	Walsenburg	55
TOTAL		**2915**

Study Results: As seen in Table 10, Scenario C modeled some resource additions in the eastern portion of the study footprint that were not included in Scenarios A or B. These include Burlington, Wray, and Big Sandy. The new generation at those locations was about 800 MW. Using the same methodology as with the Scenario B studies, the Scenario C studies assumed that the projects identified from the Scenario A and Scenario B studies would be in place.

No major additions were needed beyond those developed for Scenarios A and B. This is likely due to modeling the Energy Center to Missile Site line to have connections at Burlington and Big Sandy. If the line is constructed in this manner, it results in an Energy Center to Burlington line and a line from Burlington to Big Sandy, Road 125, and Missile Site. This allows delivery of resources in the east to Front Range loads via Missile Site and Road 125 substations.

7.4. *Scenario D*

Scenario D modeled new generation resources in South Central Colorado, at the San Luis Valley and Walsenburg substations. A total of 2,840 MW of new resources were modeled.

Table 11 Scenario D New Resources

STUDY ZONE	INJECTION LOCATION	INJECTION AMOUNT (MW)
Zone 1	Ault	0
Zone 1	Pawnee	65
Zone 1	Peetz-Logan (new)	40
Zone 1	Wray	0
Zone 2	Burlington	0
Zone 2	Big Sandy	0
Zone 2	Corner Point	0
Zone 3	EC	650
Zone 3	Lamar (new)	80
Zone 4	**SLV**	**1000**
Zone 4	**Walsenburg**	**1005**[7]
TOTAL		**2840**

Table 12 Scenario D Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
San Luis Valley-Calumet	230	115
Calumet-Comanche	345	65
Calumet-Walsenburg	230	10
TOTAL		**190**

Study Results: As seen in resource Table 11, there was approximately 2000 MW of new resources added in south-central Colorado. The existing transmission in the region was not adequate to handle those additional resources, so new transmission was proposed. Studies verified the following projects, which have also been identified through SB100 studies, to provide adequate transmission:

- San Luis Valley – Calumet: This is proposed as a double-circuit 230kV project. Studies demonstrated that 230kV construction would enable approximately 1000 MW of new generation out of the San Luis Valley.

- Calumet – Comanche: This project delivers the generation from both the San Luis Valley and the Walsenburg substations to the Front Range transmission system. The project has a suggested operating voltage of 345kV to allow for the combined injections in the region.

- Calumet – Walsenburg: This project enhances reliability of the overall system and allows injections at Walsenburg to reach the bulk transmission system.

[7] 1000 MW solar generation and 5 MW of generation associated with GDA8, as identified in Colorado Senate Bill 91.

Sensitivity studies indicated no additional injection capability was gained by increasing the voltage between San Luis Valley and Calumet from 230 kV to 345 kV. This was due to the performance limitations north of the San Luis Valley.

8. Conclusions

The CLRTPG 2018 study identified bulk system transmission plans and improvements that could integrate new resources. Participating utilities identified a resource need of 1165 MW in 2018. Since the resource injections for each of the four scenarios exceed the projected resource need for 2018; scenario models were developed to analyze transmission solutions across the CCPG footprint.

1. Results from Scenario A indicate that building high voltage transmission from the Lamar/Energy Center region to the Front Range system would allow delivery of new generation resources in southeastern Colorado. A minimum of two high-voltage lines should be developed for any additional resources in the region. At least one of the lines should terminate at or near Comanche, and the other should terminate at or near Missile Site. To accommodate new resources in eastern Colorado, the line to Missile Site could be routed so that it connects into the Burlington and Big Sandy substations. Studies showed that three lines would increase injection capability, specifically a line from Lamar/Energy Center to Burlington. Although the lines should have a minimum operating voltage of 345kV, it may be prudent to explore constructing the projects for 500kV operation when conditions warrant. Studies showed potential increase in injection capabilities at the higher voltage.

   Other potential transmission plans for the southeast Colorado region include transmission south of Lamar. Such transmission would allow for additional resources in Baca County, but only if the high voltage transmission out of Lamar/Energy Center is developed to allow new resources to be delivered to load.

   The transmission plan developed from Scenario A has many elements in common with the previous Eastern Plains Transmission Project. Both plans include transmission from the Lamar area to Comanche, Burlington, Big Sandy, and Road 125. However, the present plan interconnects with the PSCo system at Missile Site, instead of connecting with the PSCo/Western system at Midway.

2. Results from Scenario B indicate that additional high voltage transmission from Pawnee may facilitate delivery of new generation resources in northeast Colorado and Wyoming. Suggested projects include a Pawnee – Daniels Park 345kV project and a Smoky Hill – Daniels Park 345kV transmission project. Also, SB100 and WCI studies have shown the need for an Ault – Cherokee transmission project. New transmission from Ault to Cherokee would allow resource additions at or near Ault, as well as allow for increased transfer capability across WECC Path 40 (TOT 7). Therefore, both the Pawnee – Daniels Park, and the Ault – Cherokee are included in transmission plans for both

Scenario B sensitivities, studied: resource additions at or near the Pawnee and Ault substations; or for a Wyoming – Colorado Intertie Project.

3. Results from Scenario C indicate that the transmission plans that resulted from Scenarios A and B can also allow delivery of new generation resources in eastern Colorado at locations at or near Burlington, Wray, and Big Sandy. The transmission would have to be implemented so that there is a high-voltage path between Burlington, Big Sandy, Road 125, and Missile Site to allow delivery of the additional resources in the east.

4. Results from Scenario D indicate that new high-voltage transmission is needed between the San Luis Valley and Comanche. To allow for resource additions in the vicinity of Walsenburg, studies showed benefit to implementing a new 345 kV substation near Walsenburg, called Calumet, and 345 kV transmission between Calumet and Comanche. Sensitivity studies indicated that there was no benefit gained by increasing the voltage between San Luis Valley and Calumet from 230 kV to 345 kV. This was due to the performance limitations north of the San Luis Valley. Future studies should be performed to explore transmission upgrades north of San Luis Valley.

5. As specific projects are considered for construction, detailed studies involving transient and voltage stability, lighter loading conditions, operating voltage, transfer capability, and impacts to WECC Rated Paths (TOT's) may be required.

Table 13 CLRTP 2008 Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	COST ($M)
Energy Center-Burlington	500/345	70
Energy Center-Burlington-Big Sandy–Road 125-Missile Site	500/345	160
Energy Center-Comanche	500/345	80
Energy Center – Lamar	230	10
Lamar – Vilas	230/345	30
Pawnee-Daniels Park & Smoky Hill –Daniels Park	345	65
Ault – Cherokee	230	65
Wyoming – Colorado Intertie	345	
San Luis Valley – Calumet	230	115
Calumet-Comanche	345	65
Calumet-Walsenburg	230	10
TOTAL		**670**

Appendix 1

Load and Resource Sheet

CLRTPG Loads & Resources Balance for 2018 Summer		
	CLRTP	**Notes**
Existing CLRTPG Capacity	**2018**	
Installed Net Dependable Capacity	7391	
Firm Purchased Capacity		
CLRTPG Total	1743	
IPP Purchases (Assuming some contract extensions)		
CLRTPG Total	3071	
Qualifying Facilities (QF's)		
CLRTPG Total	226	
SPS Diversity Exchange	101	
Possible Projected Resources		
CLRTPG Total	1696	**Sum of Projected Resources with LSE assumed cap factor**
Total Firm Purchases	5103	
CLRTPG Net Dependable Capacity	12494	
CLRTPG Net Dependable Capacity with Projected Resources	14190	
CLRTPG Native Load Heavy Summer	13675	**Sum of CLRTPG Loads**
Interruptible Load	272	
Existing Saver's Switch	129	
Efficiency Programs	239	
ENITITY Firm Load Obligation	13035	
Total Resource Need For PSCO	716	Assuming 2007 CRP preferred plan approved
Total Resource Need For TSGT	215	
Total Resource Need For PRPA	7	
Total Resource Need For CSU	153	
Total Resource Need For BHE	74	
TOTAL CLRTPG RESOURCE NEED	**1165**	

Appendix 2

Benchmark Case and Drawing

Modifications to 2018HS1

The following changes were made to 2018HS1 review case to develop the benchmark case:

Deleted EPTP Project elements:

- Deleted BUS#73999 SANDSAG2 22 kV
- Deleted BUS#73996 HOLCOMB 500 kV
- Deleted BUS#73995 SANDSAGE 22 kV
- Deleted BUS#73591 125ROAD 115 kV
- Deleted BUS#73590 BURLSC2 500 kV
- Deleted BUS#73589 BSNDYSC1 500 kV
- Deleted BUS#73587 125ROAD 230 kV
- Deleted BUS#73581 BL_TAP 500 kV
- Deleted BUS#73582 ENGYCNTR 500 kV
- Deleted BUS#73580 BURLNGTN 500 kV
- Deleted BUS#73583 MIDWAY 500 kV
- Deleted BUS#73584 BOONE 500 kV
- Deleted BUS#73588 BURLSC1 500 kV
- Deleted BUS#73586 EGYCNTR 230 kV
- Deleted BUS#73585 B.SANDY 500 kV
- Deleted BUS#70615 LAS_ANIM 500 kV
- Deleted BUS#70641 IGCC-CT1 16.5 kV
- Deleted BUS#70642 IGCC-CT2 16.5 kV
- Deleted BUS#70643 IGCC-ST1 18 kV
- Deleted B.SANDY – GREENVAL 230 kV line (70048-73018)
- Deleted second BOONE – LAMAR CO 230 kV line (70061 – 70254)

Added transmission changes:

- Added BUS#73586 ENGYCNTR 230 kV
- Added ENGYCNTR 500 kV - ENGYCNTR 230kV 3 transformers (73582 -73586)
- Added BURLNGTN – WRAY 230 kV (73036 – 73224)
- Increased Fordham – FSV 230kV line (70410 – 73562) rating
- Increase WeldPS – FSV 230 kV line (70471 – 70410) rating
- Increased Terry – CountyLine 115 kV line (73196 – 73465) length
- Increased LongsPeak – CountyLine 115 kV line (73115 – 73465) rating
- Open Coyote Gulch – Glade Tap 115kV line(79191 – 79260)

Changed transformer properties:

- Increased RawhideA (70351 – 73165) transformer rating
- Increased RawhideB (70568 – 73165) transformer rating
- Increased RawhideC (70569 – 73165) transformer rating
- Increased RawhideF (70561 – 73165) transformer rating

- Changed Wray (73223 – 73224) voltage regulation settings
- Add new Lamar (70253 – 70254) transformer
- Changed Westhill (73087 – 73252) transformer settings

Changed shunt cap properties:

- Changed Timnath shunt Cap (73200) settings
- Changed Dixon shunt Cap (73051) settings
- Changed Horseshoe shunt Cap (73086) settings
- Changed LongsPk shunt Cap (73115) settings
- Changed Poudre shunt Cap (73156) settings
- Changed Terry shunt Cap (73196) settings
- Changed Timberline shunt Cap (73198) settings
- Changed Birdsale shunt Cap (73384) settings
- Changed Birdsals shunt Cap (73386) settings
- Changed Cttnwds shunt Cap (73395) settings
- Changed KelkerE shunt Cap (73408) settings
- Changed KelkerW shunt Cap (73409) settings
- Add Rockwood shunt Cap (79088)
- Add Pagosa shunt Cap (79086)
- Turned off Piceance shunt Cap (79352)
- Turned off C-a shunt Cap (79312)
- Add Rosebud shunt Cap (12062)
- Turned off Westhill shunt Cap (73252)

Changed load power factor:

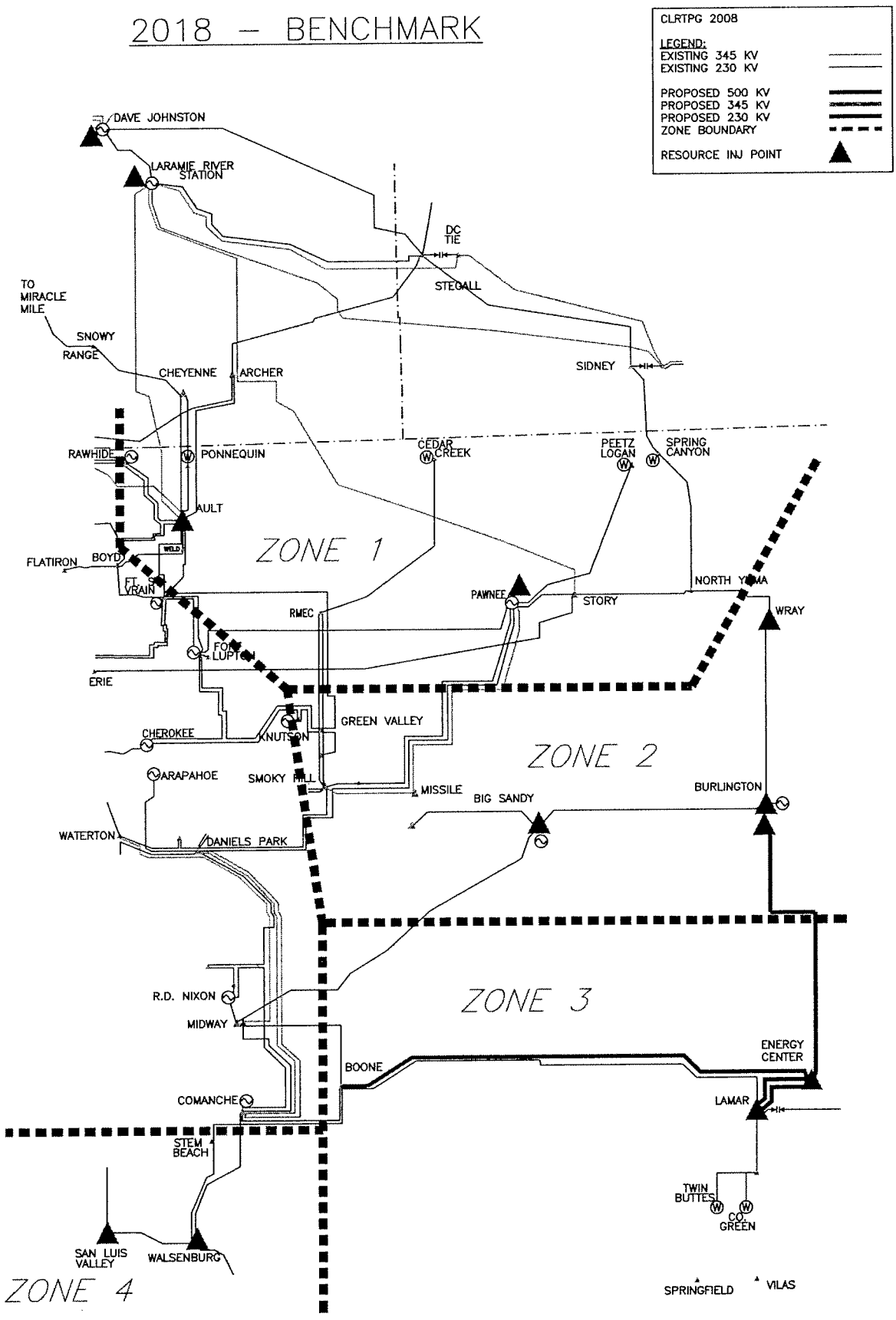
- Increased for LOAD at BUS# 73496, "CS"
- Increased for LOAD at BUS# 73388, "CS"
- Increased for LOAD at BUS# 73389, "CS"
- Increased for LOAD at BUS# 73393, "CS"
- Increased for LOAD at BUS# 73391, "CS"
- Increased for LOAD at BUS# 73395, "CS"
- Increased for LOAD at BUS# 73380, "CS"
- Increased for LOAD at BUS# 73411, "CS"
- Increased for LOAD at BUS# 73404, "CS"
- Increased for LOAD at BUS# 73430, "CS"
- Increased for LOAD at BUS# 73576, "CS"
- Increased for LOAD at BUS# 73410, "CS"
- Increased for LOAD at BUS# 73564, "CS"
- Increased for LOAD at BUS# 73409, "CS"
- Increased for LOAD at BUS# 73408, "CS"
- Increased for LOAD at BUS# 73565, "CS"
- Increased for LOAD at BUS# 73417, "CS"
- Increased for LOAD at BUS# 73387, "CS"
- Increased for LOAD at BUS# 73385, "CS"
- Increased for LOAD at BUS# 73386, "CS"
- Increased for LOAD at BUS# 73490, "CS"
- Increased for LOAD at BUS# 73420, "CS"

- Increased for LOAD at BUS# 73566, "CS"
- Increased for LOAD at BUS# 73601, "CS"
- Increased for LOAD at BUS# 73398, "CS"
- Increased for LOAD at BUS# 73396, "CS"
- Increased for LOAD at BUS# 73399, "CS"
- Increased for LOAD at BUS# 73421, "CS"
- Increased for LOAD at BUS# 73423, "CS"
- Increased for LOAD at BUS# 73425, "CS"

Corrections to generating units:

- Changed settings for Ft.Lupton (70490)
- Changed settings for Ft.Lupton (70487)
- Changed settings for Barrlake (70565)
- Changed settings for Barrlake (70566)
- Changed settings for Lincoln1 (73532)
- Changed settings for Lincoln2 (73533)
- Changed settings for SLV Solar (70931)
- Changed settings for Craig (79017)
- Changed settings for MBPP (73130)
- Changed settings for Brush (70498)
- Added generation ENGYCNTR BUS#73997 22kV 650MW

2018 – BENCHMARK



02	CLRTPG 2018 COLORADO LONG RANGE TRANSMISSION PLANNING GROUP 2018 STUDY 2018 BENCHMARK	

Appendix 3

Scenario Summaries

Scenario A Summary Report

(High Load, High South Resources)

Description

This summary describes the results for Scenario A, which is a South to North stressed case. This is for the purpose of planning transmission to accommodate full wind output and evaluate transmission alternatives in Southeast Colorado that would accommodate 2018 forecast loads and new future generation resources.

Generation Dispatch

South area resources and some north area resources were maximized in the case in order to stress Zone 3 and Zone 2.

Scenario A Existing Resources

Study zone	Injection Location	Area	Injection amount (MW)	Available amount (MW)
Zone 1	Craig	73	1322	1322
Zone 1	Pawnee	70	350	530
Zone 1	Manchief	70	150	280
Zone 1	Brush	70	148	260
Zone 2	Burlington	70	25	60
Zone 2	Lincoln	70	92	128
Zone 3	Lamar DC	70	100	200
Zone 3	TWN Butte	70	75	75
Zone 3	Colorado Green	70	162	162
Zone 5	Comanche	70	1423	1475

Scenario A New Resources

Study Zone	Injection Location	Area	Injection amount (MW)
Zone 1	Ault	73	55
Zone 1	Pawnee	70	500
Zone 1	Peetz-Logan (new)	70	410
Zone 3	EC	70	650
Zone 3	Lamar (new)	70	770
Zone 4	SLV	70	445
Zone 4	Walsenburg	70	123
TOTAL			2953

Case

The initial base case was the WECC 2018HS1 review case modified as described in the main report and Appendix 2.

Analysis Method / Sensitivities

The system was tested with various transmission system facility additions, as noted in the following table.

Added Transmission Element	Purpose
New line EC– Burlington 500 kV(345kV)	Delivery of Lamar/EC area generation
New line EC– Big Sandy 500 kV(345kV)	Delivery of Lamar/EC area generation
New line EC – Comanche 500 kV(345kV)	Delivery of Lamar/EC area generation
New line Big Sandy – 125 Road 345kV	Deliver 400-700 MW to Front Range
New line 125 Road – Corner Point/Missile 345kV	Power delivery into PSCo, dual service to Road125

The range of sensitivities were analyzed for Scenario A using contingency analysis and comparing results to the benchmark case and similar alternatives.

Power flow analyses identified the Southeast Colorado area required multiple new transmission paths out of the Lamar area to accommodate the Zone 3 high injection level. Additional transmission was needed out of Big Sandy to avoid overload of Burlington – Wray 230 kV and 115 kV lines, and the 115 kV system north of Big Sandy. Additional study will be required to justify voltage level for the Big Sandy – 125 Road – Corner Point/Missile connection.

The following alternatives where studied and reliability limits were defined:

Alternatives	Max new Zone 3 (MW)	Non-converged contingencies for the maximum injection level
EC – Burlington 345 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	300	EC – Burlington 345 kV line
Lamar – Comanche 345 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	300	Lamar – Comanche 345 kV line
EC – Burlington 345 kV line & Lamar – Comanche 345 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	1100	Comanche 345 kV – Lamar 345 kV EC 345 kV – Burlington 345 kV EC 345 kV – Lamar 230 kV
EC – Burlington 500kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	300	EC 500 kV – Burlington 500 kV EC 500 kV – EC 230 kV
EC – Comanche 500 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	300	Comanche 345 kV – Lamar 345 kV Lamar 345 kV – Lamar 230kV
EC – Burlington 500kV line & EC – Boone 500 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	1300	Boone 500 kV – Lamar 500 kV EC 500 kV – Burlington 500 kV EC 500 kV – EC 230 kV
EC – Burlington 500kV line & EC – Comanche 500 kV line Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	1500	Comanche 500 kV – EC 500 kV EC 500 kV – Burlington 500 kV
EC – Burlington 500 kV line double circuit & EC – Comanche 500 kV line & Burlington – Big Sandy 500kV Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	>1750	None
EC – Burlington 345 kV line & Lamar – Comanche 345 kV line & EC – Big Sandy 345kV Big Sandy – 125 Road 345kV 125 Road – Corner Point 345kV	>1750	None

Scenario A Conclusions and Results

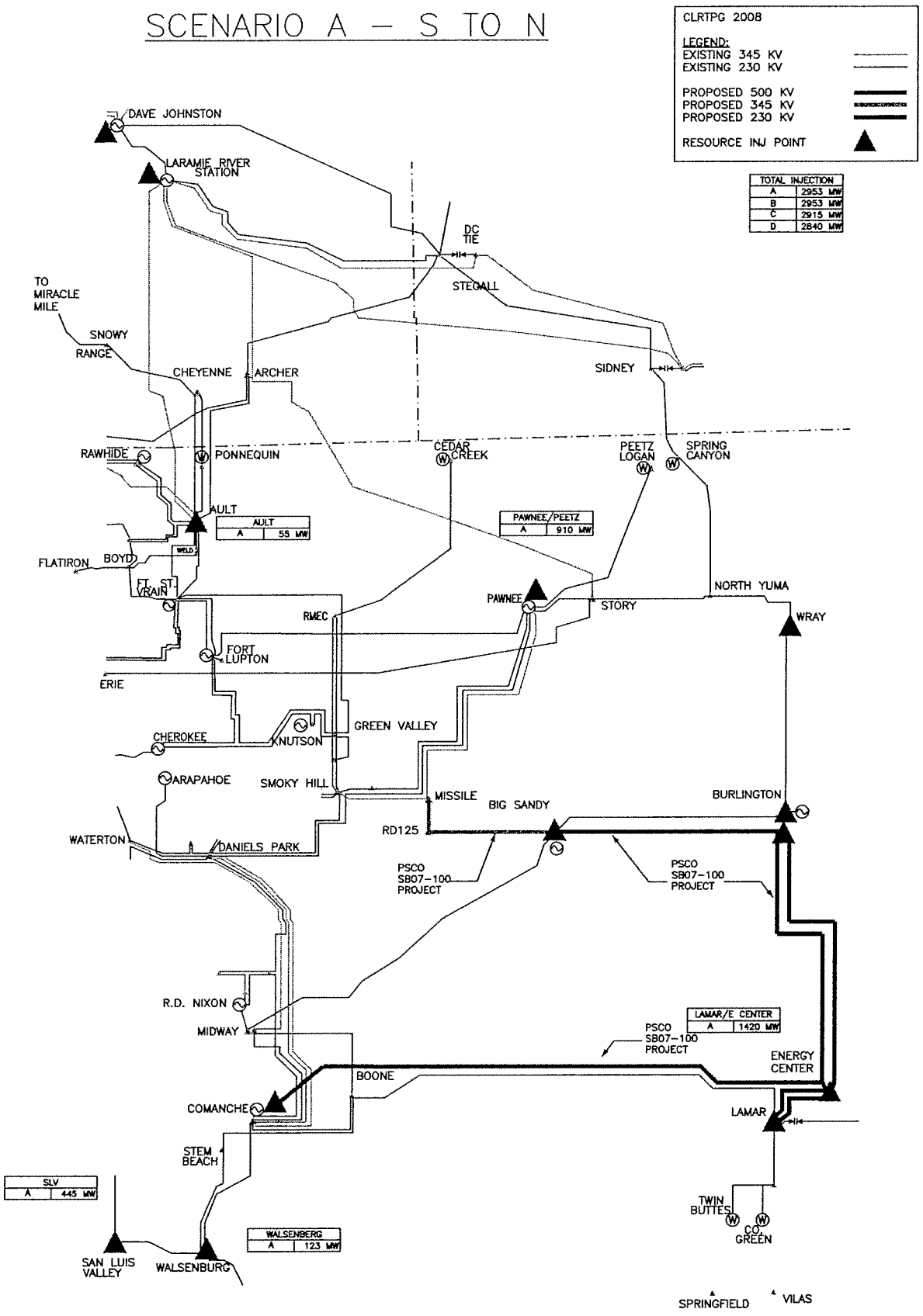
Total new resource injection: 2953 MW.

Scenario A Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
EC-BURLINGTON	500/345	70
EC-BIG SANDY-RD125-MISSILE	500/345	160
EC-COMANCHE	500/345	80
EC-LAMAR	230	10
TOTAL		320

These proposed lines and the injection locations are shown on Figure 03 – Scenario A South to North.

SCENARIO A – S TO N



03		CLRTPG 2018 COLORADO LONG RANGE TRANSMISSION PLANNING GROUP 2018 STUDY SCENARIO A SOUTH TO NORTH	

Scenario B Summary Report

(High Load, High North Resources)

Description

This report summarizes the comparison of power flow analyses for scenario B, a North to South stressed case, with heavy generation injection at Pawnee, Peetz, and Corner Point, directly or via the Wyoming to Colorado Intertie project (WCI) at Pawnee only. The WCI resource injections are located at LRS and Dave Johnston.

Generation Dispatch

Below is a table of Existing Generation followed by the New Injections in the scenario B cases.

Scenario B Existing Generation

Study Zone	Injection Location	Area	Injection (MW)	Available (MW)
Zone 1	Craig	73	1322	1322
Zone 1	Peetz (existing)	70	400	400
Zone 1	Pawnee	70	530	530
Zone 1	Manchief	70	280	280
Zone 1	Brush	70	258	260
Zone 2	Burlington	70	50	120
Zone 2	Lincoln	70	92	128
Zone 3	Lamar DC	70	100	200
Zone 3	TWN Butte	70	75	75
Zone 3	Colorado Green	70	162	162
Zone 5	Comanche	70	990	1475

Scenario B New Resources

Study Zone	Injection Location	Area	Injection (MW)	Injection amount (MW) WCI
Zone 1	Ault	73	55	55
Zone 1	Pawnee	70	500	0
Zone 1	Peetz-Logan (new)	70	210	0
Zone 2	Corner Pt/Missile	70	200	0
Z W1	LRS	73	0	600
Z W2	DJ	73	0	310
Zone 3	EC	70	650	650
Zone 3	Lamar (new)	70	770	770
Zone 4	SLV	70	445	445
Zone 4	Walsenburg	70	123	123
TOTAL			2953	2953

As indicated above, when Pawnee injections were on, there were no injections at LRS or DJ. When LRS and DJ injections were on, there were no injections simulated for Pawnee, Peetz, or Corner Point.

Case

The scenario B case included the preferred alternatives from scenario A. Sensitivities without the scenario A additions were not performed.

Analysis Method / Sensitivities

The scenario B analysis consisted of a comparison set showing the progression of the bulk transmission infrastructure required for the scenario B injections. Transmission projects were added to the case to mitigate the contingencies that did not solve.

Scenario B Conclusions and Results

The first analysis on scenario B revealed a number of contingencies that did not solve, as shown in Attachment 1. These outages centered on the Pawnee – Daniels Park, Boone, and Lamar areas. In order to handle the amount of generation injection modeled, additional transmission was needed. The following additions were made to the case:

- Add the Smoky Hill - Daniels Park 345 kV line
- Add the second Pawnee-Daniels Park 345kV line
- The Boone - Stem Beach 230 kV line was replaced with the Boone - Comanche - Stem Beach line 230 kV line. This did not affect the study results, but was a modification from the benchmark case.

These additions appear sufficient for either resource injection option (Pawnee, Peetz and Corner Point, or at DJ and LRS). After applying these changes, only one contingency that did not solve remained: the outage of the Energy Center 500/230 kV transformer. Adding a second transformer solved this contingency issue.

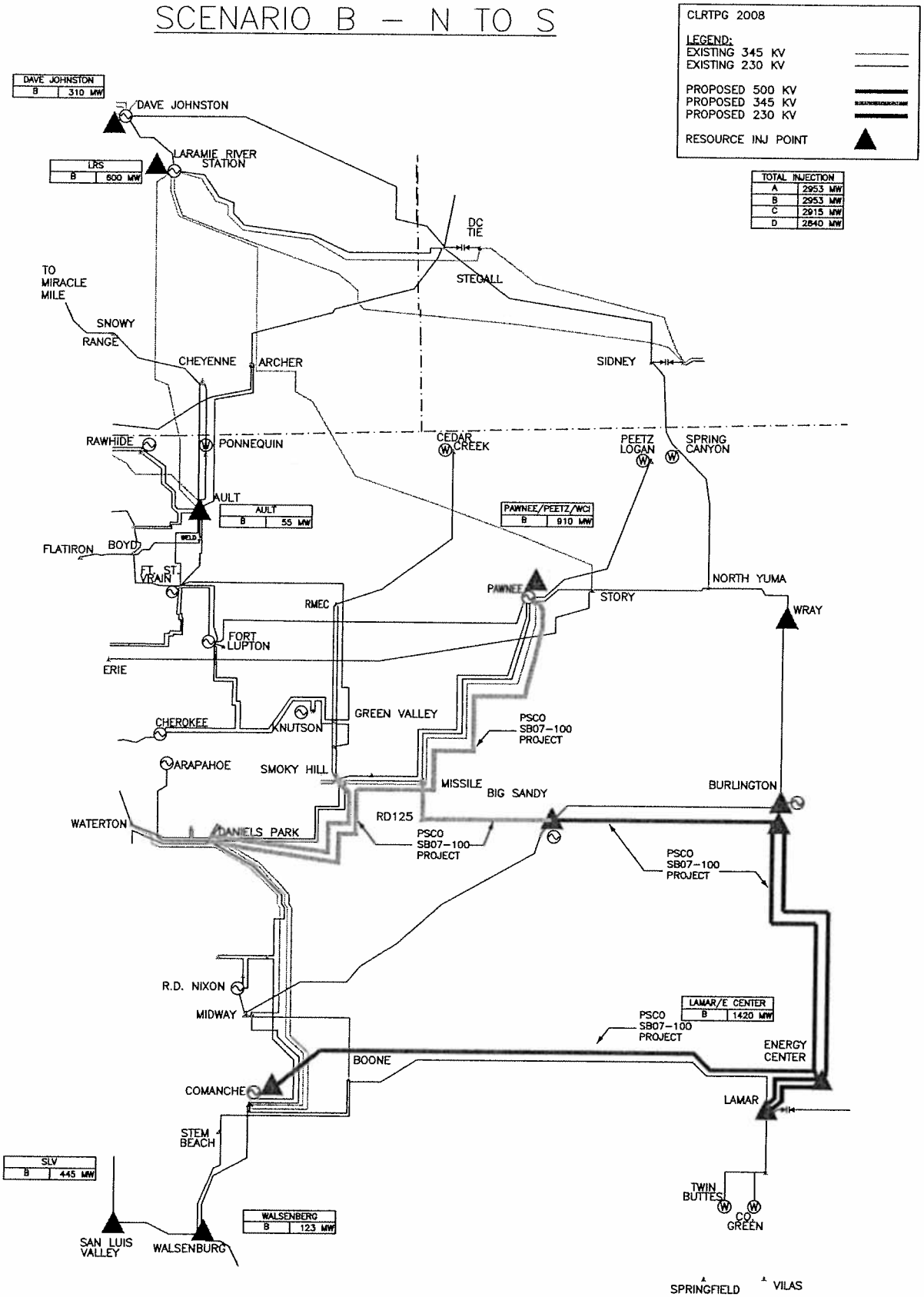
Other loading and voltage issues also were seen, however, fixes for these underlying overloads and voltage issues were not identified in this study; only the major bulk transmission additions were enumerated.

Scenario B Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
PAWNEE-DANIELS PARK-SMOKY HILL	345	65
TOTAL		65

These proposed lines and the injection locations are shown on Figure 04 – Scenario B North to South.

SCENARIO B – N TO S



04	CLRTPG 2018 COLORADO LONG RANGE TRANSMISSION PLANNING GROUP 2018 STUDY SCENARIO B NORTH TO SOUTH	

Scenario C Summary Report

(High Load, High East Resources)

Description

This report summarizes the comparison of power flow analyses for scenario C of the Colorado Long Range Transmission Planning Study. Scenario C is a case with generation injection representing higher Eastern Colorado injection as indicated below.

Generation Dispatch

Below is a table of Existing Generation followed by the New Injections in the scenario C cases.

Scenario C Existing Generation

Study Zone	Injection Location	Area	Injection (MW)	Available (MW)
Zone 1	Craig	73	1322	1322
Zone 1	Peetz-Logan (existing)	70	400	400
Zone 1	Pawnee	70	530	530
Zone 1	Manchief	70	280	280
Zone 1	Brush	70	258	260
Zone 2	Burlington	70	50	120
Zone 2	Lincoln	70	92	128
Zone 3	Lamar DC	70	100	200
Zone 3	TWN Butte	70	75	75
Zone 3	Colorado Green	70	162	162
Zone 5	Comanche	70	990	1475

Scenario C New Resources

Study Zone	Injection Location	Area	Injection (MW)
Zone 1	Ault	73	110
Zone 1	Pawnee	70	410
Zone 1	Peetz-Logan (new)	70	165
Zone 1	Wray	73	55
Zone 2	Burlington	73	630
Zone 2	Big Sandy	73	110
Zone 2	Corner Pt/Missile	70	0
Zone 3	EC	70	650
Zone 3	Lamar (new)	70	730
Zone 4	SLV	70	0
Zone 4	Walsenburg	70	55
TOTAL			2915

Case

Scenario C started with the conclusion topology from scenarios A and B. The following additions were made to the scenario A and B cases: None.

Analysis Method / Sensitivities

The scenario C analysis consisted of comparing the contingency results of the case with the scenario C injections. Transmission projects were added to the case to mitigate contingencies that did not solve. Loading and voltage criteria violations were noted, but only bulk system additions were identified.

Scenario C Conclusions and Results

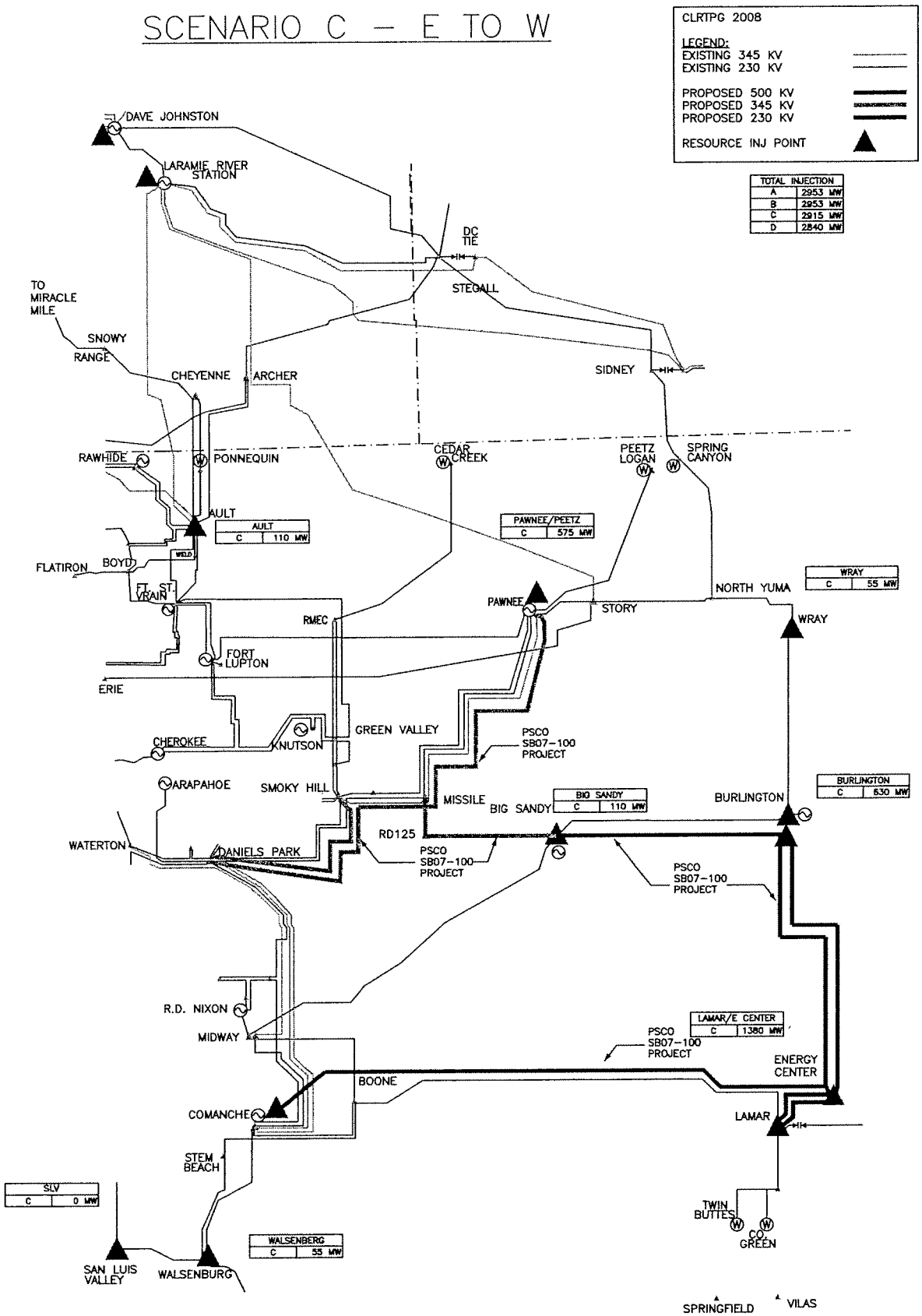
The analysis on scenario C showed no contingencies that did not solve, indicating scenario A and B topology additions are adequate for scenario C dispatch.

Loading and voltage issues were observed on the underlying system.

The total new resource injection for Scenario C was 2915 MW and no major additions were needed beyond those developed for scenarios A and B.

The injection locations are shown on Figure 05 – Scenario C East to West.

SCENARIO C – E TO W



	CLRTPG 2018	
	COLORADO LONG RANGE TRANSMISSION PLANNING GROUP 2018 STUDY	
	SCENARIO C EAST TO WEST	

Scenario D Summary Report

(High Load, High South Central Resources)

Description

This report summarizes the power flow analyses for scenario D. The scenario case has with high Southern generation injection representing large scale solar penetration, at the locations indicated below.

Generation Dispatch

Below is a table of Existing Generation followed by the New Injections in the scenario D cases.

Scenario D Existing Generation

Study zone	Injection Location	Area	Injection (MW)	Available (MW)
Zone 1	Craig	73	1322	1322
Zone 1	Peetz-Logan (existing)	70	50	400
Zone 1	Pawnee	70	505	530
Zone 1	Manchief	70	280	280
Zone 1	Brush	70	260	260
Zone 2	Burlington	70	50	120
Zone 2	Lincoln	70	92	128
Zone 3	Lamar DC	70	100	200
Zone 3	TWN Butte	70	75	75
Zone 3	Colorado Green	70	160	162
Zone 5	Comanche	70	1475	1475

Scenario D New Resources

Study zone	Injection Location	Area	Injection amount (MW)
Zone 1	Ault	73	0
Zone 1	Pawnee	70	65
Zone 1	Peetz-Logan (new)	70	40
Zone 1	Wray	73	0
Zone 2	Burlington	73	0
Zone 2	Big Sandy	73	0
Zone 2	Corner Point	70	0
Zone 3	EC	70	650
Zone 3	Lamar (new)	70	80
Zone 4	SLV	70	1000
Zone 4	Walsenburg	70	1005[8]
			2840

Case

Scenario D started with the conclusion topology from scenarios A and B.

Analysis Method / Sensitivities

The scenario D analysis consisted of comparing the contingency results of the case containing scenario A and B additions with the scenario D injections. Transmission projects were added to the case to mitigate contingencies that did not solve. Loading and voltage criteria violations were noted, but only bulk system additions were identified.

Conclusions

The analysis on scenario D showed several contingencies that did not solve. These contingencies centered on the SLV and Walsenburg areas, indicating insufficient transmission existed to accommodate the level of generation injection in these two areas.

The unsolved contingencies show the need for three high voltage transmission paths out of the generation injection sites. With only two paths, single contingency results exhibited symptoms of voltage instability on the remaining path, or on the underlying lower voltage system.

Bulk transmission additions have been developed in Xcel's Senate Bill 100 study processes that address generation additions in these areas. These additions provide for a third path from both the SLV generation injection and the injection near

[8] 1000 MW solar generation and 5 MW of generation associated with GDA8, as identified in Colorado Senate Bill 91.

Walsenburg. These additions, listed below, were therefore added to the scenario D case.

- Tap Walsenburg - Stem Beach 230 kV line at Calumet
- Change the SLV - Walsenburg 230 kV line into two (double circuit) San Luis Valley - Calumet 230 kV lines
- Calumet 230/345 kV transformer
- Calumet - Comanche 345kV line
- Move the Walsenburg generation injection to Calumet
- Delete the 2nd Boone - Comanche 230 kV line

With the additions listed above, all contingencies reach solution, indicating that no other bulk system additions were needed in scenario D.

Other loading and voltage were seen on the underlying system, but these issues were not identified or corrected in this study.

Scenario D Conclusions and Results

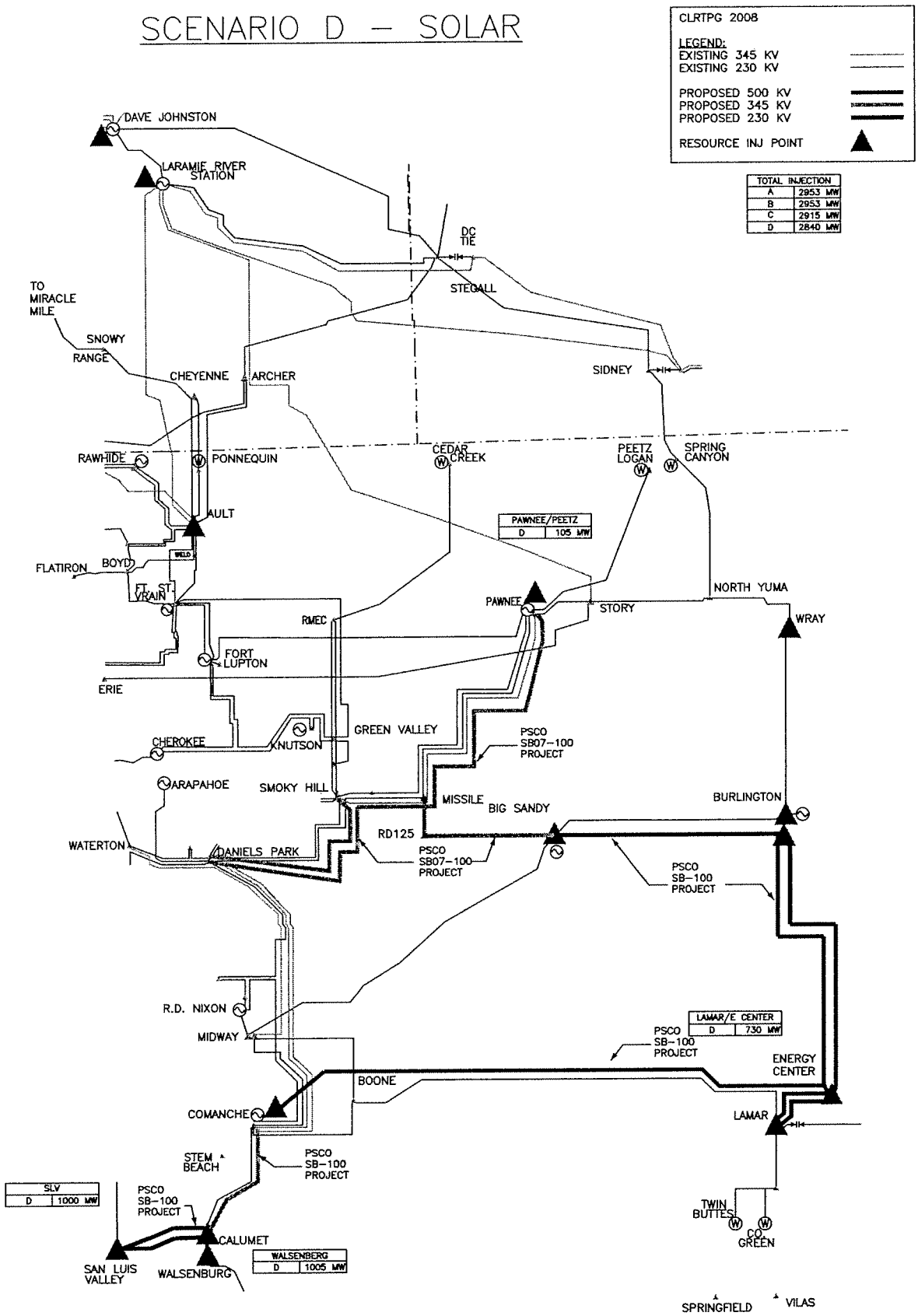
Total new resource injection: 2840 MW.

Scenario D Result Summary

TRANSMISSION PROJECT	VOLTAGE LEVEL (KV)	ESTIMATED COST ($M)
SLV-CALUMET DOUBLE CIRCUIT	230	115
CALUMET-COMANCHE	345	65
CALUMET-WALSENBURG	230	10
TOTAL		190

These proposed lines and the injection locations are shown on Figure 06 – Scenario D Solar.

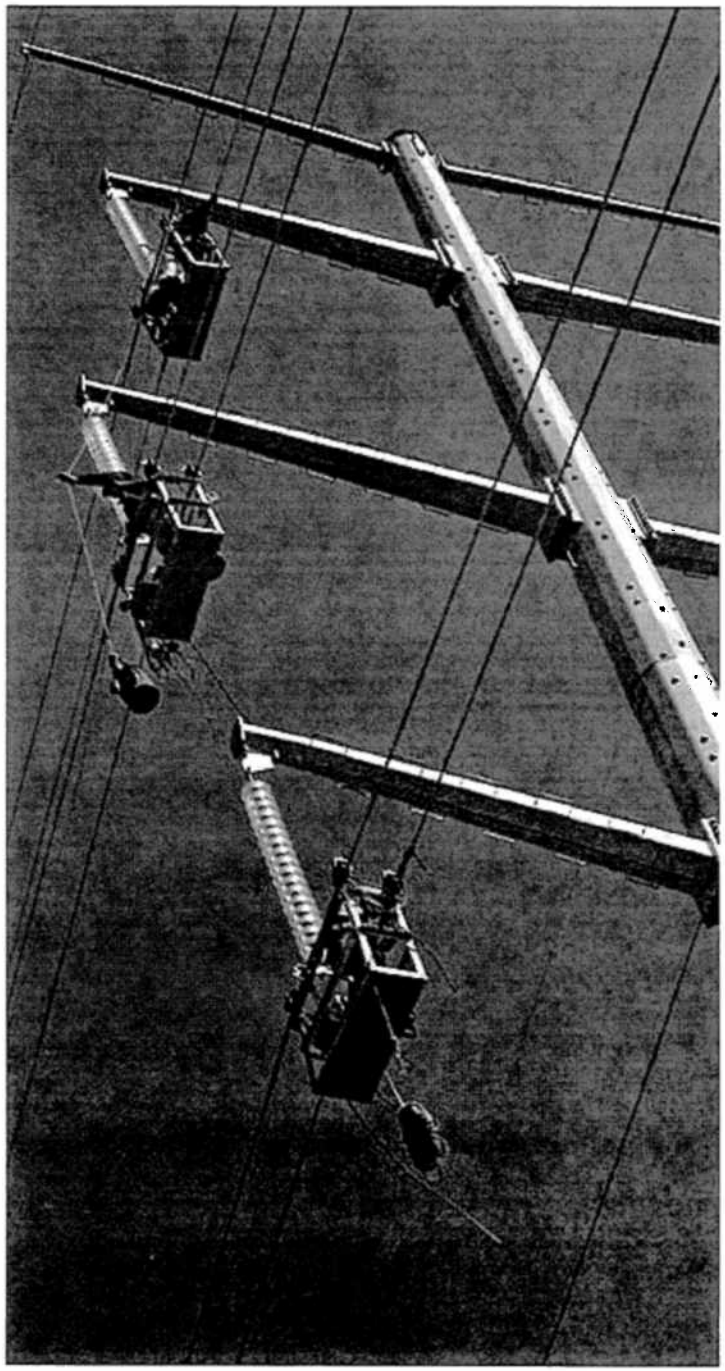
SCENARIO D – SOLAR



06	CLRTPG 2018	
	COLORADO LONG RANGE TRANSMISSION PLANNING GROUP 2018 STUDY	
	SCENARIO D HIGH SOLAR	

08I-227E

Exhibit B



PSCo 10-Year Transmission Plan/20-Year Scenario Assessment

May 2009

This report contains transmission planning data that may be conceptual in nature and is subject to change. The transmission projects listed may change scope or not be constructed.

Xcel Energy®

Executive Summary

10-Year Transmission Plan

- Five Year Capital Budget(2009-2013)
- High Plains Express Initiative Total Cost Approx. $5.13 billion (may extend into 20 year time period)
- SB-100 Transmission Plan
- FERC Generation Interconnection Studies – 23,970 MW, 81 Requests, Wind (51), Solar (10)
- SB-100. PSCo has initiated the Pawnee –Smoky Hill 345 kV line (ISD 2013) and the Missile Site Switching station (ISD12-2010)
- High Plains Express is starting stage 2 feasibility

Key Messages

10-Year Plan

- Coordinated and open transmission planning strategy that involves the electric utilities in the Rocky Mountain region and interested stakeholders
- Developed eight (8) unique transmission projects for the five (5) energy resource zones under Senate Bill - 100.
- Created an approved five year capital budget (2009 – 2013) for transmission reliability and import of renewable energy .

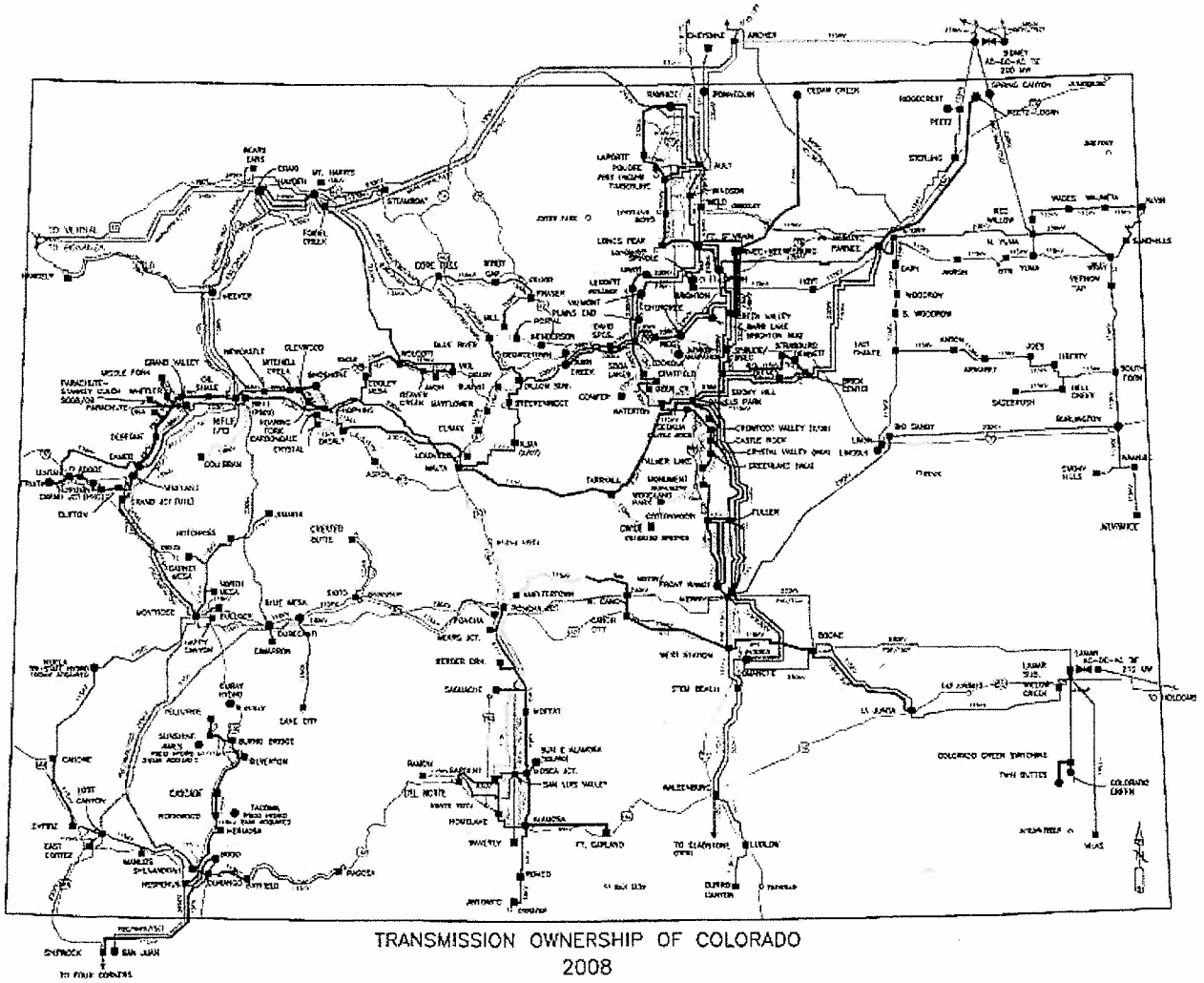
20-Year Transmission Scenario Assessment

- 20-year scenario assessment is a conceptual plan
- PSCo evaluated 6 unique transmission scenarios
- Scenarios include various levels of renewable energy that match the PSCo environmental strategy including an export strategy
- High Plains Express Initiative (HPX) develops a transmission expressway for moving renewable energy across the Rocky Mountain States

Scope and Purpose

- The purpose of this study is to document the transmission additions needed on the PSCo transmission system looking forward 10-20 years. The study is based on the most recent set of WECC approved 10 year powerflow models.
- Perform an assessment of the PSCo transmission assets based on current load forecast, resource plan, renewables, the SB-100 proposed plan and the High Plains Express project.

Transmission Ownership
Colorado



TRANSMISSION OWNERSHIP OF COLORADO
2008

PSCo System Statistics

2008

- 4153 Miles of Transmission
- 245 Substations Served
- 25 Generators Served
- 7 Wind Generators (1075 MW)
- PSCo Operating Company Peak Load 6701 MW
- PSCo Balancing Authority Peak Load 7912 MW

PSCo Transmission System

- **PSCo Transmission Assets Located Entirely in CO and Within the Western Electric Coordinating Council**
- **Connected to Southwestern Public Service Company (SPS) Through the Lamar HVDC Interconnection**
- **Major Utility Interconnections**
  - Western Area Power Administration, TSG&T, Colorado Springs Utilities, Platte River Power Authority and Black Hills Power
- **Major Wholesale Customers**
  - Intermountain REA, Black Hills, Holy Cross Energy, Yampa Valley REA and Grand Valley Electric, City of Center, Burlington, Julesburg

Planning Process Calendar 2009

Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec

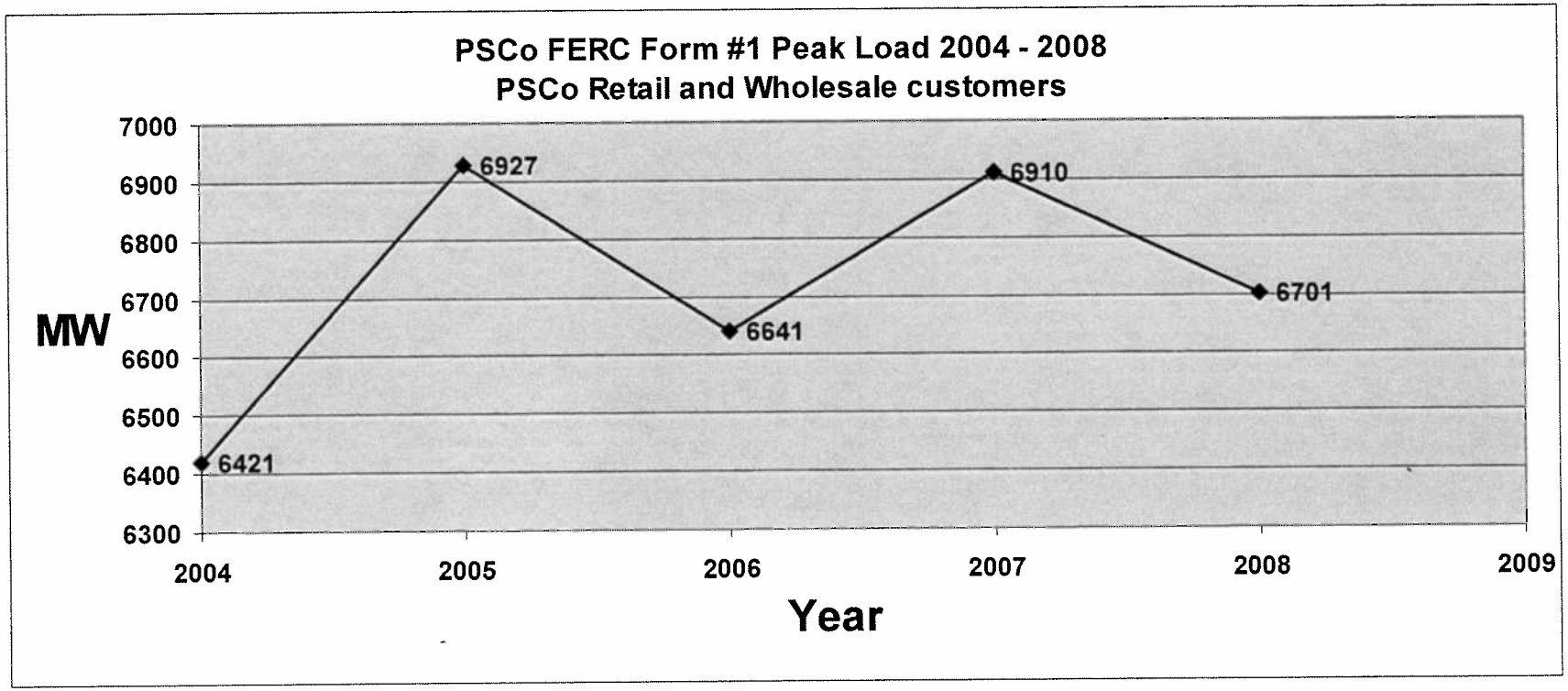
- 5 year capital budget studies
- 5 year budget approved
- 10 year plan completed
- SB100 Studies
- SB100 Biannual Filing
- SB100, CPCN Filing
- CCPG Long Range
- Resource Plan
- WestConnect
- Generation Interconnect , Load Interconnect & Transmission Service Studies
- FERC 890 3/6/09
- CCPG 4/23/09
- CCPG 8/19/09- 8/20/09
- FERC 890 12/10/09
- CCPG 12/16/09
- WestConnect Annual Meeting 1/14/09
- **WestConnect Annual Stakeholder Meeting 8/20/09**

Transmission Planning

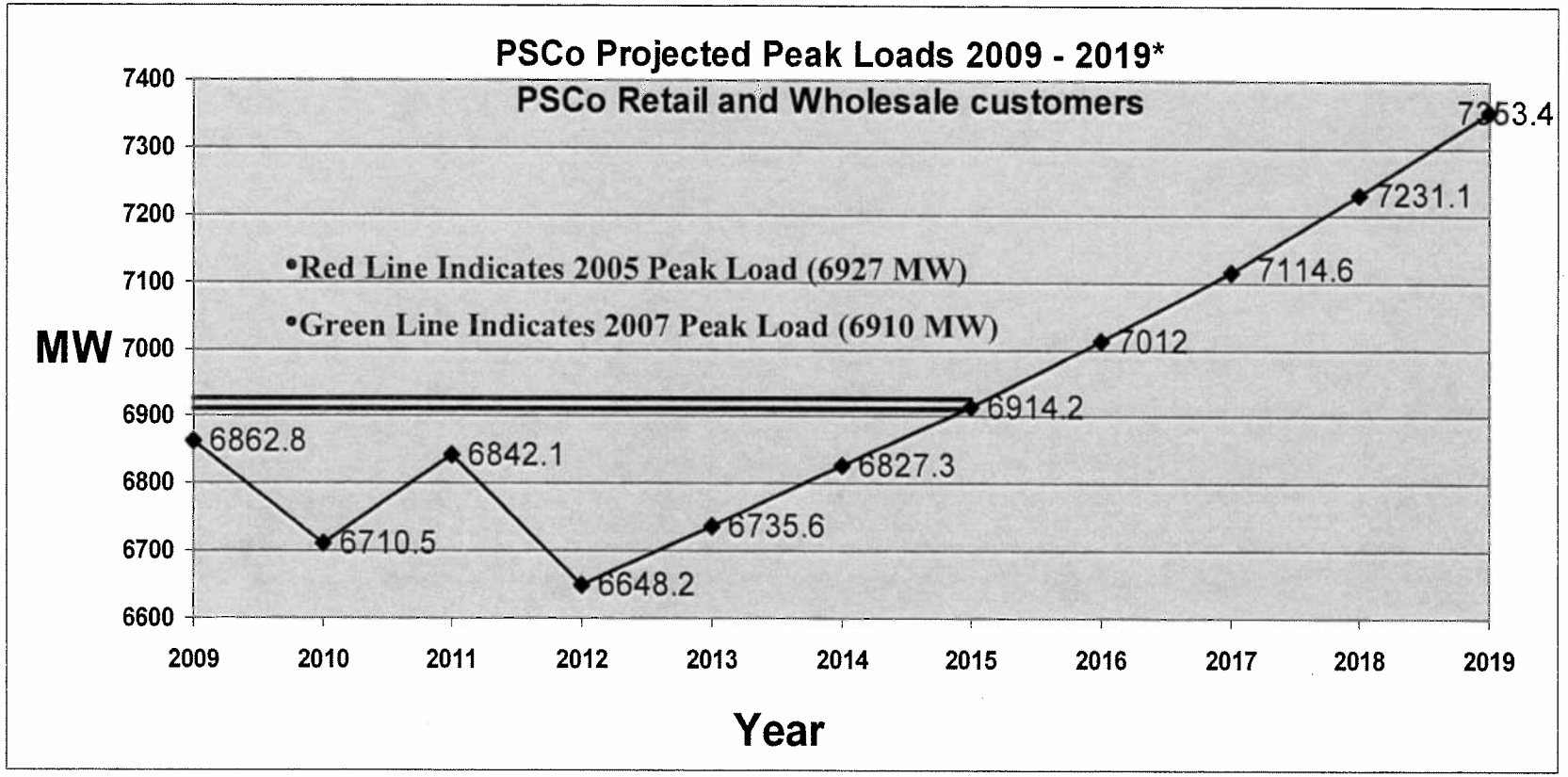
Drivers

- **Regulatory/Environmental Considerations**
  - State Renewable Portfolio Standards
  - Colorado Resource Plan (PSCo)
  - SB -100 Transmission Plans to Energy Resource Zones
- **5-Year Capital Budget for Transmission Asset Management**
  - FERC - Generation Interconnection Studies Queue – 23,970 MW, wind (51) , solar (10)
  - Transmission Service Studies
  - Wholesale/retail Load Interconnections
  - NERC reliability compliance and planning criteria
- **Load Forecast** (Feb 2009)
- **10-Year Colorado Long Range Planning Group (CLRPG) Studies** (Jan 2009)
- **High Plains Express (HPX) Initiative**

PSCo Load (MW)


PSCo FERC Form #1 Peak Load 2004 - 2008
PSCo Retail and Wholesale customers
MW
7000
6900
6800
6700
6600
6500
6400
6300
6421
6927
6641
6910
6701
2004
2005
2006
2007
2008
2009
Year

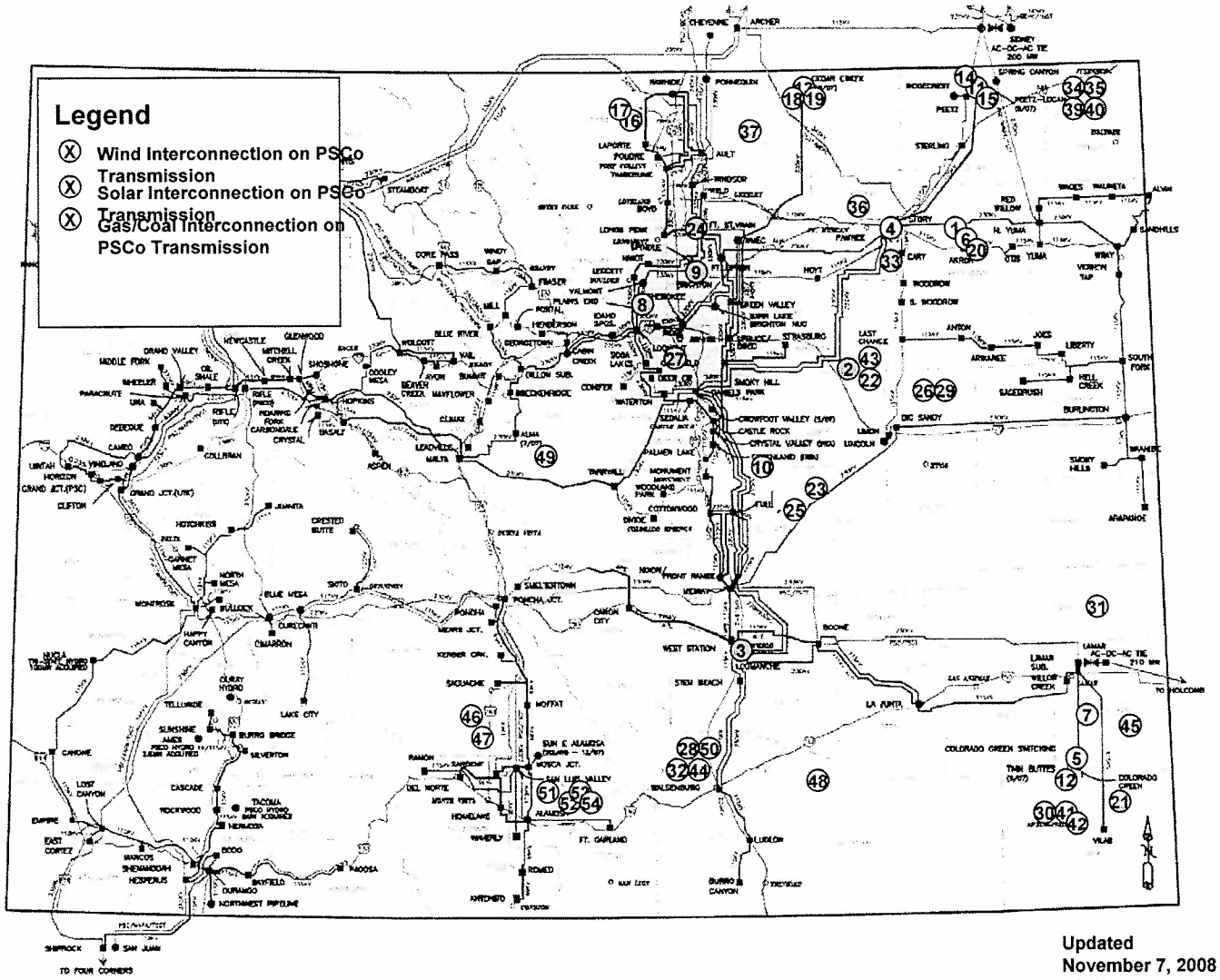
PSCo Load (MW)



*Forecast Feb. 2009

Wholesale customers reduced by 250 MW in 2010 with Comanche #3 ownership

Generation Interconnection Map



Updated
November 7, 2008

Active FERC Generation Interconnection Studies (2006-2009)

- Arapahoe – 587 MW
- Boone – 500 MW Wind
- Fort St. Vrain – 300 MW Gas; 256 MW Combined Cycle
- Green Valley – 400 MW Wind
- Hartsel – 100 MW Solar
- Walsenburg – 300 MW Wind
- Comanche – 700 MW Wind
- Keensburg – 250 MW Wind
- Ault – 1600 MW Wind
- Jackson Fuller – 601 MW Wind
- Missile Site – 800 MW Wind; 270 MW Gas
- Lamar – 2686 MW Wind
- San Luis Valley – 150 MW Wind; 1730 MW Solar
- Pawnee – 1170 MW Combined Cycle; 2820 MW Wind

Generation Interconnection Process

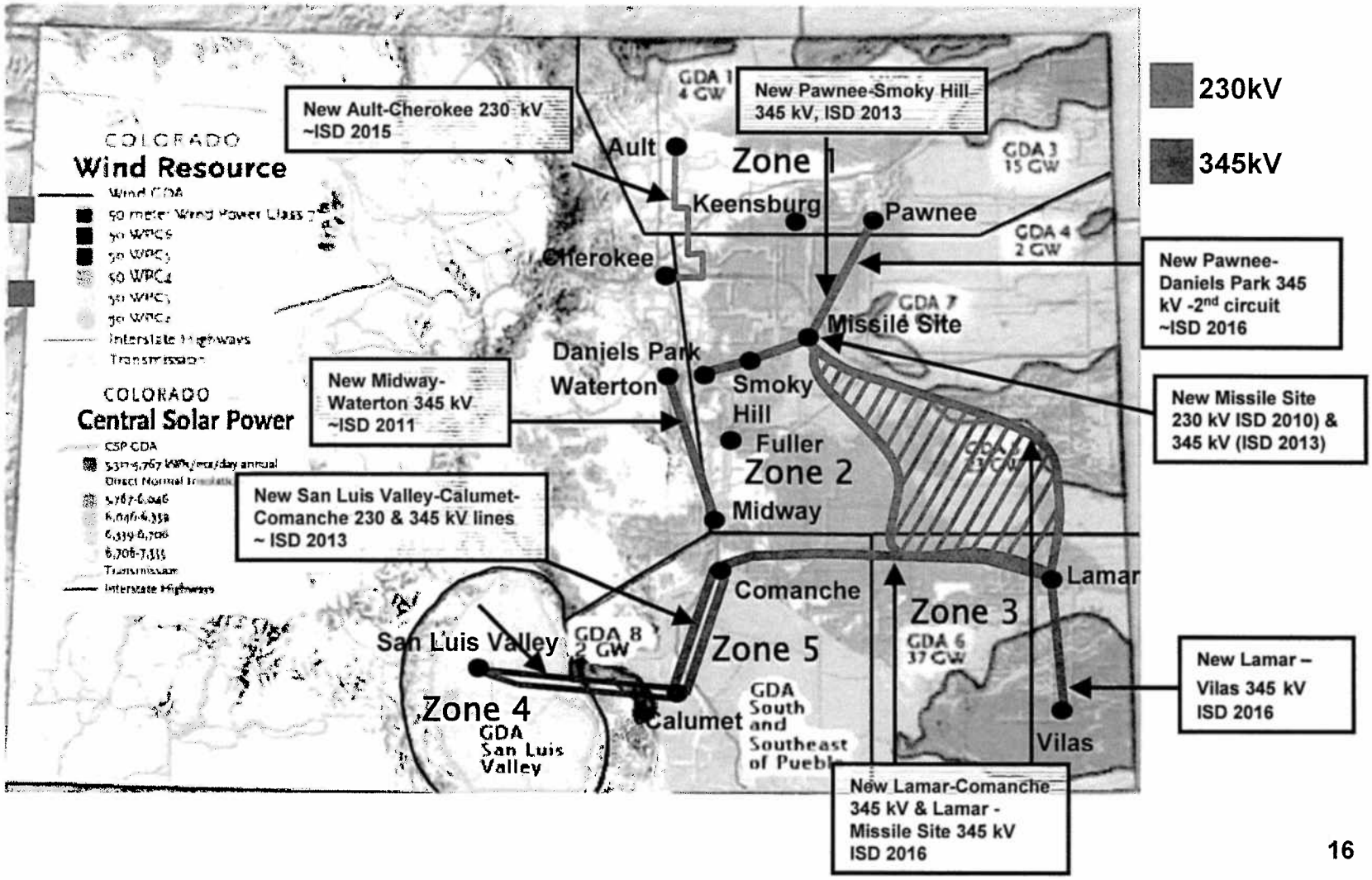
PSCo Interconnection Queue

Total Requests since 2003:	**81**
Total MW:	**23,970**
Requests by Generation Type:	
• **Wind:**	**52**
• **Solar**	**10**
• **Coal:**	**6**
• **Gas:**	**12**
• **Biomass:**	**1**

Senate Bill 07-100

- **Upon recommendations by the 2006 Transmission Task Force on Reliable Electricity Infrastructure, the 66th General Assembly passed Senate Bill 07-100. Under SB 07-100, PSCo must meet the following requirements:**
  - Designate "Energy Resource Zones (ERZ)"
  - Develop plans for the construction or expansion of transmission facilities necessary to deliver electric power consistent with the timing of the development of beneficial energy resources located in or near such zones
  - Consider how transmission can be provided to encourage local ownership of renewable energy facilities
  - Submit proposed plans, designations, and applications for certificates of public convenience and necessity to the commission for simultaneous review

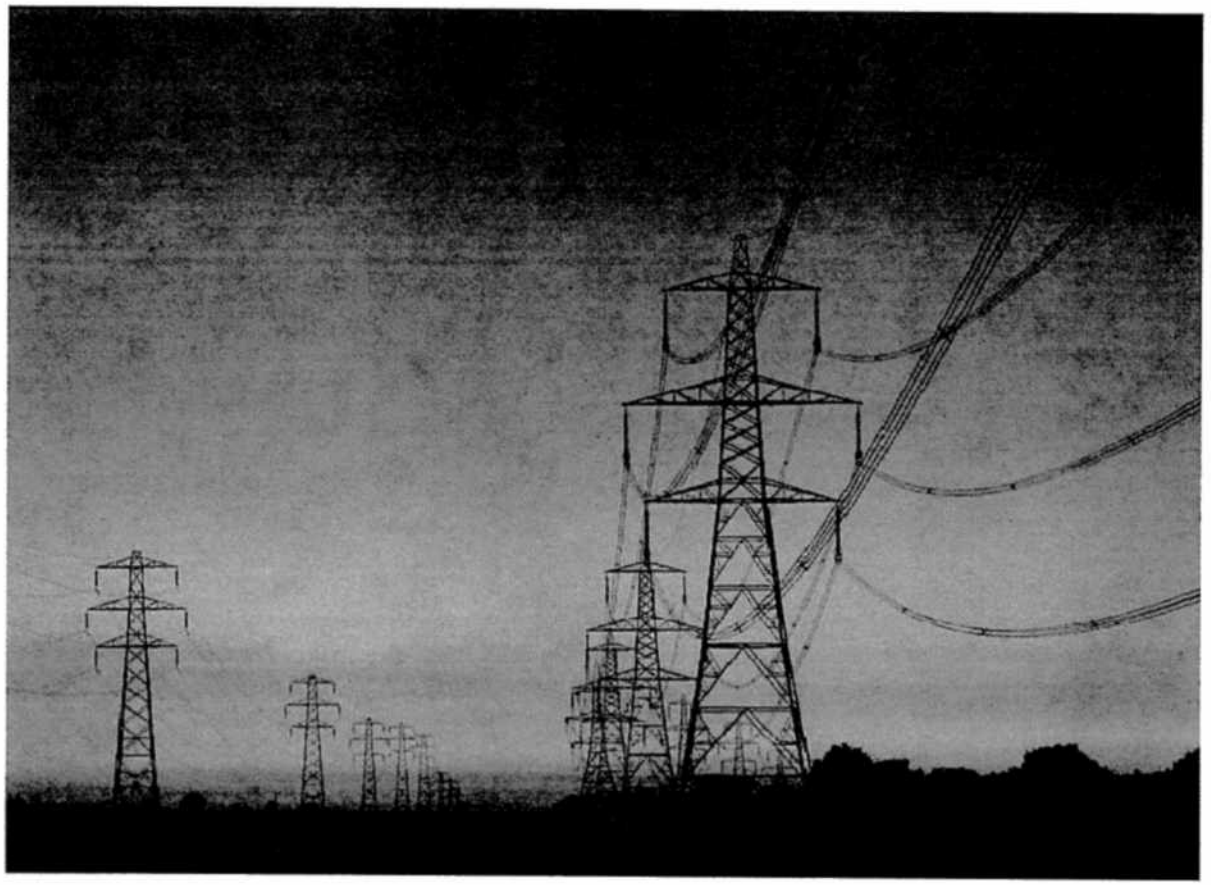
Current SB-100 Transmission Plan 3-13-2009



Proposed SB-100 Projects

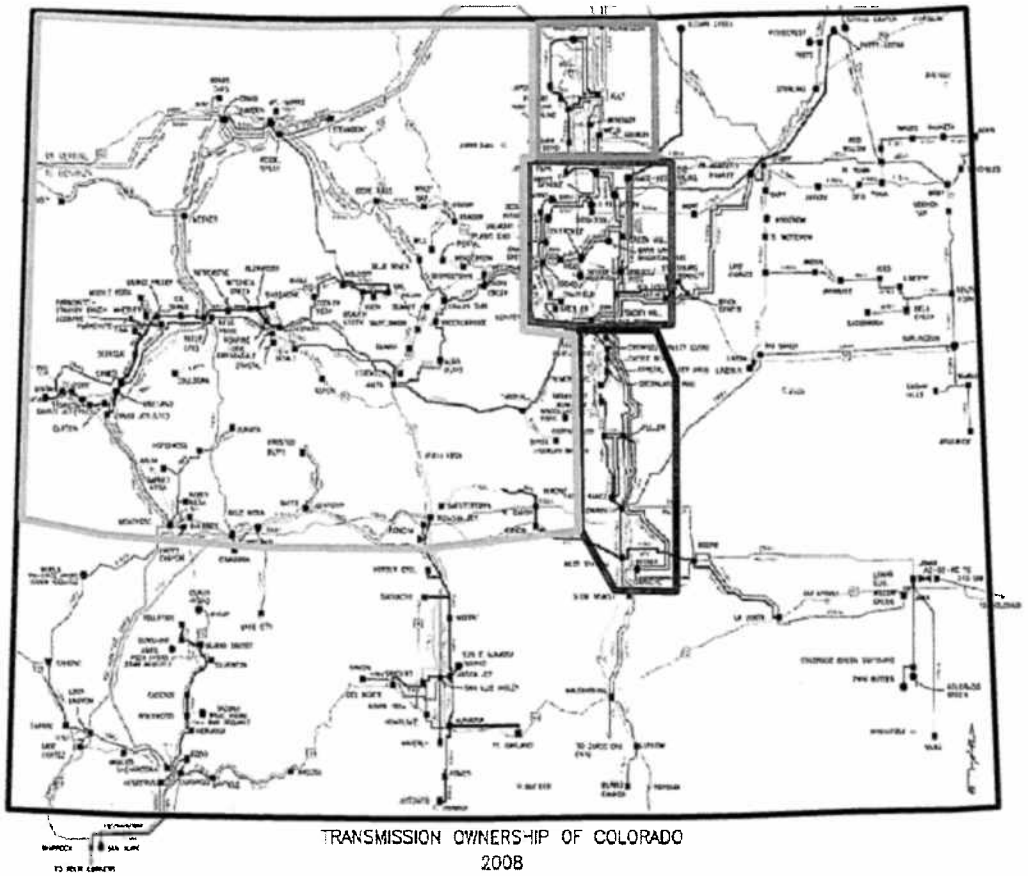
Project	Description	Generation Injection	Tenative ISD	Energy Zone
Pawnee - Daniels Park 345 kV Line	Second circuit 345 kV line in Energy Resource Zone 1	300 - 500 MW	2016	1
Ault - Cherokee 230 kV Line	New 230 kV line in Energy Resource Zone 1	300 - 600 MW	2015	1
Missile Site	345/230 kV switching station on the Pawnee - Daniels Park line in Energy Resource Zone 2	200 - 500 MW	2010 (230 kV) - 2013 (345 kV)	2
Lamar - Comanche and Lamar - Missile Site 345 kV Lines	New 345 kV lines to access Energy Resource Zone 3	800 - 1000 MW	2016	3
Lamar - Vilas 345 kV Line	New 345 kV line In Energy Resource Zone 3 to access wind rich area		2016	3
San Luis - Calumet - Comanche Line	Double circuit 230 kV line (SLV to Calumet) and double circuit 345 kV line (Calumet to Comanche)	600 - 1000 MW	2013	4&5
Midway - Waterton 345 kV Line	Needed for system reliability and utilization resources in Energy Resource Zones 3,4 and 5. Must file modification to CPCN received 9/07 in order to construct.		2011	3&4&5
Pawnee - Smoky Hill 345 kV Line	345 kV line from Pawnee to the Denver load center. Received CPCN in January 2009.	500 MW	2013	1
	*Generation values are not simultaneous			

System Plans



5-Year Capital Budget (2009-2013)

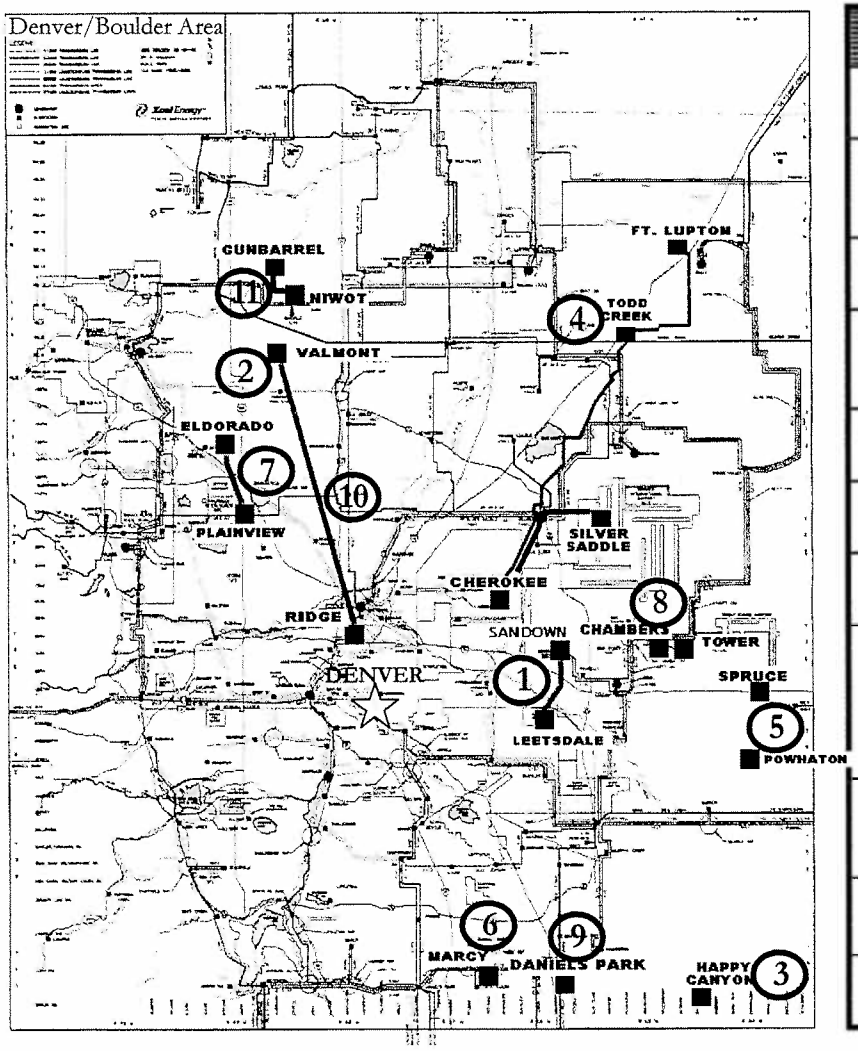
Planning Zones



TRANSMISSION OWNERSHIP OF COLORADO
2008

- Denver/Boulder
- Foothills
- Western Colorado
- Front Range (I-25 Corridor)

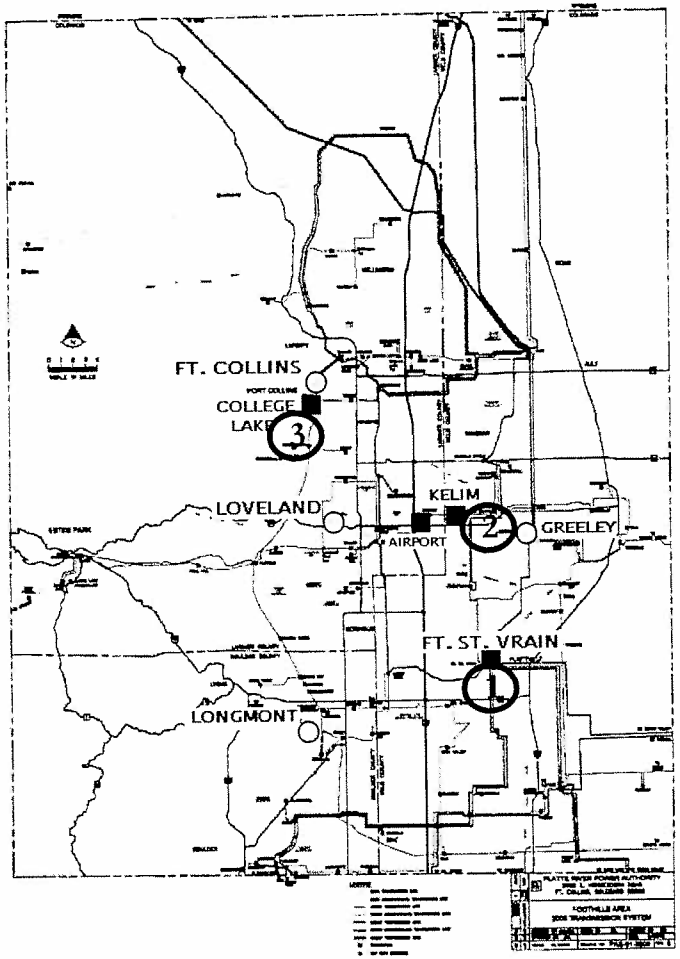
Proposed Transmission Projects
Denver/Boulder, 2009–2013



#	Project	Comments
1	Sandown – Leetsdale Line	New 115kV underground line for reliability
2	Valmont #2 230/115 kV Auto XFMR	Add second 230/115 kV 280 MVA auto transformer at Valmont
3	IREA Happy Canyon	Construct a new 115 kV substation for IREA
4	Todd Creek 115 kV Delivery Point	Provide a load delivery interconnection for TSG&T on Cherokee-Ft. Lupton 115 kV Todd Creek Substation
5	Distribution Powhaton	New Powhaton substation on the Spruce – Smoky Hill 230 kV line
6	Distribution Marcy	Add third 230/13.8 kV transformer at Marcy substation
7	Eldorado – Plainview	Replace existing 115 kV line with new single – circuit, 115 kV structures and line rated for 150
8	Chambers	Final phase of transmission infrastructure upgrades tying the 230 kV outer belt network to the 115 kV load serving transmission system between the Tower substation and the Cherokee – East 115 kV lines
9	Daniels Park 230/115 kV 280 MVA	Replace existing 230/115 kV 150 MVA transformer with 230/115 kV 280 MVA transformer
10	Valmont – Ridge Line	Rebuilding 115 kV line for higher capacity
11	GunBarrel – Niwot 230 kV	Underground 230 kV to Niwot to serve IBM, second circuit

Proposed Transmission Projects

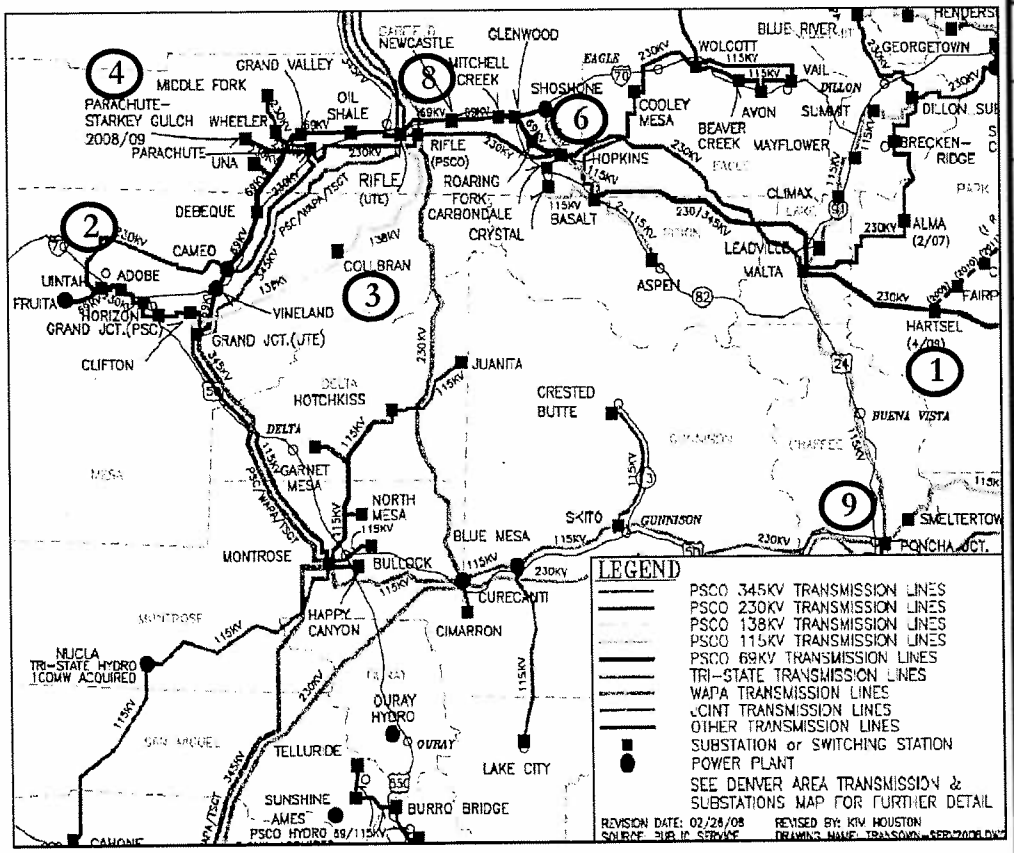
Foothills Area (2009-2013)



#	Project	Comments
1	FSV G5 & G6	Transmission upgrades required to install two new gas turbines at Ft. St. Vrain. CPCN was acquired from the CPUC
2	Distribution Kelim Sub	New distribution substation required for customers in the area north of Denver, interconnecting at PRPA's Airport substation
4	Distribution College Lake	New 230/138 kV distribution substation required for customers in the area west of Fort Collins (CSU Campus) interconnecting/ sectionalizing PRPA's Rawhide Dixon 230 kV line

Proposed Transmission Projects

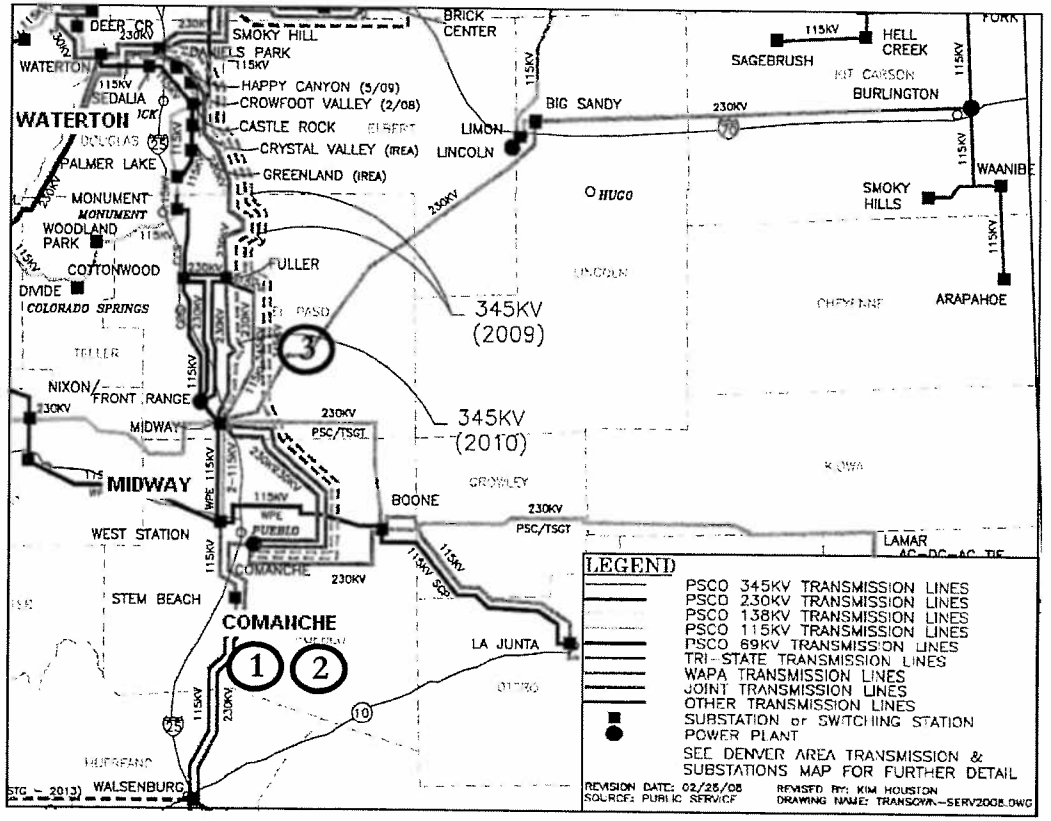
Western Colorado Area (2009-2013)



#	Project	Comments
1	IREA Hartsel	New Hartsel 230 kV substation delivery point for IREA
2	Uintah 230 kV Cap Bank	Install one 45 MVAR capacitor bank at Uintah
3	Collbran 115/12.3 kV Bank 1 Replacement	Replace existing bank 1 115/12.5 kV 2.8 MVA transformer with a 115/12.5 kV 7.5 MVA transformer
4	Clear Creek - Starkey Substation and Line	New Clear Creek 345 kV substation and 230 kV transmission line from Clear Creek to Starkey Gulch to serve gas processing retail customer
5	Uintah Sub 230-69 kV	Install 67 MVA 230/69 kV transformer at Uintah to serve PSCo load
6	Shoshone	Install new 69kV transformer at Shoshone due to catastrophic failure of penstock
7	Fruita Sub 24.9 kV Delivery	New 69/24.9 kV 7.5 MVA transformer and related equipment at Fruita substation to serve Grand Valley Rural Power load
8	Distribution New Castle	New 115/69/24.9 kV distribution substation
9	Distribution Poncha Jct. #3	Add new 25 kV main and transfer buses and two 25 kV feeders to existing 115/25kV transformer

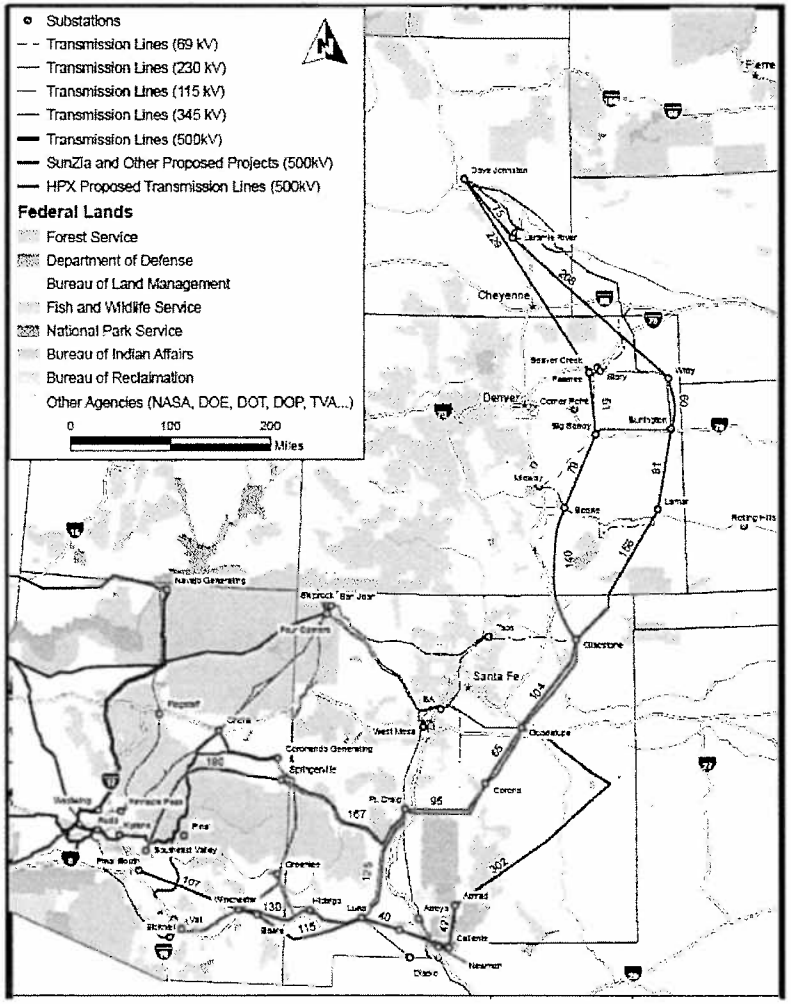
Proposed Transmission Projects

Front Range (I-25 Corridor) Area (2009-2013)



Year	Project	Comments
2010	Comanche - Reader Line #2	Construct a new underground Comanche - Reader 115 kV line
2010	Replace Comanche 230/115 kV Auto transformer	Install 2 new 280 MVA auto transformers to replace the existing ones
2012	Midway - Waterton 345 kV Line	New 345 kV Line

High Plains Express Initiative

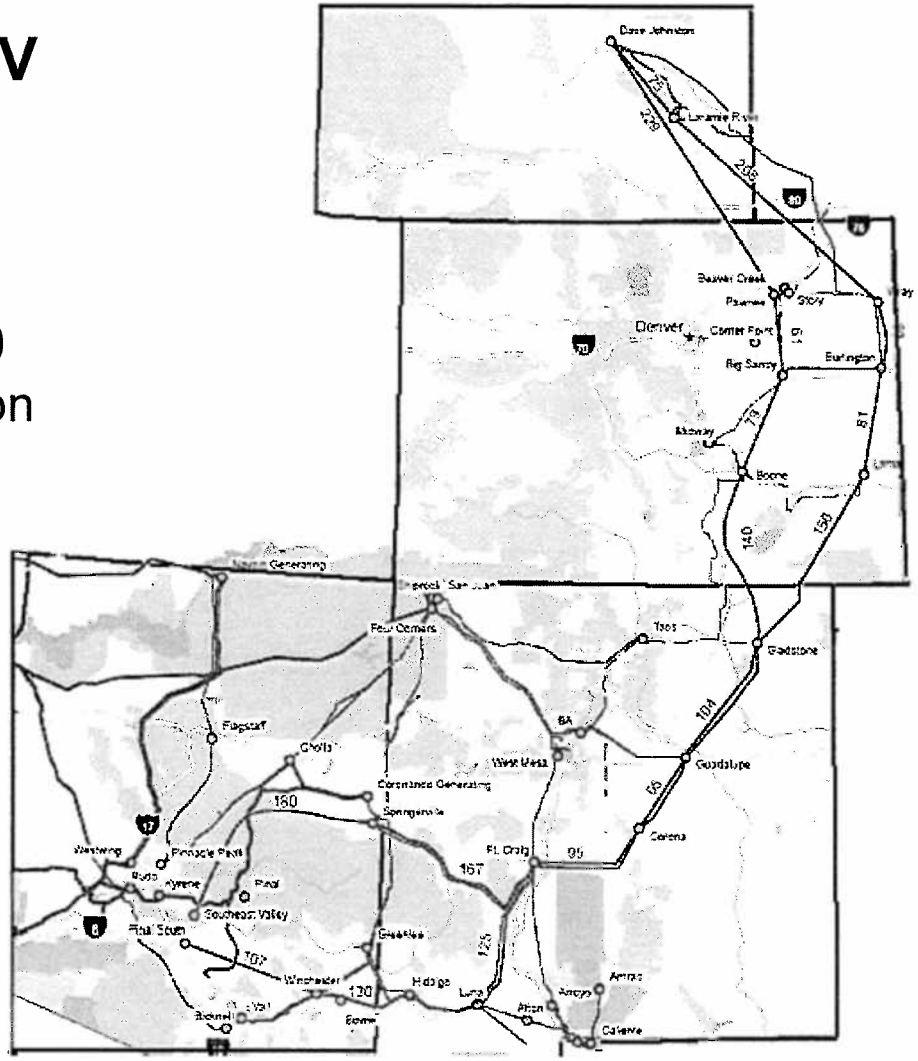


- Two 1,280 mile, 500kV, AC lines through WY, CO, NM and AZ
- 3,500 – 4,000 MW of transmission capacity
- Cost approximately $5.13 billion
- Regional Projects
- Spans both Ten Year Plan & Twenty Year Scenario Assessment

Studies – Cost Estimate

- **Two separate 500 kV AC lines**
  - Approx. 3,500 MW Capacity
  - $1.5 Mil/mile for 1,280 miles x 2 = $3.84 billion
  - Substations (10 new / 5 upgraded): $640 million
  - Series compensation: $512 million
  - SVC: $140 million

Total Costs: $5.13 billion



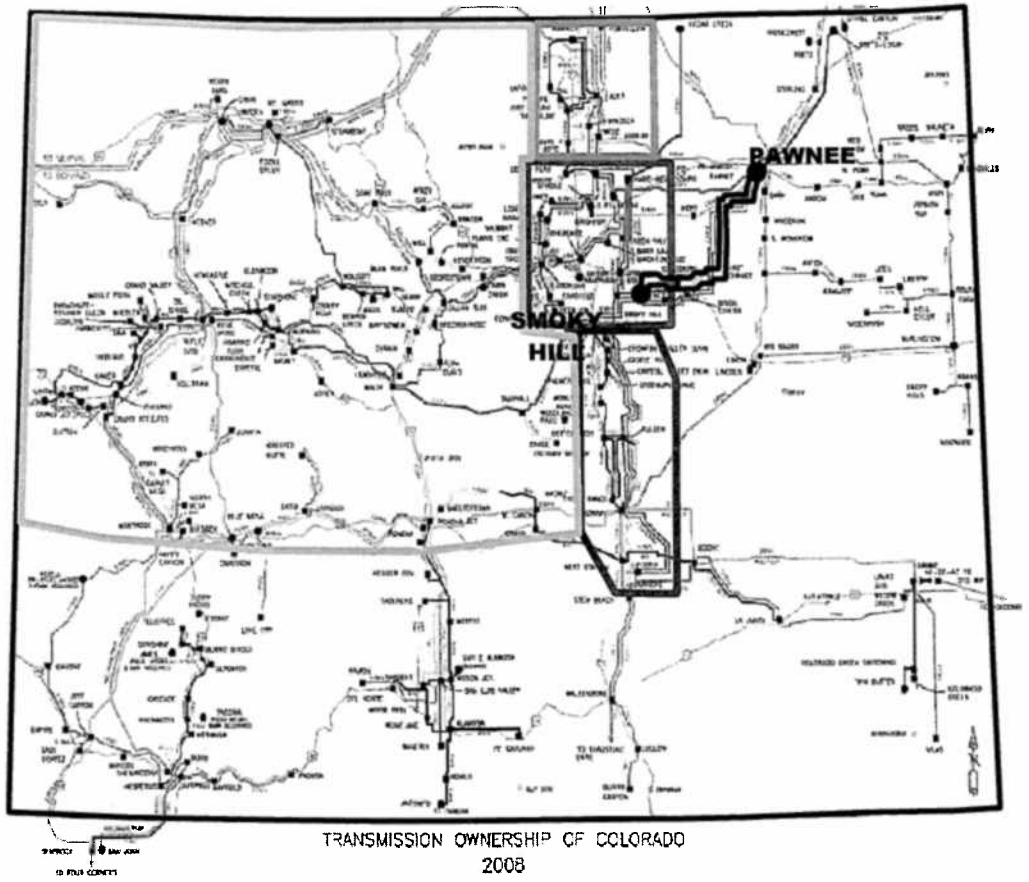
PSCo

20-Year Scenario Assessment

Scenario Index

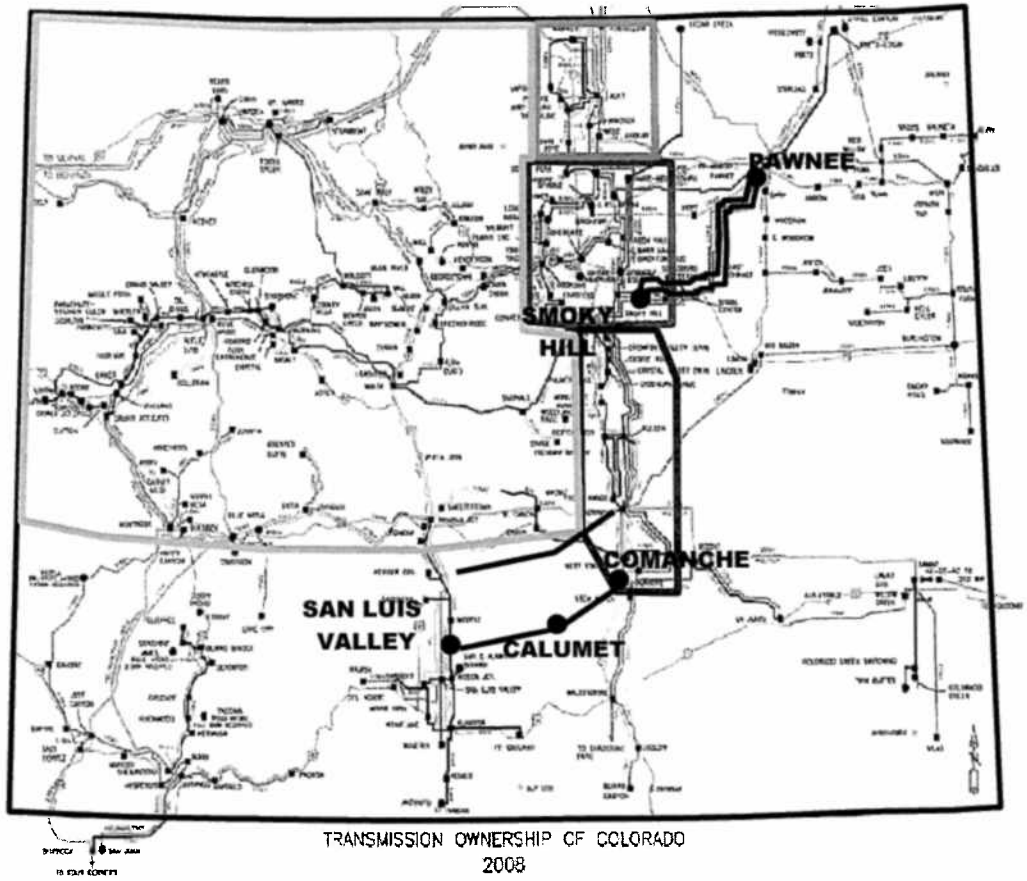
Scenario 1	Low Renewables Growth (1600 MW)
Scenario 2	Intermediate Renewables Growth (2400 MW)
Scenario 3	High Renewables Growth, SB-100 Full Build Out to Five Energy Zones (4400 MW)
Scenario 4	High Plains Express Initiative with Integrated Wind Projects
Scenario 5	Wind Export Scenario, Interconnect With Southwest Power Pool
Scenario 6	HPX Initiative with Solar Integration

Scenario 1: Low Renewables Growth (1600MW)



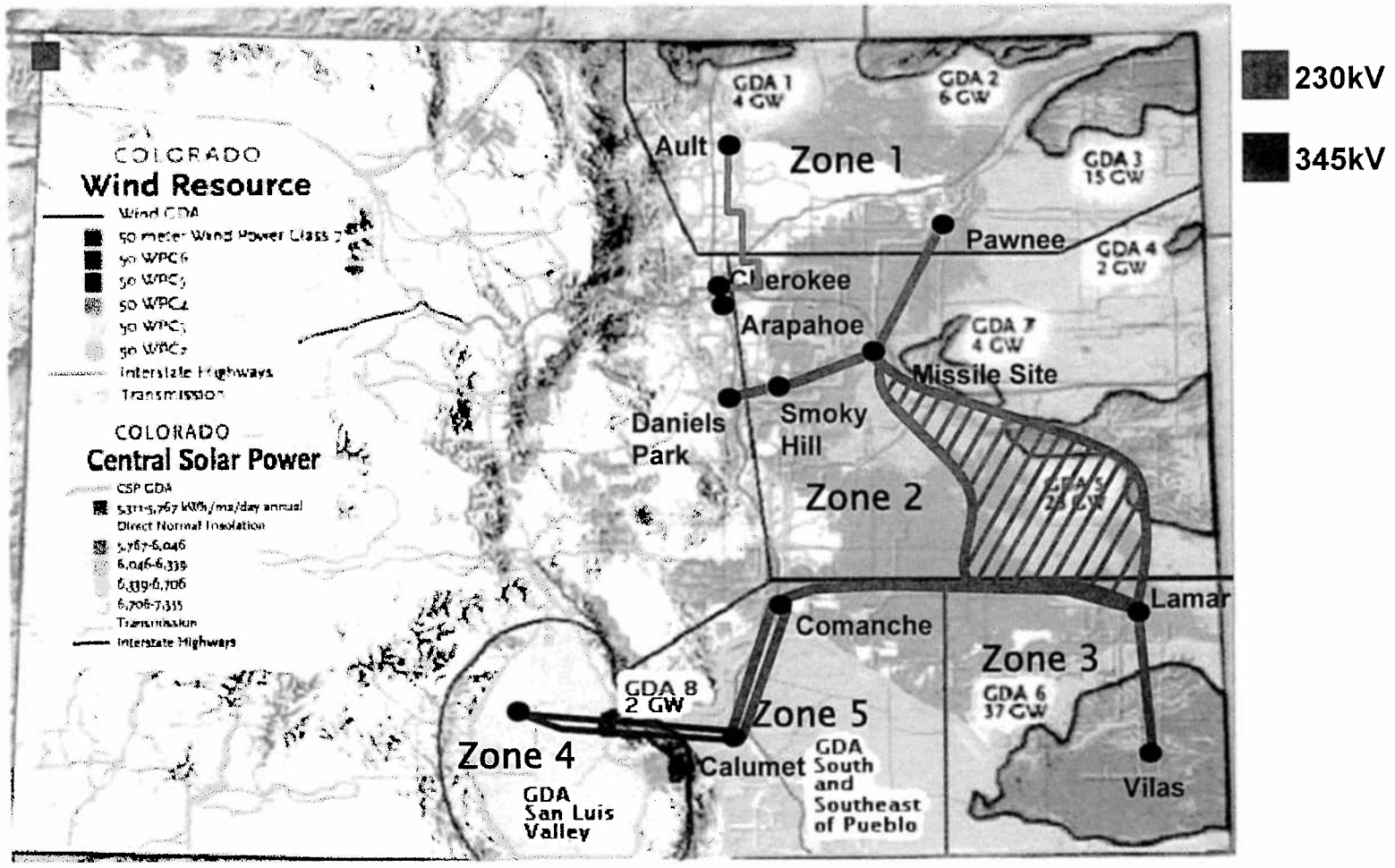
TRANSMISSION OWNERSHIP OF COLORADO
2008

Scenario 2: Intermediate Renewables Growth (2400MW)

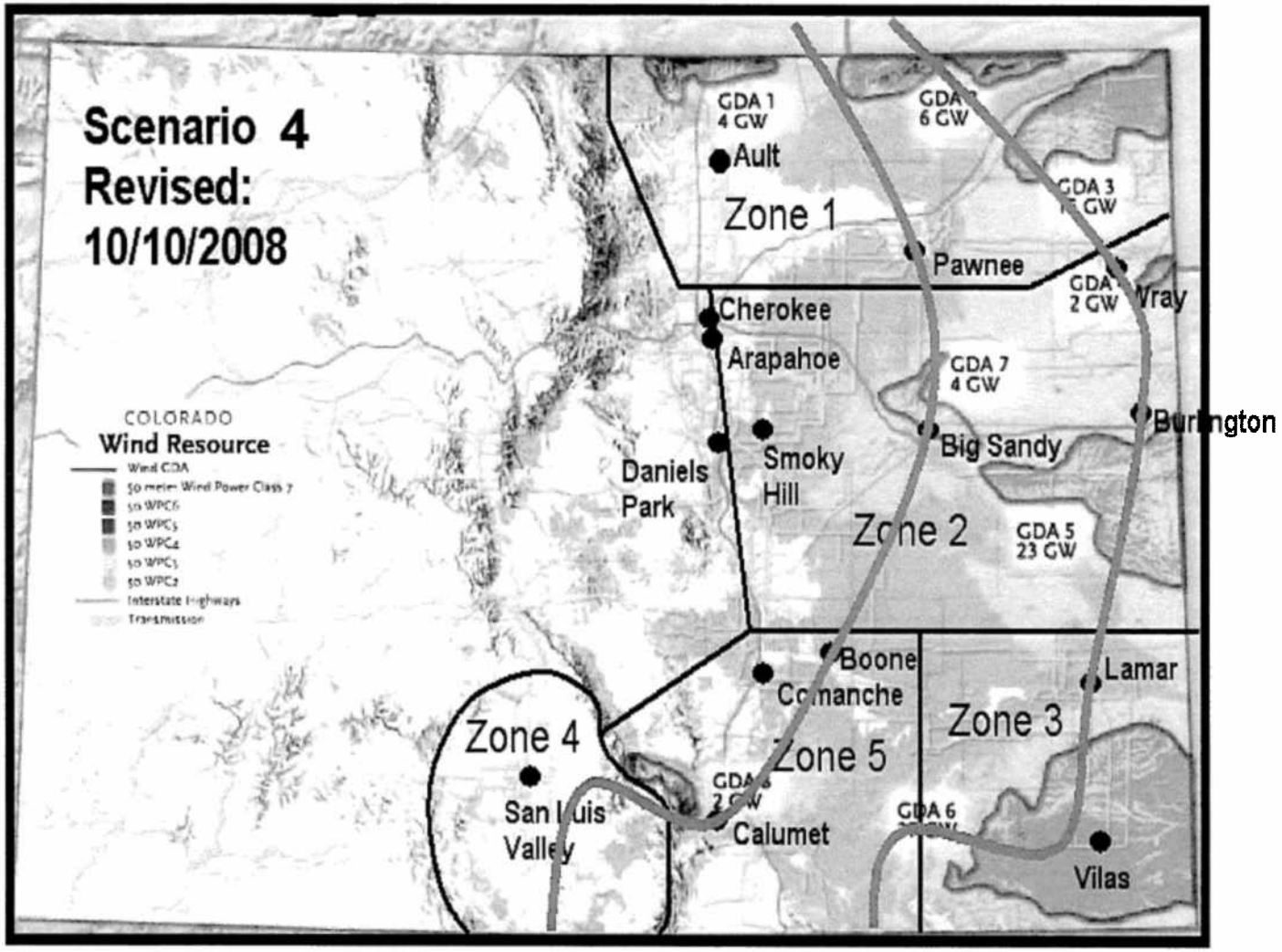


TRANSMISSION OWNERSHIP OF COLORADO
2008

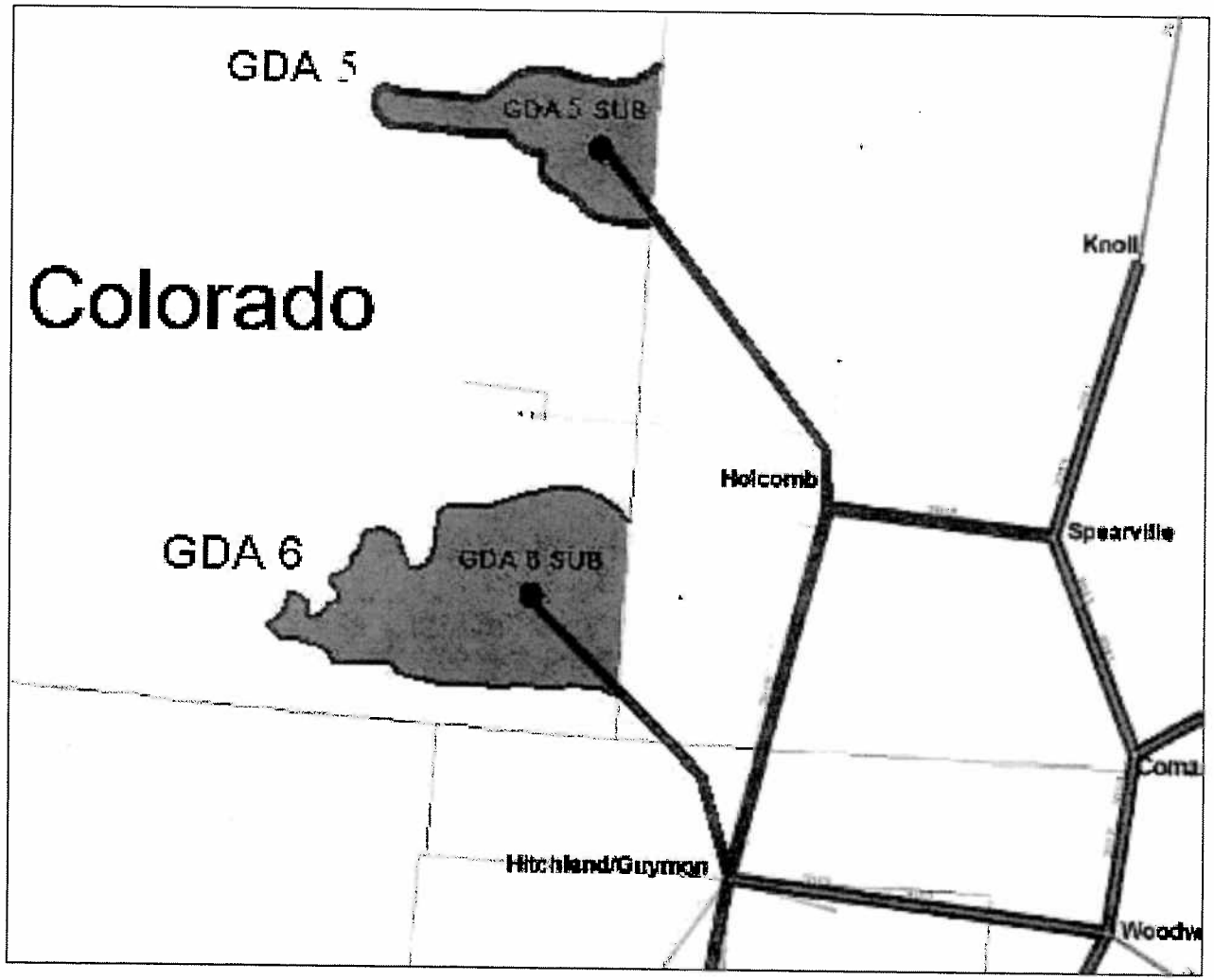
Scenario 3: High Renewables Growth, SB-100 Full Build Out



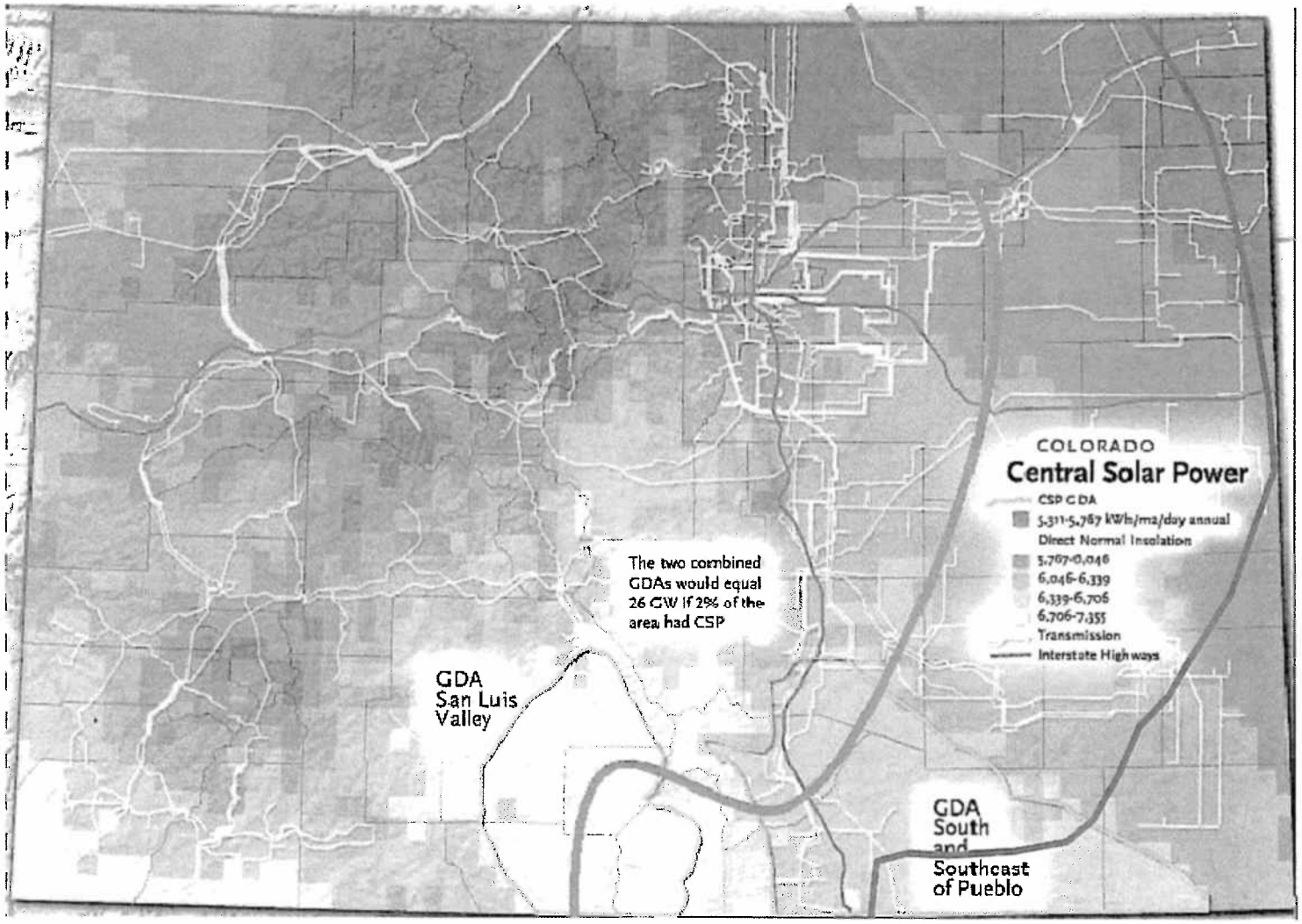
Scenario 4: High Plains Express Integration Project



Scenario 5: Wind Export Scenario, 765kV System to Interconnect with Southwest Power Pool



Scenario 6: HPX Initiative with Solar Integration



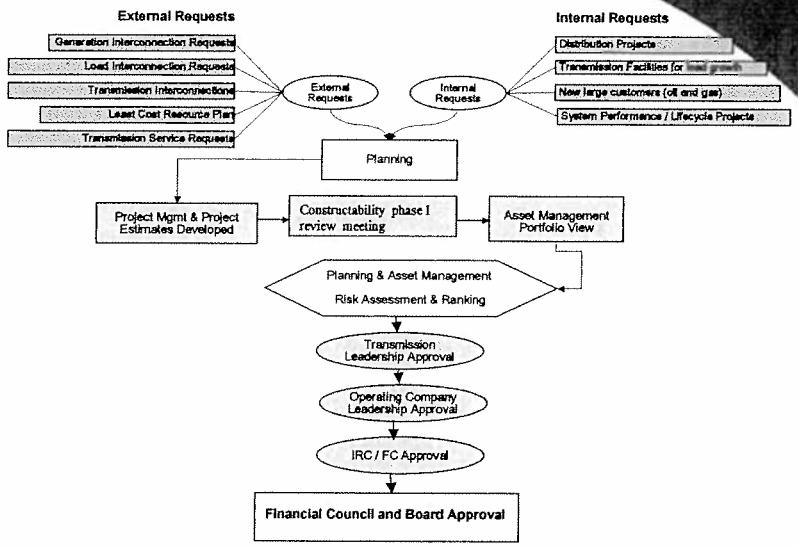
08I-227E

Exhibit C

Transmission Capital Budget Process

2010 – 2014

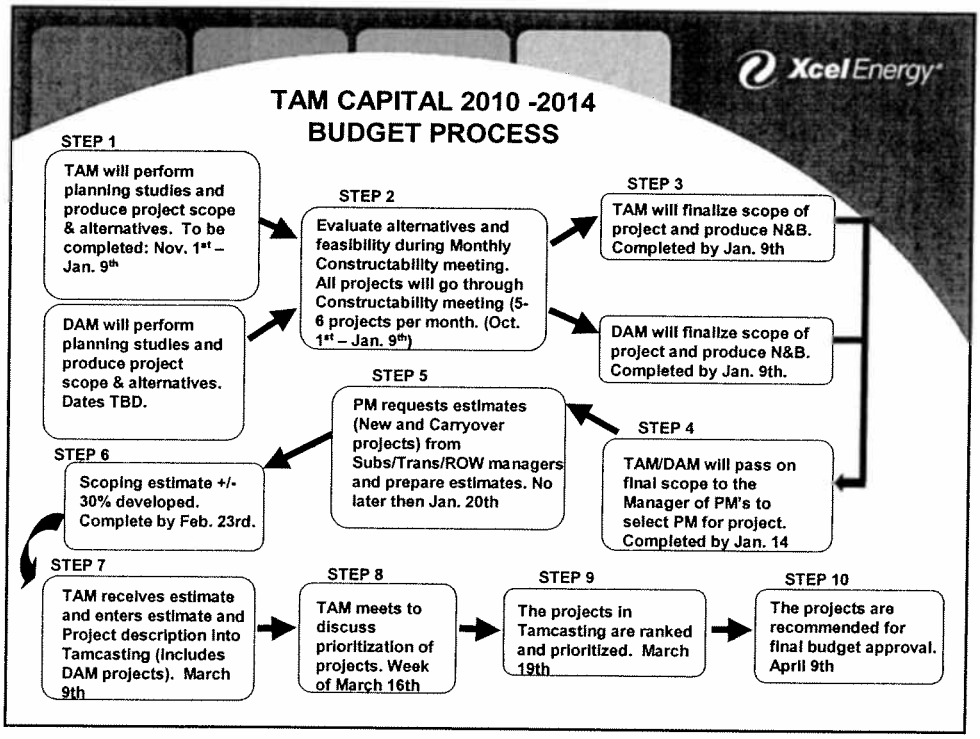
Project Creation



Planning Study Process

1. **Prepare Study Models:**
   - Utilize PSCo Base Case Preparation Process
   - Determine Appropriate WECC Base Cases as basis for Study
   - Verify Study Years, System Conditions, Demand Levels are appropriate Model projected transfers
   - Model appropriate regional loading
   - Include existing and planned facilities
   - Include Reactive Power resources as appropriate
2. **Studies**
   - Include effects of existing and planned protective systems as appropriate
   - Include effects of existing and planned control devices including load tap changers, switched shunt devices, and generation control as appropriate.
   - Include planned or maintenance outages of equipment
3. **Methodology**
   - Assess performance to meet TPL-001 (N-1) and TPL-002 (N-1) requirements
   - Assess performance to meet TPL-003 (N-2) and TPL-004 (exploratory) as appropriate.
4. **Develop Recommendations for System Upgrades**

TAM CAPITAL 2010 -2014 BUDGET PROCESS

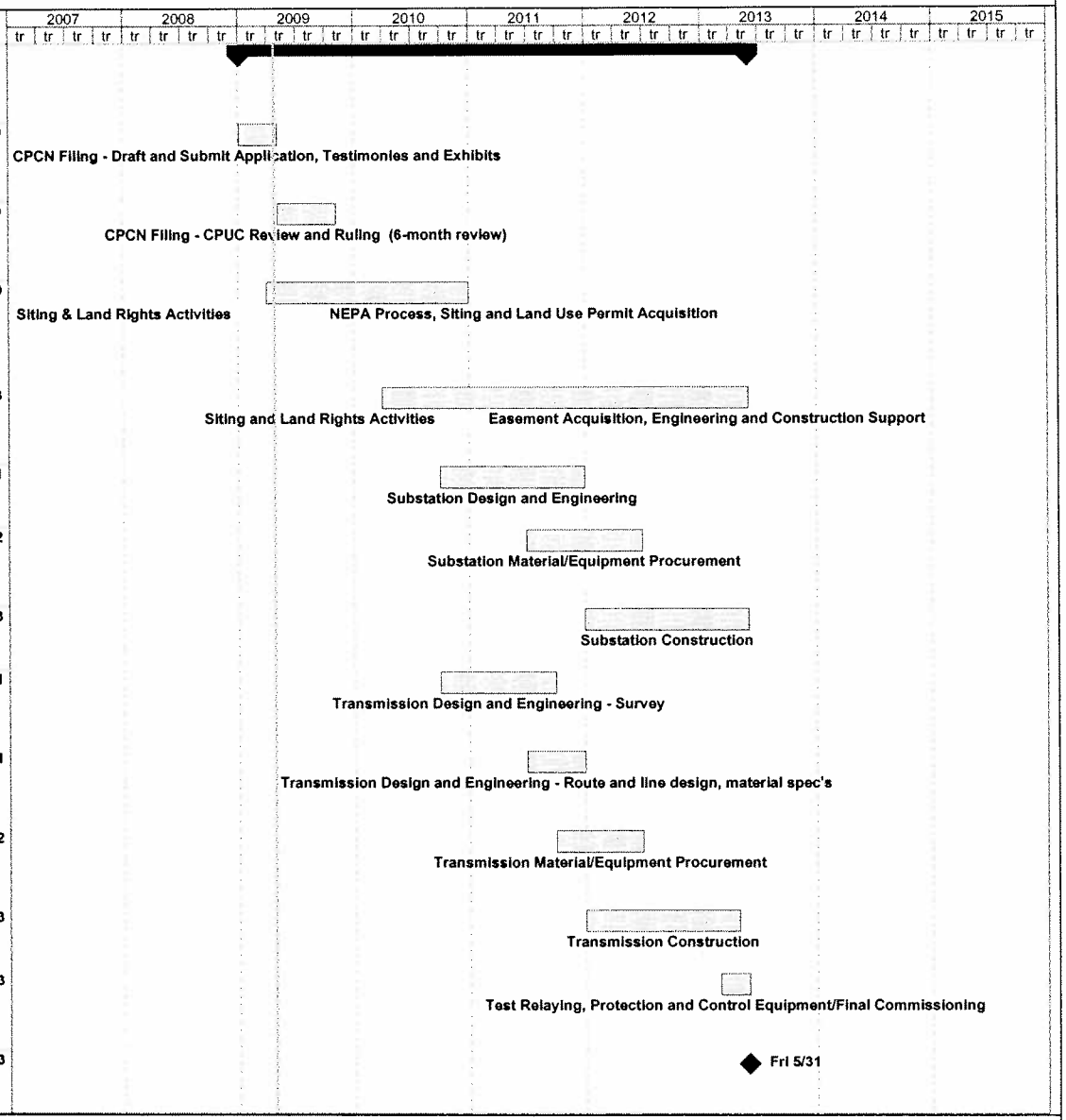


08I-227E

Exhibit D

San Luis Valley-Calumet-Comanche Transmission Project

ID	Task Name	Duration	Start	Finish
1	**San Luis Valley-Calumet-Comanche Transmission Project**	**1608 days**	**Mon 1/5/09**	**Fri 5/31/13**
2	**CPCN Filing - Draft and Submit Application, Testimonies and Exhibits**	**122 days**	**Mon 1/5/09**	**Wed 5/6/09**
3	**CPCN Filing - CPUC Review and Ruling (6-month review)**	**185 days**	**Thu 5/7/09**	**Sat 11/7/09**
4	**Siting & Land Rights Activities NEPA Process, Siting and Land Use Permit Acquisition**	**640 days**	**Wed 4/1/09**	**Fri 12/31/10**
5	**Siting and Land Rights Activities Easement Acquisition, Engineering and Construction Support**	**1157 days**	**Thu 4/1/10**	**Fri 5/31/13**
6	**Substation Design and Engineering**	**457 days**	**Fri 10/1/10**	**Sat 12/31/11**
7	**Substation Material/Equipment Procurement**	**366 days**	**Fri 7/1/11**	**Sat 6/30/12**
8	**Substation Construction**	**517 days**	**Sun 1/1/12**	**Fri 5/31/13**
9	**Transmission Design and Engineering - Survey**	**365 days**	**Fri 10/1/10**	**Fri 9/30/11**
10	**Transmission Design and Engineering - Route and line design, material spec's**	**184 days**	**Fri 7/1/11**	**Sat 12/31/11**
11	**Transmission Material/Equipment Procurement**	**274 days**	**Sat 10/1/11**	**Sat 6/30/12**
12	**Transmission Construction**	**486 days**	**Sun 1/1/12**	**Tue 4/30/13**
13	**Test Relaying, Protection and Control Equipment/Final Commissioning**	**92 days**	**Fri 3/1/13**	**Fri 5/31/13**
14	**Completion Date**	**1 day**	**Fri 5/31/13**	**Fri 5/31/13**



Project: Schedule CPCN 4-22-09.mpp
Date: Thu 4/23/09

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary

08I-227E

Exhibit E

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

* * * * *

IN THE MATTER OF THE APPLICATION OF PUBLIC SERVICE COMPANY OF COLORADO FOR APPROVAL OF ITS 2007 COLORADO RESOURCE PLAN	))))	DOCKET NO. 07A-447E

REBUTTAL TESTIMONY AND EXHIBITS OF TERESA M. MOGENSEN

ON

BEHALF OF

PUBLIC SERVICE COMPANY OF COLORADO

June 9, 2008

serve no practical purpose to attempt to classify transmission in the manner described by Mr. Dominguez, and indeed, once presented at the beginning of Mr. Dominguez's project recommendations, this approach was not further referenced or applied in any way in his subsequent testimony.

However, to describe in general the integration of transmission and describe the various functions transmission serves, Public Service can agree that transmission fills all the purposes identified by Mr. Dominguez: interconnecting generation to the transmission system, bringing generation to load, and interconnecting other utility transmission systems to Public Service's transmission system.

Q. IN HIS TESTIMONY, MR. DOMINGUEZ PROPOSES THAT A THIRTY YEAR TRANSMISSION PLANNING HORIZON, MODELS, AND ANALYSIS PROTOCOL BE MANDATED. DO YOU AGREE WITH THIS RECOMMENDATION?

A. No. Public Service plans the transmission system consistent with the practice of the industry, which currently utilizes a ten-year detailed planning horizon as prescribed by NERC standards. While seemingly a good suggestion in theory, we believe that attempting to develop and implement a thirty-year planning horizon, with the associated detailed models and generation and load assumptions necessary to do so, is in reality very impractical. The primary problem in pushing out the planning

horizon is that it interjects still more uncertainty and speculation in planning assumptions.

Even a fifteen to twenty year planning horizon has this same problem and is ultimately not that useful or reliable.

Q. COULD YOU ELABORATE ON YOUR POSITION THAT A TEN-YEAR PLANNING HORIZON IS CONSISTENT WITH INDUSTRY STANDARDS?

A. Yes. Various national standards and drivers require utilization of a ten-year planning horizon that includes technical models that represent transmission facilities, loads and resources. NERC reliability standards mandate electric utilities to perform many different assessments to verify the adequacy of a transmission system using a short-term (1-5 year) and a long-term (6-10 year) planning horizon. These include planning studies done under standards TPL-001 through TPL-004, which are a series of required studies that must be performed under many conditions for a one to ten year planning horizon[1]. FERC Order 890 requires coordinated and open regional planning and also requires a 10-year planning model. The WestConnect studies discussed below are part of the FERC 890 process, and they are utilizing 2013 and 2018 model years.

Q. DOES PUBLIC SERVICE EVER EMPLOY A LONGER TRANSMISSION PLANNING HORIZON?

[1] NERC Standard TPL-001, TPL-002, TPL-003, and TPL-004 are attached in Exhibit No. TMM-3 through 6.

A. Occasionally Public Service and other utilities will perform high level strategic or visioning-type planning studies on a slightly longer time horizon, such as the High Plains Express project. Less detailed visioning studies may extend to around twenty years out, but that is about the realistic maximum extent to achieve any kind of contextual value from the results. With each increment of time past the ten-year horizon, increasing uncertainty in key assumptions causes increasing inability to provide any realistic basis for developing a definitive and actionable transmission plan.

Q. INSTEAD OF EXTENDING THE PLANNING HORIZON, WHAT, IN YOUR VIEW, SHOULD BE THE FOCUS OF THE COMMISSION?

A. In lieu of adopting a thirty-year transmission planning horizon, the Company believes that it would be more efficient, effective, and beneficial to: (1) establish criteria under SB07-100 that establishes transmission need in advance of generation contracts or specific interconnection requests; (2) establish criteria on how much incremental new or net/total transmission capacity should be planned between various Energy Resource Zones and load centers; and (3) establish criteria on how far in advance of generation development should transmission be developed. SB07-100 provided the opportunity to establish these criteria, which is presumed to be in the public interest.

Q. WHAT SHOULD BE THE CRITERIA FOR PLANNING AND CONSTRUCTING TRANSMISSION UNDER SB07-100?

CERTIFICATE OF SERVICE

I hereby certify that on the 11th day of May, 2009, the original and seven (7) copies of the **"PUBLIC SERVICE COMPANY OF COLORADO'S COMMENTS FOR MAY 18, 2009 WORKSHOP"** set forth in Docket No. 08I-227E was served via hand delivery on:

Doug Dean, Director
The Public Utilities Commission of the State of Colorado
1560 Broadway, Suite 250
Denver, CO 80202

and copies were hand delivered or via U.S. Mail and served via email on all Parties on this service list.

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Morey Wolfson	morey.wolfson@state.co.us

/s/
Cindy A. Kline

* Denotes persons eligible to receive confidential proprietary information pursuant to the Commission's rules on confidentiality, 4 CCR 723-110-1102

** Denotes persons eligible to receive highly confidential proprietary information