Phase I Transmission Report

for the
Colorado Coordinated Planning Group
80x30 Task Force

Transmission Planning
Public Service Company of Colorado

Final Report
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Contents

I. Executive Summary

This report summarizes the studies completed under the scope of work for the Colorado Coordinated Planning Group's (CCPG) 80x30 Task Force (80x30TF) for Phase I. Phase I evaluated transmission solutions that may accommodate generation resources necessary to meet 2030 carbon reduction goals of Public Service Company of Colorado (PSCo) and other Colorado utilities as set forth in Senate Bill 19-236 (SB19-236), focusing on geographic diversity of resources while maintaining system reliability. Specifically, the transmission system reliability analyses performed evaluated various high voltage transmission projects to integrate possible future generation related to Public Service Company of Colorado's (PSCo) 2021 Electric Resource Plan (ERP) through the combined efforts of the CCPG 80x30TF.

The purpose of the report is to summarize:

1. Reliability evaluation of new and renewed purchase power generation in the Energy Resource Zones (ERZs) 1, 2, 3, and 5 in Northeastern, Eastern, and Southern areas of Colorado;
2. Proposed geographically diverse transmission projects to accommodate new renewable energy resources; and
3. Injection capability analysis at various locations on the Colorado transmission system.

The results of the study indicate that a new wide-area 345 kV transmission project interconnecting at many locations in the Northeastern, Eastern, Southern, and Metro areas of the transmission system can accommodate potential generation necessary to facilitate PSCo and potentially other utilities' 2030 carbon reduction goals. Energy storage as a non-wires alternative alone was deemed inadequate to deliver the resources from the remote energy resource zones to centralized load centers of the Front Range.

The transmission identified by the study would significantly improve the reliability of the Colorado transmission network by providing (1) additional high voltage transmission through the eastern portion of Colorado, and (2) greater access to and support of the existing transmission currently serving the Denver Metro area. The proposed transmission interconnections and terminations studied were selected based on their proximity to areas with high potential for low emission renewable energy resources. The general project areas include at least 13 Colorado counties (Weld, Morgan, Washington, Kit Carson, Cheyenne, Kiowa, Prowers, Bent, Otero, Pueblo, El Paso, Elbert, and Arapahoe). The preferred transmission Alternative is shown in Figure 1 with new 345 kV double circuit lines shown in blue overlaid on the Colorado SB07-100 Energy Resource Zone Map.

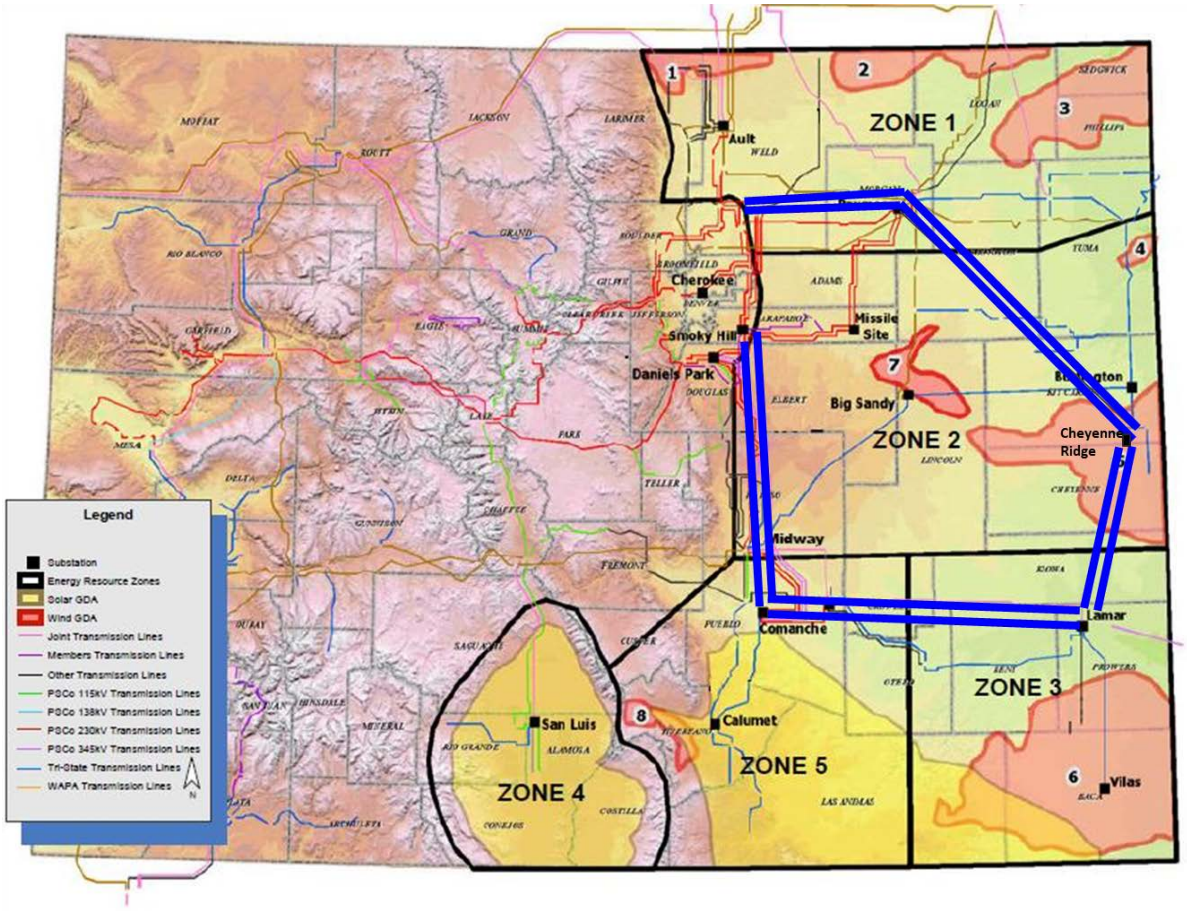

Figure 1: Proposed 345 kV Transmission Project

II. Background

On December 4, 2018 Xcel Energy announced a clean energy vision to deliver 100 percent carbon-free electricity to customers by 2050, with an interim goal of an 80 percent reduction in carbon dioxide emissions by 2030 relative to 2005 levels (80x30). On May 30, 2019, as part of a historic climate legislation package, the Colorado Governor signed into law SB19-236. SB19-236 requires select utilities to meet these same carbon reduction goals and establishes a regulatory framework for doing so. SB19-236 also requires Public Service Company of Colorado (PSCo) an Xcel Energy, Inc. company, to include in its next Electric Resource Plan (ERP), a Clean Energy Plan that sets forth a plan of actions and investments, including generation and transmission plans that meet the requirements of SB19-236. PSCo plans to file an ERP and Clean Energy Plan in early 2021 describing its generation and transmission plans for meeting the 2030 carbon emissions reduction goal set forth in SB19-236. Under Colorado Public Utilities Commission (Commission) rules, investor owned utilities (PSCo and Black Hills), and wholesale electric cooperatives (Tri-State Generation & Transmission Association "Tri-State") are required to file an electric resource plan at least every four years to provide the Commission with an evaluation of future customer energy needs and a plan for how best to meet those needs. PSCo will include a Clean Energy Plan with its resource plan filing in 2021. In January 2020, Tri-State announced its Responsible Energy Plan, which includes a goal of 50% of the energy consumed by its members coming from renewable resources by 2024. Further, Tri-State's preferred plan[1] in its December 2020 ERP filing is an 80 percent reduction in carbon dioxide emissions by 2030 relative to 2005 levels. In November 2020, Black Hills Energy announced its intention to also meet certain carbon reduction goals on its system. Other, non-Commission regulated Colorado utilities have also indicated support for looking at plans to reach Colorado's carbon reduction goals.

Traditionally, the transmission system in Colorado has been designed and constructed based on known generation additions to each provider's system. However, waiting to design and construct transmission in the wake of generation acquisition has resulted in numerous limitations to selecting and interconnecting new generation, especially beneficial energy resources located in renewable energy rich areas such as Northeastern, Eastern, and Southern Colorado, thus resulting in a "chicken and egg" timing dilemma. The time needed to develop and construct renewable resources, such as wind and solar, is much less than traditional fossil fuel plants, which in the past allowed time for transmission to be constructed to interconnect and deliver the generation. Waiting until generation projects are identified to plan transmission is no longer suitable, especially under Colorado's policy goal of reducing carbon dioxide emissions from Colorado's electric sector. SB19-236 recognizes that transmission is a critical element to achieving the state's clean energy targets as it will provide access to renewable energy rich areas in Colorado as well as other beneficial energy resources.

SB19-236 recognizes the need to address this dilemma. To aid in resolving these issues, the CCPG launched the 80x30TF in August 2020 to provide a forum for all stakeholders to collaboratively identify transmission infrastructure that will enable Colorado utilities to meet the state's decarbonization goals. The 80x30TF identified transmission that enables generation delivery from renewable energy rich areas that lack significant transmission access including northern, eastern and southern Colorado. As noted in the 80x30TF scope, this work is envisioned to be performed in two stages. This report provides the results and conclusions for Phase 1, which focuses primarily on PSCo

[1] Tri-State's preferred plan identifies the need for 400MW of new renewable generation in Eastern Colorado. The existing eastern Colorado transmission system cannot accommodate the identified new renewable generation.

and Tri-State's resource need and carbon reduction goals, focusing on ERZs 1,2,3 and 5. Phase II studies will include 80x30TF members' alternatives, additional studies requested by stakeholders.

Colorado transmission providers are able to use the 80x30TF as a public forum to develop and coordinate their respective transmission requirements and study plans.

The CCPG is a joint, high-voltage transmission system planning forum.[2] Its purpose is to assure a high degree of reliability through cooperative planning, development, and operation of the high-voltage transmission system in the Rocky Mountain Region of the Western Electricity Coordinating Council (WECC). The CCPG provides a technical forum to complete reliability studies and accomplish coordinated planning under the single-system planning concept. The CCPG, among other things, (a) facilitates local utilities' compliance with FERC's Order No. 890 and State Commission Rules, criteria, policies and guidelines and (b) provides a forum for interaction with stakeholders. CCPG recognizes the FERC Order 1000 principles for transmission planning: coordination, openness, transparency, information exchange, comparability, dispute resolution, regional participation, economic planning studies, and cost allocation. PSCo proposed the 80x30TF and subsequently received approval under CCPG on August 20, 2020 to organize the task force as a public venue to discuss studies and transmission projects seen necessary to integrate the 80% carbon reduction plan by 2030. Specifically, the 80x30TF is to serve as the transmission planning forum to develop the study process and identify the transmission alternatives that most effectively meet the needs of CCPG members and stakeholders. This forum allows stakeholders the opportunity to provide input, express needs, or identify concerns with respect to the development of transmission plans. Since launching in August 2020, the 80x30TF has met seven times, with participation from a broad range of stakeholders from the utility, developer, environmental, public interest, government, and consumer interest communities.

III. Scope, Purpose and Objectives

The 80x30TF developed a formal scoping document,[3] which identifies the purpose of the study, the process for the study, the transmission study models and assumptions, methodology, cost estimates, and schedule. The scope was further delineated into a Phase I and Phase II study. The scope and purpose of the Phase I study is to identify and propose a transmission plan that will enable PSCo to propose generation portfolios that can achieve the 80x30 clean energy target of SB19-236. At a high level, the objectives of the 80x30TF study was to result in a transmission plan that could:

- Accommodate generation resources necessary to meet 2030 carbon reduction goals;
- Maintain geographic diversity of resources; and,
- Ensure system reliability / minimize system impacts.

The resulting transmission plan is intended to meet the following objectives, which the 80X30 TF will continue to discuss and evaluate:

[2] The CCPG, the Southwest Transmission Planning Group (SWAT), and the Sierra Subregional Planning Group (SSPG) perform the transmission planning functions as Subregional Planning Groups (SPG) under WestConnect, which is a FERC Order No. 1000 planning region. The CCPG is one of at least five SPG's recognized by WECC.
[3] See the full Study Scope document at https://doc.westconnect.com/Documents.aspx?NID=19226

- Facilitate transmission access to new clean energy resources in Eastern Colorado located in or near designated Energy Resource Zones[4] (ERZs) 2 & 3 identified as per SB07-100. (Figure 2 shows a map of the Colorado ERZs).
- Enable delivery of electric power output from new clean energy resources located in or near designated ERZs 1, 2, 3 & 5 to the load centers along the Front Range.
- Provide new interconnection points to facilitate development of new clean energy resources located in or near ERZs 1, 2, 3 & 5.
- Achieve adequate reliability and operational flexibility of the resulting interconnected transmission system in Colorado for enabling significantly increased penetration of new clean energy resources.

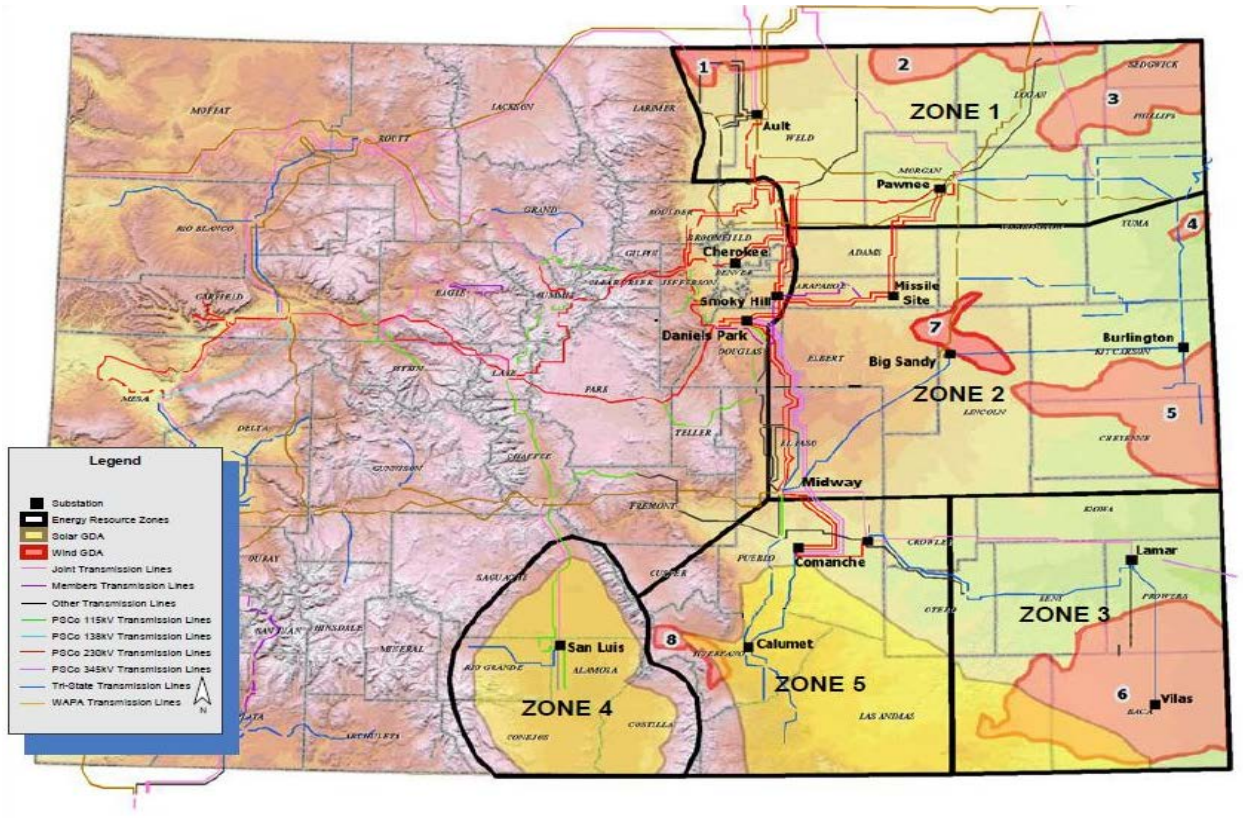

Figure 2: SB07-100 Energy Resource Zones

IV. Stakeholder Process

The CCPG is principally a subregional transmission planning group whose interest is ensuring the reliability of the interconnected transmission system in the CCPG footprint. Over the years, and as more non-utility generation owners and developers have taken greater interest in the planning and availability of the transmission system in Colorado, CCPG has offered increased opportunities for stakeholder participation and input to transmission planning considerations. Consistent with this principle, this study utilized the 80x30TF of CCPG as a forum to inform interested stakeholders of

[4] Energy Resource Zones are defined in C.R.S. 40-2-126 and have been presented to the Commission in PSCo's SB07-100 Reports.

the studies and to gather comments and alternatives for evaluation. The purpose of the group is to assure a high degree of reliability in the planning, development, and operation of the high voltage transmission system in the Rocky Mountain Region.

In the first 80x30TF meeting in October 2020, PSCo identified the need to develop transmission plans that would enable PSCo to achieve its 80x30 clean energy targets by maintaining geographic diversity of resources. A path to maintaining geographic diversity is facilitating transmission access to new renewable energy resources in ERZs 1, 2, 3 and 5. Through the open coordination process, other Colorado utilities identified solutions that would help meet their public policy needs too. Several meetings were held that included participation from a wide variety of stakeholders, including[5]:

- Apex Clean Energy
- Black Hills Energy
- Colorado Springs Utilities
- Dietze and Davis, on behalf of Independent Power Producers
- Enel North America
- Energy Strategies
- Grid Strategies
- Interwest Energy Alliance
- Juwi Inc
- National Grid Renewables
- Office of Consumer Council
- Onshore Wind
- Platte River Power Authority
- Public Service Company of Colorado
- Savion LLC
- Staff of the Colorado Public Utilities Commission
- Szot Energy Services
- Tri-State Generation & Transmission Association
- Western Resource Advocates

Meeting agendas, presentations, and meeting notes (including comments from stakeholders) are posted on the CCPG website.[6] The 80x30TF solicited and received comments to the 80x30TF Report, which are incorporated into this report. Additional stakeholder comments can be found in Appendix C.

V. Methodology

A. Studies

CCPG's 80x30TF study consisted of steady state (power flow) analysis. Facility loadings and voltages were monitored within the study area consistent with (NERC) and (WECC) standards. The Task Force used the WECC approved base cases as the basis for the power flow analysis as

[5] Additional stakeholders participated in the final meeting(s) including, RES and Invenergy.
[6] http://regplanning.westconnect.com/ccpg_80_30_tf.htm

described below. A benchmark analysis was performed to enable the comparison to alternative transmission plans. The benchmark case started from the WECC 2030 heavy summer case. The WECC 2030 heavy summer case was updated to reflect changes to the system since the time when those cases were approved as described below. Once the benchmark case was developed, steady state power flow and voltage comparison analyses were conducted for each transmission system alternative. From this analysis, the 80x30TF developed recommended transmission plans necessary to satisfy the objectives presented above and identified preferred alternatives.

B. Modeling

1. Cases

The technical analysis consisted of steady state (power flow) analysis using conventional transmission planning models. Studies utilized a ten-year transmission system planning model that originated from the approved WECC 30HS1 model.

2. Transmission Modeling

All existing transmission planned for the study horizon, 2020-2030, are included in the benchmark study case. The models reflect transmission facilities that are presently in-service and transmission facilities that are expected to be in-service during the study horizon. The additional significant transmission projects modeled in the benchmark case are:

- Missile Site – Pronghorn – Shortgrass 345 kV Gen-Tie (in-service)
- Pawnee – Daniels Park 345 kV Transmission Project (in-service)
- PSCo Voltage Control Facilities for the Colorado Energy Plan (in-service)
- Waterton – Martin 115 kV line uprate (2021)
- Monument – Flying Horse 115 kV series reactor project (2023)
- Greenwood – Denver Terminal 230 kV Line (2022)
- CSU transformer project at Briargate (2023)
- Tundra 345 kV Switching Station[7] (2022)
- Wayne Child Phase II (2022)

3. Generation Modeling

All existing generation and resources planned for the study horizon, 2020-2030, are included in the benchmark study case. Appendix A identifies the generation modeled in the benchmark case.

The planned generation in the benchmark study case includes:

- Cheyenne Ridge 500 MW wind (in-service)
- Bronco Plains 300 MW wind (in-service)

[7] A switching station is a type of substation that operates at a single voltage level (and, therefore, does not have transformers that "transform" voltage from one voltage level to another).

- Mountain Breeze 169 MW wind (in-service)
- Niyol 200 MW wind (2021)
- Thunderwolf 200/100 MW solar/storage (2022)
- Neptune 250/125 MW solar/storage (2022)
- Hartsel 72 MW solar (2022)
- Colorado Energy Plan generator at Boone/Midway 200 MW solar (2022)
- Spanish Peaks I 100 MW solar (2023)
- Spanish Peaks II 40 MW solar (2023)

New generation was added to the models on top of the existing or planned generation provided above. For the purposes of this analysis, "new generation" is a general term use to reflect generation not existing in the benchmark case. Additional transmission needed to meet 80x30 carbon reduction goals was determined by dispatching 3000 MW of new renewable generation and 3000 MW of existing renewable generation in ERZs 1, 2, 3, and 5, resulting in over three quarters of the PSCo Balancing Area (BA) demand served from renewable sources in the ERZs. New generation was located in different zones to maintain the study objective of geographical diversity of resources. The study cases for benchmark and Alternative 1 assumed 1500 MW dispatch of new renewable generation located in each the Northeast and South geographic areas. The study cases for alternatives 2-7 moved 1000 MW dispatch of new renewable generation from the South to the Southeast geographic area by including new transmission to the Southeast area. The interchange of the PSCo BA was not changed from the WECC 30HS1 model and therefore generation was not dispatched to areas outside of the PSCo BA. Table 1 below depicts the megawatts (MW) dispatched in each geographic area for every alternative studied.

Table 1: General Dispatch Assumptions

Geographic Area	ERZ	Benchmark & Alt 1 (MW)	Alts 2-7 (MW)
Northeast (new)	1,2	1500	1500
Northeast (existing)	1,2	1500	1500
South (new)	5	1500	500
South (existing)	5	1500	1500
Southeast (new)	3	0	1000
Interchange	N/A	795	795
Cabin Creek (existing)	N/A	150	150
Cherokee (existing)	N/A	350	350
Rest of PSCo (existing)	N/A	Load balance need	Load balance need

The description of the alternatives is discussed below in the 80x30 Carbon Reduction Goal Study Results section.

VI. Criteria

The study adhered to all applicable NERC Reliability Standards and WECC Regional Criteria. The pertinent System Performance Criteria for this study are included below in Sections A and B.

A. Steady State Voltage Limit Criteria[8]

Voltage violations requiring corrective actions are identified in steady state simulations when steady state voltages at extra high voltage Bulk Electric System (BES) buses are outside the following acceptable voltage limits:

- Normal (no contingency) conditions: Vmin = 0.95 per unit, Vmax = 1.05 pu
- Post-contingency conditions: Vmin = 0.90 pu, Vmax = 1.10 pu
- Voltages flagged if outside 0.90 – 1.10 per unit, and/or if the change in voltage exceeded 0.08 per unit

The screening criterion for generator voltage ride-through[9] capability is 0.90 pu to 1.10 pu for all planning event (P1 to P7[10]) contingencies. If the initial screening simulation indicates that the generator bus voltage is outside this range, follow-up simulations are performed as necessary based on a review of the generator's actual voltage ride-through capability.

B. Facility Loading Criteria

a) System-intact and Prior-Outage Conditions:

- Line loading monitored for 100% of the established lowest-rated equipment rating, as well as the conductor rating.
- Transformer loading monitored to 100% of the highest name plate rating or owner-provided rating.

b) Contingency (Forced-Outage) Conditions

- Line loading monitored for 100% of the established lowest-rated equipment rating, as well as the conductor rating.
- Voltages flagged if outside 0.90 – 1.10 per unit, and/or if the change in voltage exceeded 0.08 per unit.

VII. Cost Estimates

Cost estimates for each alternative were derived from employing the unit cost estimates from Midcontinent Independent System Operator (MISO) MTEP20 Transmission Cost Estimation Guide.[11] The estimates focused on transmission line mileage costs and did not include new interconnection stations or expansions to existing stations. Due to the line length of the alternatives it was assumed the station costs were negligible compared to the overall transmission line cost.

[8] These criteria are the same as those specified in WR1, parts 1.1.1 and 1.1.2 in the WECC Regional Criterion TPL-001-WECC-CRT-3.

[9] Ride-through is an industry term to describe generation that can withstand system disturbances that cause voltage fluctuations.

[10] P7 contingency is defined in NERC TPL-001-4 Standard as a multiple contingency resulting in the loss of two adjacent (vertically or horizontally) circuits on common structure or loss of a bipolar DC line.

[11] MISO's MTEP20 Transmission Cost Estimation Guide can be found at: https://cdn.misoenergy.org/20200414%20PSC%20Item%2007%20Transmission%20Cost%20Estimation%20Guide%20for%20MTEP%202020_DRAFT_April_clean441565.pdf

Transmission line lengths are approximations with actual line routing unknown at this time. Unit costs used from the MISO MTEP20 guide include:

- $2.6 million per mile for single circuit 345 kV line
- $4.5 million per mile for double circuit 345 kV line

The cost estimates were used for alternative comparison purposes only in determining the preferred alternatives. The estimates are assumed to be Class 5 – MISO's exploratory cost estimates which generally align with the AACE (formerly the Association for the Advancement of Cost Engineering) International Class 5 concept screening estimates. PSCo will refine and present more detailed cost estimates in forthcoming filings with the Commission.

VIII. Benchmark Case Analysis Results

A. Description

A benchmark analysis was performed to determine if there were any potential reliability issues associated with the proposed 80x30 carbon reduction plan with a "do nothing" transmission case. A high-level benchmark case one-line diagram of the transmission system in Northeastern, Eastern, and Southern Colorado is shown in Figure 3 below. The diagram ends at some of the interconnection points into the Denver Metro Area, including Waterton, Daniels Park, and Smoky Hill/Harvest Mile Substations. This figure's purpose is to provide a comparison of the transmission elements for the various alternatives. The benchmark cases include all CCPG member facilities included in the WECC-30HS1 model.

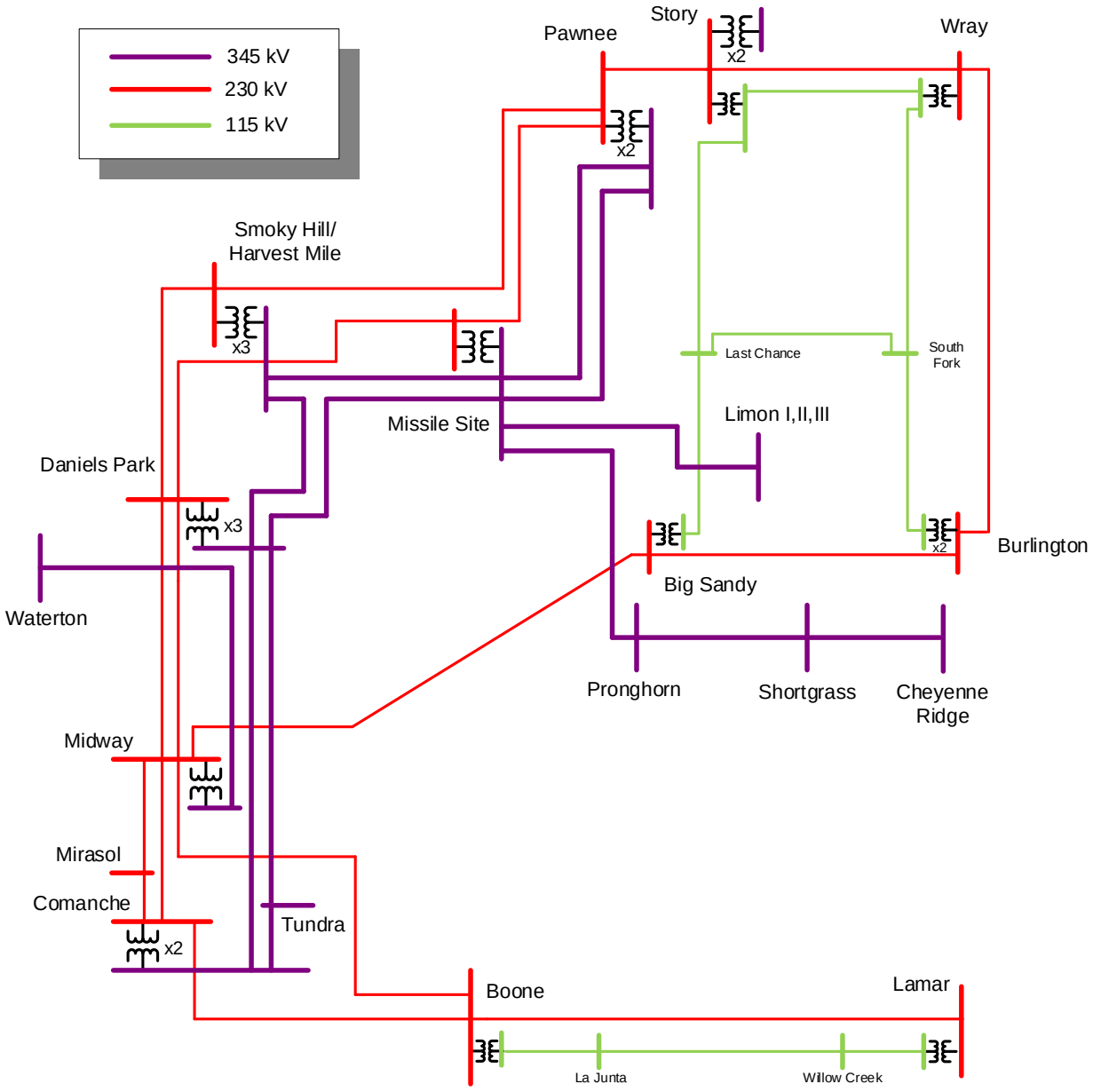

Figure 3: Benchmark System

B. Analysis Results

New generation for the Benchmark case was placed at Pawnee and Tundra Substations, effectively within ERZs 1 and 5. New generation was not placed at other locations on the system because previous analysis has determined little to no injection capability at locations within ERZs 2 and 3. The analysis identified twenty-three system intact and contingency overloads in the benchmark case that were not seen when compared to all of the other alternatives studied.

C. Summary

The studies show the existing transmission system, which is considered a "do-nothing" transmission case, is unable to reliably accommodate new generation in ERZs 1, 2, 3, and 5, and

likely unable to accommodate 2030 carbon reduction goals. Previous studies have shown no additional generation is able to be accommodated at Cheyenne Ridge and Lamar Substations.

IX. 80x30 Carbon Reduction Goal Analysis Results

As stated above, the current transmission system is limited in its ability to reliably add and deliver new generation in ERZs 2, 3 and 5 necessary to meet the 80x30 carbon reduction goals with geographical diversity. Therefore, it was necessary to develop additional transmission elements that could be included in the modeling to see how various system modifications and additions could start to accommodate generation additions that meet the 80x30 criteria. The report steps through each alternative studied and provides the alternative description, study results, summary and cost. The following table is a snapshot of these alternatives. For purposes of the study, new 345 kV lines were assumed to be constructed as bundled Aluminum Conductor Steel Reinforced (ACSR) 1272 Bittern conductor with a summer normal rating of 1637 MVA (actual ratings will depend on final project design).

Table 2: Summary of Alternatives

New Transmission Facility	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
• 345 kV switching station near Cheyenne Ridge West	x	x	x	x	x	x	x
• 345 kV bus at Burlington Substation					x		
• 345 kV double circuit line between Cheyenne Ridge and Pawnee	x	x	x	x			
• 345 kV double circuit line between Cheyenne Ridge and Burlington					x		
• 345 kV double circuit line between Cheyenne Ridge and Story						x	x
• 345 kV double circuit line between Burlington and Story					x		x
• 345 kV double circuit line between Story and Pawnee					x	x	x
• 345 kV bus at Fort St Vrain Substation	x	x	x	x	x	x	x
• 345 kV double circuit line between Pawnee and Fort St Vrain	x	x	x	x	x	x	x
• 345 kV double circuit line between Tundra and Harvest Mile	x	x	x	x	x	x	x
• 345 kV switching station at Lamar		x	x	x	x	x	
• 345 kV substation at Lamar							x
• 345 kV double circuit line between Lamar and Tundra		x	x		x	x	x
• 345 kV single circuit line between Lamar and Tundra				x			
• 345 kV double circuit line between Cheyenne Ridge and Lamar			x		x	x	x
• 345 kV single circuit line between Cheyenne Ridge and Lamar				x			
New 345 kV double circuit tower lines (miles)	330	460	550	330	550	550	550
New 345 kV single circuit tower lines (miles)				220			
Estimated costs (based on MISO unit costs in millions)	$1,500	$2,000	$2,400	$2,000	$2,400	$2,400	$2,400
Access to ERZ	1,2,5	1,2,3,5	1,2,3,5	1,2,3,5	1,2,3,5	1,2,3,5	1,2,3,5

A. <u>Alternative 1</u>

1. Description

The configuration for Alternative 1 is shown in Figure 4 below. Alternative 1 would create a new Cheyenne Ridge to Pawnee to Fort St. Vrain double-circuit 345 kV line and a Tundra[12] to Harvest Mile double circuit 345 kV line, that assumed the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile

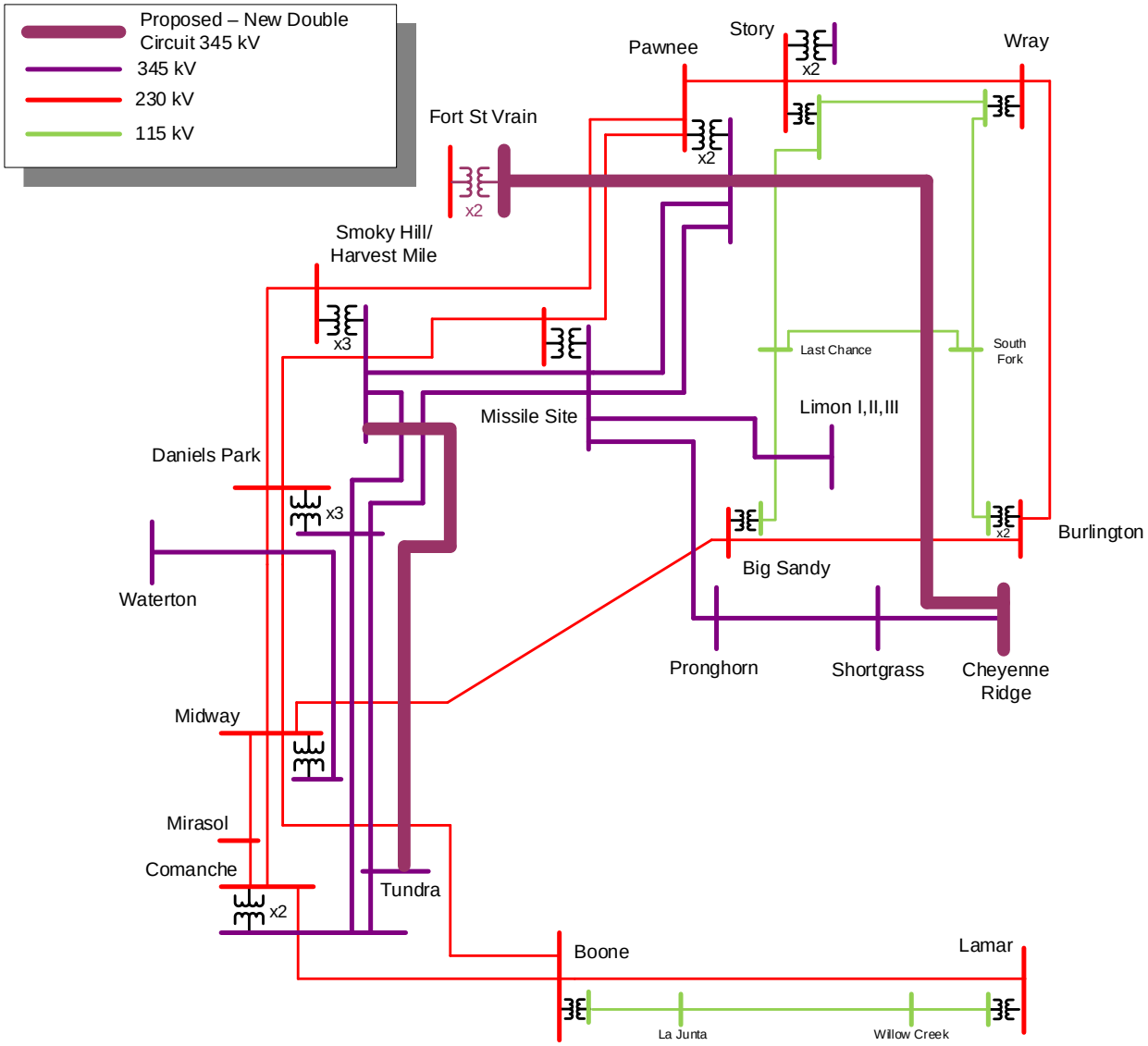

Figure 4: Alternative 1

[12] Tundra Substation Switching Station is a new, yet to be constructed interconnection facility planned to interconnect a solar generation resource approved as part of PSCo's Colorado Energy Plan Portfolio in PSCo's 2016 Electric Resource Plan.

2. Analysis Results

For Alternative 1, new generation was placed at Comanche, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, and 5. The new generation was dispatched to 1500 MW both in the Northeast and South areas for a total of 3000 MW.

Alternative 1 would consist of approximately 330 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $1.5 billion.

3. Summary

While Alternative 1 provides new generation at Comanche, Pawnee, and Cheyenne Ridge Substations, the alternative (1) does not provide new service into ERZ 3 near the Lamar area, and (2) is not looped to other locations on the system. While Alternative 1 achieves limited reliability benefits, other alternatives produce greater reliability benefits. Additionally, Alternative 1 also does not accommodate the desired geographical diversity to achieve public policy goals of carbon reduction by not providing transmission access to ERZ 3. Also, the study showed concerns with NERC P7 (common tower, N-2) outages of the new lines. For the P7 outage of the Cheyenne Ridge – Pawnee 345 kV Lines a Remedial Action Scheme (RAS) would likely be required to drop significant amounts of generation to insure stability of the system and thermal loading within ratings of the Missile Site – Pronghorn – Shortgrass – Cheyenne Ridge 345 kV Gen-Tie. Therefore, Alternative 1 does not appear to be a reasonable alternative to interconnect new generation in all the ERZs as defined in the geographical diversity objectives of the study.

B. Alternative 2

1. Description

The configuration for Alternative 2 is shown in Figure 5. The alternative creates a new Cheyenne Ridge to Pawnee to Fort St. Vrain double circuit 345 kV line and a Lamar Area to Tundra to Harvest Mile double circuit 345 kV line, and assumes the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV switching station at Lamar
- 345 kV double circuit line between Lamar and Tundra

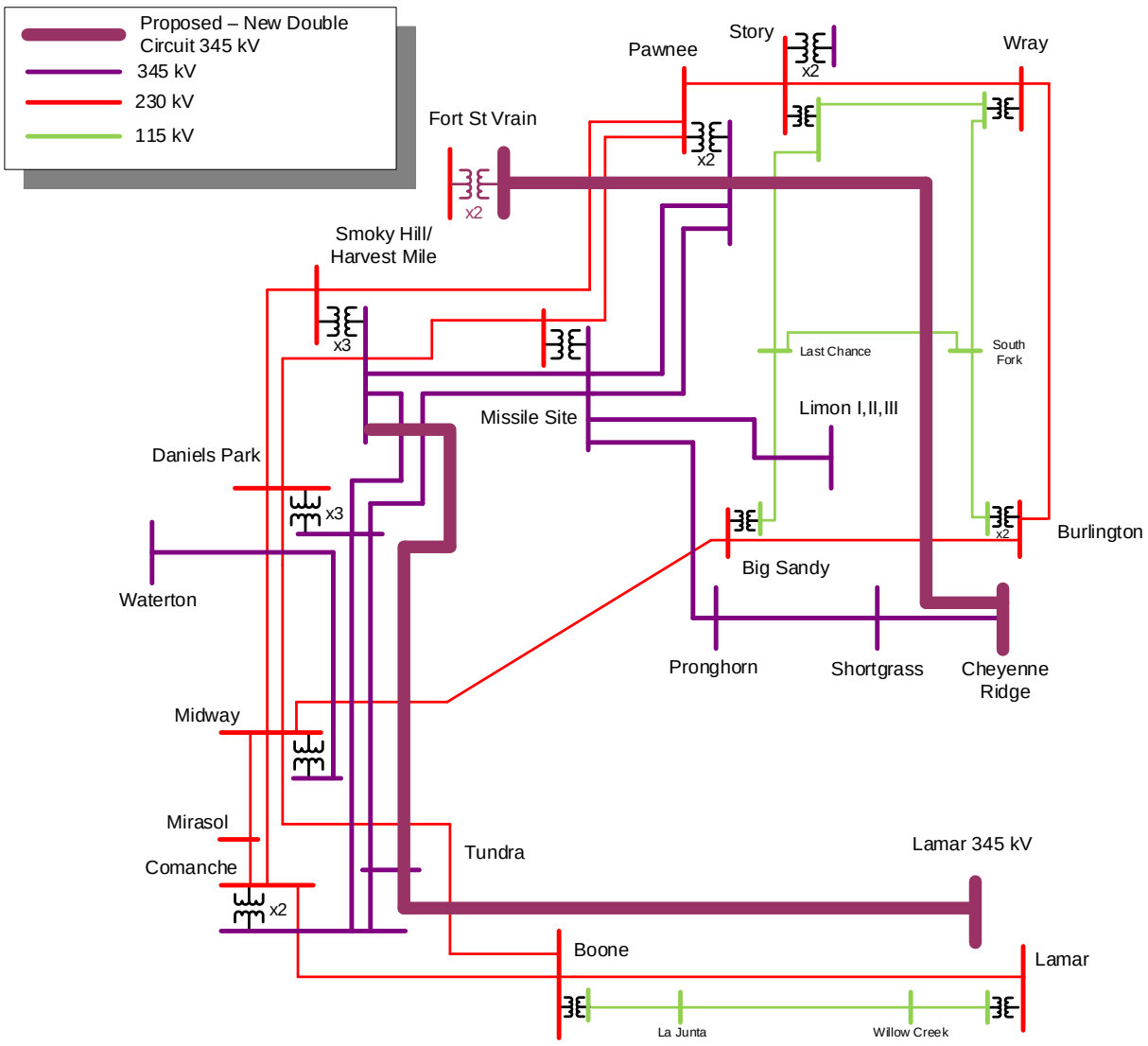

Figure 5: Alternative 2

2. Analysis Results

For Alternative 2, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 2 would consist of approximately 460 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $2.0 billion.

3. Summary

Alternative 2 effectively provides new generation capacity to meet 80x30TF objectives within all ERZs contemplated by the objective of the study. While the new double circuit 345 kV tower lines provide high ratings and reduced impedance paths, the study showed concerns with NERC P7 (common tower, N-2) outages of the new lines. For the P7 outage of the Cheyenne Ridge – Pawnee 345 kV Lines a Remedial Action Scheme (RAS) would likely be required to drop

significant amounts of generation to insure stability of the system and thermal loading within ratings of the Missile Site – Pronghorn – Shortgrass – Cheyenne Ridge 345 kV Gen-Tie. For the P7 outage of Lamar – Tundra 345 kV Lines a significant amount of generation would be dropped from the system depending on how much generation is eventually installed at the Lamar 345 kV Station.

C. Alternative 3

1. Description

The configuration for Alternative 3 is shown in Figure 6. The alternative would create a new Cheyenne Ridge to Pawnee to Fort St. Vrain double circuit 345 kV line, Lamar Area to Tundra to Harvest Mile double circuit 345 kV line, and a Cheyenne Ridge to Lamar Area double circuit 345 kV line. Note the alternative does not interconnect to the existing Lamar 230 kV substation, and assumes the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Pawnee
- 345 kV bus at Fort St. Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV switching station at Lamar
- 345 kV double circuit line between Lamar and Tundra
- 345 kV double circuit line between Cheyenne Ridge and Lamar

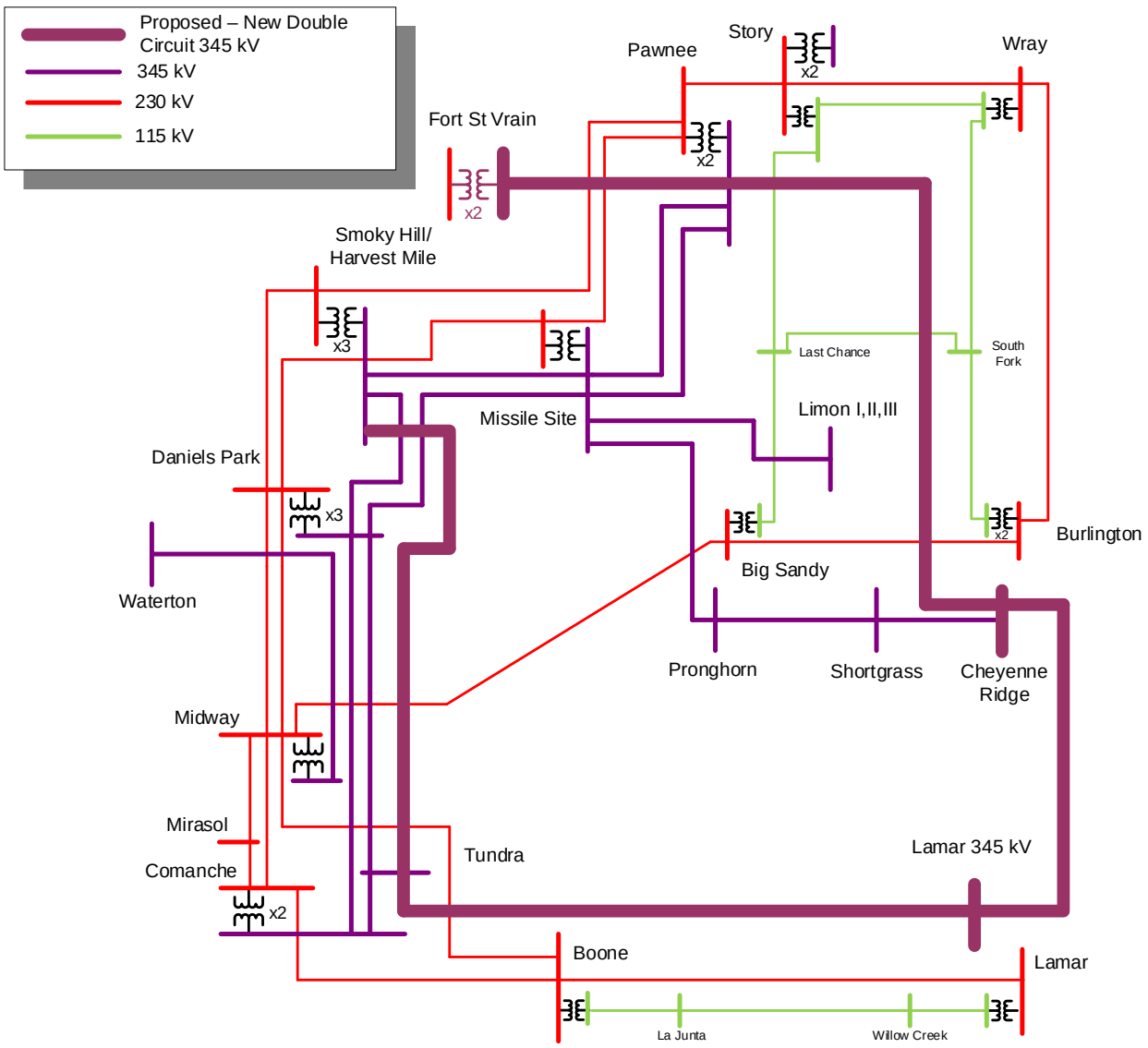

Figure 6: Alternative 3

2. Analysis Results

For Alternative 3, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 3 consists of approximately 550 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $2.4 billion.

3. Summary

Alternative 3 effectively provides transmission capacity for adding new generation toward meeting 80x30TF goals within all ERZs contemplated by the objective of the study. The study showed concerns with NERC P7 (N-2) outages similar to Alternative 2. However, the P7 issues were significantly reduced with the addition of the Cheyenne Ridge – Lamar double circuit 345 kV lines.

A Remedial Action Scheme (RAS) would likely be required but with less generation curtailment than Alternative 2.

D. Alternative 4

1. Description

The configuration for Alternative 4 is shown in Figure 7. The alternative creates a new Cheyenne Ridge to Pawnee to Fort St. Vrain double circuit 345 kV line, Lamar Area to Tundra single circuit 345 kV line, a Tundra to Harvest Mile double circuit 345 kV line, and a Cheyenne Ridge to Lamar Area single circuit 345 kV line. Note the alternative does not interconnect to the existing Lamar 230 kV substation, and assumed the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV switching station at Lamar
- 345 kV single circuit line between Lamar and Tundra
- 345 kV single circuit line between Cheyenne Ridge and Lamar

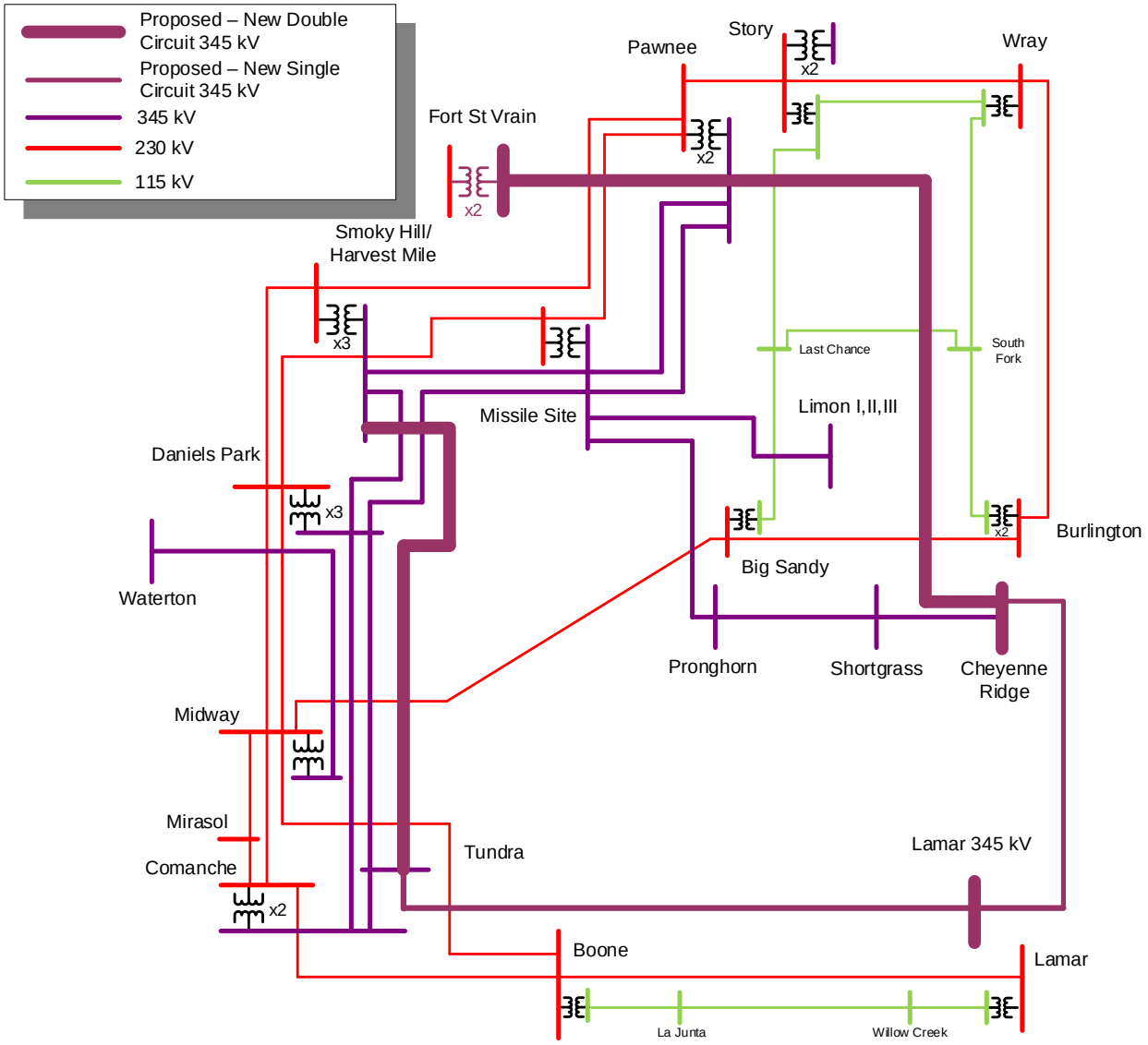

Figure 7: Alternative 4

2. Analysis Results

For Alternative 4, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 4 would consist of approximately 330 miles of new 345 kV double circuit tower lines and 220 miles of new 345 kV single circuit lines. The planning level estimate using MISO unit costs totals approximately $2.0 billion.

3. Summary

Alternative 4 would effectively provide new generation capacity to meet 80x30TF objectives within all ERZs contemplated by the objective of the study. While the new single and double circuit 345 kV tower lines provide new lines in eastern Colorado, the study showed higher reactive

support required at Lamar than Alt 3 to mitigate N-1 outages of the Lamar – Cheyenne Ridge or Lamar – Tundra 345 kV Lines. Also, the study showed concerns with NERC P7 (common tower, N-2) outages of the new lines. For the P7 outage of the Cheyenne Ridge – Pawnee 345 kV Lines a Remedial Action Scheme (RAS) would likely be required to drop significant amounts of generation to insure stability of the system and thermal loading within ratings of the Missile Site – Pronghorn – Shortgrass – Cheyenne Ridge 345 kV Gen-Tie and the Cheyenne Ridge – Lamar 345 kV line.

E. Alternative 5

1. Description

The configuration for Alternative 5 is shown in Figure 8. The alternative would create a new Cheyenne Ridge to Burlington to Story to Pawnee to Fort St. Vrain double circuit 345 kV line, Lamar Area to Tundra to Harvest Mile 345 kV double circuit line, and a Cheyenne Ridge to Lamar Area 345 kV double circuit line. Note the alternative does not interconnect to the existing Lamar 230 kV substation, and assumed the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV bus at Burlington Substation
- 345 kV double circuit line between Cheyenne Ridge and Burlington
- 345 kV double circuit line between Burlington and Story
- 345 kV double circuit line between Story and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV switching station at Lamar
- 345 kV double circuit line between Lamar and Tundra
- 345 kV double circuit line between Cheyenne Ridge and Lamar

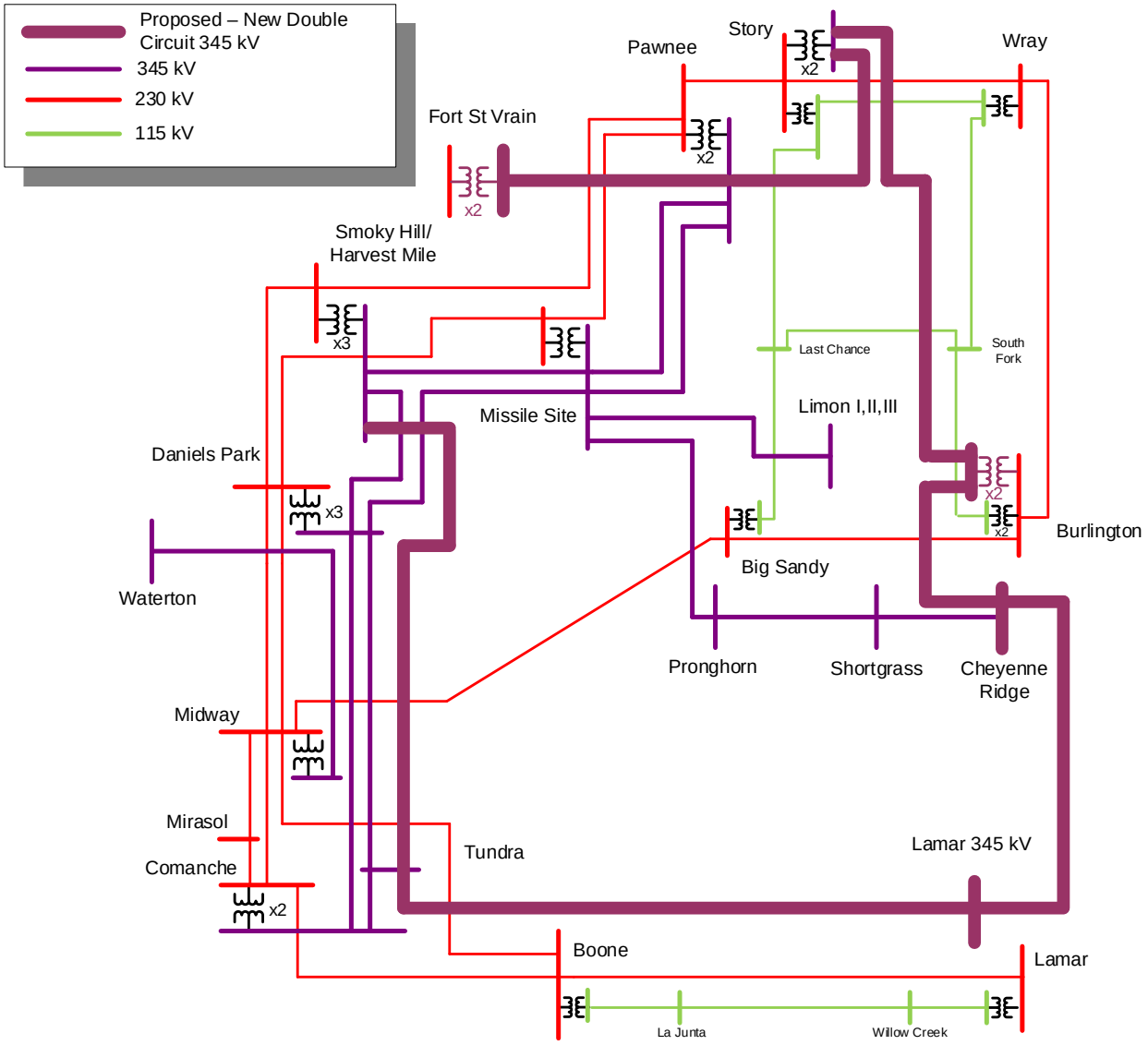

Figure 8: Alternative 5

2. Analysis Results

For Alternative 5, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 5 would consist of approximately 550 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $2.4 billion. While this approximate estimate is similar to Alternative 3, it is important to note the estimate methodology does not include substation work. Therefore, the cost would be higher than Alternative 3 with the addition of interconnections into Burlington (without an existing 345 kV yard) and Story Substations.

3. Summary

Alternative 5 would effectively provide capacity to meet 80x30TF objectives within all ERZs contemplated by the objective of the study and adds two interconnection points in eastern Colorado as compared to Alternative 3. The study showed no concerns with interconnection into Burlington and Story Substations.

F. Alternative 6

1. Description

The configuration for Alternative 6 is shown in Figure 8. The alternative creates a new Cheyenne Ridge to Story to Pawnee to Fort St Vrain double circuit 345 kV line, Lamar Area to Tundra to Harvest Mile 345 kV double circuit line, and a Cheyenne Ridge to Lamar Area 345 kV double circuit line. Note the alternative does not interconnect to the existing Lamar 230 kV substation, and assumed the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Story
- 345 kV double circuit line between Story and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV switching station at Lamar
- 345 kV double circuit line between Lamar and Tundra
- 345 kV double circuit line between Cheyenne Ridge and Lamar

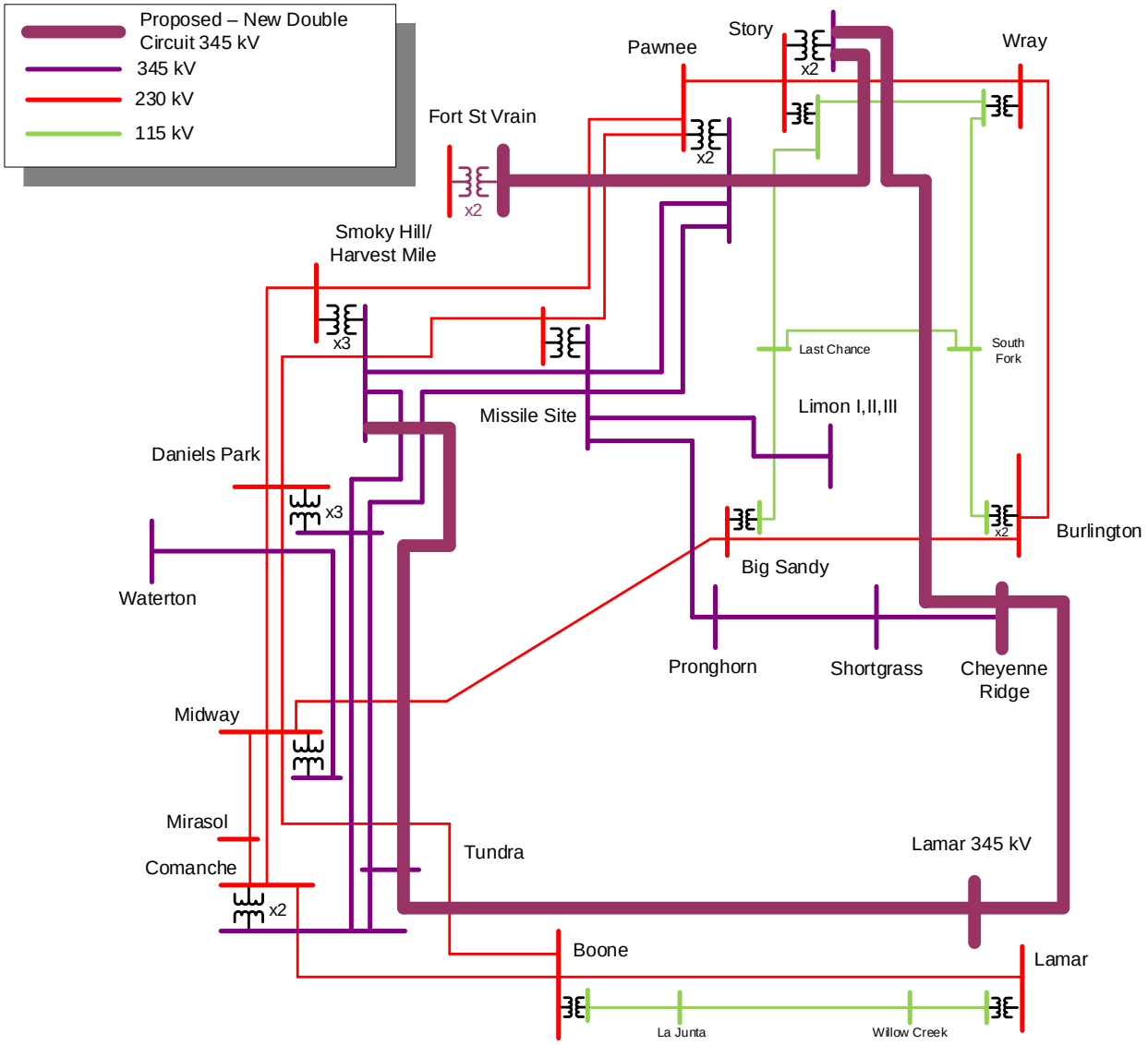

Figure 9: Alternative 6

2. Analysis Results

For Alternative 6, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 6 would consist of approximately 550 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $2.4 billion. While this approximate estimate is similar to Alternative 3 and Alternative 5, it is important to note the estimate methodology does not include substation work. Therefore, the cost would be higher than Alternative 3 and lower than Alternative 5 with the addition of the interconnection into Story Substation.

3. Summary

Alternative 6 would effectively provide capacity to meet 80x30TF objectives within all ERZs contemplated by the objective of the study and would add one additional interconnection point in eastern Colorado as compared to Alternative 3. The study showed no concerns with interconnection into Story Substation.

G. Alternative 7

4. Description

The configuration for Alternative 7 is shown in Figure 10. The alternative creates a new Cheyenne Ridge to Story to Pawnee to Fort St Vrain double circuit 345 kV line, Lamar to Tundra to Harvest Mile 345 kV double circuit line, and a Cheyenne Ridge to Lamar 345 kV double circuit line. This alternative builds upon Alternative 6 with an additional interconnection into the existing Lamar 230 kV substation, and assumed the following components:

- 345 kV switching station near Cheyenne Ridge West
- 345 kV double circuit line between Cheyenne Ridge and Story
- 345 kV double circuit line between Story and Pawnee
- 345 kV bus at Fort St Vrain Substation
- 345 kV double circuit line between Pawnee and Fort St Vrain
- 345 kV double circuit line between Tundra and Harvest Mile
- 345 kV bus at Lamar
- 345 kV double circuit line between Lamar and Tundra
- 345 kV double circuit line between Cheyenne Ridge and Lamar

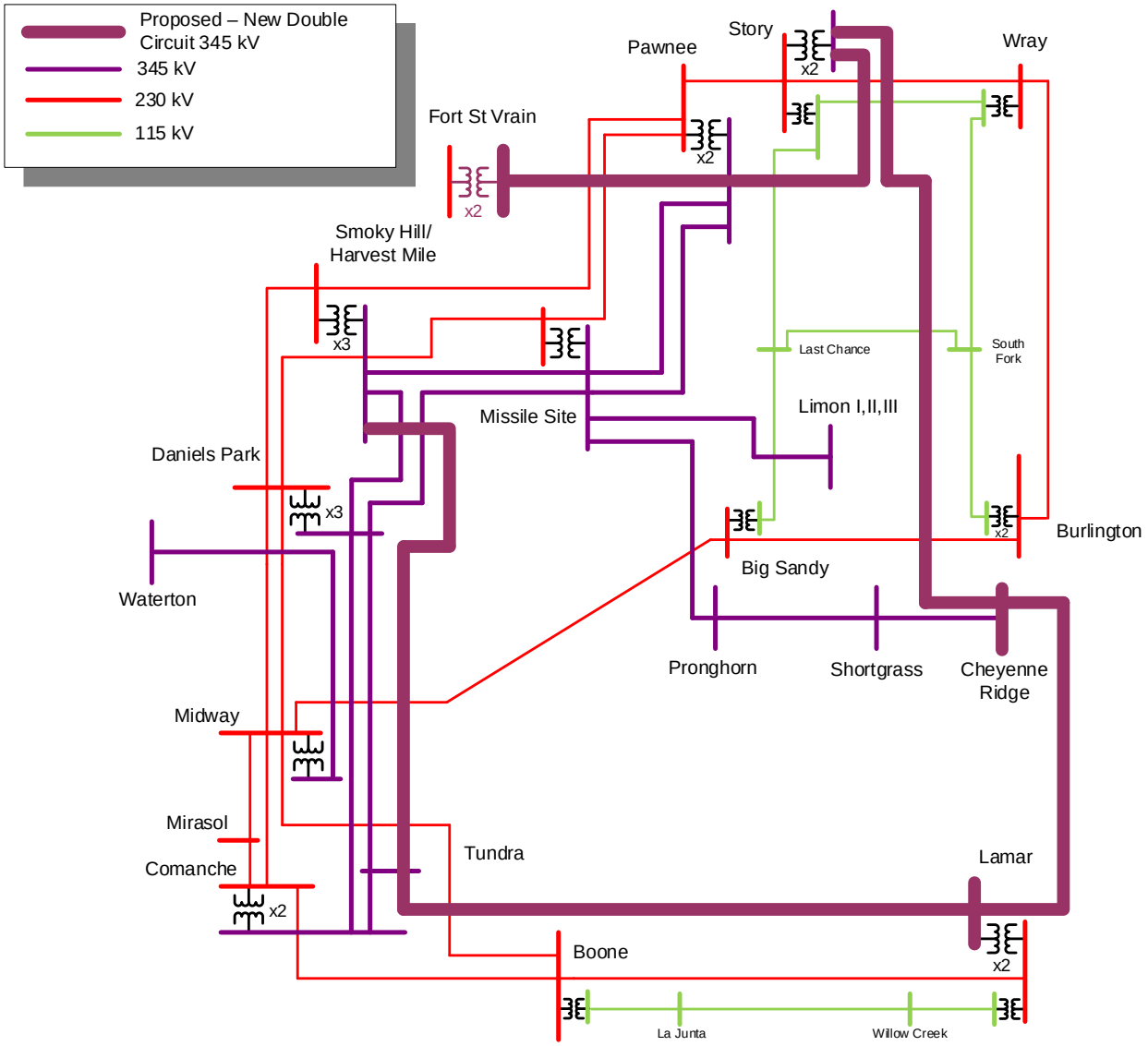

Figure 10: Alternative 7

5. Analysis Results

For Alternative 7, new generation was placed at Comanche, Lamar, Pawnee, Missile Site, and Cheyenne Ridge Substations, effectively within ERZs 1, 2, 3, and 5. The new generation was dispatched to 1500 MW in the Northeast, 500 MW in the South, and 1000 MW in the Southeast for a total of 3000 MW.

Alternative 7 would consist of approximately 550 miles of new 345 kV double circuit tower lines. The planning level estimate using MISO unit costs totals approximately $2.4 billion. While is approximate estimate is similar to Alternative 3 and Alternative 5, it is important to note the estimate methodology does not include substation work. Therefore, the cost would be higher than Alternative 3 and lower than Alternative 5 with the addition of the interconnection into Story and Lamar Substations.

6. Summary

Alternative 7 would effectively provide capacity to meet 80x30 goals within all ERZs contemplated by the objective of the study and would add two additional interconnection point in eastern Colorado as compared to Alternative 3. The study showed no concerns with interconnection into Story and Lamar Substations. Additionally, a new connection into the existing Lamar substation would effectively strengthen the Lamar area transmission system and mitigate existing reliability concerns of PSCo and Tri-State, specifically related to the outage of the Lamar-Boone 230kV line.

H. Alternatives Evaluation Study Results Summary

The number of overloaded facilities for the Benchmark and Alternative cases is shown in Table 3 below. As the table shows, there are significantly more overloaded facilities in the Benchmark case as compared to the Alternatives. Even with a reduced number of overloaded facilities, the Alternative cases continue to show overloaded facilities mostly in the Denver Metro Area. Mitigation of these overloaded facilities is outside the scope of the 80x30TF Phase I study and are planned to be addressed as more information is known on the specific location and technology type of future generation.

Table 3: Number of Overloaded Facilities

Region of Overloaded Facilities	80x30TF Bench	80x30TF Alt 1	80x30TF Alt 2	80x30TF Alt 3	80x30TF Alt 4	80x30TF Alt 5	80x30TF Alt 6	80x30TF Alt 7
Denver Metro	27	13	13	17	16	15	15	16
South	8	1	1	1	1	2	1	1
Southeast	4	2	2	2	2	2	2	1

A list of overloaded facilities can be found in Appendix B.

I. 345 kV versus 500 kV Transmission

The Task Force was presented with the concept of building a 500 kV double circuit loop using the same general paths as studied in the 345 kV study. This 500 kV discussion was raised toward the end of the Phase I Study activity, after the December meetings where the preferred 345 kV Alternatives were identified, thus it was not an alternative studied in Phase I. However, to the extent an alternative at 345 kV can meet the 80x30TF objectives for delivering electric power output from new clean energy resources located in or near the ERZs studied, 500 kV would also perform that function. However, more studies would be necessary to consider a cost to benefit analysis for introducing 500 kV in Colorado where currently no transmission at this voltage exists.

J. Energy Storage

The purpose of the 80x30TF is to develop a transmission expansion plan, which will enable Colorado utilities to achieve the 80 percent reduction in carbon emissions by 2030 as described in SB 19-236. This will be achieved by establishing extended connections between renewable energy resource zones to the load centers. These connections are critical to the reliable and efficient delivery of future energy resources into the transmission system.

The benefits of energy storage technologies are ever evolving and undisputable in certain scenarios. In most cases, their capabilities are better suited to augment existing transmission assets by enabling load management, opportunity to store excess resources, and voltage support.

Of the many capabilities and applications of energy storage, there is not a relevant energy storage application suitable to deliver the resources from the remote energy resource zones into the centralized load centers. In most cases, the energy resource zones reside along the Colorado – Kansas state border. The problem of delivery can only be addressed by the physical connections from the resource zones into the areas that will consume the resource and thus energy storage technology or a non-wire alternative are inadequate solutions to the identified carbon reduction needs.

While energy storage technologies and their unique capabilities to enhance existing transmission systems will continue to be evaluated by Transmission Providers for potential use in future transmission projects, wide deployment of energy storage was not employed for purposes of this study as it does not offer a realistic or practical alternative to wires-based transmission. Bidders will, however, have the opportunity to submit solar plus storage projects in PSCo's upcoming ERP.

X. Selection of Preferred Alternatives

Alternatives were evaluated based on Study objectives stated in Section III, which include the project's ability to:

- Facilitate transmission access to new clean energy resources[13] in Eastern Colorado located in or near designated ERZs 2 & 3 identified as per SB07-100.
- Enable delivery of electric power output from new clean energy resources located in or near designated ERZs 1, 2, 3 & 5 to the load centers along the Front Range.
- Provide new interconnection points to facilitate development of new clean energy resources located in or near ERZs 1, 2, 3 & 5.
- Achieve adequate reliability and operational flexibility of the resulting interconnected transmission system in Colorado for enabling significantly increased penetration of new clean energy resources sufficient to meet the 80x30TF objectives.

Additional consideration was given to the ability for each Alternative to optimize the reliable integration of at least 3000 MW dispatched incremental renewable resource additions through resource geographic diversity and minimizing thermal and voltage violations on the existing transmission system. Specific attention was also given to each Alternative's ability to mitigate double circuit common tower outages (NERC Category P7).

While each Alternative considered would accommodate 3000 MW of generation, based on the study objectives, resource geographic diversity and minimizing thermal and voltage violations on the underlying transmission system, two alternatives, Alternative 3 and Alternative 7, emerged as the top performers and were thereby selected as the recommended preferred Alternatives, depending on utility participation. On a standalone basis, Alternative 3 was the recommended alternative to serve PSCo's

[13] As defined by SB19-236, "Clean Energy Resource" means any electricity-generating technology that generates or stores electricity without emitting carbon dioxide into the atmosphere. Clean energy resources include, without limitation, eligible energy resources as defined in Section 40-2-124(1)(a).

80x30 carbon reduction objectives. As a joint-utility project, Alternative 7 provided comparable benefits in meeting the study objective and was the recommended alternative if Tri-State chooses to participate in the project to meet its Responsible Energy Plan and public policy needs consistent with the timeframes needed to meet certain carbon reduction goals. Specifically, Alternatives 3 and 7 provided the overall best study results from a reliability and resource diversity perspective through the least amount of identified thermal and voltage violations when compared to the other Alternatives. Additionally, Alternatives 3 and 7 provide access to the currently transmission constrained wind generation development area south of Lamar, and the establishment of a reliable looped transmission system configuration and by maintaining capacity under double circuit common tower outages. Further, Alternatives 3 and 7 provide a robust 345 kV backbone to accommodate new generation development in eastern Colorado, subsequently reducing the line mileage for "gen tie" lines developers might otherwise be required to build to access the transmission network.

XI. Injection Capability Analysis

A. Background

Some 80x30TF Stakeholders raised concerns with the generation dispatch methodology used in the analysis. Specifically, stakeholders were concerned generation across eastern Colorado was not dispatched to create stressed system conditions that would be used in traditional generation interconnection and transmission service studies. The concern was that the dispersed generation methodology of dispatching existing generation in the ERZs 1, 2, 3, and 5 at a level lower than 100 percent of its nameplate rating while adding other new generation in the same location/area would not accurately represent new firm generation accommodated by an alternative. Stakeholders desired verification that under Network Resource Interconnection Service Study procedures what injection capability was possible.

To address this concern, an analysis was performed to determine parallel injection capability using Alternative 3 and sensitivities with Alternative 5, 6 and 7.

B. Methodology

The injection study was performed using Alternative 3 and by adding new generators at Cheyenne Ridge and Lamar. Dispatch between the two locations was assumed to be 60 percent at Cheyenne Ridge and 40 percent at Lamar. The aggregate output of these generators was increased in 50 MW increments while aggregate generation associated with coal and gas facilities along the Front Range reduced by 50 MW increments. This injection analysis was performed between 0 and 3500 MW. The stopping point for the 345 kV analysis was 3500 MW since no additional coal or gas plants located along the Front Range were available to be dispatched down. Existing units along the Rush Creek Gen-Tie were dispatched at 100 percent and at Pawnee and Comanche were dispatched at 80 percent. Sensitivity analyses were performed networking Alternative 3 and Story, Burlington, and/or Lamar, to reflect Alternatives 5, 6, and 7.

A sensitivity analysis was performed with Alternative 3 at 500 kV. The 500kV analysis was performed between 0-5000 MW, however between 3500-5000 MW, existing renewables along the Front Range were reduced in order to stress the power transfer limits from the periphery of the system.

In all scenarios, 'large' reactive devices were placed at specific buses to regulate voltage and improve simulation results. The devices were placed at the following locations with the following voltage set-points.

Table 4: Reactive Power Injection Locations and Voltage Setpoints

345 kV System	500 kV System	Voltage Setpoint (PU)
St. Vrain	St. Vrain	1.00
Cheyenne Ridge East	Cheyenne Ridge East	1.02
Lamar	Lamar	1.02
Tundra	Tundra	1.00
Harvest Mile	---	1.00

C. Results

Across all the alternatives and scenarios, there were no significant overloads associated with the transfer of energy from the Cheyenne Ridge and Lamar generation hubs to the Front Range transmission system. The bulk of the overloads occurred in the Denver Metro area, similar to the 80x30 Carbon Reduction Goal Analysis discussed previously but are due to the lack of local Denver Metro generation and the consequential higher imports, rather than the transfer itself.

Reactive power requirements needed to maintain acceptable system voltage is the larger driver on the injection limits, indicating the potential for stability limitations. At the higher end of the studied injection levels, the reactive power requirements to achieve the setpoint values in the table above are significant. Notably, the reactive devices are attempting to hold the voltage setpoint, if those values were able to operate within a specified band the size of the reactive power injection could be reduced. However, this reduction does not come without risk as lower operating N-0 and N-1 voltages place the system closer to a stability limit.

The sensitivities networking at Story, Lamar, and Burlington demonstrated the following:

- Networking at Story
  - Slight reductions in Denver Metro overloads
  - Improved system voltages
- Networking at Lamar
  - Slight reductions in Denver Metro overloads
  - Improved system voltages
  - Corrects/fixes existing reliability concerns in the Lamar area
  - Terminal Upgrades required on:
    - Boone – Lamar 230 kV
    - Lamar – Willow Ck – Lamar bus tie 115 kV
  - Cross-trip RAS needed for loss of both Lamar – Tundra 345 kV lines
    - Low likelihood NERC P6/P7 event
- Networking at Burlington
  - Slight reductions in Denver Metro overloads
  - Improved system voltages
  - Significant Network Upgrades required on underlying system

The slight reduction in overloads and improved system voltage illustrates the benefits of a higher degree of networking on the transmission system. Also, the 500 kV sensitivity showed possible higher injection levels with reduced capacitive reactive power requirements.

XII. General Conclusions

The results of the study indicate that a new wide-area 345 kV transmission project interconnecting at many locations in the Northeastern, Eastern, and Southern portions of the transmission system, and into the Denver Metro area, can accommodate potential generation necessary to meet the state's 2030 carbon reduction goals. The project would create a new Cheyenne Ridge to Pawnee to Fort St. Vrain double circuit 345 kV line, Lamar Area to Tundra to Harvest Mile 345 kV double circuit line, and a Cheyenne Ridge to Lamar Area 345 kV double circuit line, providing efficient and cost-effective access to renewable generation located in ERZs 1, 2, 3, and 5.

Alternatives 3 and 7 are transmission projects identified by the study that would significantly improve the reliability of the Colorado transmission network. Alternative 3 would improve reliability by providing additional high voltage transmission through the eastern portion of Colorado by providing greater access to and support of the existing transmission currently serving the Denver Metro area. Alternative 3 could be modified to add interconnections at Story, Burlington, and/or Lamar as shown in Alternatives 5, 6, and 7 should other Transmission Providers choose to utilize a portion of the project to meet their public policy needs.

The project can also be constructed in stages in order to accommodate the anticipated interconnection of projects in the upcoming resource acquisitions of utilities and the ability to capture available federal tax credits.

XIII. Appendix A

Table 5: Generation Dispatch in Benchmark Study Case

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
70010	TBII_GEN 0.6900	70	PSCOLORADO	1	78	78	78	-6	25
70017	SI_GEN 0.6000	70	PSCOLORADO	1	15	15	30	-3	15
70069	CABCRKA 13.800	70	PSCOLORADO	1	150	150	162	40	41
70070	CABCRKB 13.800	70	PSCOLORADO	0	150	150	162	23	43
70074	80X30_GV 34.500	70	PSCOLORADO	0	0	0	215	36	72
70074	80X30_GV 34.500	70	PSCOLORADO	0	0	0	285	36	95
70075	80X30_CAMEO 34.500	70	PSCOLORADO	0	0	0	21	-6	7
70075	80X30_CAMEO 34.500	70	PSCOLORADO	0	0	0	29	-10	10
70077	BOONE_CEP 34.500	70	PSCOLORADO	1	91	91	113	34	34
70082	80X30_BOON 34.500	70	PSCOLORADO	0	0	0	43	5	14
70082	80X30_BOON 34.500	70	PSCOLORADO	0	0	0	57	5	19
70104	CHEROK2 15.500	70	PSCOLORADO	1	0	0	0	48	110
70105	80X30_CHER 22.000	70	PSCOLORADO	0	0	0	250	50	125
70105	80X30_CHER 22.000	70	PSCOLORADO	0	97	97	108	36	36
70105	80X30_CHER 22.000	70	PSCOLORADO	0	73	73	142	47	47
70106	CHEROK4 22.000	70	PSCOLORADO	0	350	350	383	119	229
70145	CHEROKEE5 18.000	70	PSCOLORADO	1	100	100	185	58	96
70146	CHEROKEE6 18.000	70	PSCOLORADO	1	100	100	185	95	95
70147	CHEROKEE7 18.000	70	PSCOLORADO	1	150	150	228	82	128
70180	FRUITA 13.800	70	PSCOLORADO	0	18	18	20	1	7
70188	FTLUP1-2 13.800	70	PSCOLORADO	0	40	40	44	-2	31
70188	FTLUP1-2 13.800	70	PSCOLORADO	0	40	40	50	-2	33
70189	80X30_FTLUP 22.000	70	PSCOLORADO	0	0	0	400	-133	133
70189	80X30_FTLUP 22.000	70	PSCOLORADO	0	0	0	172	-57	57
70189	80X30_FTLUP 22.000	70	PSCOLORADO	0	0	0	228	-76	76
70264	80X30_MIDW 34.500	70	PSCOLORADO	0	0	0	43	7	14
70264	80X30_MIDW 34.500	70	PSCOLORADO	0	0	0	57	7	19
70300	MIDWY_CEP 34.500	70	PSCOLORADO	1	80	80	100	33	33
70310	PAWNEE 22.000	70	PSCOLORADO	1	327	327	535	115	115
70314	MANCHEF1 16.000	70	PSCOLORADO	0	0	0	140	22	110
70315	MANCHEF2 16.000	70	PSCOLORADO	0	48	48	140	-50	110
70334	PUB_DSLS 4.1600	70	PSCOLORADO	0	0	0	8	0	4
70337	80X30_PAWN 34.500	70	PSCOLORADO	0	100	100	294	75	98
70337	80X30_PAWN 34.500	70	PSCOLORADO	1	100	100	613	187	204
70344	R.F.DSLS 4.1600	70	PSCOLORADO	0	0	0	10	0	4
70406	ST.VR_2 18.000	70	PSCOLORADO	0	120	120	134	56	102
70407	ST.VR_3 18.000	70	PSCOLORADO	0	120	120	124	47	76
70408	ST.VR_4 18.000	70	PSCOLORADO	0	140	140	145	68	86
70409	ST.VRAIN 22.000	70	PSCOLORADO	1	134	134	318	143	143

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
70440	80X30_UINTAH34.500	70	PSCOLORADO	0	0	0	21	-1	7
70440	80X30_UINTAH34.500	70	PSCOLORADO	0	0	0	29	-1	10
70448	VALMONT6 13.800	70	PSCOLORADO	0	50	50	57	-4	32
70485	ALMSACT1 13.800	70	PSCOLORADO	0	0	0	19	0	14
70486	ALMSACT2 13.800	70	PSCOLORADO	0	0	0	19	0	14
70487	JMSHAFR4 13.800	70	PSCOLORADO	1	35	35	35	11	28
70487	JMSHAFR4 13.800	70	PSCOLORADO	1	33	33	33	11	31
70490	JMSHAFR3 13.800	70	PSCOLORADO	1	36	36	36	27	30
70490	JMSHAFR3 13.800	70	PSCOLORADO	0	0	0	50	9	9
70493	JMSHAFR2 13.800	70	PSCOLORADO	0	0	0	51	8	9
70495	JMSHAFR1 13.800	70	PSCOLORADO	1	36	36	36	11	31
70495	JMSHAFR1 13.800	70	PSCOLORADO	1	35	35	35	11	31
70498	QF_BCP2T 13.800	70	PSCOLORADO	0	0	0	34	-3	14
70498	QF_BCP2T 13.800	70	PSCOLORADO	0	0	0	36	-5	24
70499	QF_B4-4T 13.800	70	PSCOLORADO	0	20	20	24	-6	15
70499	QF_B4-4T 13.800	70	PSCOLORADO	0	20	20	25	-6	15
70500	QF_CPP1T 13.800	70	PSCOLORADO	0	24	24	24	6	13
70500	QF_CPP1T 13.800	70	PSCOLORADO	0	24	24	24	6	13
70501	QF_CPP3T 13.800	70	PSCOLORADO	0	25	25	27	6	15
70502	PIONEER_IR_S34.500	70	PSCOLORADO	1	52	52	80	-6	26
70548	APT_DSLS 4.1600	70	PSCOLORADO	0	0	0	10	0	4
70553	ARAP5&6 13.800	70	PSCOLORADO	0	38	38	39	-16	39
70553	ARAP5&6 13.800	70	PSCOLORADO	0	38	38	40	-16	40
70554	ARAP7 13.800	70	PSCOLORADO	0	46	46	47	-10	37
70556	QF_B4D4T 12.500	70	PSCOLORADO	0	60	60	70	-6	35
70557	VALMNT7 13.800	70	PSCOLORADO	0	40	40	42	-11	32
70558	VALMNT8 13.800	70	PSCOLORADO	0	40	40	42	8	32
70559	80X30_VALM 34.500	70	PSCOLORADO	0	0	0	108	36	36
70559	80X30_VALM 34.500	70	PSCOLORADO	0	0	0	142	47	47
70560	LAMAR_DC 230.00	70	PSCOLORADO	0	100	100	210	9	50
70561	80X30_SPRUCE34.500	70	PSCOLORADO	0	265	265	294	67	98
70561	80X30_SPRUCE34.500	70	PSCOLORADO	0	460	460	613	117	204
70562	80X30_SPRUCE18.000	70	PSCOLORADO	0	0	0	250	47	83
70563	80X30_SPRUCE18.000	70	PSCOLORADO	0	0	0	200	67	67
70565	KNUTSON1 13.800	70	PSCOLORADO	1	49	49	68	45	45
70566	KNUTSON2 13.800	70	PSCOLORADO	1	49	49	68	45	45
70577	FTNVL1&2 13.800	70	PSCOLORADO	0	35	35	40	11	27
70577	FTNVL1&2 13.800	70	PSCOLORADO	0	35	35	40	11	28
70578	FTNVL3&4 13.800	70	PSCOLORADO	0	34	34	40	21	24
70578	FTNVL3&4 13.800	70	PSCOLORADO	0	35	35	40	12	27
70579	FTNVL5&6 13.800	70	PSCOLORADO	0	35	35	40	12	26

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
70579	FTNVL5&6 13.800	70	PSCOLORADO	0	35	35	40	12	28
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70580	PLNENDG1_1 13.800	70	PSCOLORADO	0	5	5	5	1	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70585	PLNENDG2_1 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70586	PLNENDG2_2 13.800	70	PSCOLORADO	0	8	8	8	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70587	PLNENDG1_2 13.800	70	PSCOLORADO	0	5	5	5	0	2
70588	RMEC1 15.000	70	PSCOLORADO	0	125	125	142	57	57
70589	RMEC2 15.000	70	PSCOLORADO	0	125	125	151	12	65
70591	RMEC3 23.000	70	PSCOLORADO	0	300	300	313	11	123
70593	SPNDLE1 18.000	70	PSCOLORADO	0	140	140	143	48	109
70594	SPNDLE2 18.000	70	PSCOLORADO	0	140	140	141	48	102
70595	80X30_HARV-M34.500	70	PSCOLORADO	0	265	265	294	52	98

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
70595	80X30_HARV-M34.500	70	PSCOLORADO	0	460	460	613	90	204
70602	80X30_CYR1 34.500	70	PSCOLORADO	1	0	625	833	105	277
70602	80X30_CYR1 34.500	70	PSCOLORADO	1	0	625	833	105	277
70602	80X30_CYR1 34.500	70	PSCOLORADO	0	625	625	833	111	277
70602	80X30_CYR1 34.500	70	PSCOLORADO	0	625	625	833	111	277
70603	80X30_PAWN 34.500	70	PSCOLORADO	0	125	125	833	268	277
70603	80X30_PAWN 34.500	70	PSCOLORADO	0	625	625	833	146	277
70603	80X30_PAWN 34.500	70	PSCOLORADO	1	625	0	833	115	277
70603	80X30_PAWN 34.500	70	PSCOLORADO	1	625	0	833	115	277
70616	TITAN_S1 0.6300	70	PSCOLORADO	1	45	45	50	-6	16
70622	80X30_MS 34.500	70	PSCOLORADO	0	100	100	294	11	98
70622	80X30_MS 34.500	70	PSCOLORADO	1	100	100	613	48	204
70629	RUSHCK_W1 34.500	70	PSCOLORADO	1	157	157	380	-1	132
70631	RUSHCK_W2 34.500	70	PSCOLORADO	1	91	91	220	-15	41
70633	CEP_2 34.500	70	PSCOLORADO	1	124	124	300	95	99
70635	LIMON1_W 34.500	70	PSCOLORADO	1	83	83	201	-12	66
70636	LIMON2_W 34.500	70	PSCOLORADO	1	83	83	201	-11	66
70637	LIMON3_W 34.500	70	PSCOLORADO	1	83	83	201	-14	66
70646	CHEYNRD_W 34.500	70	PSCOLORADO	1	96	96	232	77	77
70647	CHEYNRD_E 34.500	70	PSCOLORADO	1	110	110	268	88	88
70653	CEP_5 34.500	70	PSCOLORADO	1	161	161	200	62	66
70665	JKFUL_W1 0.6900	70	PSCOLORADO	1	46	46	124	29	41
70666	JKFUL_W2 0.6900	70	PSCOLORADO	1	46	46	125	24	41
70670	CEDARPT_W1 0.6900	70	PSCOLORADO	1	51	51	124	0	0
70671	CEDARPT_W2 0.6900	70	PSCOLORADO	1	52	52	126	0	0
70696	EVRAZ_CEP 34.500	70	PSCOLORADO	1	193	193	240	16	80
70701	CO_GRN_E 34.500	70	PSCOLORADO	1	81	81	81	26	26
70702	CO_GRN_W 34.500	70	PSCOLORADO	1	81	81	81	26	26
70703	TWNBUTTE 34.500	70	PSCOLORADO	1	65	65	65	1	26
70710	PTZLOGN1 34.500	70	PSCOLORADO	1	158	158	201	5	66
70712	PTZLOGN2 34.500	70	PSCOLORADO	1	50	50	120	0	39
70713	PTZLOGN3 34.500	70	PSCOLORADO	1	33	33	80	1	26
70714	PTZLOGN4 34.500	70	PSCOLORADO	1	72	72	175	17	49
70721	SPRNGCAN 0.5700	70	PSCOLORADO	0	49	49	65	-14	31
70723	RDGCREST 34.500	70	PSCOLORADO	1	12	12	30	0	0
70726	SPANPKS2_GEN0.6300	70	PSCOLORADO	0	0	0	40	0	23
70777	COMAN_3 27.000	70	PSCOLORADO	1	522	522	780	257	257
70778	CEP_6 34.500	70	PSCOLORADO	1	201	201	250	82	82
70819	CEP_3 34.500	70	PSCOLORADO	1	127	127	169	55	55
70823	CEDARCK_1A 34.500	70	PSCOLORADO	1	165	165	220	49	49
70824	CEDARCK_1B 34.500	70	PSCOLORADO	1	60	60	80	64	66

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
70825	CEDAR2_W1 0.6600	70	PSCOLORADO	1	94	94	125	13	43
70826	CEDAR2_W2 0.6900	70	PSCOLORADO	1	76	76	101	-14	25
70827	CEDAR2_W3 0.6600	70	PSCOLORADO	1	19	19	25	9	9
70900	80X30_HUSKY 34.500	70	PSCOLORADO	0	0	0	50	16	16
70923	80X30_HARTSE34.500	70	PSCOLORADO	0	0	0	21	1	7
70923	80X30_HARTSE34.500	70	PSCOLORADO	0	0	0	29	1	10
70928	CEP_7 34.500	70	PSCOLORADO	1	72	72	72	0	0
70929	80X30_COMA 34.500	70	PSCOLORADO	0	0	0	207	10	69
70929	80X30_COMA 34.500	70	PSCOLORADO	0	0	0	275	13	92
70931	GSANDHIL_PV 34.500	70	PSCOLORADO	1	17	17	19	0	0
70932	SLV_PV 34.500	70	PSCOLORADO	1	27	27	30	0	0
70933	COGENTRIX_PV34.500	70	PSCOLORADO	1	27	27	30	0	0
70934	COMAN_S1 0.4180	70	PSCOLORADO	1	100	100	125	14	52
70935	HOOPER_PV 34.500	70	PSCOLORADO	1	47	47	52	0	0
70950	ST.VR_5 18.000	70	PSCOLORADO	0	130	130	157	18	46
70951	ST.VR_6 18.000	70	PSCOLORADO	0	130	130	157	42	46
70952	80X30_FSV 34.500	70	PSCOLORADO	0	0	0	215	65	72
70952	80X30_FSV 34.500	70	PSCOLORADO	0	0	0	285	22	95
70953	80X30_Tundra	70	PSCOLORADO	1	500	0	1000	149	333
70953	80X30_Tundra	70	PSCOLORADO	1	500	0	1000	149	333
70953	80X30_Lamar	70	PSCOLORADO	1	0	500	1000	149	333
70953	80X30_Lamar	70	PSCOLORADO	1	0	500	1000	149	333
70954	80X30_COM23034.500	70	PSCOLORADO	1	450	450	800	105	267
70956	80X30_MID23034.500	70	PSCOLORADO	0	0	0	800	43	267
70958	80X30_BON23034.500	70	PSCOLORADO	0	0	0	300	18	100
70994	TI-18-0809 0.6300	70	PSCOLORADO	1	100	100	100	39	59
71001	BAC_MSA GEN113.800	70	PSCOLORADO	1	91	91	90	2	21
71002	BAC_MSA GEN213.800	70	PSCOLORADO	1	91	91	90	3	21
71003	BAC_MSA GEN413.800	70	PSCOLORADO	1	40	40	40	0	40
71003	BAC_MSA GEN413.800	70	PSCOLORADO	1	40	40	40	0	40
71003	BAC_MSA GEN413.800	70	PSCOLORADO	1	25	25	25	0	16
71004	BAC_MSA GEN513.800	70	PSCOLORADO	1	40	40	40	1	40
71004	BAC_MSA GEN513.800	70	PSCOLORADO	1	40	40	40	1	40
71004	BAC_MSA GEN513.800	70	PSCOLORADO	1	25	25	25	1	16
71005	BAC_MSA GEN613.800	70	PSCOLORADO	1	40	40	40	0	25
71009	BUSCHRWTG1 0.7000	70	PSCOLORADO	1	4	4	29	-5	9
71013	BUSCHRNCH_LO0.7000	70	PSCOLORADO	1	20	20	59	1	19
71016	PEAKVIEWLO 0.7000	70	PSCOLORADO	1	10	10	60	-3	27
72004	PANO_GEN 0.7000	73	PSCOLORADO	0	0	0	149	0	49
72703	CRSL_GEN 0.7000	73	PSCOLORADO	1	131	131	150	-9	77
72714	KC_GEN 0.7000	73	PSCOLORADO	1	40	40	51	-3	17

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
72719	CT_GEN 0.7000	73	PSCOLORADO	1	75	75	104	10	50
72724	AXIAL_GEN 0.6300	73	PSCOLORADO	0	0	0	145	0	57
72729	DOLORES_GEN 0.6300	73	PSCOLORADO	0	0	0	110	0	44
72739	NIYOL_GEN 0.6300	73	PSCOLORADO	0	0	0	200	0	97
72746	COYOTE_GEN 0.6300	73	PSCOLORADO	0	0	0	120	0	47
73054	ELBERT-1 11.500	73	PSCOLORADO	1	90	90	103	3	3
73129	MBPP-1 24.000	73	PSCOLORADO	1	903	903	605	205	275
73130	MBPP-2 24.000	73	PSCOLORADO	1	600	600	605	205	275
73181	SIDNEYDC 230.00	73	PSCOLORADO	1	200	200	200	-210	-90
73226	YELLO1-2 13.800	73	PSCOLORADO	1	60	60	65	18	39
73226	YELLO1-2 13.800	73	PSCOLORADO	1	60	60	65	18	39
73227	YELLO3-4 13.800	73	PSCOLORADO	1	70	70	76	13	39
73227	YELLO3-4 13.800	73	PSCOLORADO	1	60	60	65	11	39
73289	RCCT1 13.800	73	PSCOLORADO	1	17	17	17	-3	15
73291	RCCT2 13.800	73	PSCOLORADO	1	17	17	17	-3	15
73292	RCCT3 13.800	73	PSCOLORADO	1	17	17	17	-3	15
73293	RCCT4 13.800	73	PSCOLORADO	1	17	17	17	-3	15
73299	BIGTHOMP 4.2000	73	PSCOLORADO	1	3	3	5	0	0
73302	BRLNGTN1 13.800	73	PSCOLORADO	1	25	25	48	-9	44
73303	BRLNGTN2 13.800	73	PSCOLORADO	1	25	25	48	-9	44
73306	ESTES1 6.9000	73	PSCOLORADO	1	10	10	16	12	12
73307	ESTES2 6.9000	73	PSCOLORADO	1	10	10	16	13	13
73308	ESTES3 6.9000	73	PSCOLORADO	1	10	10	16	13	13
73316	GREENMT1 6.9000	73	PSCOLORADO	1	9	9	14	1	31
73317	GREENMT2 6.9000	73	PSCOLORADO	1	9	9	14	1	10
73319	MARYLKPP 6.9000	73	PSCOLORADO	1	7	7	10	-6	7
73324	POLEHILL 13.800	73	PSCOLORADO	1	32	32	38	23	23
73328	WILLMFRK 2.4000	73	PSCOLORADO	1	1	1	3	0	0
73332	ALCOVA1 6.9000	73	PSCOLORADO	1	15	15	20	6	10
73333	BOYSEN1 4.2000	73	PSCOLORADO	1	5	5	8	-1	4
73333	BOYSEN1 4.2000	73	PSCOLORADO	1	5	5	8	-1	4
73334	BBILL1-2 6.9000	73	WAPA R.M.	1	4	4	7	2	3
73334	BBILL1-2 6.9000	73	WAPA R.M.	1	4	4	7	2	3
73339	HEART MT 2.4000	73	WAPA R.M.	1	4	4	7	4	4
73341	NSS2 13.800	73	WAPA R.M.	1	91	91	88	5	23
73347	SHOSHONE 6.9000	73	WAPA R.M.	1	2	2	3	2	2
73349	FREMONT1 11.500	73	WAPA R.M.	1	28	28	33	-3	21
73350	FREMONT2 11.500	73	WAPA R.M.	1	28	28	33	-3	22
73351	GLENDO1 6.9000	73	WAPA R.M.	1	15	15	19	2	2
73352	GLENDO2 6.9000	73	WAPA R.M.	1	15	15	19	2	2
73353	GUERNSY1 2.4000	73	WAPA R.M.	1	2	2	3	2	2

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
73356	KORTES1 6.9000	73	WAPA R.M.	1	8	8	14	2	8
73357	KORTES2 6.9000	73	WAPA R.M.	1	8	8	14	2	6
73358	KORTES3 6.9000	73	WAPA R.M.	1	8	8	14	2	6
73363	SEMINOE1-2 6.9000	73	WAPA R.M.	1	10	10	15	0	8
73363	SEMINOE1-2 6.9000	73	WAPA R.M.	1	10	10	15	0	8
73438	ALCOVA2 6.9000	73	WAPA R.M.	1	15	15	20	6	9
73439	BBILL3-4 6.9000	73	WAPA R.M.	1	4	4	7	2	3
73441	SEMINOE3 6.9000	73	WAPA R.M.	1	10	10	15	-1	8
73444	GUERNSY2 2.4000	73	WAPA R.M.	1	2	2	3	2	2
73448	FLATIRN1 13.800	73	WAPA R.M.	1	42	42	48	26	27
73449	FLATIRN2 13.800	73	WAPA R.M.	1	42	42	48	26	27
73449	FLATIRN2 13.800	73	WAPA R.M.	1	7	7	9	0	0
73461	ELBERT-2 11.500	73	WAPA R.M.	1	90	90	103	33	33
73462	SPIRTMTN 6.9000	73	WAPA R.M.	1	4	4	5	3	3
73520	BFDIESEL 4.2000	73	WAPA R.M.	0	0	0	10	3	9
73532	LINCOLN1 13.800	73	WAPA R.M.	1	40	40	69	-3	47
73533	LINCOLN2 13.800	73	WAPA R.M.	1	40	40	63	-3	47
73631	COHIWND_G1 0.7000	73	WAPA R.M.	1	60	60	67	0	33
73635	COHIWND_G2 0.7000	73	WAPA R.M.	1	23	23	23	9	10
74014	NSS_CT1 13.800	73	WAPA R.M.	1	40	40	37	-8	9
74015	NSS_CT2 13.800	73	WAPA R.M.	1	23	23	37	-8	11
74016	WYGEN 13.800	73	WAPA R.M.	1	93	93	95	13	29
74017	WYGEN2 13.800	73	WAPA R.M.	1	100	100	100	0	8
74018	WYGEN3 13.800	73	WAPA R.M.	1	110	110	115	15	38
74029	LNG_CT1 13.800	73	WAPA R.M.	1	40	40	37	-6	16
74042	CLR_1 0.6000	73	WAPA R.M.	1	20	20	29	-3	1
74043	SS_GEN1 0.6000	73	WAPA R.M.	1	27	27	42	-5	2
74053	BC_DVAR 0.5000	73	WAPA R.M.	0	0	0	0	0	0
74061	CPGSTN_1 13.800	73	WAPA R.M.	1	40	40	37	6	44
74061	CPGSTN_1 13.800	73	WAPA R.M.	1	40	40	37	6	32
74061	CPGSTN_1 13.800	73	WAPA R.M.	1	25	25	21	4	16
74062	CPGSTN_2 13.800	73	WAPA R.M.	1	40	40	37	12	20
74063	CPGSTN_3 13.800	73	WAPA R.M.	1	43	43	50	7	39
74063	CPGSTN_3 13.800	73	WAPA R.M.	1	43	43	50	7	39
74063	CPGSTN_3 13.800	73	WAPA R.M.	1	20	20	25	3	15
76301	ARVADA1 13.800	73	WAPA R.M.	1	7	7	7	-2	5
76302	ARVADA2 13.800	73	WAPA R.M.	1	7	7	7	-2	5
76303	ARVADA3 13.800	73	WAPA R.M.	1	7	7	7	-2	5
76305	BARBERC1 13.800	73	WAPA R.M.	1	7	7	7	1	5
76306	BARBERC2 13.800	73	WAPA R.M.	1	7	7	7	1	5
76307	BARBERC3 13.800	73	WAPA R.M.	1	7	7	7	1	5

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
76309	HARTZOG1 13.800	73	WAPA R.M.	0	0	0	7	0	5
76310	HARTZOG2 13.800	73	WAPA R.M.	0	0	0	7	0	5
76311	HARTZOG3 13.800	73	WAPA R.M.	1	7	7	7	2	5
76313	TK DVAR1 0.5000	73	WAPA R.M.	1	0	0	1	0	16
76314	TK DVAR2 0.5000	73	WAPA R.M.	1	0	0	1	2	16
76351	RCDC W 230.00	73	WAPA R.M.	1	200	200	200	-10	10
76404	DRYFORK 19.000	73	WAPA R.M.	1	440	440	440	47	260
76502	SPFSHPRK 69.000	73	WAPA R.M.	0	0	0	4	0	0
78011	RAWHIDE 24.000	70	WAPA R.M.	0	300	300	304	84	135
78012	RAWHIDEA 13.800	70	WAPA R.M.	0	60	60	70	-1	32
78013	RAWHIDEB 13.800	70	WAPA R.M.	0	60	60	70	20	32
78014	RAWHIDEC 13.800	70	WAPA R.M.	1	60	60	70	21	32
78015	RAWHIDED 13.800	70	WAPA R.M.	1	60	60	70	23	32
78016	RAWHIDEF 18.000	70	WAPA R.M.	1	120	120	138	41	60
78022	RH_PV_GEN 0.6000	70	WAPA R.M.	1	25	25	32	1	12
78515	FTRNG3CC 21.000	70	WAPA R.M.	1	208	208	208	132	132
78516	RD_NIXON 20.000	70	WAPA R.M.	0	0	0	225	45	45
78517	FTRNG1CC 18.000	70	WAPA R.M.	1	140	140	141	63	63
78518	FTRNG2CC 18.000	70	WAPA R.M.	1	141	141	141	59	59
78519	BIRDSAL1 13.800	70	WAPA R.M.	0	0	0	18	0	14
78520	BIRDSAL2 13.800	70	WAPA R.M.	0	0	0	18	0	14
78521	BIRDSAL3 13.800	70	WAPA R.M.	0	0	0	23	0	20
78522	DRAKE 6 13.800	70	WAPA R.M.	0	0	0	0	51	0
78523	DRAKE 7 13.800	70	WAPA R.M.	0	0	0	0	48	0
78524	TESLA1 13.800	70	WAPA R.M.	1	24	24	28	-5	3
78525	NIXONCT1 12.500	70	WAPA R.M.	0	0	0	27	0	24
78526	NIXONCT2 12.500	70	WAPA R.M.	0	0	0	27	0	22
78527	PIKE_PVPLANT0.6000	70	WAPA R.M.	1	89	89	175	18	40
78528	GYAK_PV1 0.6000	70	WAPA R.M.	1	18	18	35	15	15
78529	WC_PVPLANT 0.6300	70	WAPA R.M.	1	30	30	60	5	30
78537	TNGG_A 13.800	70	WAPA R.M.	1	27	27	27	5	13
78537	TNGG_A 13.800	70	WAPA R.M.	1	27	27	27	5	13
78537	TNGG_A 13.800	70	WAPA R.M.	1	27	27	27	5	13
78538	TNGG_B 13.800	70	WAPA R.M.	1	27	27	27	7	13
78538	TNGG_B 13.800	70	WAPA R.M.	1	27	27	27	7	13
78541	PIKE_BESS 0.6000	70	WAPA R.M.	1	25	25	25	5	12
78543	TNGG_FC 13.800	70	WAPA R.M.	1	27	27	27	-5	13
78656	BRIARGATE N 115.00	70	WAPA R.M.	1	25	25	25	12	12
78863	HORIZON 230.00	70	WAPA R.M.	1	31	31	117	60	60
79015	80X30_CRAIG 34.500	73	WAPA R.M.	0	0	0	147	-12	49
79015	80X30_CRAIG 34.500	73	WAPA R.M.	0	0	0	195	-12	65

Bus Number	Bus Name	Area	Area Name	In Service	Pgen BM-Alt 1	Pgen Alt2-7	Pmax	Qgen	Qmax
79016	CRAIG 2 22.000	73	WAPA R.M.	0	42	42	470	-136	216
79017	CRAIG 3 22.000	73	WAPA R.M.	0	478	478	478	-16	145
79019	MORRO1-2 12.500	73	WAPA R.M.	1	75	75	81	-7	59
79019	MORRO1-2 12.500	73	WAPA R.M.	1	75	75	81	-7	60
79033	80X30_HAYDEN34.500	73	WAPA R.M.	0	0	0	192	-2	64
79033	80X30_HAYDEN34.500	73	WAPA R.M.	0	0	0	256	-2	85
79040	HAYDEN1 18.000	73	WAPA R.M.	0	139	139	212	-1	70
79041	HAYDEN2 22.000	73	WAPA R.M.	0	98	98	286	58	130
79055	80X30_RIFLE 34.500	70	WAPA R.M.	0	0	0	172	-10	57
79055	80X30_RIFLE 34.500	70	WAPA R.M.	0	0	0	228	-10	76
79123	FONTNLLE 4.2000	73	WAPA R.M.	1	7	7	11	4	4
79154	FLGORG1 11.500	73	WAPA R.M.	1	50	50	56	-7	38
79155	FLGORG2 11.500	73	WAPA R.M.	1	50	50	56	-7	39
79156	FLGORG3 11.500	73	WAPA R.M.	1	50	50	56	-7	39
79157	BMESA1-2 11.500	73	WAPA R.M.	1	39	39	44	-1	29
79157	BMESA1-2 11.500	73	WAPA R.M.	1	39	39	44	-1	30
79162	CRYSTAL 11.500	73	WAPA R.M.	1	30	30	35	0	18
79164	TOWAOC 6.9000	73	WAPA R.M.	1	8	8	12	-4	7
79166	MOLINA-L 4.2000	73	WAPA R.M.	1	3	3	5	1	2
79172	MOLINA-U 4.2000	73	WAPA R.M.	1	6	6	9	0	4
79176	MCPHEE 2.4000	73	WAPA R.M.	1	1	1	1	0	0
79251	QFATLAS1 13.800	73	WAPA R.M.	1	30	30	31	-4	22
79251	QFATLAS1 13.800	73	WAPA R.M.	1	15	15	15	-2	11
79252	QFATLAS2 13.800	73	WAPA R.M.	1	15	15	15	-4	11
79252	QFATLAS2 13.800	73	WAPA R.M.	1	15	15	15	-4	11
740039	TRK_CRK LO 0.6000	70	WAPA R.M.	1	200	200	206	29	100

XIV. Appendix B

Table 6: Overloads Shown in Benchmark and Alternative Cases

Overloaded Facility	Region	Type	OH/UG	Owner	Base Case Rating (MVA)	Contingency	80x30TF Benchmark	80x30TF Alt 1	80x30TF Alt 2	80x30TF Alt 3	80x30TF Alt 4	80x30TF Alt 5	80x30TF Alt 6	80x30TF Alt 7
Greenwood-Monaco 230	Metro	Line	OH/UG	PSCo	503*	Buckley2-Smoky Hill 230	N-0 OL	123%	123%	129%	127%	128%	128%	131%
Monaco-Sullivan 230	Metro	Line	OH/UG	PSCo	470*	Buckley-Smoky Hill 230	N-0 OL	125%	125%	131%	129%	129%	130%	132%
Leetsdale-Sullivan 230	Metro	Line	OH/UG	PSCo	396	Buckley-Smoky Hill 230	126%	102%	102%	108%	106%	107%	107%	109%
Buckley-Tollgate 230	Metro	Line	OH	PSCo	484	Greenwood-Monaco 230	125%	113%	113%	119%	118%	118%	118%	119%
Buckley-Smoky Hill 230	Metro	Line	OH	PSCo	506	Greenwood-Monaco 230	119%	108%	108%	114%	113%	113%	113%	114%
Leetsdale-Monroe 230	Metro	Line	UG	PSCo	396	Daniels Park-Santa Fe 230	N-0 OL	107%	107%	116%	112%	113%	114%	116%
Leetsdale-Harrison 115 kV	Metro	Line	UG	PSCo	141	Leetsdale-Monroe 230 kV	121%			105%	103%	103%	103%	106%
Daniels Park-Prairie #1 230	Metro	Line	OH	PSCo	576*	Daniels Park-Prairie #2 230	146%	109%	109%	110%	108%	110%	109%	114%
Daniels Park-Prairie #2 230	Metro	Line	OH	PSCo	576*	Daniels Park-Prairie #1 230	145%	108%	108%	109%	108%	109%	109%	113%
Greenwood-Prairie # 1 230 kV	Metro	Line	OH	PSCo	576*	Daniels Park-Prairie #1 230 kV	134%			129%	127%	128%	128%	102%
Greenwood-Prairie #2 230 kV	Metro	Line	OH	PSCo	576*	Daniels Park-Prairie #2 230 kV	136%			100%				104%
Havana1-Chambers 115	Metro	Line	OH	PSCo	120	Havana2-Chambers 115	N-0 OL	130%	130%	101%	100%		100%	101%
Waterton-WatertonTP 115	Metro	Line	OH	PSCo	127	Soda Lake 230/115	N-0 OL	118%	118%	136%	134%	135%	135%	139%
Waterton-MartinTP 115	Metro	Line	OH	PSCo	138	Arapahoe 230/115	120%	102%	102%	108%	107%	108%	108%	109%
Daniels Park-Happy Canyon 115	Metro	Line	OH	PSCo	132	Parker-Bayou 115		100%	100%					
WL_Child-Archer 230	Metro	Line	OH	TSGT	637	Ault-LRS 345	N-0 OL	112%	112%	119%	120%	121%		
Arapahoe-Santa Fe 230	Metro	Line	OH	PSCo	319	Arapahoe-Greenwood 230	N-0 OL			103%	101%	101%	102%	105%
Derby 2-Havana 115	Metro	Line	OH	PSCo	120	Havana2-Chambers 115	108%			102%	101%	101%	101%	102%
Arap_A-Sheridan	Metro	Line	OH	PSCo	127	Ault-LRS 345	101%							
Deer Creek-Soda Lake 115	Metro	Line	OH	PSCo	120	Chatfield-Waterton 230	129%							
Elati-Monroe 230	Metro	Line	OH	PSCo	398	Greenwood-Arapahoe 230	122%							
Ft.Lupton-Pawnee 230	Metro	Line	OH	PSCo	481	Pawnee-Story 230	121%							
Jewell2-Tollgate 230	Metro	Line	OH	PSCo	484	Greenwood-Monaco 230	105%							
Pawnee-Story 230	Metro	Line	OH	PSCo	581	Pawnee-Ft.Lupton 230	129%							
Archer-Terry Ranch 230	Metro	Line	OH	PSCo	442	Ault-LRS 345	111%							
Ault-Terry Ranch 230	Metro	Line	OH	PSCo	457	Ault-LRS 345	111%							
BrushTP-EFMORGTP	Metro	Line	OH	PSCo	160	BeaverCk-Adena 115	104%							
EFMORGTP-FMWest	Metro	Line	OH	PSCo	121	BeaverCk-Adena 115	110%							
Vollmert-Fuller 115 kV	South	Line	OH	CSU	173	Paddock-Falcon 115	121%					100%		103%
FV-MidwayBR 115	South	Line	OH	BHC	115	MidwayBR-RD_Nixon 230	110%	116%	116%					
W.Canon-Hogback 115	South	Line	OH	BHC	120	MidwayBR-W.Canon 230	144%			110%	107%	109%	109%	115%
Midway-W.Station 115	South	Line	OH	BHC	80	Ftn_Lk-North Ridge 115	102%							
MidwayPS-MidwayBR	South	Line	OH	WAPA	430	Midway-Fuller 230	142%							
MidwayPS-Fuller 230	South	Line	OH	PSCo	478	MidwayPS-MidwayBR 230	110%							
PuebloTP-Stem_Beach	South	Line	OH	TSGT	92	Comacnhe-Walsenburg 230	116%							
Blkfortp_Blk_Sqmv	South	Line	OH	CSU	143	Daniels Park-Fuller 230	101%							
Curecant-S.Canal 115	Southwest	Line	OH	WAPA	137	Curecanti-Northfork 230	108%							
Montrose-S.Canal 115	Southwest	Line	OH	WAPA	137	Curecanti-Northfork 230	101%							
Lam_Co-Wilow_Ck 115	Southeast	Line	OH	TSGT	107	Boone-Lamar 230	Blown Up	Blown Up	112%	124%	124%	124%	124%	
LaJuntaW-RockyFrd 69	Southeast	Line	OH	BHC	23	Boone-S.Fowler 115	116%	116%	116%	116%	116%	116%	116%	116%

XV. Appendix C

A. Mark D. Detsky Comments of Independent Power Producers (IPPs) on portfolios of Office of Consumer Counsel (OCC) representative Chris Neil

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MEMORANDUM

TO: Colorado Coordinated Planning Group (CCPG) 80 X 30 Task Force

FROM: Mark D. Detsky

DATE: February 22, 2021

SUBJECT: Comments of Independent Power Producers (IPPs) on portfolios of Office of Consumer Counsel (OCC) representative Chris Neil

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Thank you for the opportunity to present a rebuttal to the comments of the OCC's 31 portfolios based on bids submitted to Public Service Company of Colorado (Public Service) in 2017. The IPP coalition would like the 80 X 30 Task Force Report to reflect widespread support from the independent power producer market for this desperately needed transmission expansion in eastern Colorado. The project conceived in this report is an important first step to achieving Colorado's carbon dioxide emission reduction targets that will apply to each of Colorado's load serving transmission providers.

The IPP community expects that these issues will be explored in transmission and resource planning proceedings at the Colorado PUC. However, there are three points the IPP community wishes to raise for the CCPG's consideration in this report:

1. **The OCC's Comments Do Not Reflect the Current or Expected Market Reality**

A large part of Mr. Neil's comments concern the formation of a market connection to the Southwest Power Pool (SPP), and interconnections to the western California Independent System Operator (CAISO) via the TransWest Express project. Mr. Neil's analysis takes these assumptions a step further in relying on the inclusion of an 800 MW AC-DC tie to be located at the Public Service Cheyenne Ridge substation (without any cost estimate), also involving the "reconnection" of a 300 MW wind project with an executed and completed interconnection agreement, and then a 50 – 150 mile line from the TransWest Express project to Colorado which would form an interconnection to the CAISO.

First, the IPP market supports various market structures being pursued in Colorado and agrees with Mr. Neil that market structures could provide many economic benefits. However, Mr. Neil's assumptions for the purpose of his analysis are not realistic to meet a 2030 timeline for the carbon emission goals of Colorado. First, joining one or both of the SPP and CAISO markets is a multi-year process on its own, but then operating within those market structures to study and construct specific ties and upgrades is an additional layer of unknown, but certain, delay. This is especially true in considering a new, large, AC-DC tie to SPP. Such a project would have to not only navigate the SPP transmission planning process, but it would also be subject to market rules between the western and eastern interconnections that include non-synchronous operation, and go through SPP's cost allocation review process. These hurdles are significant, introduce substantial timeline delay, and have not been analyzed in any level of detail from a transmission or cost perspective. Finally, Mr. Neil's analysis of SPP nodal pricing is not reflective of long-term market conditions, but instead represents one possible 15-minute snapshot.

With regard to the Wyoming tie, the TransWest line includes an approximately 700 + mile DC line crossing multiple states. Irrespective of the economic feasibility, regulatory, and permitting hurdles, the IPP market is not confident about when the line would be "in service" to California, never mind to Colorado, especially where that option has not been offered by the private proponent of that project. The economics of the PCW project depend on the TransWest line and not a line to Colorado, and wind generation in Wyoming is subject to a $1.00/MW tax.

Further, it is not appropriate to plan a transmission system expansion into Wyoming for the benefit of one IPP project. The high level of uncertainty about whether the PCW project would be built, even if TransWest is built, also raises the question whether Public Service could pursue development of alternative local generation and transmission as a Plan B if PCW fails. Even if the line and connected Wyoming generation were built as envisioned, the physical interconnection into Colorado grid and the power purchase contract structuring adding additional layers of complexity and uncertainty, requiring many additional considerations not addressed by Mr. Neil.

2. The 2017 Bids in the Public Service RFP Are Not a Sound Basis to Preliminarily Judge a Transmission Proposal.

Mr. Neil bases a criticism by finding that the proposed loop project would not provide efficient service to projects bid into the 2017 Public Service solicitation. From a market standpoint, Mr. Neil makes several errors in his assumptions. First, bids made in the 2017 Public Service RFP were optimized to connect the transmission system as it existed at that time, because new transmission was only treated as a cost in the bid evaluation process. Thus, the reason there are not many projects near the proposed loop is precisely because transmission options didn't exist. Second, the bid interconnection points referenced in many cases included long radial lines to project locations that are not reflected it Mr. Neil's analysis.

From a market policy perspective, it is not good policy in this transmission planning report to pre-suppose the outcome of a solicitation that is to occur in approximately one year, based on bids

and pricing that existing nearly four years ago. RFP processes involve different modeling tools than transmission, and involve assumptions, market conditions, and evaluations that are not within the scope of transmission planning.

3. It is Not Appropriate to Continue to Rely on Long Radial Transmission Lines.

A third significant prong of Mr. Neil's analysis is his assumption that market participants could rely on "ERIS" transmission service as opposed to network service. This assumption is not correct. ERIS, or non-firm service, is an "interconnection product" under FERC law that a generator, at its discretion, may select. ERIS is not the same thing as a utility tool for managing a load and resource balance. The type of service procured by a generator is based on many factors, not the least of which includes project financing arrangements.

The current transmission system in Eastern Colorado is "full", from a legal perspective if not a technical perspective. Existing generators have binding interconnection contracts to inject power from their projects. From a technical perspective, long high voltage radial lines, especially in Eastern Colorado, are known to create transient stability issues. This is evident from the Rush Creek Task Force studies and the subsequent installment of Static Var compensators. Creating a network of lines alleviates this problem to a large extent. If Colorado joins a RTO/Market, a networked grid adds measurable benefits and options to market participants, both buyers and sellers of power.

B. Additional Comments of behalf of the Interwest Energy Alliance

February 22, 2021

Patrick Corrigan

80x30 Task Force

Re: Additional Comments on behalf of the Interwest Energy Alliance

The Interwest Energy Alliance participated in the 80x30 Task Force ("Task Force") and provided input on several occasions. The Task Force was formed out of the Colorado Coordinated Planning Group ("CCPG") to provide power flow studies with assumptions gathered from all participating utilities in Colorado, but was primarily led by Public Service Company of Colorado's ("PSCo's") need to prepare for the significant generation additions anticipated to serve its 2021 Electric Resource Plan and Clean Energy Plan ("PSCo ERP/CEP") requirements. New generation will require new injection capacity from various areas around the state, including areas which have been dormant related to potential generation development due to lack of infrastructure in prime renewable zones and inadequate capacity on the existing network. The sites cannot be fully developed and prepared to respond to requests for proposals ("RFPs") when there is no interconnection point which can accommodate new projects at reasonable cost. Therefore, the bid review modeling does not reflect the numerous projects with potential savings that are further back in the development process. Furthermore, reliability is enhanced if bids are developed from various areas of the state in each RFP, rather than requiring bids to be chosen from a cluster concentrated in a single area which has recently had transmission upgrades. This geographic and technical diversity reduces variability and uncertainty, with other grid support, and can help avoid numerous long radial lines. Coloradans would be better served by state-wide planning and less reliance on long gen-tie lines which can increase costs and reliability challenges and contribute to land use concerns and conflicts.

Interwest applauds the contributions of each utility into the Task Force discussions. The process was necessarily compressed as to time, but included careful review of a number of relevant scenarios. The 345 kV lines included in Alternative 3 and Alternative 7 appear to be required to serve PSCo's anticipated generation additions contemplated as part of the PSCo ERP/CEP. In addition, Interwest appreciates the added injection study proposal and results provided by Tri-State Generation and Transmission Association ("Tri-State") because its own additional needs should also be addressed in major transmission investments and transmission lines to be built in Colorado. The needs of the various utilities operating in Colorado through 2030 and thereafter, as well as scenarios reflecting opportunities for additional cost savings from increased regional flows are all relevant to the work of this Task Force, if not in this Phase I, in future Phases and studies to follow in the very near term. The lines planned and built out of these studies will last for decades. Thorough review of the transmission plan sufficiency at this stage is warranted, because stranded costs will result if 345 kV infrastructure is built with very large reactive support requirements, and 500 kV lines are ultimately required at some point in the future to serve minimum demand or market efficiency requirement.

Interwest generally supports the comments submitted by Dietze and Davis responding to the comments submitted on several occasions to the Task Force on behalf of the Office of Consumer Counsel ("OCC"). The OCC asserts that since the middle of the state has reflected numerous projects in the development stage in the last RFP, and that we should assume that these bids will still be available and should be the source of new projects for the PSCo ERP/CEP. However, the location of bids submitted in response to past RFPs was necessarily constrained by the transmission system as it existed at that time, rather than a system which reflected future potential. Colorado utilities have been aware of this "chicken and egg"

issue for some years and should be acknowledged for their efforts to prevent the substantial lost opportunities from failure to plan and invest in new transmission lines required to tap into additional renewable resources around the state. As stated by PSCo, the time is now:

> The transmission system in Colorado is often designed and construction based on known generation additions to each providers system. Waiting to design and construct transmission in the wake of generation acquisition has resulted in numerous limitations to interconnecting new generation, especially beneficial energy resources located in energy rich areas such as Northeastern and Southern Colorado. To aid in resolving this chick and egg issue, the Colorado Coordinated Planning Group (CCPG) proposed the 80x30 Task Force in August 2020 to provide a forum for all stakeholders to collaboratively identify the transmission backbone infrastructure needed to enable the Colorado utilities meet the goals of Colorado's Clean Energy Plan. As noted in the 80x30 Task Force scope, this work is envisaged to be performed in two stages – this report provides the results and recommendations for Phase 1.

The OCC comments side-step the cost-saving benefits to be achieved by expanding the network transmission system in Colorado. The OCC ignores the need for planning past 2030 towards Colorado's 2040 and 2050 goals, and the need to serve all utilities operating in Colorado. The OCC also minimizes the steps to be taken before transmission can be planned and built through a regional market construct. Markets will take several years to become operational in Colorado, even after commitment to their cost savings are accepted and approved by Colorado utilities and decision-makers. In the interim, emissions reductions cannot be achieved on a cost-effective basis without substantial upgrades to the existing system, and expansion into previously-unserved areas.

Interwest does not believe that the final scenarios studied by the Task Force serves all of Colorado's transmission expansion needs over the next 10 years, much less the next 20 or 30 years. There are areas left without upgrades which leaves undeveloped low-cost wind and solar resources, including in the San Luis Valley and the Western Slope. Therefore, these questions should continue to be addressed in comprehensive planning discussions and through utility bilateral agreements. A number of important issues remain unresolved by this Task Force, including seams and upgrades to the existing system to make it work as efficiently as possible. The Rule 3627 review may help spur further coordination between utilities which is sorely needed in Colorado.

Very truly yours,
Lisa Tormoen Hickey
Attorney for the Interwest Energy Alliance

C. The Office of Consumer Counsel Statement on the 80x30TF Report

The Office of Consumer Counsel ("OCC") acknowledges the effort put forth by members of the Colorado Coordinated Planning Group ("CCPG"), and, in particular, the 80x30 Task Force ("80x30TF") in producing this report. The OCC recognizes that the role of the CCPG is high-level, coordinated transmission planning, as described in Section II of this report. And, appropriately, the

CCPG does not focus on project-specific planning efforts such as land acquisition, permitting, routing or even estimate costs.

In recent years, the leadership of the state of Colorado has developed polices for the utilities to replace fossil-based generation with clean energy amidst many other policy efforts. The CCPG has an important role in identifying options to achieve these policy goals. This 80x30TF report identifies just one possibility to interconnect renewable energy from the identified energy resource zones. But the OCC is concerned that the size and the scope of the alternatives presented are only part of the story - that there may be a better, more comprehensive solution that achieves the goals of SB19-236 and SB07-100, including integrating renewables and reliability in a manner that is just, reasonable and cost-effective – whether the comprehensive solution uses the existing system, ties to the Eastern Interconnection, utilizes another out-of-state option or includes other in-state options. This cannot be determined if we focus on Public Service's proposed alternatives before we look at the bigger picture. The comments below address several areas that should be considered before committing to transmission facilities that may not be necessary at this time and, as such, may not be the best solution for ratepayers or the people of Colorado. Note that these comments are written based on the latest draft report as the final draft of the report, containing revisions in line with discussions at the February 18 task force meeting, is not available as of the time of filing these comments.

A. Scope and Objectives

At the initial 80x30TF meeting, Public Service brought forth its objectives and alternatives. The objectives were revised and agreed to by the task force and are stated in *Section III, Scope, Purpose and Objectives*. This section goes on to further refine the goals, focusing on SB07-100. These refinements help clarify the scope, but the study scope did not, and should not, focus entirely on SB07-100. The OCC is not opposed to expanding the transmission system in order to accommodate

renewable resources. However, high-level planning should be an open process to provide options and evaluate the impacts of varying possibilities, not predetermined positions.

B. Reference Baseline

The first problem is that Public Service, which developed the alternatives and completed the planning studies for each alternative, did not provide a baseline study that evaluated whether the additional capacity could be accommodated on the existing transmission system, with specific system improvements. That is, this report referenced projected generation needs for the upcoming Clean Energy Plan, but it did not set a baseline "do-nothing" alternative which would site new generation near existing injection capabilities and upgrade the system accordingly, as is the typical process for transmission planning. Rather, the generation in the provided "benchmark" case would be sited exclusively at the eastern outskirts of the existing system. Because there were sufficient bids in the 2016 ERP proposing to connect to the existing system and meet the expected needs of the upcoming Clean Energy Plan, the OCC requested that the 80x30TF look at the possibility of this true "do-nothing" alternative, but it was not presented to the 80x30TF. A massive transmission expansion such as that proposed in this report should be approached with caution, to ensure the projects are necessary and that they provide the reliability needed for a secure system without overbuilding.

C. The Chicken and the Egg

The OCC is aware that Public Service is set to propose its Clean Energy Plan, and states that this transmission expansion is needed in advance of the Clean Energy Plan. However, as this report states, this is a chicken and egg situation – which comes first. This proposed transmission loop may help the Clean Energy Plan – by providing transmission access. But if this proposed transmission loop precedes the Clean Energy Plan, it is quite possible to be overbuilt at a significant cost to ratepayers. As such, it is premature to study the transmission plan in advance of the ERP. Any decision regarding investment in transmission expansion must be made in conjunction with the ERP.

D. Potential for Bias

The OCC is concerned with the potential for bias in this report. We have been told in many proceedings that transmission planning is not a simple, quick analysis. However, the entire process for this report from the initial scoping meeting to the draft report spanned only about three months. Although the task force consisted of members from many different entities, the scope, the alternatives and the studies included in this Phase I effort were all controlled by Public Service. While this may not be in and of itself a problem, it is important to be aware that when the inputs are primarily controlled by one entity, the results may be biased to meet the needs or desires of that entity. Here, Public Service must meet the needs of the Clean Energy Plan required by statute and this bias may preclude identification of opportunities and synergies with the existing system or even other entities, ultimately at the expense of ratepayers. This is of particular importance as coal generation is retired statewide in light of a carbon-free future. One example of this potential for bias is that Public Service identified networking Cheyenne Ridge gen-tie as an objective at the initial meeting. Although this was removed as an objective in that meeting, it was included in all alternatives. The OCC is not making a technical evaluation of this concept, but decision-makers using this report need to ensure that networking of the gen-tie would provide added reliability and significant operational improvements, considering the massive costs for the selected alternative. Without an alternative omitting the networking of this gen-tie, there can be no way to determine this.

E. Cost Estimates

It is important to note that, with an estimated cost of $2.4 billion, these estimates are based on a rule-of-thumb and are not inclusive of all upgrades necessary to get the energy to the loads. There are several areas where costs would likely change, most often as adders. First, this cost estimate is just a number with no justification – this report clearly states the source of the estimates is on a $/mile basis from MISO. Appropriate for this point in time in the process, the estimate is just an indicative

estimate – it has no basis in actual estimating methods. It is a guess based on a rule-of-thumb and could turn out to be significantly different – either higher or lower. Second, although the alternatives appear to reduce the number of overloads that could result when moving the renewable energy into the Denver Metro area, they are only compared to the benchmark analysis. There is not an identification of the overloads in the true baseline situation described above. These overloads are shown in Table 3 in Section H of the report and will be an additional cost on top of the estimate provided in this report. The cost of resolving any such Denver Metro overloads could run to the hundreds of millions of dollars. Further, Public Service has not demonstrated that it can fully resolve the Denver Metro overloads, which would be necessary to get the energy from the energy resource zones to the Denver Metro load center. Third, as this system is primarily used for getting renewable energy out of the renewable energy zones, there will likely be a need for a significant amount of reactive power. These needs are not known, as the generation mix and locations are not known. However, the costs to meet these reactive power needs may be significant and would be in addition to the $2.4 billion. Fourth, the costs to upgrade existing stations were considered to be negligible compared to $2.4 billion. This may be true, but if there are multiple upgrades requiring additional land and reconfiguration, the costs could add up to be a noticeable increase in costs.

F. Amount of Renewable Capacity

The Report is not clear regarding the amount of renewable capacity that this transmission system is trying to accommodate. Earlier work reflected that Public Service's resource planning group stated that 2,800 MW of wind and 2,100 MW of solar for a total of 4,900 MW was needed to meet the emissions reduction goal. At some point, this was reduced to 2,160 MW of new wind with the possible replacement of 640 MW of existing wind whose contracts expire. This report discusses 3,000 MW of renewables, but does not explain where this number came from and its relationship to the

earlier values of 4,900 MW from Public Service's resource planning group. And this change did not appear to impact the alternatives.

G. Conclusion

The OCC is concerned with the impact of this large plan on ratepayers – which is in addition to the ordinary transmission activities, such as additions and upgrades to meet load growth. The OCC believes it is essential to have a full picture of issues, opportunities and related costs in order to make informed decisions. Recognizing this is a high-level project plan, this report is still lacking some analyses to make this a complete transmission study. As such, it is important to give this report appropriate weight when referencing this in litigated proceedings.

D. RES Stakeholder Comment for 80x30 Phase 1 Report

RES appreciates the opportunity to comment on the 80x30 Task Force Phase I Transmission Report. The goals of this study include evaluating the buildout of transmission with a goal of injecting geographically diverse sources of renewable energy to replace existing fossil fuel generation in order to meet the 80x30 carbon reduction goals. As a renewable energy developer headquartered in Colorado, RES appreciates the opportunity to lend our perspective on this study.

RES agrees with the findings regarding the need for additional transmission, and believes there are a number of benefits to the Alternative 3 transmission plan for renewable developers and the future integration of renewable energy on the Xcel transmission system that are not mentioned in the study which we would like to bring to the Planning Group's attention.

1) By crossing a number of landowners with the Cheyenne Ridge – Lamar stretch, this project would create competitive downward price pressure for renewable projects. When there is more land to choose from, competition will help keep land prices reasonable.
2) By tying in areas with high wind (Cheyenne) to areas with high solar (Tundra – Lamar), the transmission project utilization will be increased due to the occasionally complementary nature of the two resources.
3) By linking two high renewable resource areas the additional transmission creates more short circuit stability. One recommendation for additional analysis would be to compare the N-1 Weighted Short Circuit Ratio or dynamic analysis in order to assess the grid strength of the options. It would be unfortunate if dynamic stability later limited the amount of renewable generation below the thermal limits.
4) By tying Cheyenne Ridge to Lamar the project gives advantages to future development. Since the 80x30 goals are only an incremental goal, the future value of the transmission alternatives should be considered. Some helpful attributes Alternative 3 has to future transmission development:
    a. The ability to direct flows along the loop with a FACTS device.
    b. More fully integrating solar and wind resources to a location friendly to export, Lamar.

   c. More fully integrating load centers to a location friendly to import, Lamar.
5) RES has not experienced an occasion where transmission was overbuilt to integrate future renewable generation. In our experience, what seem like ambitious transmission projects for renewable generation quickly appear inadequate to meet all the potential generation development.

RES believes that if these benefits are included in the analysis, *and with additional grid strength analysis added to the study*, Alternative 3 will become the clear option for meeting the 80x30 goal and further GHG reduction plans.

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