PUBLIC SERVICE COMPANY OF COLORADO
2021 ERP & CEP
TRANSMISSION SYSTEM IMPACT STUDY
FOR THE APPROVED PORTFOLIO

Xcel Energy - Transmission Planning
October 11, 2024

CONTENTS

List of Appendices

I. EXECUTIVE SUMMARY

Following the Colorado Public Utilities Commission's ("Commission") approval of Public Service Company of Colorado's ("Public Service" or the "Company") historic 2021 Electric Resource Plan and Clean Energy Plan (the "2021 ERP & CEP"), the Company's transmission planning team has conducted detailed technical analysis to identify the transmission system improvements that will be needed to deliver the 2021 ERP & CEP's Approved Portfolio to Public Service's customers.

This Transmission Planning Study Report ("Report" or "Study Report") memorializes the technical studies the Company has conducted to date, and also identifies a portfolio of Transmission Network Improvement Projects ("Projects") that are needed to reliably accommodate the Approved Portfolio and deliver it to Public Service's customers. The Company's top priorities remain ensuring it can safely and reliably deliver electric power to its customers. The Approved Portfolio of generation resources by itself cannot do so and meet the State's emission reduction goals without the necessary changes to the transmission system.

In conducting this Study, the Company's overarching objectives were to: (1) evaluate impacts to the existing transmission network in light of the new generation approved as part of the 2021 ERP & CEP; and, (2) determine both the overall operational feasibility, from a transmission perspective, of the Approved Portfolio and, where applicable, identify transmission system improvements needed to ensure generation can be delivered to Public Service's system under varying system conditions while meeting customer demand and ensuring reliability, and (3) seek to ensure Projects are right sized for the future to minimize the need for further incremental upgrades to the facilities identified in this Study Report where possible. These objectives remain as the needs of the transmission system continue to be reviewed.

As the Company indicated in its 2021 ERP & CEP, there are numerous challenges to interconnecting a portfolio the size of that approved in the 2021 ERP & CEP. In studying what transmission infrastructure is needed to reliably deliver the Approved Portfolio, one overarching challenge is the scale and location of new renewable generation sited in remote areas of the State. The Company's transmission system was not originally designed to accommodate this.

Many complexities exist in the transmission system in the Denver Metro area due to the concentrated amount of load in and around Denver. As increasing amounts of power are imported into the Denver Metro area versus generated within the Denver Metro area, energy largely moves onto the Company's higher voltage 230 kilovolt ("kV") system under normal system operations[1]. The interconnectivity of the Denver Metro system increases the reliability and resilience of the transmission system as a whole, but also increases the vulnerability of various elements to overloads, thus requiring new solutions and enhancements.

Through this Study Report, the Company's Transmission Planning team has identified a necessary portfolio of Transmission Network Improvement Projects, each geographically targeting one of three critical arteries that feed power into the Denver Metro area: (1) the Daniels Park Path Upgrades, (2) the Smoky Hill Path Upgrades, and (3) the Cherokee Area Upgrades. These Projects have been designed to reliably address system needs of the Approved Portfolio

[1] The Company's Denver Metro area is largely made up of 115kV and 230kV systems. Unplanned outages on the higher voltage system can cause flows to shift to underlying interconnected lower voltage system.

and are needed to ensure future deliverability in many operational scenarios. The Projects are shown on a map in Figure 1 and listed in more detail in Table 1 below.

Figure 1 – Transmission Network Improvement Projects Portfolio

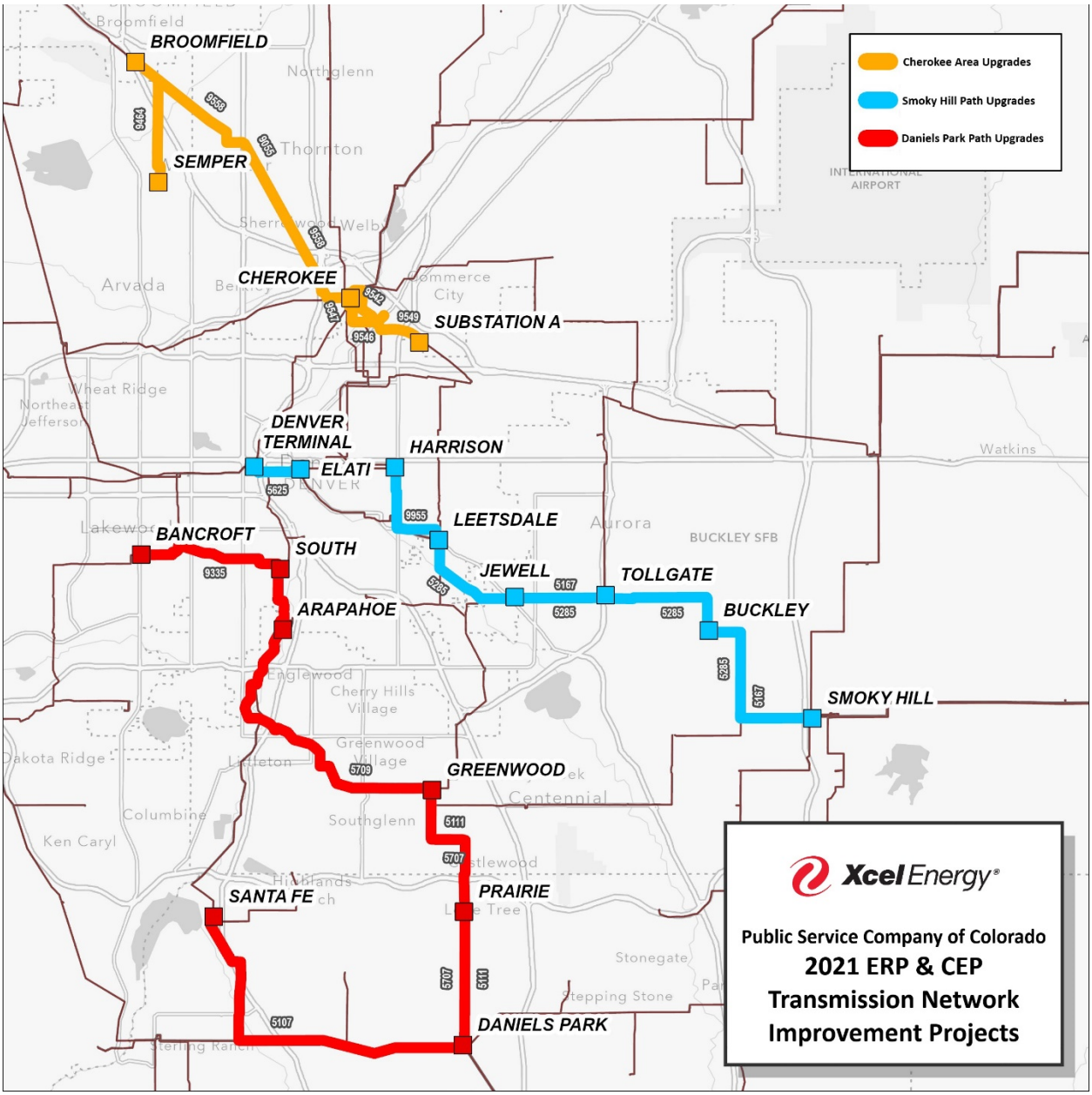


Table 1 – Components of the Transmission Network Improvement Projects

Project Element	Planned Upgrade
Daniels Park Path Upgrades	
Daniels Park Substation	Add fourth 345/230 kV transformer
Circuits 5111 and 5707: Daniels Park - Prairie - Greenwood	Uprate by reconductoring existing 230 kV circuits
Greenwood Substation	Uprate 230 kV bus tie breaker
Circuit 5717: Greenwood - Monaco Series Reactor	Add series reactor on Greenwood - Monaco circuit, located in the Greenwood Substation
Circuit 5709: Greenwood – Arapahoe	Uprate by reconductoring existing 230 kV circuit
Arapahoe Substation	Uprate 115 kV bus tie breaker
	Add second 230/115 kV Transformer
Circuit 9335: Arapahoe - South Tap - Bancroft	Uprate by reconductoring existing 115 kV circuit
Circuit 9332: Arapahoe - Air Liquide Tap - South - Gray Street	Uprate by reconductoring existing 115 kV circuit
South Substation	Expand substation to add new 230 kV Yard with 230/115 kV transformer
Circuit 5107: Daniels Park - Santa Fe	Uprate by reconductoring existing 230 kV circuit
Smoky Hill Path Upgrades	
Smoky Hill Substation	Add new 345/230 kV transformer
Smoky Hill - Buckley Circuit 5167	Uprate by reconductoring existing 230 kV circuit
Smoky Hill - Buckley - Tollgate - Jewell - Leetsdale Circuit 5285	Uprate by reconductoring existing 230 kV circuit
Denver Terminal - Elati Circuit 5625	Uprate by reconductoring existing 230 kV circuit
Leetsdale - Harrison Circuit 9955	Uprate by reconductoring existing 115 kV circuit

Table 1 - Components of the Transmission Network Improvement Projects Continued

Cherokee Area Upgrades	
New Substation A	Construct a new 115 kV substation tying Circuits 9542, 9546, and 9549
New Transmission Line Cherokee - New Substation A	Construct a new 115 kV transmission line from the new 115 kV substation to the north 115 kV bus in the Cherokee Substation
Circuit 9542: Cherokee to New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the in-and-out at the new 115 kV Substation to Cherokee
Cherokee to Mapleton to New 115 kV Substation Circuit 9546: Cherokee – Mapleton – New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the in-and-out at the new 115 kV Substation to Mapleton and Cherokee
Circuit 9549: Cherokee – Conoco – New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the new 115 kV Substation to Conoco South
Circuits 9055, 9558, and 9464: Cherokee – Federal Heights – Semper – Broomfield	Uprate by reconductoring existing 115 kV circuit

The Daniels Park Path is located in the southern Denver Metro area while the Smoky Hill Path is located in the eastern Denver Metro area. These two paths together share in the principal duty of delivering remote generation from Energy Resource Zones established in the Colorado SB07-100 into the Denver Metro area. The power flow cases reveal that the Daniels Park and Smoky Hill paths serve considerable load and are highly utilized throughout the various high-renewable dispatch scenarios which occur due to changes in our generation mix. The upgrades along those paths are designed to maximize the existing system's capabilities - first, by removing limiting elements from substations to allow existing transmission facilities to be used to their fullest capabilities, and second, by increasing line ratings through reconductoring or use of alternative technologies. The Cherokee Area Upgrades deliver generation throughout the Denver Metro and serves this dense, high-demand area *via* 115kV and 230kV networks.

The Company is proposing one greenfield transmission substation and one new 115 kV transmission line segment as part of the Transmission Network Improvement Projects, otherwise all system upgrades will take place in and around existing corridors and facilities, which will maximize the capability of the Company's existing transmission system. This approach is beneficial in that it mitigates the need for acquiring large swaths of additive land now. However, this will present challenges in that the work will largely occur in densely populated and congested areas and given the mechanical limitations of electrical equipment in these critical areas, additional capacity cannot realistically be gained in the future without significant construction upgrades to these transmission paths.

The Company's comprehensive analysis of the Projects considered factors such as feasibility, alignment with long-term goals, cost-effectiveness, and community impacts. Recognizing the challenges of developing new transmission in and around the Denver Metro area, the Company

has also sought to leverage new technologies and materials that will cost-effectively maximize the capability of the Company's existing transmission network.

The Company's Transmission Planning team will continue to study the 2021 ERP & CEP resource portfolio and bring forward to the Commission any additional transmission needs, such as voltage control, reactive support, and interconnection facilities that it identified are needed to reliably support the Approved Portfolio.

II. BACKGROUND

A. PURPOSE AND OBJECTIVE OF THE TRANSMISSION NETWORK IMPROVEMENT PROJECTS STUDY

The purpose of this transmission planning study is to: (1) evaluate impacts to the existing transmission network in light of the new generation approved as part of the 2021 ERP & CEP; and, (2) determine both the overall operational feasibility, from a transmission perspective, of the Approved Portfolio and, where applicable, identify transmission system improvements needed to ensure generation can be delivered to Public Service's system under varying system conditions while meeting customer demand and ensuring reliability.

As part of the transmission planning study process, the Company's Transmission Planning organization analyzed the addition of more than 5.5 GW (nameplate) of additional generation selected as part of the Approved Portfolio. The focus of this analysis was to identify the transmission upgrades and improvements that will enable the Company to safely and reliably integrate the Approved Portfolio generation into the transmission system in accordance with NERC standards and Western Electricity Coordinating Council ("WECC") criteria. Additionally, through this process, the Company evaluated sensitivities to identify unique transmission limitations that may arise due to different generation dispatch assumptions. Finally, the study process thoroughly vetted transmission mitigations to ensure adequate near term and long-term mitigation of identified transmission violations.

The Company conducted this study based on the following key objectives:

- Develop a portfolio of transmission solutions that will accommodate generation resources from the Approved Portfolio in order to meet the overarching goals of the CEP; and
- Develop and maintain a robust transmission system that meets near-term and long-term transmission system needs which continues to ensure safe and reliable transmission service.
- Maximize the opportunities presented by both the Inflation Reduction Act of 2022 ("IRA") and Colorado's Power Pathway Project ("Pathway Project"). Bringing $10 billion in IRA benefits to customers, $14 billion in energy investment to Colorado, and $2.5 billion in tax benefits alone to local communities in the coming decades.

The transmission planning study was performed by Public Service's Transmission Planning team, and the initial results were presented to interested stakeholders vis-a-vis the Company's Local Transmission Planning Process as outlined in the Company's Tariff, Attachment R.

B. 2021 Electric Resource Plan and Clean Energy Plan

In March of 2021, Public Service filed its 2021 ERP & CEP with the Colorado Public Utilities Commission ("Commission") in Proceeding No. 21A-0141E. The purpose of the 2021 ERP & CEP was to plan for the resource needs to serve Public Service's customers and to retire existing coal-fired generation while acquiring the generation resources needed to achieve an 80 percent reduction in carbon emissions by 2030 consistent with Colorado Senate Bill ("SB") 19-236.

Prior to filing the 2021 ERP & CEP, the Company also filed an application requesting a Certificate of Public Convenience and Necessity ("CPCN") for the Colorado's Power Pathway Project ("Pathway Project"), a 550-mile, 345 kV transmission backbone that will connect Front Range load centers to renewable resource rich areas in northeastern, eastern, and southeastern Colorado (Proceeding No. 21A-0096E). In June 2022, the Commission issued a CPCN for the Pathway Project, which is currently under construction with in-service dates of various Segments ranging between 2025 and 2027.

As part of the 2021 ERP & CEP, Public Service conducted its 2022 All-Source Request for Proposals to acquire generation resources between 2025 and 2028. Public Service received more than 1,000 competitive bids for generation resources, and in September 2023, the Company filed its 120-Day Report ("2021 ERP & CEP 120-Day Report") proposing a Preferred Portfolio of generation resources to be acquired to serve Public Service's customers.

In its 2021 ERP & CEP 120-Day Report, Public Service evaluated and identified additional investments potentially needed to support the Company's transmission network in order to deliver the energy generated by the Preferred Portfolio to customers. The Company identified several categories of investments, including: network upgrades in the Denver Metro Area and the San Luis Valley; grid strength reinforcement; and, reactive/voltage support. The Company's Phase II Transmission Report (Appendix Q to the 2021 ERP & CEP 120-Day Report)[2] presented a portfolio of transmission projects tailored to the Preferred Portfolio; however, the Company noted that it would need to engage in more detailed studies around the final, approved portfolio, as well as its Federal Energy Regulatory Commission ("FERC")-governed Open Access Transmission Tariff ("OATT") coordinated transmission planning process, to identify final transmission needs.

On January 23, 2024, the Commission approved a modified resource portfolio through Decision No. C24-0052 (*i.e.*, the "Approved Portfolio"). In March of 2024 Transmission Planning was notified of some minor changes to the bidders in the approved portfolio. As the case building efforts were still underway and to be as accurate as possible, these changes were applied to the study cases. The Approved Portfolio consists of approximately 1,720 MW of solar, 1,848 MW of energy storage (including both stand-alone and paired with solar resources), 2,053 MW of wind, and 450 MW of natural gas generation plants and leverages federal clean energy incentives included in the Inflation Reduction Act of 2022 ("IRA"), which will bring billions of dollars in benefits to Public Service's customers and support the clean energy transition. The 2021 ERP & CEP will fundamentally transition Public Service's generation fleet by phasing out coal generation resources by the end of 2030.

The Approved Portfolio consists of 20 generation projects with varying levels of nameplate capacity, points of interconnection, and fuel type. Much of the generation in the Approved Portfolio

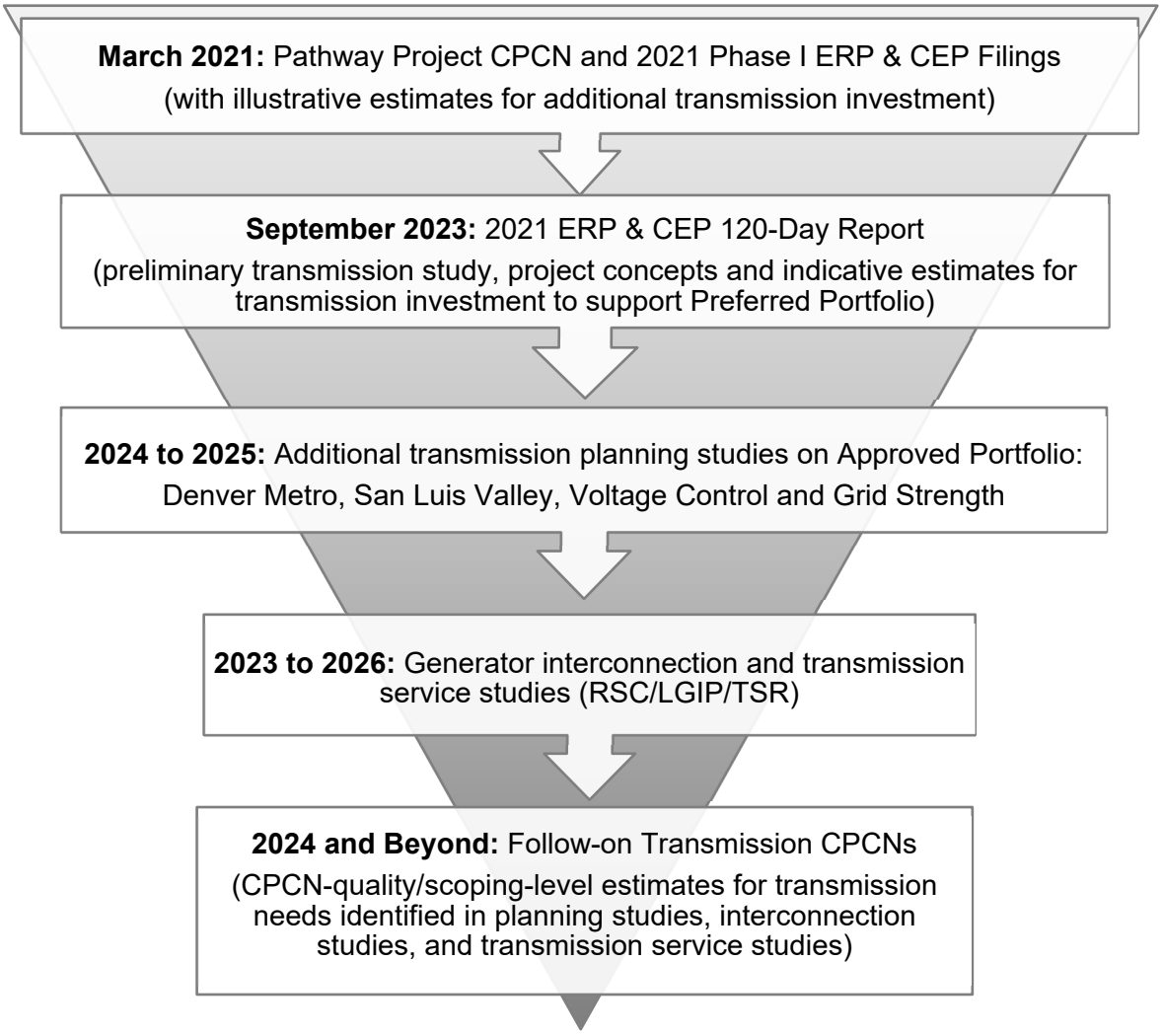
[2] https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/PUBLIC%20Appendix%20Q%20-%20Transmission%20Report.pdf

is located in remote areas of Colorado, with a significant amount interconnecting to the Pathway Project. The total nameplate of generation capacity which includes co-located energy storage of the Approved Portfolio is 6,071 MW. More detailed information about the Approved Portfolio studied in this Report is included in Appendix A.

By this Study Report, the Company puts forward the Transmission Network Improvement Projects, an updated 2021 ERP & CEP transmission plan for the Denver Metro area that is tailored to the Approved Portfolio. Public Service acknowledges generation resource projects that will ultimately develop to serve load have changed, and in fact continue to change, since Decision No. C24-0052. The Company cannot wait for all of those issues to be resolved as some may not be identified or known for potentially years into the future. Public Service must move forward with identified transmission projects due to the significant length of time it requires to execute a transmission project, including obtaining siting, permitting, material acquisition, execution, and commissioning. Additionally, the Company's analysis has indicated that moving forward with this portfolio presents a "no regrets" approach as it does not anticipate fundamental changes to the conclusions of the transmission planning process and study presented here despite on-going generation portfolio dynamics.

Figure 2 below provides a high-level diagram reflecting where the Company is in the process of studying and gaining approval for the transmission portfolio needed to support its 2021 ERP & CEP.

Figure 2: 2021 ERP & CEP Transmission Analysis Timeline



C. Transmission Challenges in and Around the Denver Metro Area

The Company's top priorities remain ensuring it can safely and reliably deliver electric power to its customers. The Approved Generation Portfolio by itself cannot do so and meet the State's emission reduction goals without the necessary changes to the transmission system. In studying what transmission infrastructure is needed to accomplish these various objectives, there are several unique and overarching challenges that the Company must navigate.

An overarching challenge is that generation type (intermittent renewable), scale (number of MWs), and location in remote areas must meet load in the Denver Metro area. As the type, scale and location of electric generation sources continues to expand outside the Denver Metro area, the transmission system will experience significant changes in its power flows that the Company's transmission system – particularly in the Denver Metro area – was not designed to accommodate.

Another challenge is the complexity of the transmission system within the Denver Metro area. As power is imported into the Denver Metro area, energy largely moves onto the Company's higher voltage 230 kilovolt ("kV") system under normal system operations and then moves to numerous interconnected substations and additive transmission lines and then distribution lines at varying voltages. The interconnectivity of the Denver Metro system increases the reliability and resilience of the transmission system as a whole, but also increases the vulnerability of various elements to overloads.

Compounding this complexity is the continued population and commercial/industrial growth in and around the Denver Metro area, which is only expected to continue. This growth creates challenges for developing the infrastructure necessary to serve the customers of today and tomorrow. While the Company has focused its efforts on developing a transmission portfolio that largely leverages existing infrastructure, land is becoming scarcer and property costs are increasing. Conducting work in highly congested areas presents challenges from a constructability standpoint, including outage coordination, permitting challenges, public and stakeholder concerns, noise and magnetic field issues, substations that were not originally constructed with significant room for expansion, and staging challenges.

Regulatory, siting, permitting, and land use processes only compound these challenges. In recent years, the Company has been pressed to file more CPCNs, and for projects it historically would not have filed CPCNs for. Moreover, urban and suburban developments have encroached on areas where many of the Company's existing assets are located, with this density making it more difficult to do work within or around existing electric infrastructure. This is contributing to increased public opposition to new work, and heightened public demands from the Company when executing new work and seeking local permits. Primary authority over siting and permitting is not within the Commission's primary jurisdiction, but instead governed by a patchwork of local, state, and federal entities and agencies, which can complicate and extend the amount of time needed to develop, gain approval for, and construct new transmission projects. The Company must increasingly grapple with questions like when to pursue land rights if it does not yet have a CPCN, whether and when to order materials and supply with long-lead times if it does not yet have a CPCN, and when to commence local siting and permitting processes if it does not yet have a CPCN. As the state undergoes its energy transition, the Company must obtain more permits and land rights than ever before, often negotiating with landowners and local jurisdictions that are not always aligned with the State's clean energy goals, and communities that have increasing demands from the utility in exchange for obtaining the necessary approvals, permits, and land rights. These challenges, coupled with recent macroeconomic and supply chain issues, mean

that transmission projects, including new lines, upgrades, substations, and even work "within the fence" is taking longer, and becoming more costly and complex.

D. Stakeholder Engagement & Acknowledgments

In conducting its study process, the Company followed Public Service's transmission planning process as outlined in Attachment R to the Company's OATT. Public Service held an initial stakeholder meeting on February 15, 2024 to review the Approved Portfolio and finalize the draft study plan. The draft study plan was sent to stakeholders on February 2, 2024 along with the meeting notice. A second meeting was held on May 30, 2024 to review study results and the Company's conceptual transmission plan. All meeting materials and notes can be found on the Company's OASIS webpage.

The transmission planning study was performed by Public Service's Transmission Planning team, and the initial results were presented to interested stakeholders *vis-a-vis* the Company's Local Transmission Planning Process.

Stakeholder meetings were held in person and virtually *via* Microsoft Teams link that included participation from a wide variety of stakeholders. The following stakeholders attended at least one meeting based on the Company's attendance records:

- Tri-State Generation & Transmission Association
- City of Aspen
- Guzman Energy
- CORE
- EP Electric
- Apex Clean Energy
- Grid Reliability LLC
- Colorado Springs Utilities
- Pattern Energy
- SWCA Environmental Consultants
- AYPA Power
- HDR Inc.
- Galehead Development
- Black Hills Energy
- TRC Companies
- K.R. Saline & Associates: Energy Consultants
- Western Area Power Administration
- Applied Energy Services
- PacifiCorp
- NMPP Energy
- Ulteig
- Yampa Valley Electric Association
- RWE
- Outshine Energy
- Platte River Power Authority
- Public Service Company of New Mexico
- Kaplan Kirsch
- Dietze & Davis
- Kinetic Power Co.
- National Grid Renewables
- Southwestern Power
- Colorado Electric Transmission Authority
- Holy Cross
- Invenergy
- NextEra Energy
- Gridliance
- NATRS
- Energy Strategies
- Connect Gen LLC
- Enel
- APS
- Innergex
- Col
- New Law Group
- Innergex
- BuckyBall System

Modeling data updates on future system topology changes, load forecasts, and generation forecasts, were requested from the participants above. The following entities provided updates on some or all of these categories, which were applied to the models used in this study. To the extent that the modeling data updates provided by these entities impacted transmission system needs within the scope of this Study Report, those needs are reflected within the results presented here.

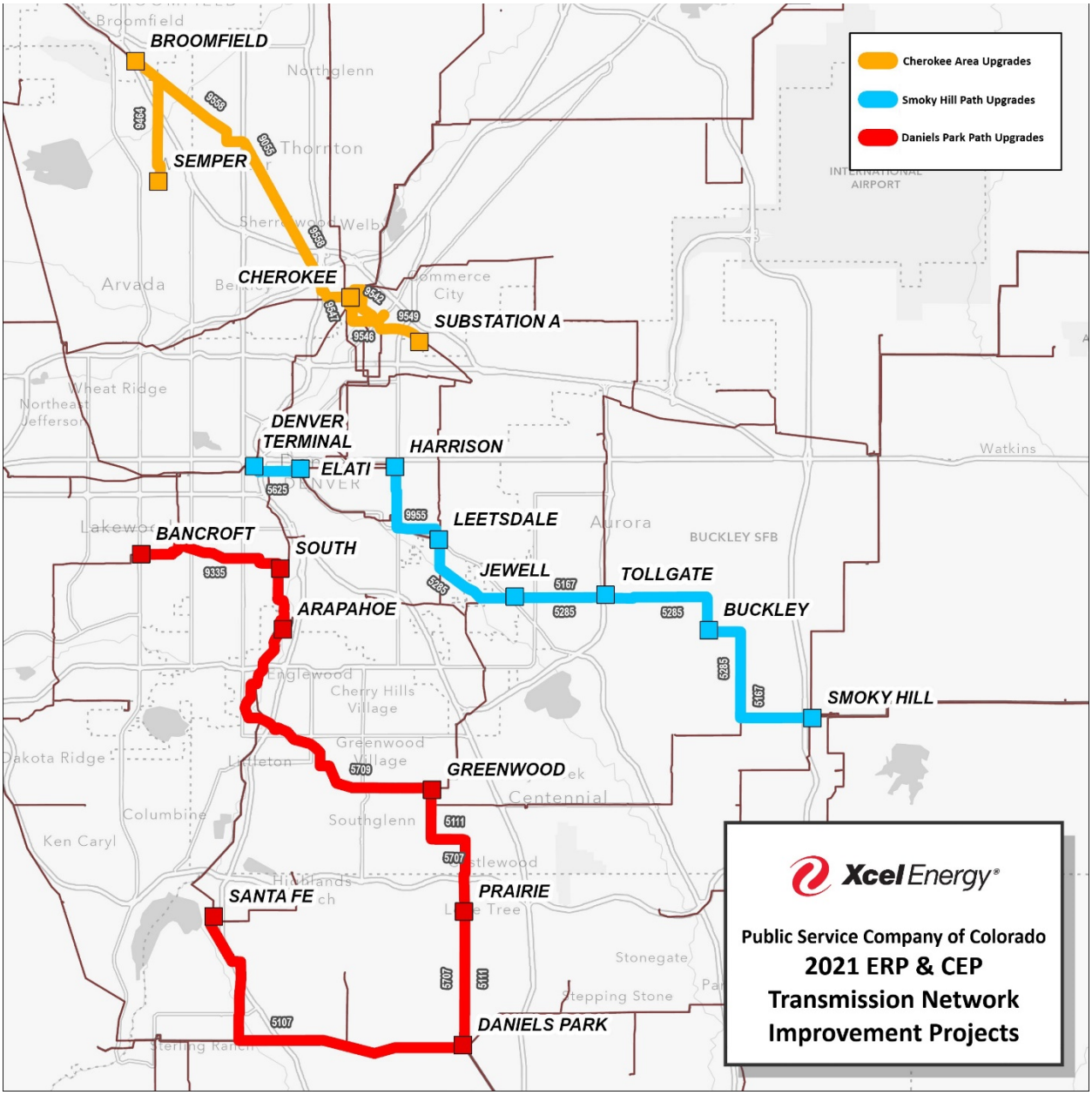
- Black Hills Energy
- Colorado Springs Utilities
- Platte
- River Power Authority
- Tri-State Generation & Transmission Association
- Western Area Power Administration

III. TRANSMISSION NETWORK IMPROVEMENT PROJECTS

In this Study Report, the Company identifies the Transmission Network Improvement Projects ("Project" or "Projects") needed to support generation acquired in the Company's 2021 ERP & CEP. The Projects consists of upgrades to three key network paths within the Denver Metro area that will serve as the predominant arteries to deliver the CEP's renewable generation from southern and eastern Colorado to the bulk of the Company's customers located within the Denver Metro area. The three Transmission Network Improvement Projects include: (1) the Daniels Park Path Upgrades, (2) the Smoky Hill Path Upgrades, and (3) the Cherokee Area Upgrades. The Daniels Park Path is located in the southern Denver Metro area while the Smoky Hill Path is located in the eastern Denver Metro area. These two paths together share in the principal duty of delivering remote generation into the Denver Metro area. The power flow cases reveal that the Daniels Park and Smoky Hill paths serve considerable load and are highly utilized throughout the various high-renewable dispatch scenarios which occur due to changes in our generation mix. The upgrades along those paths are designed to maximize the existing system's capabilities - first, by removing limiting elements from substations to allow existing transmission facilities to be used to their fullest capabilities, and second, by increasing line ratings through reconductoring or use of alternative technologies. The Cherokee Area Upgrades deliver generation throughout the Denver Metro and serves this dense, high-demand area *via* 115kV and 230kV networks.

The Company is proposing one greenfield transmission substation and one new 115 kV transmission line segment as part of the Transmission Network Improvement Projects, otherwise all system upgrades will take place in and around existing corridors and facilities, which will maximize the capability of the Company's existing transmission system. This approach is beneficial in that it mitigates the need for acquiring large swaths of additive land now. However, this will present challenges in that the work will largely occur in densely populated and congested areas and given the mechanical limitations of electrical equipment in these critical areas, additional capacity cannot realistically be gained in the future without significant construction upgrades to these transmission paths. The Company's comprehensive analysis of the Projects considered factors such as feasibility, alignment with long-term goals, cost-effectiveness, and community impacts. Recognizing the challenges of developing new transmission in and around the Denver Metro area, the Company has also sought to leverage new technologies and materials that will cost-effectively maximize the capability of the Company's existing transmission network. Figure 3 below provides a visual overview of the Transmission Network Improvement Projects.

Figure 3 – Transmission Network Improvement Projects



A. Detailed Project Descriptions and Alternatives

Below, we provide a detailed description of each of the three components of the Transmission Network Improvement Projects: (1) the Daniels Park Path Upgrades, (2) the Smoky Hill Path Upgrades, and (3) the Cherokee Area Upgrades.

1. Daniels Park Path Upgrades

Daniels Park has been and continues to be one of the main injection points from the 345 kV transmission system in the Denver Metro area. From a Transmission Planning perspective, Daniels Park is also referred to as the southern metro transmission constraint. The Approved Portfolio will significantly increase flows across the southern metro transmission constraint, further exacerbating this constraint on the transmission system.

Through the upgrades identified in Table 2 below, the Company will increase the capabilities of the existing transmission paths that move power from southern Colorado to Public Service customers via the Daniels Park Substation.

Table 2 – Daniels Park Path Upgrades

Project Element	Planned Upgrade	Existing Rating	New Rating
Daniels Park Substation	Add fourth 345/230 kV transformer	N/A	560 MVA
Circuits 5111 and 5707: Daniels Park - Prairie - Greenwood	Uprate by reconductoring existing 230 kV circuits	5111: ≈1434 A 5707: 1200 A	2300 A
Greenwood Substation	Uprate 230 kV bus tie breaker	≈1215 A	2400 A
Circuit 5717: Greenwood - Monaco Series Reactor	Add series reactor on Greenwood - Monaco circuit, located in the Greenwood Substation	N/A	N/A
Circuit 5709: Greenwood – Arapahoe	Uprate by reconductoring existing 230 kV circuit	1440 A	2400 A
Arapahoe Substation	Uprate 115 kV bus tie breaker	1596 A	2000 A
	Add second 230/115 kV Transformer	N/A	280 MVA
Circuit 9335: Arapahoe - South Tap - Bancroft	Uprate by reconductoring existing 115 kV circuit	≈ 797 A	1200 A
Circuit 9332: Arapahoe - Air Liquide Tap - South - Gray Street	Uprate by reconductoring existing 115 kV circuit	600 A	798 A
South Substation	Expand substation to add new 230 kV Yard with 230/115 kV transformer	N/A	280 MVA
Circuit 5107: Daniels Park - Santa Fe	Uprate by reconductoring existing 230 kV circuit	≈ 1214 A	2000 A

Below is a more detailed description of each element of the Daniels Park Path Upgrades identified above.

Daniels Park Substation

The Daniels Park Substation is one of the primary import points for the Denver Metro area, where power that is transmitted long distances from southern and southeastern Colorado on Public Service's 345 kV transmission system is stepped down to the 230 and 115 kV transmission network that moves power within the Denver Metro load center. With the additional flows through the Daniels Park Substation onto the 230 kV system in a wide range of evaluated scenarios, the N-1[3] loss of any one of the three existing 345/230 kV transformers at the Daniels Park Substation results in overloads to the remaining transformers. The Company's analysis indicates that the addition of a fourth 345/230 kV transformer to the Daniels Park Substation mitigates these overloads.

Energy storage was qualitatively evaluated as a potential alternative, but the significant levels of power flow experienced at Daniels Park coupled with the need to continue serving load from the 230 kV system would require an infeasibly large energy storage solution to mitigate the overloads.

Power flow control devices, such as phase-shifting transformers ("PST") were evaluated, but in this case they are not viable alternatives due to the amount of power flowing into the southern metro transmission constraint. Based on discussions with PST vendors, employing the use of power flow control devices to mitigate these overloads would require a significant and costly build-out, and ultimately cause the need to invest in costly rebuilds and additional transmission assets to different parts of the system.

Circuits 5707 and 5111: Daniels Park – Prairie – Greenwood

Circuits 5707 and 5111 are a double circuit 230 kV transmission line that originate at the Daniels Park Substation and connect to the Prairie and Greenwood Substations. Changes in system flows caused by increased generation located to the south and east of the Denver Metro area result in significant overloads of these circuits in all scenarios studied in this Report. Circuit 5111 is currently rated for approximately 1434 amps, while Circuit 5707 is currently rated for 1200 amps. An N-1 loss of 5111 causes 5707 to overload to more than 40% of its normal rating in 2025. Additionally, with the loss of line 5707, system flows transfer to line 5111 and cause an overload of 25%.

The Company therefore identifies an upgrade to the existing Daniels Park to Greenwood 230 kV transmission circuits to address these overloads. This upgrade will involve replacing the conductor on each circuit with a new conductor rated for 2300 amps and associated equipment upgrades at the Daniels Park, Prairie, and Greenwood Substations. Transmission Engineering will be responsible for determining the exact type of conductor to be used in this upgrade, but it is anticipated that the Company will deploy an advanced High-Temperature Log Sag ("HTLS") conductor on the existing towers to meet the recommended rating.

The Company evaluated a range of adequate ratings and identified 2300 amps as the preferred rating as this presents a feasible upgrade that can be installed on this circuit using existing towers versus completely rebuilding the segment. Further increases above 2300 amps or increasing the

[3] Terminology used to describe the outage or unexpected failure of a single component, transmission line, circuit breaker, switch or other electrical element under contingency analysis.

voltage class of these circuits could further increase the capacity of this path, however, the Company did not quantitatively evaluate this alternative because space constraints at the Daniels Park, Prairie, and Greenwood Substations along with the limitations of the transmission line right-of-way. Such a conversion would be significantly more costly and challenging to construct. A new 230 kV circuit connecting the Daniels Park and Arapahoe Substations could also potentially alleviate these overloads, however, the Company did not further investigate the construction of a greenfield transmission circuit given that the overloads are mitigated through an upgrade of the existing circuits. Additionally, a PST that directs flows away from Daniels Park to the 345 kV line towards Missile Site lessens loading on Circuits 5707 and 5111, however, existing PST technologies and standard sizing are not capable of reducing flows enough to eliminate the overloads on these circuits. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the Advanced Transmission Technology ("ATT") section below, the Company has concluded that neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives for this upgrade.

Greenwood Substation

Based on the increased flows from the south that necessitate the upgrade to Circuits 5707 and 5111 discussed above, our planning analysis also identified a need to upgrade the bus tie breaker in the Greenwood Substation. The Company has identified the need to replace the existing 1215-amp bus tie breaker with a new bus tie breaker rated at 2400 amps. The Company conceptually evaluated other alternatives to this upgrade, including energy storage, but no superior or viable alternatives to this element were identified because the overloads can be mitigated through the limited scope of directly replacing limiting elements identified within the substations.

Circuit 5709: Greenwood – Arapahoe and Circuit 5717: Greenwood – Monaco Series Reactor

Power that flows along Circuits 5707 and 5111 that is not offloaded to the distribution system at the substations between Daniels Park and Greenwood continues to flow toward the center of the Denver Metro area by splitting along two paths: primarily toward the Leetsdale substation but also toward the Arapahoe Substation. Under a range of scenarios, the transmission path from Greenwood to Leetsdale experienced N-1 overloads above 150% of the paths existing continuous rating and the transmission path from Greenwood to Arapahoe experiences N-1 overloads to as much as 107% of the circuit's existing continuous rating.

The Company evaluated two alternatives to alleviate the overloads of circuits that extend from the Greenwood Substation toward the center of the Denver Metro. These include: (1) installing a power flow controller on the Greenwood to Monaco circuit paired with upgrading the 230 kV Greenwood to Arapahoe Circuit 5709; or (2) upgrading the existing 230 kV circuits and substations along the Greenwood to Leetsdale path. The Company's preferred alternative is to install a power flow controller on the Greenwood to Monaco circuit paired with upgrading the 230 kV Greenwood to Arapahoe Circuit 5709. This alternative is superior due to the higher cost and complexity of upgrading the Greenwood to Leetsdale path.

The preferred alternative alleviates overloads on the Greenwood to Leetsdale path by using a power flow control device to redirect power flows away from that path and onto the Greenwood to Arapahoe circuit. For the power flow controller, the Company's Transmission Engineering evaluated both a conventional series reactor and an ATT known as a Smart Valve. Based on

cost, availability, and space constraints, the Company identified the need for a series reactor to control power flow. To accommodate the redirected flows, this upgrade also involves replacing the existing conductor rated at 1440 amps with new conductor rated for 2400 amps between the Greenwood and Arapahoe substations. Circuit 5709 was recently placed into service as part of the Greenwood – Denver Terminal 230 kV project. This identified upgrade makes use of the new towers and only involves the replacement of the conductor between the Greenwood and Arapahoe Substations. While the Company's Transmission Engineering will determine the specific type of conductor for this upgrade, we anticipate installing an advanced HTLS conductor on the existing towers to meet the recommended rating.

In addition to the two alternatives discussed above, the Company also qualitatively considered other alternatives to this upgrade including energy storage and ATTs but did not identify any other viable solutions. As discussed above regarding Circuits 5707 and 5111, a new 230 kV circuit connecting the Daniels Park and Arapahoe Substations, along with power flow control devices, could also potentially alleviate these overloads. The Company did not further investigate constructing this type of greenfield transmission circuit given that the overloads are mitigated by upgrading existing circuits.

Arapahoe Substation

The Company has identified two upgrades needed at the Arapahoe Substation based on increased flows from the south of the Denver Metro area.

First, the Company's analysis identified overloads to the 115 kV bus tie breaker in the Arapahoe Substation. Based on those overloads, the Company has identified the need to replace the existing 1596-amp bus tie breaker with a new bus tie breaker with a rating of 2000 amps. The Company did not identify any other viable alternatives to this upgrade because it is the direct replacement of a limiting element identified within the substation.

In some dispatch cases, contingencies resulted in overloads to the 230/115 kV transformer in the Arapahoe Substation. In order to mitigate these overloads, the Company will need to add a new transformer in the substation to support both predominant power flows in southwest Denver as well as additional load growth. This 230/115 kV transformer will support the 115 kV system in the Denver Metro area by mitigating the overload on the other 230/115 kV transformer currently at Arapahoe substation. Other options to redirect flow and mitigate the overloads on the existing 230/115 kV transformer were considered, but these options would require redirecting flows coming into the southern metro transmission constraint and onto different 230/115 kV transformers, which is not considered a preferred alternative to installing an additional transformer given the increased complexity and expected higher cost.

Circuit 9332: Arapahoe – Air Liquide Tap – South – Gray Street

The existing 115 kV Arapahoe – Air Liquide Tap – South – Gray Street Circuit 9332 is currently rated at 600 amps. While the conductor used on this circuit is rated at 798 amps, the circuit cannot be used at the maximum conductor rating due to the presence of 600-amp switches in substations. Under an N-1 loss of the 115 kV bus tie at the Arapahoe Substation, circuits connecting the Arapahoe and South substations experienced overloads. To increase the circuit rating to match the existing conductor rating, the Company has identified the need to replace the limiting switches in the 115 kV substations along this circuit to allow for it to be operated at the full 798-amp rating of the conductor. The Company conceptually evaluated other alternatives to this upgrade, including energy storage, but no superior or viable alternatives to this upgrade were

identified because the overloads can be mitigated through the limited scope of directly replacing limiting elements identified within the substations which was determined as the most cost-effective solution.

Circuit 9335: Arapahoe – South Tap – Bancroft

As discussed in relation to the Arapahoe – Air Liquide Tap – South – Gray Street Circuit 9332 circuit, under the N-1 loss of the 115 kV bus tie at the Arapahoe Substation, circuits between the Arapahoe Substation and South Substation experience overloads under a variety of dispatch scenarios studied in this analysis. In order to address these overloads, the Company's preferred alternative is to upgrade this circuit by rebuilding it at a rating of 1200 amps. Based on feedback from the Company's Transmission Engineering team, this circuit is not considered a viable candidate for reconductoring due to the age and condition of the existing towers. Alternatives to this project were qualitatively considered, including adding an additional circuit along this path, however, the Company did not further investigate the construction of a greenfield transmission circuit given that the overloads are mitigated through upgrading the existing circuit. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither technology was determined to be capable to serve as a viable alternative for this upgrade.

South Substation

The study identified overloads on each of the 230/115 kV transformers in the Arapahoe Substation under the N-1 loss of the other parallel transformer. Additionally, the N-1 loss of the Arapahoe bus tie caused an overload of the Denver Terminal bus tie. The Company evaluated several alternatives to resolve these overloads. While these overloads could be addressed through further upgrades to all the identified overloaded elements (*i.e.*, the Arapahoe 230/115 kV transformers and the Denver Terminal bus tie), the Company identified a single upgrade that addresses these overloads simultaneously by adding greater power transformation capacity in this part of the Denver Metro area. Energy storage was qualitatively considered as an alternative to this upgrade; however, it was not identified as a viable alternative to this upgrade due to the overloads being caused by the contingency loss of other transmission assets. The Company is planning to expand its existing 115 kV South Substation through by using an in and out tap on the 230 kV Arapahoe to Dakota Circuit 5623 and add a 230/115 kV, 280 MVA transformer at the newly expanded South Substation.

Circuit 5107: Daniels Park – Santa Fe Circuit 5107

Under the N-1 loss of the Greenwood to Arapahoe Circuit 5709 in the Comanche Stress Case dispatch scenario, this 230kV circuit from Daniels Park to Santa Fe experiences a 102% overload. Given the location of this segment, the Company anticipates loading on this path will only continue to increase going forward. Thus, in order to resolve this overload, the Company plans to reconductor this circuit, which will increase its rating from approximately 1214 amps to 2000 amps. Transmission Engineering will be responsible for determining the exact type of conductor to be used in this upgrade, but the Company anticipates installing an advanced HTLS conductor on the existing towers to meet the recommended rating.

The Company considered other ATTs as alternatives to this element but did not identify any viable solutions that would avoid the need to uprate the line. As discussed in the ATT section, the Company's evaluation did not identify dynamic line rating as a viable alternative to the upgrade of this circuit. Though the overload is caused by a contingency, this overload could potentially

be mitigated with the deployment of an energy storage system at the Arapahoe 230 kV Substation. This alternative was qualitatively analyzed and identified as a non-preferred alternative compared to reconductoring the overloaded circuit as it would require additional land adjacent to the Arapahoe Substation, the installation of a complicated switching scheme to isolate the 230 kV and 115 kV systems, and the installation of multiple transformers. Additionally, further analysis would be needed to validate that the flows on this line are sufficiently low in off-peak hours to fully charge the battery and allow it to operate when needed to mitigate the identified overload. Such an energy storage system would have limited secondary value to the grid as it would only be deployed for the purpose of mitigating the overload. Based on this analysis, the Company does not consider energy storage deployment to be a preferred or viable alternative to the identified upgrade.

2. SMOKY HILL PATH UPGRADES

Similar to the Daniels Park path, Smoky Hill and its neighbor Harvest Mile have been, and continue to be, primary injection points from the 345 kV transmission system into the Denver Metro area. Combined, this location is referred to as the eastern metro transmission constraint. The addition of the Approved Portfolio will significantly increase flows across the eastern metro transmission constraint. Through the upgrades described below in Table 3 below, the Company has identified the need to increase the capabilities of the eastern transmission path that move power from outside of the Denver Metro to customers on the other side of the transmission constraint.

Table 3 – Smoky Hill Path Upgrades

Project Element	Description	Existing Rating	New Rating
Smoky Hill Substation	Add new 345/230 kV transformer	N/A	560 MVA
Smoky Hill - Buckley Circuit 5167	Uprate by reconductoring existing 230 kV circuit	1262 A	2000 A
Smoky Hill - Buckley - Tollgate - Jewell - Leetsdale Circuit 5285	Uprate by reconductoring existing 230 kV circuit	1200-1214 A	2000 A
Denver Terminal - Elati Circuit 5625	Uprate by reconductoring existing 230 kV circuit	770 A	2000 A
Leetsdale - Harrison Circuit 9955	Uprate by reconductoring existing 115 kV circuit	708 A	1900 A

Below is a more detailed description of each element of the Smoky Hill Path Upgrades identified above.

Smoky Hill Substation

The Smoky Hill Substation is one of the primary import points for the Denver Metro area. Here, power that is transmitted long distances from eastern and southeastern Colorado on Public Service's 345 kV transmission system steps down to the 230 kV and 115 kV transmission network that moves power within the Denver Metro load center. With the additional flows through the Smoky Hill Substation onto the 230 kV system in a wide range of evaluated scenarios, the N-1 loss of either one of the two existing 345/230 kV transformers at the Smoky Hill Substation results in overloads to the remaining transformer. The Company qualitatively evaluated a range of alternatives to mitigate the overloads to the Smoky Hill 345/230 kV transformers and identified the addition of a third 345/230 kV transformer to the Smoky Hill Substation as the preferred alternative to mitigate this overload.

Energy storage was qualitatively evaluated as a potential alternative, but the significant levels of power flow experienced at Smoky Hill and the need to continue serving load from the 230 kV system would require an infeasibly large energy storage solution to mitigate the overloads. Power flow controller devices were also qualitatively evaluated but are also not capable of managing the levels of power flow at the Smoky Hill Substation. These are therefore not considered viable alternatives.

Circuits 5167 and 5285: Smoky Hill – Buckley – Tollgate – Jewell – Leetsdale Circuit 5285

Circuits 5167 and 5285 are a 230 kV double circuit transmission line originating at the Smoky Hill Substation with connections at the Buckley, Tollgate, and Jewell Substations. At the Leetsdale Tap, located to the west of the Jewell Substation, the circuits split and Circuit 5285 continues to the Leetsdale Substation, while Circuit 5167 continues to the Sullivan Substation. Similar to the overloads identified on Circuits 5707 and 5111 discussed in the Daniels Park Path Upgrades, Circuit 5167 from Smoky Hill to Buckley and Circuit 5285 from Smoky Hill to Leetsdale experience significant overloads under N-1 contingencies due to increased renewable imports into the Denver Metro area from the Smoky Hill/Harvest Mile area.

The Company‘s preferred alternative is to upgrade the existing 230 kV transmission lines between Smoky Hill and Leetsdale to address these overloads. This upgrade will involve replacing the conductor currently installed on each circuit with a new conductor rated for 2000 amps. Transmission Engineering will be responsible for determining the exact type of conductor to be used in this upgrade, but the Company anticipates it will install an advanced HTLS conductor on the existing towers to meet the recommended rating. The Company's Transmission Planning analysis indicates that upgrades to Circuit 5285 are required for the entire path from Smoky Hill to Leetsdale. While power flows indicate that Circuit 5167 only requires an upgrade between Smoky Hill and Buckley to avoid overloads, the Company’s Transmission Engineering organization recommends that Circuit 5167 also be simultaneously upgraded between Buckley Substation and the Leetsdale Tap due to engineering design, procurement, permitting, and construction considerations. This is largely driven by the efficiencies that can be achieved by upgrading both circuits attached to the same towers at the same time. While further upgrades would be required to allow the circuit rating to be increased for the full path to the Sullivan Substation, upgrading Circuit 5167 in this manner creates additional transmission headroom and minimizes the future need for rework on this transmission circuit.

The Company evaluated a range of alternatives in identifying this proposed upgrade. The Company identified 2000 amps as the preferred rating as this was the balance between the highest capacity upgrade that could be installed on the existing towers without requiring a complete rebuild of the path. While increasing the voltage of these circuits could further increase the capacity on this path, the Company did not quantitatively evaluate this alternative because space constraints at the substations and transmission line right-of-way make this conversion would be extremely costly. Additionally, a PST that directs flows away from away from Smoky Hill could lessen loads on these circuits, however, existing PST technologies are not capable of reducing flows enough to eliminate the overloads on these circuits and would either cause or exacerbate overloads on other circuits, in turn requiring more significant upgrades in other parts of the Denver Metro area. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this element, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives for this element.

A new 230 kV circuit connecting the Harvest Mile and Cherokee Substations, including intermediate terminations, could also alleviate these overloads. However, the overloads identified in this analysis are mitigated through an upgrade of the existing circuits. While such a project is not needed to meet the system needs caused by the Approved Portfolio, the construction of a new parallel path will likely be needed in the future to support additional load growth, the retirement of generation resources in the Denver Metro area, and the addition of more renewable generation outside of the Denver Metro area.

Circuit 5625: Elati – Denver Terminal

Circuit 5283, an underground 230 kV transmission line connecting the Leetsdale, Monroe, and Elati Substations, and Circuit 5625 from Elati to Denver Terminal, are the parallel path to the Greenwood – Arapahoe – Denver Terminal 230 kV circuit. As noted in the Network Topology & Planned Projects section above, Public Service has previously identified the need to upgrade Circuit 5283 based on the condition of the underground conductor that recently led to the circuit being derated. During an N-1 outage of the Greenwood – Arapahoe – Denver Terminal circuit, the increased flows on this parallel path can be accommodated by the increased rating planned for Circuit 5283, however, Circuit 5625 from Elati to Denver Terminal experiences overloads based on the rating of the exiting transmission line and substation equipment. The Company evaluated a range of alternatives to address the overloads on Circuit 5625 and identified that upgrading the circuit to equal the new rating planned for Circuit 5283 from Leetsdale to Elati is the preferred solution to mitigate this overload.

The Elati to Denver Terminal is the continuation of Circuit 5283. Similarly, increasing the segment rating is the only feasible solution that addresses the root of the problem. Shifting power flow from the 230kV circuit with either a PST or series reactor does not increase the overall path rating and causes overloading on parallel circuits. Though battery storage could be deployed, due to factors associated with battery duration and state of charge, this technology does not provide a reliable option to mitigate NERC violations, which could remain for an unknown outage duration.

Circuit 9955: Leetsdale – Harrison

With increased imports flowing across the 230 kV system toward the center of the Denver Metro area, the 115 kV Leetsdale to Harrison Circuit 9955 experiences overloads across a variety of dispatch scenarios as a result of the N-1 loss of the 230 kV Leetsdale – Monroe Circuit 5283. As this is a 115 kV line running parallel to a 230 kV line, much of the flows on the 230 kV line transfer over to the 115 kV line with the loss of the 230kV circuit. To address the overloads caused by this outage, the Company proposes to rebuild this line from its current 708 A rating to 1900 A. Energy storage is not a viable alternative to this upgrade given that limited operational durations are not capable of fully mitigating N-1 overloads, and because space constraints preclude the installation of large-scale energy storage systems. Additional alternatives were also considered, but all solutions required new greenfield transmission line expansion along with a re-configuration of the 115 kV lines in downtown Denver. The Company did not further investigate these options as the overloads were mitigated through upgrades of the existing circuits at a lower cost and complexity.

Circuit 9007: Capitol Hill to Denver Terminal

During the analysis performed and under most of the dispatch scenarios, Circuit 9007 between the Denver Terminal and Capitol Hill substations was identified as an overload in certain cases. This line overloads under a wide variety of N-1 contingencies. For example, in the 2028 Comanche stress case, there were more than ten metro area contingencies that caused this line to overload more than 30% of its normal operating rating. The Company's Transmission Planning team engaged in an iterative process with the Company's engineering teams to identify an upgrade to the circuit, however, through this effort the Company determined that an upgrade that sufficiently mitigated the overloads was infeasible for a variety of factors. Circuit 9007 is an underground high-pressure fluid-filled transmission line, and there are currently no conductors available that would be able to achieve the necessary line rating uprate while utilizing the existing underground pipe and transmission line right-of-way. This type of transmission line, being high

pressure fluid filled is restricted to upgrade by its nature. The three phase transmission conductors are wrapped in paper, placed in a steel conduit (approximately six inches in diameter), and impregnated with mineral oil, which is held under pressure by pumping plants at either end of the line. The mineral oil is circulated as a mechanism to both cool and dissipate thermal variability at any bend or angle in the line. New paper-wrapped conductor with slightly higher capacity could be pulled into the conduit at an estimated cost of approximately $31.5 million. But this limited upgrade would not allow for the ampacity required. The existing line route is densely urban and includes a river crossing. This crossing could not be used for alternative engineering solutions, such as conductor insulated by cross linked polyethylene (commonly abbreviated as XLPE). Similarly, the Company's engineering teams were unable to identify an alternative route at this time. The installation of a new underground 115kV transmission line would entail utility planning and redesign in collaboration with the City of Denver. The solution would include XLPE transmission conductors installed in a large concrete duct bank (approximately 10 ft. by 10 ft.). The route would be as direct as possible with many underground utilities coordinated. The substations at either end of the line would require extensive construction to cut over from the HPFF line to the XLPE and remove the HPFF facilities.

The Company evaluated whether an operational solution was available for this overload within the dispatch scenarios and contingencies studied. Through this analysis, the Company has determined that, based on current load and generation assumptions, it could choose to open this line should the contingency arise and still effectively operate the system around such an overload. To this end, the tables in Appendix B are shown with this line open. This action to switch open the line as needed ,was evaluated here as an interim solution and would be leveraged by system operators under contingency conditions. While the Company believes this is a reasonable solution for the time being, this is not expected to be a long-term solution. Accordingly, the Company plans to continue studying this overload, and identify whether and what feasible long-term Transmission Planning or engineering solution may be warranted. The Company will update stakeholders and the Commission as appropriate through future filings.

3. CHEROKEE AREA UPGRADES

The Cherokee Substation - by virtue of the connected generation located at this substation - plays a key role in supporting the Denver Metro area transmission system by providing counter flow to the eastern and southern Denver Metro constraints. To fully maximize the proposed upgrades identified in this study, and to mitigate additional overloads caused by the change in the system generation portfolio, the Company has identified the following system improvements around in and around Cherokee, as reflected in Table 4 below.

Table 4 – Cherokee Area Upgrades

Project Element	Description	Existing Rating	New Rating
New Substation A	Construct a new 115 kV substation tying Circuits 9542, 9546, and 9549	N/A	N/A
New Transmission Line Cherokee - New Substation A	Construct a new 115 kV transmission line from the new 115 kV substation to the north 115 kV bus in the Cherokee Substation	N/A	1600 A
Circuit 9542: Cherokee to New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the in-and-out at the new 115 kV Substation to Cherokee	770 A	1600 A
Cherokee to Mapleton to New 115 kV Substation Circuit 9546: Cherokee – Mapleton – New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the in-and-out at the new 115 kV Substation to Mapleton and Cherokee	799 A	1600 A
Circuit 9549: Cherokee – Conoco – New Substation A	Uprate by reconductoring/ rebuilding existing 115 kV circuit from the new 115 kV Substation to Conoco South	799 A	1200 A
Circuits 9055, 9558, and 9464: Cherokee – Federal Heights – Semper – Broomfield	Uprate by reconductoring existing 115 kV circuit	798-1029 A	2000 A

Below is a more detailed description of each element of the Daniels Park Path Upgrades identified above.

New Substation A[4]

There are a variety of N-1 outages on lines and transformers around Cherokee that materialize under the variety of the generation dispatch scenarios analyzed in this study. The initial mitigation

[4] At this time, the Company is referring to this substation as “New Substation A” as a placeholder until a formal name is selected for the new substation.

solution was to re-establish the Cherokee 115 kV bus tie. However, after working with our engineering teams, it was deemed an infeasible solution due to the short circuit fault current between the two buses, which would expand the scope of the solution to include replacement of multiple circuit breakers within the substation. This would have called for replacing at least 34 substation breakers along with significant bus reconfiguring work. Multiple alternatives to the Cherokee bus-tie were evaluated and subsequently rejected for greenfield solution, which is the addition of a new 115 kV switching station approximately two miles southeast of the existing Cherokee substation. This new 115 kV station will include in and out taps of lines 9542,9546, and 9549.

As an alternative to constructing this new substation, the Company considered and evaluated the rebuild of the Chambers-Havana-Arsenal-Derby – Cherokee 115 kV Circuit. The Company also evaluated reconfiguring the line connections coming into both the 230 and 115 kV Cherokee buses. None of the alternatives studied would fully mitigate the overloads, or, involved significantly larger and more complex project scopes than the proposed solution.

New Transmission Line Cherokee – New Substation A

To mitigate overloads on the transmission paths in and out of the Cherokee Substation, the Company will need to add a two-mile new 1600 A rated 115 kV transmission line between the new 115 kV Substation A and Cherokee. The Company evaluated several alternatives to this new line, including multiple line rebuilds around the Denver Metro area. These alternatives were eliminated as they were more expansive and less beneficial than the Company's planned solution. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings were technologically capable to serve as viable alternatives for this upgrade.

Circuit 9542: Cherokee – New Substation A

Line 9542 currently has a line rating of 770 A. For this element, the Company plans to uprate the section between the Cherokee Substation and the new 115 kV New Substation A to 1600 amps. This rating is sufficient for the system under multiple N-1 contingencies to move power between the Cherokee North and South buses, thus mitigating overloading other elements of the system. The Company qualitatively considered several alternatives to this upgrade, but all solutions would have required new greenfield transmission lines and additional re-configuration of the downtown 115 kV lines. The Company did not further investigate the construction of a greenfield transmission reconfiguration given that the overloads are mitigated through upgrades to the existing circuit. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives for the upgrade.

Circuit 9546: Cherokee to Mapleton to New Substation A

Circuit 9546 between Cherokee to Mapleton and Sandown currently has a line rating of 799 amps. As part of this element, the Company plans to uprate the sections between Cherokee to Mapleton and the new 115 kV switching station to 1600 A. This rating is sufficient for the system under multiple N-1 contingencies to move power between the Cherokee North and South buses, thus mitigating other overloads on the system. Additional alternatives were qualitatively considered, but all solutions would have required new greenfield transmission lines and additional re-configuration of the downtown 115 kV lines. The Company did not further investigate the

construction of a greenfield transmission circuit/reconfiguration given that the overloads are mitigated through upgrades of the existing circuit. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives for this upgrade.

Circuit 9549: Cherokee – Conoco – New Substation A

Circuit 9549 between Conoco South and Sandown currently has a line rating of 799 amps. As part of this upgrade, the Company plans to uprate the section of line between the new 115 kV switching station and Conoco South to 1200 A. This rating is sufficient for the system under multiple N-1 contingencies to move power between the Cherokee North and South buses, thus mitigating overloads on other elements of the system. Additional alternatives were qualitatively considered, but all solutions would have required new greenfield transmission lines and additional re-configuration of the downtown 115 kV lines. The Company did not further investigate the construction of a greenfield transmission circuit/reconfiguration given that the overloads are mitigated through upgrades of the existing circuit. Energy storage and dynamic line ratings were qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives.

Circuits 9055, 9558, and 9464: Cherokee – Federal Heights – Semper – Broomfield

The prevailing flows on this path run from Valmont to Cherokee. With the addition of the Approved Portfolio, under the dispatch scenarios described in this study, we now see the direction of flow change direction and flow out from Cherokee in a northern direction. With this change, an N-1 outage of either circuit will overload the other. The lines on this path currently have ratings ranging from 798-1029 A. To mitigate these overloads, the Company has identified the need to rebuild these circuits to a rating of 2000 amps. Additional alternatives were qualitatively considered, but all solutions would have required new greenfield transmission lines. The Company did not further investigate the construction of such a greenfield transmission circuit given that the overloads are mitigated through upgrades of the existing circuit. Energy storage and dynamic line ratings were also qualitatively evaluated as alternatives for this upgrade, however, for the reasons discussed in the ATT section, neither energy storage nor dynamic line ratings are technologically capable to serve as viable alternatives.

B. Comparison to Previous Study Results & Looking to the Future

1. Additional Studies

Transmission planning is not a static activity that occurs at a single point in time and thus careful consideration must be taken when reshaping the state's grid to reliability and cost effectively meet the state's emission reduction goals. The Projects identified in this Study Report reflect the Company's analysis of the generators included in the portfolio approved by the Colorado Public Utilities Commission in the 2021 ERP & CEP, but do not reflect additional future needs for future resource additions and additional load growth expected beyond the horizon of this Study. The Company will continue to evaluate the transmission network across the state through the established processes as we strive to incorporate new load requests, a growing distribution network, as well as generation retirements and replacements. In October 2024, the Company will file its Just Transition Solicitation ("JTS") resource acquisition plan with the Colorado Public Utilities Commission to acquire additional generation resources to serve growing load and meet emissions reduction requirements through 2031. The Company will put forward additional transmission analysis in that proceeding describing anticipated future transmission needs.

Denver Metro Voltages

Voltage issues are directly impacted by the load profile and reactive power demands of the load's power factor. There is an opportunity to right size the reactive components, such as capacitor banks and shunt reactors to adequately adjust the voltage level as needed when evaluating new transformer additions. This evaluation is highly dependent on the anticipated load levels at the specific substation locations.

During the study process the Company monitored voltage levels pre- and post- contingency. Two areas within the Denver Metro were identified as having voltage violations driven by increased load. Lafayette and Waterton substation will both require voltage support and will be added as part of the substation work when the additional transformer banks are added to the existing stations or mitigated though the addition of new distribution stations if needed. Please see Appendix B for the Pre and Post Thermal Overloads Under Contingency for 2025 – 2028.

San Luis Valley

Within the 2021 ERP & CEP 120 Day Report, there were five network upgrade projects identified as needed within the San Luis Valley. The system needs within the San Luis Valley were not evaluated within the scope of this Study Report. However, the Company will seek to evaluate these further within the Colorado Coordinated Planning Group and its San Luis Valley ("SLV") Subcommittee. This is anticipated to commence late 2024 or early 2025 based the availability of the SLV Subcommittee.

Open Access Transmission Tariff Studies

Interconnection and transmission service for all generation bids are subject to the terms of the Xcel Energy's OATT. Generator interconnection requests are subject to the applicable Large Generator Interconnection Process ("LGIP") contained within Attachment N of the OATT. To qualify the resources acquired through the 2021 ERP & CEP as Designated Network Resources ("DNRs") to serve Network Load, or Public Service's retail customers, the Company will request Network Integration Transmission Service ("NITS") for all generators pursuant to its OATT. This study is not intended as a replacement for the LGIP or DNR process and results of studies

conducted pursuant to OATT requirements may identify incremental network upgrades necessary to provide transmission service to generation acquired in the 2021 ERP & CEP. For example, the studies conducted pursuant to the OATT may identify incremental transmission system needs based on the replacement of failed bids in the 2021 ERP & CEP or the results of studies of prior-queued interconnection and network service requests not accounted for in this Study Report.

2. Differences from the 2021 ERP & CEP 120-Day Report Transmission Analysis

In the Company's 2021 ERP & CEP 120-Day Report and accompanying Phase II Transmission Report, the Company put forth a preliminary portfolio of potential transmission projects to support the Company's Preferred Portfolio, consisting of the May Valley – Longhorn Extension of the Colorado's Power Pathway Project, Denver Metro Transmission Network upgrades, San Luis Valley Transmission network Upgrades, and Grid Strength Reinforcement and Reactive/Voltage Support. The Phase II Transmission Report identified a set of specific network upgrades, including 25 projects primarily located in the Denver Metro area and San Luis Valley.[5]

The Transmission Network Improvement Projects for area are expected to be significantly reduced in cost compared the Denver Metro Transmission Network Upgrades presented in the Company's Phase II Transmission Study. This reduction is due in large part to the deferral of projects based on delayed resource acquisitions. The Company's analysis in the Just Transition Solicitation continues to identify that larger-scale transmission needs originally identified in the 2021 ERP & CEP 120-Day Report remain in consideration for future needs. In addition, the Company's refined and more developed transmission study efforts also afforded the ability to identify and evaluate feasible and more cost-effective alternatives.

By performing the analysis on both the Preferred Portfolio and later a more refined analysis on the Approved Portfolio, the Company was able to gain critical insight into how the transmission system may respond with the CEP's renewable generation acquisitions. The Company also compared and contrasted the 2021 ERP & CEP 120-Day Report transmission study results with the study results within this Report to determine which projects had alignment between the larger Preferred Portfolio and the Approved Portfolio. These common projects were evaluated further to test for durability across multiple dispatch scenarios and were sized (*i.e.* project rating) accordingly to avoid any potential redesigns. Projects unique to this Study were also pressure tested against several stress conditions associated with different dispatches to ensure an appropriate project rating.

Through this study process the Company has determined the future transmission system will need an additional significant transmission path into the Denver Metro area to alleviate system constraints expected to result from growing load and the continued clean energy transition. This need was originally reflected in the 2021 ERP & CEP 120-Day Report as a double circuit 230 kV line from Harvest Mile to Cherokee with connections at additional substations currently located along this path. This project is not identified as needed to reliably deliver the output of the Approved Portfolio to Public Service's customers, due primarily to the reduced size of the Approved Portfolio compared to the Preferred Portfolio that served as the basis of the Company's transmission analysis in the 2021 ERP & CEP. While the Company is not proposing this project as needed at this time, the Company continues to believe that a 230 kV transmission path in the Denver Metro area will be needed based on load growth and additional generation identified in

[5] An analysis of the upgrades needed for the San Luis Valley is subject to a separate review through the Colorado Coordinated Planning Committee and will be brought forward at a future time.

the JTS. The Transmission Network Improvement Projects have been developed with this future project in mind to ensure the Projects identified in this study are properly valued. The double circuit expansion concept has been shown support the Daniels Park and Smoky Paths delivering generation to the Denver Metro area. This conceptual third path helps to share in the flow among the two existing paths and will provide increased reliability and operational flexibility. The construction of an additional path will only further increase the system benefits from many of the Projects outlined in this study to help reliably serve the system in the future.

In the next section, the Company will walk through the details of the Transmission Planning Study process employed to identify and evaluate the Transmission Network Improvement Projects identified above.

IV. TRANSMISSION PLANNING STUDY PROCESS

The Company's approach to transmission planning prioritizes the identification of cost-effective projects that improve the resiliency and reliability of the transmission network. Proposed transmission projects must accomplish the goal of relieving potential overloads as well as providing operational flexibility to account for unexpected outages and unique operational circumstances. Further, the Company seeks to enhance value by seeking projects with multi-level benefits. The Company seeks to develop projects that balance short- and long-term system needs with costs. This is done by evaluating the transmission project concepts under a multitude of scenarios and dispatch stress cases to ensure the project is durable and adequate to serve customers' needs for years to come.

Importantly, the planning approach that Public Service has taken strives to transition our transmission system consistent with our evolving clean energy transition and thus considers long-term system growth, typically on a multi-year timeline and utilizes multiple dispatch scenarios which make further use of renewable generation to serve loads. This is particularly important in Colorado, where the Company's service territory is looking at significant load growth and state policies which increasingly prioritize the replacement of fossil-fueled generation with low carbon resources. Given the cost impacts of replacing assets early in their usable life, the Company avoids the development of minimum viable transmission projects that are unable to accommodate expected future growth and instead prioritizes projects that strike a reasonable balance between short- and long-term system needs. This is done by evaluating the transmission project concepts on a long-term horizon using forecasted load growth assumptions and applying a dispatch stress.

In evaluating the Approved Portfolio from a transmission planning perspective, the Company identified transmission deficiencies, needs, and projects by evaluating transmission system performance across a range of scenarios and time horizons. For each case analyzed, power flow contingency analysis results were produced for both system performance criterion; thermal and voltage violations during system intact (N-0) and single contingency event (N-1) analysis. The thermal violations represent the transmission capacity limiting facilities. Thermal (capacity) violations attributed to station equipment ratings are mitigated by replacing the limiting element(s) within substation. For example, thermal (capacity) violations that are transmission line conductor rating limited can be mitigated by reconductoring or rebuilding the line, or by identifying a transmission expansion alternative that mitigates multiple thermal violations by providing an additional transmission path in the network. Conductor upgrades can provide capacity benefits but may not be able to provide the same amount of capacity benefits as constructing an additional transmission line.

A. STUDY ASSUMPTIONS

This study focuses on the delivery of renewable generation included in the Approved Portfolio and the associated transmission impacts to Public Service's system to accommodate the delivery of the Approved Portfolio to the Company's load centers. The study analyzes aggressive renewable dispatch levels consistent with the levels required to meet the Company's emissions reduction targets consistent with the 2021 ERP & CEP.

1. GENERATION ASSUMPTIONS

The study assumes an increased amount of renewable generation dispatch and limits the use of thermal generators to a defined amount in each case as described in the Generation Dispatch section below. This approach was designed to identify system issues under a high renewable

dispatch scenario. By maintaining a consistent level of thermal generation across each year case study and allowing the growing load to be served by renewable generation such as wind and solar, the study highlights system constraints that may occur on high wind and high solar potential days. This enables the Company to identify areas of the transmission network that need enhancements so the Company can achieve its carbon emission goals, serve customers reliably, and reduce curtailments. The generation assumptions account for the planned new generation resources included in the Approved Portfolio detailed in Appendix A, as well as planned unit retirements and power purchase agreement expirations during the years studied. The Company's power flow case files contain benchmark generation data consistent with the generation and dispatch assumptions detailed in this Report.

2. Planning Criteria

The analysis included steady state system intact and steady state P-1 (single) contingency conditions monitoring both thermal and voltage violations. Public Service adheres to the WECC thermal and voltage criteria as outlined in Table 5 below and in accordance with both the Company's FERC 715 filing and the TPL-001 WECC-CRT, which are provided in Appendices D and E.

Table 5: Steady State Planning Criteria

Element	System Intact Condition	Post-Contingency Condition
Transmission Line Loading	100% of Continuous Rating	100% of Continuous Rating for single (P-1) Contingency
Transformer Loading	100% of Continuous Rating	100% of 8-hour Rating
Bus Voltage	0.95 to 1.05 per unit	0.90 to 1.10 per unit

System conditions for area and inter-area ties were monitored for any violations. Violations outside of Public Service ownership were tracked for further analysis with neighboring Transmission Owners.

3. Software

The software used in this study was Siemens PSS®E version 35.6.1

4. Study Case Loads

The total load for Public Service's Balancing Authority (BA, WECC Area 70 (or A70)) in each case is listed below. These load values are provided by Public Service's Resource Planning and Load Forecasting teams.

Table 6: Total Load for Public Service's Balancing Authority by Case[6]

Year	Peak Demand (PSCO Scaled Load)
2025	6760
2026	6862
2027	7049
2028	7040
Clean Energy Plan (2029)	7301
Just Transition Solicitation (2031)	7491

5. Network Topology & Planned Projects

The Company developed the study cases from WECC approved models to reflect the listed study horizons. The following projects are included per the Company's In-Service date as noticed per the Company's FERC 890 Project updates.

Table 7: Projects by In Service Year

2025	Colorado's Power Pathway 345 kV Segment 2 Colorado's Power Pathway 345 kV Segment 3 May Valley 345 kV Substation Goose Creek 345 kV Substation Canal Crossing 345 kV Substation Kestrel 230kV Substation Waterton Substation Expansion
2026	Colorado's Power Pathway 345 kV Segment 1 Poder Substation
2027	Gilman – Avon 115 kV Colorado's Power Pathway 345 kV Segment 4 Colorado's Power Pathway 345 kV Segment 5 Leetsdale – Monroe – Elati 230 kV Line 5283 Upgrade Sandstone 345 kV Gray Street Substation Upgrade Barker Substation (Transformers 1 & 2)
2028	Climax – Robinson Rack – Gilman 115 kV

[6] Note that these load growth assumptions are based on point-in-time assumptions that are intended to align this transmission portfolio with the 2021 ERP & CEP proceeding. The Company is updating its forward-looking load growth assumptions and respective transmission analysis as part of its Just Transition Solicitation based upon higher load growth forecasts, which are discussed in more detail in that proceeding and its associated transmission study report.

B. Power Flow Case Development

The Company centered its transmission study on several scenario analyses, with five scenarios categorized by year given the range of anticipated generation in-service dates (2025 Peak Demand, 2026 Peak Demand, 2027 Peak Demand, 2028 Peak Demand, 2030 Peak Demand), and four sensitivities (Twilight Sensitivity, Comanche Area Stress Sensitivity, Pathway Project Sensitivity, and No Cherokee Sensitivity). Due to the varying commercial operation dates of each generation bids over the four-year period of the 2021 ERP & CEP as well as the implementation of significant transmission topology, the study used multiple WECC approved cases as starting cases to analyze system impacts of the generation changes by year. The following cases were developed and updated to reflect previously planned projects as reported in the Company's latest FERC 890 Transmission Plan. The following cases were developed from the WECC approved cases and were shared with neighboring utilities for topology, load, and generation review. Since Public Service is summer peaking, "Peak Demand" cases reflect the forecasted summer peak for that study year. The following cases serve as seed cases for scenario cases.

- 2025 Peak Demand Case
- 2026 Peak Demand Case
- 2027 Peak Demand Case
- 2028 Peak Demand Case

The developed models were evaluated and verified to:

1. Contain the latest topology available at the initialization of this study.
2. Reflect forecasted load for the respective year and season.
3. Reflect forecasted generation retirements and proposed ERP generation.

1. Generation Dispatch

The following table describes the dispatch of existing and new generation as they are available in the power flow case. This set of thermal generators listed were selected based on their geographical diversity on Public Service's system to provide generation from different directions. The furthest generator from the Metro is located at Comanche. The thermal generation was kept static at the values listed below across each year which was intended to take advantage of the additional new renewable generation and test the networks capability to deliver the added Approved Portfolio generation. It should be noted that wind is used to balance against increases in load. Thus, slight differences exist in wind dispatch between years as load growth increases.

Table 8 – MODEL DISPATCH VALUES

System Operating Scenario	Solar	Thermal					Wind	Battery Storage
		CHER-CC	RMEC-CC	FSV-CC	PAWN*	COMA		
Gross Peak Demand (Summer Mid-Day, Max Solar)	90% Rated	570	200	330	200	450	Balance Net Load = Gross Load minus (Solar + Fossil)	0
Twilight Evening Demand (Summer Evening, No Solar)	0	570	200	330	200	450	Balance Net Load = Gross Load minus (Storage + Fossil)	100% Rated

*Pawnee is used as the Area swing and will not always be exactly 200 MW due to transmission losses.

Peak Demand Case

The Peak Demand dispatch leverages a high amount of solar (90%) and balances the remaining load with the available wind resources while dispatching the thermal units at the values shown in Table 8. These thermal units were selected due to their diverse geographical locations across Public Service's system. Specifically, units to the north, south, and east of the metro along with the selected Denver Metro units. This dispatch is considered a reasonable base level dispatch that utilizes all resources minus battery storage. Battery storage is leveraged in the Twilight Evening Peak Case.

Twilight Evening Peak Case

The Twilight Case was dispatched to reduce the amount of solar resources, while retaining a high level of load demand. This dispatch conceptualizes a short daylight period with an enduring evening load. In addition, this dispatch could also reflect a day in which there is a lack of solar resources. The Twilight Evening Peak case increases the use of energy storage and balances the reduction in solar resources with wind resources.

2. STRESS DISPATCH SCENARIOS

The following dispatch scenarios were established to stress the system for a variety of system conditions which may arise. This variation in dispatch helps ensure that proposed transmission projects are durable under various worst-case conditions. It should be noted that these stress conditions are unique operating conditions which may or may not arise but are used here to ensure the proposed transmission upgrades are durable and withstand a reasonable stress test.

These additional scenarios were established by modifying the generation dispatch to achieve the desired stress. These stress cases were discussed with Stakeholders at the time of the Study Plan development.

Comanche to Metro Directional Stress

Given the large amounts of generation near and around the Pueblo area, and to better understand the impacts to the existing 345 kV transmission corridor into the Denver Metro area, generation in proximity to Comanche was increased to produce a high flow on the transmission corridor from south to north into Denver. By doing so, this analysis further evaluates the southern path into the Denver Metro area. Further, this generation stress condition evaluates the addition of portions of the Pathway Project segment that will be in-serviced in 2027. The Company has referred to this part of the system as one of the critical backbone paths into Denver and thus evaluating this path is ensures transmission components are adequately sized as increased power flow travels north from the Comanche area. Projects identified along the Daniels Park Path were shown to experience severe overloads under this stress condition, which is consistent with the expected result.

High Renewable Pathway Stress Case

The Pathway Project was developed to accommodate renewable energy resources expected to come online as a result of the 2021 ERP & CEP and beyond. This stress case was developed to emphasize renewable generation coming online *via* the Pathway Project by increasing the proposed portfolio of generation located on the Pathway Project. This generation stress case was designed to identify potential issues with large amounts of injections on the Pathway Project and to identify potential issues on the network as power traverses the network to load centers across the southern and eastern path into the Denver Metro area. Projects identified along the Smoky Hill Path were shown to experience severe overloads under this condition, which also provides a consistent result that aligns with the expected result.

No Cherokee Case

The “No Cherokee” case was proposed by Stakeholders as an additional stress case. The absence of Cherokee generation presents a challenge that has been shown in other studies as well as in real-time operations, which has led to the existing Denver Metro constraint - posted to the Company’s OASIS site and referred to as the “East Generation and South Generation Nomogram”[7]. This stress case has been used to inform and understand how the proposed transmission network upgrades endure this extreme dispatch case. The Cherokee generation provides significant counterflow on Denver Metro lines as well as voltage support in this critical area. Though the Company may not operate this system in this configuration, the analysis is revealing to better understand Cherokee’s criticality on the network system performance. Projects presented in this Study Report are not driven by this extreme dispatch case.

3. Future Generation Scenarios

The following scenarios were evaluated within this study as a forward-looking analysis to identify constraints that may arise beyond 2028.

[7] https://www.oasis.oati.com/woa/docs/PSCO/PSCOdocs/MSST-PSCO_PSCo.South-PSCo_Nomogram_June_7_2024.pdf

2030 Clean Energy Plan

The 2030 Clean Energy Plan contemplates an additional 1000 MW generic wind by the end of 2029. The Company used informed engineering assumptions for generation location and size.

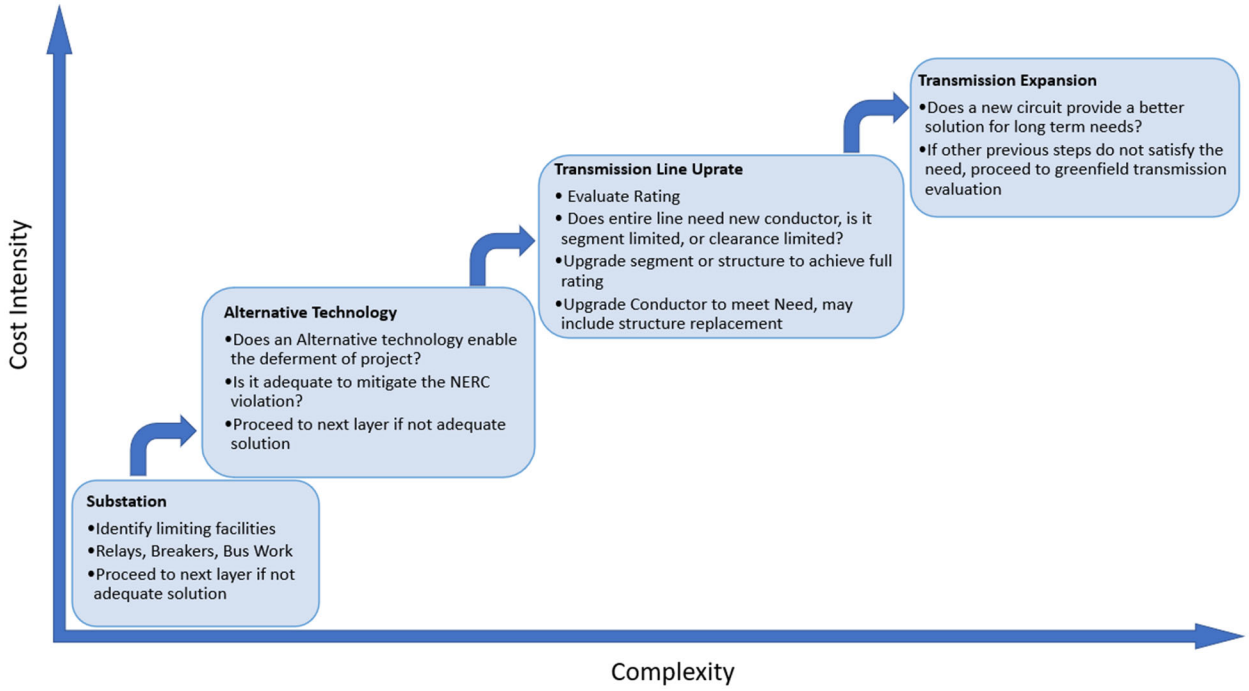
Just Transition Solicitation

The Company's JTS filing will focus on replacing the Comanche Unit 3, meeting 2030 emissions reduction requirements, and meeting the Company's resource needs through 2031. This evaluation built upon the Clean Energy Plan Scenario with an additional 3850 MW of generation. This analysis is indicative and does not serve as the final analysis. Further study will be presented in the Company's Phase 1 JTS Filing in October of 2024.

C. Project Selection Process

The Company's decision-making process for the selection of preferred alternatives is structured to begin with the most minimally invasive solution with regard to both scope and cost and scale up to major transmission expansions as necessary, as reflected in Figure 4 below.

Figure 4: Project Scope Evaluation Process[8]



This method ensures that immediate needs are effectively met while also taking into account long-term goals and cost-effectiveness. The progression from minor to major solutions is driven by careful analysis, iterative evaluation, professional experience and judgment, and strategic insight.

To explain, initially, Transmission Planning begins by identifying the simplest, most cost-effective solutions to address a given transmission violation. In some cases, limitations are located at the substation with facilities that are electrically "in series" with the transmission segment and have an electrical current carrying capacity less than the transmission line. In this scenario, additional capacity can be unlocked through technical upgrades to facilities or conductor. The Company then re-evaluates the potential solution in its power flow model to ensure its adequate in every test case. These minimally invasive solutions are designed to provide additional capacity with lower financial investment than, say, constructing a new transmission line. Through the study process these technical solutions are evaluated to assess their performance and durability across different dispatch cases and load profiles.

When a minimally invasive solution is found to be inadequate or reach its limits, that project is re-assessed as a candidate for a more significant solution. This moves the selection process from

[8] Examples in the figure are provided to illustrate the process and are not all inclusive.

the first step to the next incremental step as reflected in Figure 4 above, which includes evaluation of potential ATT solutions. At this point in the study, the Company's power flow analyses have identified how severe an overload may be such that we can better understand what may be needed to mitigate the violation. For example, after an initial screening of study results, it can be determined that a device is 110% overloaded under the worst-case contingency thus allowing the planner to calculate how much more capacity is needed after evaluating multiple stress scenarios. With these calculations in hand, ATTs can be compared to determine whether their capabilities align with the system needs. Additional discussion regarding ATTs is presented in Section D below.

Next, our team evaluates the existing transmission topology and physical construction to ensure a cost-effective solution is not overlooked. In some cases, an entire transmission segment may be limited by a physical clearance issue or a portion of the line retaining a conductor with a lower rated capacity. The Company's Transmission Line Engineering team is deployed to determine if an opportunity exists to remedy the limitation. Prior to advancing to structure replacements, an evaluation is done on whether an ATT conductor could save costs of structure replacements.

Arriving at the most complex and robust solution for any violation does not happen without the exhaustive evaluation of the prior steps. The Company understands that these project types can have significant impacts to the communities served. Therefore, greenfield transmission expansions are ideally designed to mitigate multiple network violations and include multi-level value benefits such as renewable energy delivery, rebuild or multi-project avoidance, and improved distribution and transmission load serving capability. The figure above is intended to reflect the multi-stage evaluation process the Company used to evaluate potential transmission solutions within this Report.

D. ADVANCED TRANSMISSION TECHNOLOGIES

As the transmission violations were identified, the Company holistically evaluated ATTs to determine whether ATTs may provide a feasible and cost-effective solution to addressing transmission system needs. The Company considered a broad range of ATTs including High-Temperature, Low-Sag ("HTLS") conductor types and other Grid Enhancing Technologies ("GETs").

The predominant system issues that need to be solved for with the addition of the Approved Portfolio include the increase in electric flow from the south at Daniels Park and from the east at Smoky Hill. Accordingly, the Company's Transmission Planning team evaluated whether ATTs or GETs could provide robust solutions in any instances to reliably mitigate violations along those paths. Consistent with the terms of the Settlement Agreement approved by the Commission in Proceeding No. 21A-0096E, this Report provides a detailed explanation of each ATT considered. Below is a summary of how each technology was evaluated.

1. ENERGY STORAGE

Energy Storage has been shown to leverage the concept of counter-flow, which can help alleviate an overload by injecting power into a specific bus to "push back" on flows which may experience an overload in certain situations, such as times of high renewable generation being injected onto the transmission system. The concept can work in some situations, but carries risk depending on the state of charge of the storage device and duration of output. Given that transmission outages can cause overloads that can be detrimental to asset health and are compounded by generator dispatch, it is difficult to rely on a battery, which could have a wide spectrum of charge level. These variables ultimately limit the situations where energy storage can reliably mitigate many transmission violations.

A critical resource in evaluating Energy Storage throughout this study process was "A Guide to Evaluating Energy Storage Alternatives" as developed by the Colorado Coordinated Planning Group ("CCPG") Energy Storage Work Group, which was accepted by CCPG members in June of 2023.[9] Energy Storage was considered throughout this study process and as part of all mitigation solutions, however, it was not determined to be a feasible alternative to address any of the system needs identified in this Study Report. A key concept outlined in the document under the feasibility section states, "[i]f the purpose and need of a project is to address an anticipated NERC Reliability Standard violation, certain types of ESAs are not feasible. Energy storage is currently not a feasible solution to address these violations as the availability of energy and ability to mitigate the issue cannot be guaranteed." As such, any overloads caused by a contingency event cannot be resolved through the deployment of energy storage.

2. TRANSMISSION TOPOLOGY OPTIMIZATION

The concept of transmission optimization seeks to find a reconfiguration option or route around a particular congested or overloaded facility. While this action of topology reconfiguration in and of itself is not an ATT per se, as this is often done by transmission system operators, when paired with the appropriate software designed to run multiple outage configurations and combinations, this can offer advanced optimization that may result in capacity benefits. Optimization software can account for the system configuration in near real time, to include de-energized facilities which may be out for maintenance or construction, then optimize the configuration based on a number

[9] https://doc.westconnect.com/Documents.aspx?NID=21026

of iterative solutions. Here, the Company evaluated the potential deployment of topology optimization combined with appropriate software, but determined that with respect to the violations at issue here and the magnitude of capacity overloads, it was determined that topology optimization did not provide sufficient capacity needed to mitigate the transmission violations.

3. Dynamic Line Rating

Dynamic Line Ratings are transmission line ratings that reflect up-to-date forecasts of weather conditions, such as ambient air temperature, wind, cloud cover, solar heating, and precipitation, in addition to transmission line conditions such as tension or sag. There can be significant benefit to dynamically rating a transmission line to unlock additional capacity. Conversely, as line ratings take into account the above-mentioned weather parameters the rating can also be reduced for such conditions such as high ambient temperatures or solar heating. As such, due to the functional dependency of real time weather metrics on the dynamic line rating, the benefit of this technology is more suited for use within the operational timeframe rather than the long-term planning horizon where having available capacity to deliver is critical regardless of daily weather metrics. The Company continues to evaluate a variety of dynamic line rating technologies and is working to implement the systems upgrades necessary to operationalize dynamic line ratings. However, facilities that have ratings limited by certain underground conductors or substation equipment, such as many facilities in the Denver Metro area, do not benefit from these technologies.

4. Advanced Transmission Conductors

Advanced transmission conductors are conductors which offer an increase in capacity, efficiency and mechanical performance compared to traditional conductors compared to traditional aluminum conductor, steel reinforced (“ACSR”) cables and are sometimes referred to as high-temperature, low-sag composite (“HTLS”) conductors. More information about advanced conductors is available in the Advanced Conductor Scan Report published by the Idaho National Lab.[10] For all projects that require an existing transmission line to be uprated, the Company’s Transmission Engineering organization has considered whether an HTLS conductor technology would be suitable. The selection of a specific conductor type is not necessarily within the scope of this Study Report; however, the transmission planning process considers the capabilities of advanced conductors in determining whether an upgrade to an existing transmission path is a feasible alternative.

5. Advanced Power Flow Control

A product that was considered but not included in the Transmission Network Improvement Projects is advanced power flow control technology. Power flow control is a set of technologies that can push or pull power to and away from potentially overloaded transmission lines. While this technology did appear to mitigate the transmission violations by modifying the inductance or capacitance of the line to synthesize a capacitive or inductive reactance to either push or pull power, further analysis determined it was not cost-effective, particularly in comparison to a traditional series reactor. Through engineering evaluation, it was determined that this technology requires ancillary equipment and physical space along the existing right of way, that would increase project costs and expand the scope.

[10] https://www.energy.gov/sites/default/files/2024-08/Advanced%20Conductor%20Report%20December%202023.pdf

6. SUPPLEMENTAL ALTERNATIVES EVALUATED

There are several other ATT concepts that may help to mitigate transmission violations, such as testing if power can be rerouted away from overloaded areas by permanently reconfiguring transmission terminations or evaluating if loads can be balanced along congested paths to avoid a violation. The Company studied several such options.

For example, several different configurations were tested early in the process at the Daniels Park Substation to understand if adding or removing a line at Daniels Park could provide another path into the Denver Metro area and lessen the impact on the Daniels Park to Greenwood lines. Results indicated that the power flow will seek to continue into the Daniels Park due to the amount of concentrated load in that area. In addition, the concept was further evaluated with an additional conceptual circuit to reduce impedance further, yet that test did not improve the previous results and the concept was set aside.

Load balancing was evaluated on the eastern path of the Denver Metro area to test if any of the identified violations could be avoided by re-arranging load along that path. For example, a project to shift load served by the Tollgate Substation to a different adjacent transmission line was initially evaluated. However, due to the violation appearing again in later case years, this load shift alternative was determined not to be durable and did not meet the Company's desire to implement a robust transmission solution for long-term needs. Thus, uprating the line through a reconductoring project was determined as the preferred alternative.

Additionally, the Company did take into account the northern part of the Denver Metro area through its analysis. One such evaluation included an additional conceptual line to determine if there was any benefit added by providing another path into Cherokee from Fort St. Vrain in the north. The concept was centered on the idea that added flow into Cherokee could potentially help support counter flow similar to the current benefit of Cherokee's generation output. Even with the addition of PSTs to the Pathway Project between Canal Crossing and Fort St. Vrain, there was not enough flow making its way into the Denver Metro area and past Cherokee to have a positive impact on the transmission violations to the south and east of the Denver Metro area.

Finally, an informal assessment was made to determine what amount if any would reduce the number of transmission violations should more generation be made available on the northern side of the Denver Metro area. This assessment confirmed that there is a positive relationship between generation at or north of Cherokee substation and transmission issues on the south and east of the metro area. This is often referenced as the counter-flow generation with regard to Cherokee's output.

E. Project Design

Through this Study Report, the Company presents the results of its analysis of the electrical engineering of the bulk power system to identify the need for system expansion to reliably deliver the Approved Portfolio. However, this Study Report does not encompass all steps necessary for the development and construction of a transmission project including the design, siting, engineering specifications, local and public outreach and engagement, and construction plans. Below the Company briefly describes some of these constructability issues the Transmission Network Improvement Projects, all of which could impact the feasibility, timeline, scope, and costs of the projects identified herein.

1. Feasibility & Risk

Once a preferred transmission solution is identified through the transmission planning process, many other necessary steps remain before such a transmission solution can ultimately be developed, such as siting, transmission line and substation design engineering, constructability and risk analysis, and the development and implementation of project management and execution plans. In support of the further development of the Transmission Network Improvement Projects, the Company's Integrated System Planning organization is developing preliminarily scope, feasibility, estimated cost, and schedule consistent with Public Service's Project Planning and Execution Process ("PPEP"). The PPEP is intended to ensure a project is feasible, determine constructability, and to identify any practical implementation constraints or challenges, such as project risks, and lead time for materials.

Such an assessment will identify issues that could render a planning-identified solution infeasible, such as physical space limitations at substation sites. For example, significant time was spent to determine the best location for the additional transformer at Daniels Park within the existing boundary of the substation site. Through an iterative scrub process and working sessions, an adequate location was identified.

Each of the Projects identified in this Study Report have been evaluated through the initial stages of the PPEP and have been determined to be feasible based on this preliminary investigation. While some project alternatives discussed in this Study Report were considered on a qualitative basis and were eliminated from consideration, in situations where more than one viable electrical solution was identified and validated by the Transmission Planning process the Company conducted further preliminary investigation into feasibility, cost, and constructability to guide the selection of the preferred alternative. Though the Company evaluates each project individually, the risk remains that projects may change or be modified based on outside factors that are unknown at the time of initial engineering estimate. The PPEP is designed to manage and reduce the amount of risk within each project.

When this preliminary project scope, schedule and estimate are completed, the Company intends to seek a Certificate of Public Convenience and Necessity from the Colorado Public Utilities Commission to construct the Projects.

2. Project Schedule and In-Service Dates

This planning analysis evaluates constrained thermal generation paired with a high renewable generation dispatch to meet the Company's clean energy goals. Projects identified through the incremental study horizon are reflected in the year in which they are first identified. Due to the complexity and long lead times of material, many upgrades in the Transmission Network

Improvement Projects may not be placed in service until later in the Resource Acquisition Period of the 2021 ERP & CEP. This does not reflect a lack of system reliability, but rather a limitation to the amount of renewable generation that may be accommodated during Project buildout. The Company continues to evaluate the construction schedule to properly sequence outages required to safely construct and implement the Transmission Network Improvement Projects in a way that is safe, reliable, and adds value for customers. At this time, the Company has not finalized the development of construction schedules in-service dates for the Transmission Network Improvement Projects but will present planned in-service dates for the Projects as part of its upcoming CPCN filing.

3. COST ESTIMATES

Given the complexity of the Transmission Network Improvement Projects, the Company is still in the process of developing refined cost estimates for these Projects. In addition to the materials, supplies, and labor needed to support this portfolio, the Company's cost estimates must take into account the complex outage coordination that will be needed to support this work, along with the unique siting, land rights, and permitting aspects of the Projects. The Company is also evaluating the most cost-effective way to proceed with this work, including, for instance, what portions may be suited for development and construction by third-party contractors.

At this time, the Company has not completed the development of refined cost estimates for the Transmission Network Improvement Projects but will present detailed cost estimates for the Projects as part of its upcoming CPCN filing.

Appendix A – Approved Portfolio

#	Fuel Type	Nameplate Capacity (MW)	Collocated Storage (MW)	Point of Interconnection	Estimated In-Service Date
1	Solar + Storage	325	200	Comanche 230kV Substation	Oct 2025
2	Wind	500		Goose Creek Substation	Dec 2025
3	Wind	500		May Valley Substation	Feb 2026
4	Wind	450		Goose Creek Substation	Mar 2026
5	Gas	50		Alamosa Substation - 69kV bus	Mar 2026
6	Wind	603		Goose Creek Substation	May 2026
7	Solar	115		230 kV Poncha-SLV line	June 2026
8	Storage	199		St Vrain 345kV	Aug 2026
9	Solar	335		Comanche 230 kV Substation	Sept 2026
10	Storage	199		Spindle 230kV	Nov 2026
11	Solar + Storage	355	178	PSCo trx line between Missile & Pawnee Subs	Mar 2027
12	Storage	200		Comanche PSCo 345 kV	May 2027
13	Gas	200		Fort Lupton 115 KV substation	May 2027
14	Gas	200		Fort St. Vrain 230 KV substation	May 2027
15	Solar + Storage	90	72	Alamosa Terminal - Blanca Peak - 115kV line	May 2027
16	Storage	200		Hartsel 230kV substation	Dec 2027
17	Solar	200		PSCo's Mirasol 230kV Switchyard	June 2028
18	Solar + Storage	300	100	New 230kV Switchyard on Boone-Midway line	June 2028
19	Storage	250		Goose Creek 345kV Substation	June 2028
20	Storage	250		Pawnee 345KV Substation	June 2028

2025	Pre Mitigation			Post Mitigation		
<----------MONITORED_BRANCH---------->	Peak	Comanche Stress	No Cherokee	Peak	Comanche Stress	No Cherokee
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	126.12	117.57	60.57	78.48	72.25	27.43
70398 BEAVER_CK_N 115.00 70399 BEAVER_CRK_P230.00 T1	85.31	70.96	115.74	84.48	70.36	115.77
70277 MAPLETO2 115.00 70377 SANDOWN 115.00 1	105.52	97.11	38.86	See MAPLETO2 to NEW_SUB_A entry		
70423 BOULDER_CAN1115.00 70492 BOULDER_HYD 115.00 1	101.57	100.47	99.92	99.95	99.51	99.15
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	100.27	100.5	87.24	85.4	85.24	74.28
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	130.73	123.57	72.49	93.09	89.45	53.52
70023 ALLISON 115.00 70400 SODA_LAKES 115.00 1	101.56	103.44	99.73	98.55	99.76	99.46
70045 BANCROFT 115.00 70242 KENDRICK 115.00 1	97.66	97.6	98.02	97.88	97.6	97.28
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	97.52	91.3	49.54	58.19	56.2	44.14
70538 CHAMBERS 115.00 70539 CHAMBERS 230.00 T1	105.25	107.25	107.11	98.48	101.23	104.88
70538 CHAMBERS 115.00 70539 CHAMBERS 230.00 T2	105.25	107.25	107.11	98.48	101.23	104.88
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	157.48	120.64	99.38	41.7	33.41	25.38
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	149.91	139.23	137.97	73.91	69.16	67.16
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	154.65	123.87	104.42	49.14	40.82	32.67
70365 SULLIVAN_2 230.00 70481 MONACO_12 230.00 1	135.68	125.61	127.02	87.33	81.25	80.63
70139 DANIEL_PK 230.00 70323 PRAIRIE_3 230.00 2	134.47	127.64	124	77.67	76.43	71.54
70189 GREENWOOD_2 230.00 70481 MONACO_12 230.00 1	132.02	122.67	124.08	See GREENWOOD_2 to GREE-SR entry		
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	113.96	87.73	138.23	66.4	64.86	132.13
70260 LEETSDALE 230.00 70365 SULLIVAN_2 230.00 1	122.88	112.56	113.77	72.8	66.18	65.26
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	122.81	116.34	112.76	72.45	71.34	66.45
70285 MIDWAY_PS 115.00 70286 MIDWAYPS 230.00 T1	119.64	73.56	54.44	115.87	72.39	53.51
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	120.05	110.15	113.05	72.33	66.51	67.41
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	118.57	108.82	111.7	72.34	66.53	67.43
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	108.43	102.91	146.52	45.14	40.65	50.04
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	110.48	108.07	107.56	96.86	96.42	103.64
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	118.07	84.07	75.8	32.94	26.19	34.14
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	108.42	105.92	105.38	94.09	93.58	101.2
70139 DANIEL_PK 230.00 70331 PRAIRIE_1 230.00 1	108.37	106.2	100.18	77.22	76.08	71.19
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T3	105.19	99.79	94.63	82.05	78.34	74.42
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T4	105.19	99.79	94.63	82.05	78.34	74.42
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T5	105.19	99.79	94.63	82.05	78.34	74.42
70037 ARAPAHOE_B 115.00 70038 ARAPAHOE 230.00 T5	101.55	109.01	101.81	89.19	96.61	89.03
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	99.8	90.08	92.74	61.2	55.23	56
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	97.9	98.24	93.18	83.96	83.42	81.72
70208 GRAY_STREET 115.00 70252 LAKEWOOD_2 115.00 2	97.87	88	54.04	85.91	77.94	53.48
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	96.5	78.91	78.78	90.33	73.16	73.67
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	96.5	78.91	78.78	90.33	73.16	73.67
70112 CLARK 230.00 70241 JORDAN 230.00 1	93.63	79.91	87.42	71.48	59.72	65.68
70208 GRAY_STREET 115.00 70251 LAKEWOOD_1 115.00 1	95.95	86	48.4	84.16	75.96	47.81
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	96.06	94.26	88.2	69.76	68.79	63.86
70192 FORT_LUPTON 230.00 70311 PAWNEE 230.00 1	88.22	69.25	76.72	78.94	68.1	75.87
70126 CONOCO 115.00 70377 SANDOWN 115.00 1	93.77	85.8	49.99	Refer to CONOCO to NEW_SUB_A entry		
70110 CHEROKEE_N 115.00 70174 FEDERHT23 115.00 1	92.15	87.41	66.21	62.1	59.16	40.22
70599 SMOKY_HILL 345.00 70624 MISS_SITE 345.00 1	88.74	56.88	65.23	77.24	56.96	65.28
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	90.09	80.12	82.64	54.8	48.64	49.31
70208 GRAY_STREET 115.00 70402 SOUTH 115.00 1	89.44	92.82	50.72	90.51	95.67	52.4
70036 ARAPAHOE_A 115.00 70037 ARAPAHOE_B 115.00 1	86.82	90.33	79.19	69.84	70.59	64.98
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	68.5	78.7	120.57	68.84	77.13	106.92
70107 CHEROKEE 230.00 70108 CHEROKEE_S 115.00 T1	84.19	67.49	92.37	55.65	47.87	73.11
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	89.4	82.53	79.96	95.19	88.84	83.88
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	Refer to GREENWOOD_2 230.00 to MONACO_12 entry			87.41	81.88	81.42
70037 ARAPAHOE_B 115.00 70401 SOUTH_TAP 115.00 1	78.85	81.85	83.36	97.17	96.19	94.91
70036 ARAPAHOE_A 115.00 70531 AIR_LIQ_TP 115.00 1	88.85	84.95	87.65	98.67	95.21	100.17
70036 ARAPAHOE_A 115.00 70441 UNIVERS1 115.00 1	56.14	56.18	87.63	63.66	66.47	98.32
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	Refer to MAPLETO2 to SANDOWN entry			67.85	61.62	19.79
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	Refer to GREENWOOD_2 230.00 to MONACO_12 entry			87.41	81.88	81.41
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	Refer to CONOCO to SANDOWN entry			68.51	62.66	37.33

2026	Pre Mitigation					Post Mitigation				
<----------MONITORED_BRANCH---------->	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	112.64	116.13	120.03	136.48	62	81.38	81.63	74.79	80.99	32.6
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	100.94	104.13	98.77	102.7	93.8	87.83	93.22	86.19	90.28	81.06
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	118.09	120.82	121.94	126.89	109.55	87.86	95.58	87.65	92	70.36
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	137.35	132.29	151.6	140.01	163.37	67.82	64.59	75.38	69.17	79.55
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	97.33	111.09	86.78	114.89	131.98	Open	Open	Open	Open	Open
70023 ALLISON 115.00 70400 SODA_LAKES 115.00 1	98.98	97.98	106.78	103.64	109.61	96.36	97.34	98.56	97.59	96.49
70139 DANIEL_PK 230.00 70323 PRAIRIE_3 230.00 2	122.91	113.09	143.03	125.29	142.66	68.68	61.73	83.73	69.84	77.76
70045 BANCROFT 115.00 70242 KENDRICK 115.00 1	97.55	97.87	97.24	97.12	100.02	97.56	97.42	97.69	97.82	96.91
70538 CHAMBERS 115.00 70539 CHAMBERS 230.00 T1	91.84	91.37	91.61	90.78	98.61	83.26	85.92	84.21	85.35	96.28
70538 CHAMBERS 115.00 70539 CHAMBERS 230.00 T2	91.84	91.37	91.61	90.78	98.61	83.26	85.92	84.21	85.35	96.28
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T3	109.9	99.22	120.07	110.24	117.18	83.77	75.54	91.43	83.97	88.53
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T4	109.9	99.22	120.07	110.24	117.18	83.77	75.54	91.43	83.97	88.53
70139 DANIEL_PK 230.00 70601 DANIEL_PK 345.00 T5	109.9	99.22	120.07	110.24	117.18	83.77	75.54	91.43	83.97	88.53
70444 VALMONT_1 115.00 70447 VALMONT 230.00 T8	84.48	85.68	83.45	84.49	93.77	75.41	77.05	73.6	75	85.99
70440 VALMONT_2 115.00 70447 VALMONT 230.00 T7	83.82	85.2	82.64	83.83	93.17	74.86	77.01	73.06	74.72	85.82
70277 MAPLETO2 115.00 70377 SANDOWN 115.00 1	91.67	95.04	98.87	115.36	41.33	See MAPLETO2 to NEW_SUB_A entry				
70365 SULLIVAN_2 230.00 70481 MONACO_12 230.00 1	123.76	119.11	137.71	126.18	150.25	79.89	75.81	89.82	81.67	96.49
70265 LOOKOUT_1 115.00 70266 LOOKOUT 230.00 T1	51.57	55.7	50.73	52.53	63.2	50.36	54.5	50.93	52.08	65.09
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	111.8	101.93	131.69	114.02	131.3	63.69	56.64	78.72	64.76	72.75
70260 LEETSDALE 230.00 70365 SULLIVAN_2 230.00 1	111.16	105.88	125.78	113.51	139.06	65.37	60.83	75.61	67	82.66
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	111.19	113.73	115.75	113.14	131.75	68.1	69.37	71.03	69.63	79.88
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	109.83	112.33	114.34	111.75	130.12	68.11	69.38	71.04	69.63	79.88
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	97.1	98.33	100.37	98.85	115.32	85.36	88.23	89.24	87.68	110.97
70139 DANIEL_PK 230.00 70331 PRAIRIE_1 230.00 1	98.73	84.99	119.08	100.09	110.09	68.26	57.67	83.3	69.4	76.06
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	102.95	97.63	114.89	104.88	116.73	45.05	43.88	49.9	46.51	48.31
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	94.39	95.62	97.82	96.15	113.49	82.16	85.22	86.24	84.6	109.14
70037 ARAPAHOE_B 115.00 70038 ARAPAHOE 230.00 T5	108.29	101.82	104.71	111.48	109.95	80.96	80.26	84.83	81.61	97.32
70126 CONOCO 115.00 70377 SANDOWN 115.00 1	96.15	100.13	92.23	93.06	46.09	Refer to CONOCO to NEW_SUB_A entry				
70244 LAFAYETTE 115.00 70444 VALMONT_1 115.00 1	90.76	92.1	91.05	91.62	90.97	89.57	90.3	89.7	90.3	88.67
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	91.77	94.04	96.19	93.6	112.32	57.23	58.44	60.02	58.66	69.04
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	91.79	83.89	107.06	94.04	109.79	29.06	27.38	33.63	30.05	32.34
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	86.92	72.91	107.31	88.13	98.28	61.11	50.33	76.15	62.12	68.88
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	95.76	106.22	99.99	97.34	104.79	66.86	74.87	69.46	68.12	73.55
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	95.76	106.22	99.99	97.34	104.79	66.86	74.87	69.46	68.12	73.55
70259 LEETSDALE_1 115.00 70282 LEETSDALE_2 115.00 1	105.91	134.76	Open	Open	Open	56.1	57.27	70.16	61.56	106.85
70259 LEETSDALE_1 115.00 70260 LEETSDALE 230.00 T4	101.95	113.39	83.92	87.28	98.39	67.04	69.24	75.54	71.04	99.67
70624 MISS_SITE 345.00 70628 PRONGHORN 345.00 1	100.92	101.39	84.73	84.4	87.78	100.71	101.23	84.77	84.34	87.64
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	94.98	94.33	116.61	115.49	176.48	46.59	44.69	50.75	46.73	73.2
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	92.17	88.12	101.2	94.59	107.2	80.49	80.76	86.08	81.58	85.96
70112 CLARK 230.00 70241 JORDAN 230.00 1	88.81	107.45	76.54	91.63	106.5	73.13	93.55	58.45	75.6	85.93
70410 FT_ST_VRAIN 230.00 70916 FT_ST_VRAIN 345.00 T7	87.93	101.03	84.57	91.35	98.71	86.11	99.44	82.77	89.69	97.01
70410 FT_ST_VRAIN 230.00 70916 FT_ST_VRAIN 345.00 T8	87.93	101.03	84.57	91.35	98.71	86.11	99.44	82.77	89.69	97.01
70283 MEADOW_HILLS230.00 70396 SMOKY_HILL 230.00 1	80.6	91.37	73.75	82.21	90.71	71.19	82.67	62.97	72.7	78.68
70259 LEETSDALE_1 115.00 70441 UNIVERS1 115.00 1	89.33	91.23	80.38	80.7	82.23	84.42	85	83.18	84.85	77.26
70260 LEETSDALE 230.00 70282 LEETSDALE_2 115.00 T5	87.97	90.65	70.06	71.76	94.12	65.07	67.22	73.39	68.98	96.99
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	88.15	82.42	99.99	90.02	102.01	37.67	36.61	42.57	39.19	40.97
70208 GRAY_STREET 115.00 70402 SOUTH 115.00 1	78.66	78.95	92.79	97.37	94.36	84.17	84.84	86.69	84.89	96.64
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	86.32	88.24	92.04	103.24	52.84	59.5	60.55	55.7	59.65	44.03
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	81.17	76.39	91.87	82.52	98.43	86.3	79.9	98.42	87.95	102.18
70263 LITTLET1 115.00 70483 WATERTN_TP 115.00 1	82.05	77.95	91.02	84.51	97.09	70.44	70.68	75.98	71.4	75.99
70036 ARAPAHOE_A 115.00 70037 ARAPAHOE_B 115.00 1	85.02	82.5	90.25	85.12	110.38	67.74	66.15	74.22	69.31	81.34
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	70.27	74.42	76.81	71.77	131.43	74.49	84.48	78.45	79.34	96
70144 DENVER_TRM_2115.00 70149 DENVER_TERM 230.00 T2	61.4	62.62	60.06	58.81	110.04	56.56	67.65	58.13	59.54	76.17
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	82.34	84.55	86.75	84.16	103.35	50.94	52.14	53.61	52.32	62.76
70599 SMOKY_HILL 345.00 70624 MISS_SITE 345.00 1	83.81	87.77	69.49	88.12	94.78	84.83	93.24	70.66	89.8	95.77
70037 ARAPAHOE_B 115.00 70401 SOUTH_TAP 115.00 1	82.28	77.08	80.43	81.98	93.35	89.96	88.63	96.6	91.63	104.35
70182 HARRISON_PS2115.00 70215 HARRISON_PS1115.00 1	46.5	46.13	56.58	56.38	93.06	61.32	57.69	67.93	61.07	102.63
70154 DERBY_1 115.00 70216 HAVANA1 115.00 1	73.22	74.54	76.62	74.89	91.81	63.6	66.68	67.42	65.72	90.13
70036 ARAPAHOE_A 115.00 70531 AIR_LIQ_TP 115.00 1	86.63	86.99	84.93	83.96	74.85	91.82	89.77	95.82	92.87	89.72
70139 DANIEL_PK 230.00 70527 SANTA_FE 230.00 1	69.12	63.25	79.48	70.49	80.34	77.44	70.69	89.13	78.87	90.1
70037 ARAPAHOE_B 115.00 70038 ARAPAHOE 230.00 T6						80.96	80.26	84.83	81.61	97.32
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					80.41	76.78	89.6	82.15	95.7
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					80.41	76.78	89.59	82.14	95.7
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	Refer to MAPLETO2 to SANDOWN entry					70.86	71.16	64.27	70.46	23.91
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	Refer to CONOCO to SANDOWN entry					69	60.43	64.56	64.35	39.66
70189 GREENWOOD_2 230.00 70481 MONACO_12 230.00 1	120.77	116.65	133.59	123.07	145.06	Refer to GREENWOOD_2 230.00 to GREE-SR entry				

2027	Pre Mitigation					Post Mitigation				
<----------MONITORED_BRANCH---------->	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	152.08	142.6	166.44	156.24	174.19	79.36	74.67	87.09	81.64	88.71
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	124.22	119.26	117.43	120.81	93.62	87.69	92.67	91.22	95.03	88.97
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	120.8	119.07	107.5	110.98	71.06	82.52	85.18	79.35	79.07	37.83
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	106.15	109.26	104.7	107.05	96.71	82.68	87.66	82.26	85.03	80.78
70365 SULLIVN2 230.00 70481 MONACO_12 230.00 1	142.02	133.24	156	146.17	164.79	80.08	74.98	89.91	82.76	91.91
70139 DANIELPK 230.00 70323 PRAIRIE_3 230.00 2	136.17	124.92	151.36	139.25	152.36	78.1	72.21	88.84	80.04	86
70023 ALLISON 115.00 70400 SODALAKE 115.00 1	105.62	105.15	108.89	106.22	113.18	103.47	104.29	104.34	103.97	103.33
70037 ARAP_B 115.00 70038 ARAPAHOE 230.00 T5	101.86	100.83	107.65	103.64	111.56	92.46	91.69	98.41	95.89	104.18
70045 BANCROFT 115.00 70242 KENDRICK 115.00 1	103.71	102.43	103.02	103.4	103.33	100.64	100.26	100.7	100.2	101.7
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	123.68	120.56	130.93	127.24	142.42	74.49	71.67	78.92	76.83	84.09
70107 CHEROKEE 230.00 70108 CHEROKEE_S 115.00 T1	36.8	82.17	83.62	75.64	83.7	41.76	53.23	56.03	50.82	88.86
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	122.14	119.07	129.31	125.67	140.68	74.49	71.68	78.93	76.84	84.11
70244 LAFAYETTE 115.00 70444 VALMONT_1 115.00 1	99.95	99.19	99.43	99.86	100.16	97.18	98.32	98.32	98.07	97.46
70107 CHEROKEE 230.00 70110 CHEROKEE_N 115.00 T2	69.46	91.8	93.03	93.2	67.6	54.03	57.36	63.73	78.3	91.63
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	124.72	113.57	139.63	127.66	140.45	72.97	67.03	83.64	74.85	80.78
70444 VALMONT_1 115.00 70447 VALMONT 230.00 T8	93.93	96.42	88.42	89.08	98.73	84.92	85.32	76.56	76.42	89.07
70440 VALMONT_2 115.00 70447 VALMONT 230.00 T7	84.37	94.79	83.72	85.13	91.8	76.27	85.44	73.59	75.53	83.44
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	159.94	150.54	177.37	167.48	162.87	53.07	34.93	57.66	54.82	52.68
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	105.07	100.95	107.95	105.94	116.35	90.97	89.46	96.59	93.84	113.41
70260 LEETSDALE 230.00 70365 SULLIVN2 230.00 1	128.97	119.55	143.37	132.82	151.31	63.91	58.23	73.93	66.16	75.26
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T1	90.52	89.63	90.19	90.43	97.14	83.79	84.07	84.8	84.57	97.09
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T2	90.52	89.63	90.19	90.43	97.14	83.79	84.07	84.8	84.57	97.09
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T3	110.49	108.17	114.51	113.06	115.81	83.55	81.85	86.6	85.44	87.25
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T4	110.49	108.17	114.51	113.06	115.81	83.55	81.85	86.6	85.44	87.25
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T5	110.49	108.17	114.51	113.06	115.81	83.55	81.85	86.6	85.44	87.25
70259 LEETSDALE_1 115.00 70441 UNIVERS1 115.00 1	94.96	95.87	92.73	95.19	89.56	84.77	84.59	83.72	84.34	78.74
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	161.05	151.21	181.29	170.18	164.42	45.61	27.3	49.91	47.18	45.07
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	119.98	109.73	136.53	126.48	122.68	37.16	28.48	41.05	38.17	36.3
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	118.47	113.54	125.75	121.76	123.02	83.99	80.62	89.18	86.39	87.52
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	118.47	113.54	125.75	121.76	123.02	83.99	80.62	89.18	86.39	87.52
70139 DANIELPK 230.00 70331 PRAIRIE_1 230.00 1	108.35	96.3	123.02	109.96	116.57	77.34	69.11	88.1	78.63	82.52
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	104.2	100.97	111.07	107.27	121.35	63.51	60.44	67.66	65.57	72.6
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	101.71	150.5	133.11	152.38	121.61	Open	Open	Open	Open	Open
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	102.46	98.45	105.77	103.62	114.31	87.85	86.38	93.91	91.11	111.51
70112 CLARK 230.00 70241 JORDAN 230.00 1	94.78	101.91	90.04	97.45	110.07	80.63	89.28	74.68	83.37	92.27
70396 SMOKY_HILL 230.00 70596 HARVEST_MI 230.00 1	96.41	92.16	103.42	99.58	101.22	72.21	69.23	84.71	74.75	75.82
70142 DEERCRK 115.00 70400 SODALAKE 115.00 1	102.54	88.63	118.82	103.91	113.26	102.83	88.6	118.19	104.16	109.76
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	95.12	91.76	101.88	97.92	111.5	57.21	53.97	61.17	59.08	65.94
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	95.91	90.14	102.17	96.69	106.43	87.56	87.59	87.5	87.39	87.63
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	96.37	84.26	110.96	97.85	104.26	70.02	61.69	80.69	71.22	75.07
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	94.16	86.79	104.26	96.69	108.02	70.72	65.44	78.4	72.57	78.47
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	127.61	153.28	169.48	152.57	183.24	51.52	48.68	55.76	52.04	79.94
70110 CHEROKEE_N 115.00 70174 FEDERHT23 115.00 1	93.61	86.76	94.04	93.24	87.35	62.19	58.22	62.77	62.17	51.74
70208 GRAY_STREET 115.00 70252 LAKEWOOD_2 115.00 2	101.32	82.84	98.97	95.92	72.85	87.03	73.57	89.5	84.91	80.39
70208 GRAY_STREET 115.00 70251 LAKEWOOD_1 115.00 1	100.34	81.59	97.7	94.68	69.66	89.03	71.5	87.57	82.84	77.22
70277 MAPLETO2 115.00 70377 SANDOWN 115.00 1	99.61	97.96	86.38	89.57	50.41	See MAPLETO2 to NEW_SUB_A entry				
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	97.62	93.31	88.09	90.27	55.22	64.56	66.79	62.91	63.8	47.16
70036 ARAP_A 115.00 70037 ARAP_B 115.00 1	91.74	88.86	95.96	92.96	98.88	74.1	71.03	80.72	76.17	87
70285 MIDWAYPS 115.00 70286 MIDWAYPS 230.00 T1	91.4	70.3	116.23	86.22	82.23	90.43	69.23	114.88	85.11	80.64
70162 EAST_1 115.00 70171 EAST_2 115.00 1	90.68	80.9	92.3	88.11	96.4	79.73	74.06	85.21	79.51	90.97
70036 ARAP_A 115.00 70531 AIR_LIQ_TP 115.00 1	90.24	84.26	92.82	90.58	86.59	73.38	70.09	76.57	74.67	71.45
70126 CONOCO 115.00 70377 SANDOWN 115.00 1	90.1	86.52	91.06	89.41	65.14	Refer to CONOCO to NEW_SUB_A entry				
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	77.19	107.78	110.2	111.25	139.24	78.06	91.48	91.48	95.47	119.64
70265 LOOKOUT_1 115.00 70266 LOOKOUT 230.00 T1	84.59	95.61	93.85	92.48	90.66	55.77	63.8	63.21	66.18	73.72
70398 BEAVER_CK1 115.00 70399 B.CRK_PS 230.00 T1	88.2	95.5	81.19	90.93	90.44	87.22	94.68	80.23	89.97	89.55
70144 DENVER_TRM_2115.00 70149 DENVER_TERM 230.00 T2	61.19	95.34	100.12	99.23	106.6	61.94	82.47	84.3	81.38	91.06
70260 LEETSDALE 230.00 70282 LEETSDALE_2 115.00 T5	86.75	94	104.27	96.33	106.24	70.83	70.35	82.06	76.78	102.28
70139 DANIELPK 230.00 73477 FULLER 230.00 1	67.63	39.39	102.3	64.17	71.14	65.66	37.47	100.24	62.12	68.59
70653 TUNDRA 345.00 70654 COMANCHE 345.00 2	56.55	17.21	101.56	46.72	55.41	58.08	18.69	103.03	48.3	57.18
70653 TUNDRA 345.00 70654 COMANCHE 345.00 1	55.99	17.04	100.54	46.25	54.85	57.5	18.5	102	47.81	56.61
70259 LEETSDALE_1 115.00 70282 LEETSDALE_2 115.00 1	88.97	88.83	96.64	90.66	91.12	65.57	62.45	82.11	72.28	114.56
70259 LEETSDALE_1 115.00 70260 LEETSDALE 230.00 T4	80.89	85.01	96.28	88.66	109.64	72.93	72.45	84.4	79.02	105.07
70463 WATERTON 115.00 70464 WATERTON 230.00 T1	88.87	84.31	94.22	89.65	95.27	84.59	80.22	89.67	85.13	90.26
70182 HARRISON_PS2115.00 70215 HARRISON_PS1115.00 1	64.99	85.32	92.92	84.05	95.19	68.84	64.39	75.08	69.62	111.85

2027	Pre Mitigation					Post Mitigation				
<----------MONITORED_BRANCH---------->	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee
70463 WATERTON 115.00 70464 WATERTON 230.00 T2	88.83	85.09	92.92	88.88	94.28	87.73	83.31	90.93	87.57	90.28
70263 LITTLET1 115.00 70483 WATERTN_TP 115.00 1	85.39	79.79	91.76	86.22	95.94	76.74	76.76	77.17	76.59	77.09
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T1	85.41	81.3	91.2	87.71	88.56	65.29	62.08	73.08	67.09	67.93
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T2	85.41	81.3	91.2	87.71	88.56	65.29	62.08	73.08	67.09	67.93
70283 MEADOWHL 230.00 70396 SMOKY_HILL 230.00 1	83.68	87.77	81.84	85.92	94.44	75.68	80.52	73.25	77.88	83.74
70037 ARAP_B 115.00 70401 SOUTH_TAP 115.00 1	77.61	74.44	84.33	79.88	92.07	68.87	66.58	73.99	70.84	77.03
70154 DERBY_2 115.00 70216 HAVANA1 115.00 1	79.49	78.24	85.43	82.97	90.97	67.95	67.43	75.07	72.85	91.14
70208 GRAY_STREET 115.00 70402 SOUTH 115.00 1	81.89	82.88	82.55	82.96	83.57	66.75	68.04	69.52	68.89	75.7
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					80.8	76.21	89.91	83.43	91.98
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					80.79	76.2	89.91	83.42	91.97
70037 ARAP_B 115.00 70038 ARAPAHOE 230.00 T6						92.46	91.69	98.41	95.89	104.18
70139 DANIELPK 230.00 70527 SANTA_FE 230.00 1	78.13	71.27	86.94	79.82	86.86	89.03	65.94	98.99	91.21	98.04
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	Refer to MAPLETO2 to SANDOWN entry					71.99	74.92	69.18	68.57	31.91
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	Refer to CONOCO to SANDOWN entry					72.78	69.14	68.67	65.16	36.45
70189 GREENWOOD_2 230.00 70481 MONACO_12 230.00 1	137.62	129.63	150.55	141.6	159.04	Refer to GREENWOOD_2 230.00 to GREE-SR entry				

2028	Pre Mitigation					Post Mitigation				
<----------MONITORED_BRANCH---------->	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	162.37	146.93	169.48	162.77	188.48	83.96	76.12	89.44	84.8	96.86
70107 CHEROKEE 230.00 70108 CHEROKEE_S 115.00 T1	39.61	79.7	104.08	48.57	80.94	54.27	54.35	59.64	59.1	74.05
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	125.77	120.37	118.36	124.89	94.91	53.87	57.33	59.83	61.51	44.36
70365 SULLIVN2 230.00 70481 MONACO_12 230.00 1	151.48	136.78	158.91	152.3	178.85	84.15	75.44	91.65	85.09	99.5
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	102.45	102.89	98.2	102.03	91.8	85.71	88.08	87.32	88.74	81.7
70139 DANIELPK 230.00 70323 PRAIRIE_3 230.00 2	145.46	129.02	154.23	145.23	165.25	82.64	73.68	91.17	83.14	93.98
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	119.02	111.51	101.81	134.79	69.1	82.6	84.55	76.14	84.09	29.02
70653 TUNDRA 345.00 70654 COMANCHE 345.00 2	69.45	17.2	113.54	56.72	68.14	71.24	18.74	115.11	58.58	70
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	130.83	123.11	132.92	131.53	151.82	77.48	73.38	80.11	78.45	89.46
70653 TUNDRA 345.00 70654 COMANCHE 345.00 1	68.75	17.03	112.4	56.15	67.45	70.52	18.55	113.95	57.99	69.3
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	129.24	121.62	131.28	129.91	149.96	77.49	73.4	80.13	78.46	89.47
70037 ARAP_B 115.00 70038 ARAPAHOE 230.00 T5	103.26	99.34	111.24	110.7	115.87	87.4	88.04	86.85	91.57	90.98
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	168.23	104.35	160.62	107.59	112.5	Open	Open	Open	Open	Open
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	170.2	148.05	183.16	177.12	183.22	58.06	51.33	61.77	58.75	61.65
70244 LAFAYETTE 115.00 70444 VALMONT_1 115.00 1	101.89	99.19	99.91	101.64	100.55	99.48	98.29	98.47	98.43	98.35
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	133.47	117.39	142.3	133.36	153.01	77.36	68.45	85.9	77.89	88.68
70260 LEETSDALE 230.00 70365 SULLIVN2 230.00 1	136.96	121.83	146.05	139.01	165.8	67.1	58.17	75.15	68.45	83.15
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T1	100.69	100.52	100.77	105.93	109.07	97.01	94.58	95.17	96.85	108.04
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T2	100.69	100.52	100.77	105.93	109.07	97.01	94.58	95.17	96.85	108.04
73211 WELD LM 115.00 73212 WELD LM 230.00 1	94.55	95.06	93.82	94.36	95.12	93.98	94.68	93.2	93.68	94.8
70259 LEETSDALE_1 115.00 70441 UNIVERS1 115.00 1	95.56	93.21	91.66	92	89.09	47.49	46.82	46.7	46.73	46.81
70020 CASTLRCK_TP1115.00 70091 CASTLRCK 115.00 1	99.59	96.72	96.08	99.38	100.87	98.35	95.85	94.3	98.4	99.46
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	172.78	147.54	187.85	181.12	186.87	50.32	43.54	54.13	51	53.96
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T3	115.07	110.92	117.17	117.56	122.75	87.03	84.09	88.65	88.69	92.25
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T4	115.07	110.92	117.17	117.56	122.75	87.03	84.09	88.65	88.69	92.25
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T5	115.07	110.92	117.17	117.56	122.75	87.03	84.09	88.65	88.69	92.25
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	129.97	107.88	141.75	135.46	141.86	41.59	34.84	45.48	42.3	45.26
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	123.29	117.19	128.12	126.57	132.86	87.24	83.13	90.81	89.75	94.52
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	123.29	117.19	128.12	126.57	132.86	87.24	83.13	90.81	89.75	94.52
70139 DANIELPK 230.00 70331 PRAIRIE_1 230.00 1	115.91	99.79	125.63	114.93	127	81.91	70.63	90.39	81.71	90.34
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	109.47	102.1	112.64	111.2	130.47	65.85	61.92	68.53	67	77.79
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	107.84	102.07	111.47	114.51	125.72	96.28	91.88	98.59	97.53	121.25
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	105.62	99.69	109.47	112.59	124.43	93.41	88.75	95.82	94.7	119.7
70396 SMOKY_HILL 230.00 70596 HARVEST_MI 230.00 1	103.25	96.46	107.04	105.37	111.59	78.11	71.84	89.37	78.56	83.53
70112 CLARK 230.00 70241 JORDAN 230.00 1	96.44	100.32	90.21	98.48	114.02	81.34	87.63	75.52	83.52	94.89
70090 FORT_LUPTON2115.00 70192 FORT_LUPTON 230.00 T3	96.31	98.49	98.84	100	102.44	95.26	98.56	97.03	97.45	101.93
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	103.36	87.43	113.37	102.57	114.47	74.35	63.15	82.88	74.22	82.78
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	99.19	91.87	103.2	101.71	120.69	59.1	55.28	61.82	60.38	71.04
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	100.6	88.01	157.63	173.73	185.78	51.22	48.56	55.3	52.02	79.49
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	100.55	89.29	106.43	101.07	118.29	75.27	67.11	81.04	75.93	86.91
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	95.89	91	101.68	96.49	109.52	85.68	82.67	85.46	85.7	87.94
70110 CHEROKEE_N 115.00 70174 FEDERHT23 115.00 1	97.48	87.65	96.24	95.56	90.48	63.78	57.55	62.85	62.23	54.2
70198 GILCREST 115.00 70219 ANADARKO_TAP115.00 1	92.64	93.1	87.46	93.53	101.02	85.25	87.82	80.97	84.45	95.58
70208 GRAY_STREET 115.00 70252 LAKEWOOD_2 115.00 2	100	84.1	95.62	96.51	71.65	96.28	83.1	99.67	94.31	84.78
70208 GRAY_STREET 115.00 70251 LAKEWOOD_1 115.00 1	97.49	81.56	93.51	94.03	66.82	94.09	80.76	97.36	92.1	82.47
70198 GILCREST 115.00 70202 GODFRETP 115.00 1	89.28	89.59	84.55	90.07	96.79	82.54	84.82	78.67	81.78	91.81
70036 ARAP_A 115.00 70531 AIR_LIQ_TP 115.00 1	95.31	86.21	95.21	94.1	89.99	76.89	77.03	81.91	78.98	96.91
70283 MEADOWHL 230.00 70396 SMOKY_HILL 230.00 1	86.92	88.65	82.75	87.4	97.45	77.59	80.79	74.19	78.55	85.8
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	101.27	73.22	114.24	89.1	130.86	49.11	58.51	75.46	66.08	82.55
70126 CONOCO 115.00 70377 SANDOWN 115.00 1	100.15	84.46	81.83	94.13	55.03	Refer to CONOCO to NEW_SUB_A entry				
70074 CALIFORN_TP 115.00 70087 CAPITOL_HILL115.00 1	99.26	78.41	65.09	88.28	32.69	66.98	67.06	65.66	66.72	56.26
70074 CALIFORN_TP 115.00 70276 MAPLETO1 115.00 1	99.26	78.41	65.11	88.28	32.69	66.98	67.06	65.66	66.72	56.26
70277 MAPLETO2 115.00 70377 SANDOWN 115.00 1	98.23	90.68	80.53	115.46	48.58	See MAPLETO2 to NEW_SUB_A entry				
70108 CHEROKEE_S 115.00 70276 MAPLETO1 115.00 2	93.35	76.99	66.47	85.16	28.47	69.48	69.52	68.5	69.24	61.59
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	90.72	87.76	83.45	99.74	54.03	60.7	66.15	60.66	59.88	47.12
70139 DANIELPK 230.00 73477 FULLER 230.00 1	81.67	41.12	111.85	75.54	89.72	78.81	38.43	110.47	72.86	86.08
70036 ARAP_A 115.00 70037 ARAP_B 115.00 1	89.44	85.44	103.43	90.39	103.06	61.21	57.89	66.42	61.56	74.54
70037 ARAP_B 115.00 70401 SOUTH_TAP 115.00 1	79.85	75.07	97.7	83.98	101.84	61.34	57.33	65.02	61.51	69.97
70260 LEETSDALE 230.00 70282 LEETSDALE_2 115.00 T5	79.22	74.58	96.69	103.57	110.99	65.07	61.04	71.49	68.07	95.51
70259 LEETSDALE_1 115.00 70282 LEETSDALE_2 115.00 1	86.97	86.25	96.12	99.32	103.09	65.84	61.32	77.44	71.25	116.93
70312 RAY_LEWI 115.00 70327 PONCHA_E 115.00 1	87.05	42.06	94.82	80.62	90.98	85.2	42.34	93.23	78.79	89.12
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T1	89.04	83.98	93.09	91.38	95.85	68.02	64.08	76.31	69.91	73.58
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T2	89.04	83.98	93.09	91.38	95.85	68.02	64.08	76.31	69.91	73.58
70263 LITTLET1 115.00 70483 WATERTN_TP 115.00 1	85.46	80.73	91.35	86.13	99.11	75.08	72.42	75	75.1	77.6

2028	Pre Mitigation					Post Mitigation				
<----------MONITORED_BRANCH---------->	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee	Peak	Twilight	Comanche Stress	Pathway Stress	No Cherokee
70395 SMOKY_HILL_N115.00 3WNDTR WND 2 T1	89.34	88.7	90.98	89.86	94.86	87.65	84.3	89.54	88.63	95.96
70259 LEETSDALE_1 115.00 70260 LEETSDALE 230.00 T4	84.81	79.72	90.92	90.1	129.67	66.7	62.85	73.25	69.45	97.54
70182 HARRISON_PS2115.00 70215 HARRISON_PS1115.00 1	47.06	39.74	86.35	95.6	97.05	68.4	64.18	74.87	69.68	113.27
70073 CALIFORNIA 115.00 70108 CHEROKEE_S 115.00 1	89.56	75.14	64.36	95.26	39.56	See CHEROKEE_S to NEW_SUB_A entry				
70154 DERBY_2 115.00 70216 HAVANA1 115.00 1	82.64	77.05	86.49	88.12	101.05	70.32	65.6	73.13	71.66	97.06
70040 ARSENAL 115.00 70217 HAVANA2 115.00 1	78.05	72.76	81.72	83.67	95.67	66.6	62.14	69.18	67.88	91.93
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					84.86	76.8	91.69	85.61	98.98
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	Refer to GREENWOOD_2 230.00 to MONACO_12 entry					84.85	76.79	91.69	85.61	98.97
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T6						87.24	83.13	90.81	89.75	94.52
70038 ARAPAHOE 230.00 70527 SANTA_FE 230.00 1	71.09	61.42	76.73	71.33	82.45	82.42	72.09	90.08	83.09	95.79
70036 ARAP_A 115.00 70441 UNIVERS1 115.00 1	62.25	59.77	73.5	64.48	64.41	64.13	63.19	75.57	66.79	101.47
70402 SOUTH 115.00 70531 AIR_LIQ_TP 115.00 1	85.01	76.12	84.99	83.81	79.8	84.29	84.54	89.23	86.37	103.41
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	Refer to MAPLETO2 to SANDOWN entry					72.14	74.33	65.79	74.03	21.65
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	Refer to CONOCO to SANDOWN entry					75.92	71.42	71.28	78.3	34.18
70189 GREENWOOD_2 230.00 70481 MONACO_12 230.00 1	146.96	133.35	153.36	147.32	172.05	Refer to GREENWOOD_2 230.00 to GREE-SR entry				

2030 Clean Energy

<----------MONITORED_BRANCH---------->	Peak + 1GW Wind
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	93.02
70107 CHEROKEE 230.00 70108 CHEROKEE_S 115.00 T1	57.45
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	54.06
70365 SULLIVN2 230.00 70481 MONACO_12 230.00 1	93.8
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	87.48
70139 DANIELPK 230.00 70323 PRAIRIE_3 230.00 2	90.44
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	79.28
70653 TUNDRA 345.00 70654 COMANCHE 345.00 2	36.2
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	86.67
70653 TUNDRA 345.00 70654 COMANCHE 345.00 1	35.84
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	86.67
70037 ARAP_B 115.00 70038 ARAPAHOE 230.00 T5	81.92
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	Open
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	64.95
70244 LAFAYETTE 115.00 70444 VALMONT_1 115.00 1	102.56
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	84.88
70260 LEETSDALE 230.00 70365 SULLIVN2 230.00 1	76.96
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T1	96.18
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T2	96.18
73211 WELD LM 115.00 73212 WELD LM 230.00 1	94.78
70259 LEETSDALE_1 115.00 70441 UNIVERS1 115.00 1	48.87
70020 CASTLRCK_TP1115.00 70091 CASTLRCK 115.00 1	101.95
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	56.96
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T3	94.2
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T4	94.2
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T5	94.2
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	47.94
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	97.13
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	97.13
70139 DANIELPK 230.00 70331 PRAIRIE_1 230.00 1	87.75
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	74.84
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	103.64
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	100.99
70396 SMOKY_HILL 230.00 70596 HARVEST_MI 230.00 1	87.03
70112 CLARK 230.00 70241 JORDAN 230.00 1	95.07
70090 FORT_LUPTON2115.00 70192 FORT_LUPTON 230.00 T3	98.34
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	79.8
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	68.08
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	57.17
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	83.4
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	91.07
70110 CHEROKEE_N 115.00 70174 FEDERHT23 115.00 1	65.57
70198 GILCREST 115.00 70219 ANADARKO_TAP115.00 1	86.31
70208 GRAY_STREET 115.00 70252 LAKEWOOD_2 115.00 2	101.86
70208 GRAY_STREET 115.00 70251 LAKEWOOD_1 115.00 1	99.31
70198 GILCREST 115.00 70202 GODFRETP 115.00 1	83.79
70036 ARAP_A 115.00 70531 AIR_LIQ_TP 115.00 1	85.55
70283 MEADOWHL 230.00 70396 SMOKY_HILL 230.00 1	86.16
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	56.09

2030 Clean Energy	
<----------MONITORED_BRANCH---------->	Peak + 1GW Wind
70074 CALIFORN_TP 115.00 70087 CAPITOL_HILL115.00 1	68.17
70074 CALIFORN_TP 115.00 70276 MAPLETO1 115.00 1	68.17
70108 CHEROKEE_S 115.00 70276 MAPLETO1 115.00 2	71.2
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	58.53
70139 DANIELPK 230.00 73477 FULLER 230.00 1	66.89
70036 ARAP_A 115.00 70037 ARAP_B 115.00 1	66.91
70037 ARAP_B 115.00 70401 SOUTH_TAP 115.00 1	66.22
70260 LEETSDALE 230.00 70282 LEETSDALE_2 115.00 T5	77.22
70259 LEETSDALE_1 115.00 70282 LEETSDALE_2 115.00 1	82.52
70312 RAY_LEWI 115.00 70327 PONCHA_E 115.00 1	69.72
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T1	75.49
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T2	75.49
70263 LITTLET1 115.00 70483 WATERTN_TP 115.00 1	79.83
70395 SMOKY_HILL_N115.00 3WNDTR WND 2 T1	98.32
70259 LEETSDALE_1 115.00 70260 LEETSDALE 230.00 T4	80.42
70182 HARRISON_PS2115.00 70215 HARRISON_PS1115.00 1	77.29
70154 DERBY_2 115.00 70216 HAVANA1 115.00 1	78.3
70040 ARSENAL 115.00 70217 HAVANA2 115.00 1	73.68
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	93.9
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	93.9
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T6	97.13
70038 ARAPAHOE 230.00 70527 SANTA_FE 230.00 1	91.54
70036 ARAP_A 115.00 70441 UNIVERS1 115.00 1	75.64
70402 SOUTH 115.00 70531 AIR_LIQ_TP 115.00 1	92.27
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	68.89
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	73.23

2031 JTS Look Ahead

<----------MONITORED_BRANCH---------->	Peak JTS Look Ahead
70189 GREENWOOD_2 230.00 70212 GREENWOOD_1 230.00 1	90.83
70107 CHEROKEE 230.00 70108 CHEROKEE_S 115.00 T1	44.33
70148 DENVER_TRM_1115.00 70208 GRAY_STREET 115.00 1	59.38
70365 SULLIVN2 230.00 70481 MONACO_12 230.00 1	90.39
70045 BANCROFT 115.00 70208 GRAY_STREET 115.00 1	93.92
70139 DANIELPK 230.00 70323 PRAIRIE_3 230.00 2	88.94
70108 CHEROKEE_S 115.00 70277 MAPLETO2 115.00 1	88.33
70653 TUNDRA 345.00 70654 COMANCHE 345.00 2	46.1
70046 BUCKLEY2 230.00 70396 SMOKY_HILL 230.00 1	84.84
70653 TUNDRA 345.00 70654 COMANCHE 345.00 1	45.64
70046 BUCKLEY2 230.00 70491 TOLLGATE 230.00 1	84.86
70037 ARAP_B 115.00 70038 ARAPAHOE 230.00 T5	79.33
70087 CAPITOL_HILL115.00 70148 DENVER_TRM_1115.00 1	Open
70260 LEETSDALE 230.00 70291 MONROEPS 230.00 1	60.2
70244 LAFAYETTE 115.00 70444 VALMONT_1 115.00 1	105.36
70189 GREENWOOD_2 230.00 70323 PRAIRIE_3 230.00 1	83.08
70260 LEETSDALE 230.00 70365 SULLIVN2 230.00 1	70.77
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T1	99.82
70538 CHAMBERS 115.00 70539 CHMBERS 230.00 T2	99.82
73211 WELD LM 115.00 73212 WELD LM 230.00 1	97.87
70259 LEETSDALE_1 115.00 70441 UNIVERS1 115.00 1	49.84
70020 CASTLRCK_TP1115.00 70091 CASTLRCK 115.00 1	100.63
70163 ELATI1 230.00 70291 MONROEPS 230.00 1	51.56
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T3	89.22
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T4	89.22
70139 DANIELPK 230.00 70601 DANIELPK 345.00 T5	89.22
70149 DENVER_TERM 230.00 70163 ELATI1 230.00 1	41.91
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T4	90.17
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T5	90.17
70139 DANIELPK 230.00 70331 PRAIRIE_1 230.00 1	87.35
70239 JEWELL2 230.00 70491 TOLLGATE 230.00 1	71.67
70217 HAVANA2 115.00 70538 CHAMBERS 115.00 2	100.33
70216 HAVANA1 115.00 70538 CHAMBERS 115.00 1	97.44
70396 SMOKY_HILL 230.00 70596 HARVEST_MI 230.00 1	80.91
70112 CLARK 230.00 70241 JORDAN 230.00 1	93.11
70090 FORT_LUPTON2115.00 70192 FORT_LUPTON 230.00 T3	99.89
70212 GREENWOOD_1 230.00 70331 PRAIRIE_1 230.00 2	78.94
70239 JEWELL2 230.00 70260 LEETSDALE 230.00 1	63.98
70215 HARRISON_PS1115.00 70282 LEETSDALE_2 115.00 1	55.69
70038 ARAPAHOE 230.00 70189 GREENWOOD_2 230.00 1	80.92
70463 WATERTON 115.00 70483 WATERTN_TP 115.00 1	94.18
70110 CHEROKEE_N 115.00 70174 FEDERHT23 115.00 1	68.72
70198 GILCREST 115.00 70219 ANADARKO_TAP115.00 1	92.33

2031 JTS Look Ahead

<----------MONITORED_BRANCH---------->	Peak JTS Look Ahead
70208 GRAY_STREET 115.00 70252 LAKEWOOD_2 115.00 2	107.96
70208 GRAY_STREET 115.00 70251 LAKEWOOD_1 115.00 1	104.98
70198 GILCREST 115.00 70202 GODFRETP 115.00 1	89.4
70036 ARAP_A 115.00 70531 AIR_LIQ_TP 115.00 1	81.84
70283 MEADOWHL 230.00 70396 SMOKY_HILL 230.00 1	87.33
70144 DENVER_TRM_2115.00 70148 DENVER_TRM_1115.00 1	54.68
70074 CALIFORN_TP 115.00 70087 CAPITOL_HILL115.00 1	71.43
70074 CALIFORN_TP 115.00 70276 MAPLETO1 115.00 1	71.43
70108 CHEROKEE_S 115.00 70276 MAPLETO1 115.00 2	74.18
70108 CHEROKEE_S 115.00 70298 NORTH_PS 115.00 1	63.94
70139 DANIELPK 230.00 73477 FULLER 230.00 1	80.27
70036 ARAP_A 115.00 70037 ARAP_B 115.00 1	64.51
70037 ARAP_B 115.00 70401 SOUTH_TAP 115.00 1	65.73
70260 LEETSDALE 230.00 70282 LEETSDALE_2 115.00 T5	72.17
70259 LEETSDALE_1 115.00 70282 LEETSDALE_2 115.00 1	70.72
70312 RAY_LEWI 115.00 70327 PONCHA_E 115.00 1	125.87
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T1	70.15
70596 HARVEST_MI 230.00 70597 HARVEST_MI 345.00 T2	70.15
70263 LITTLET1 115.00 70483 WATERTN_TP 115.00 1	82.56
70395 SMOKY_HILL_N115.00 3WNDTR WND 2 T1	91.67
70259 LEETSDALE_1 115.00 70260 LEETSDALE 230.00 T4	74
70182 HARRISON_PS2115.00 70215 HARRISON_PS1115.00 1	74.64
70154 DERBY_2 115.00 70216 HAVANA1 115.00 1	74.31
70040 ARSENAL 115.00 70217 HAVANA2 115.00 1	69.67
70481 MONACO_12 230.00 770189 GREE-SR 230.00 1	91.65
70189 GREENWOOD_2 230.00 770189 GREE-SR 230.00 2	91.64
70396 SMOKY_HILL 230.00 70599 SMOKY_HILL 345.00 T6	90.17
70038 ARAPAHOE 230.00 70527 SANTA_FE 230.00 1	87.94
70036 ARAP_A 115.00 70441 UNIVERS1 115.00 1	68.77
70402 SOUTH 115.00 70531 AIR_LIQ_TP 115.00 1	89.26
70277 MAPLETO2 115.00 770277 NEW_SUB_A 115.00 1	77.42
70126 CONOCO 115.00 770277 NEW_SUB_A 115.00 1	87.9

25 Peak

Violations				Deviation			
Contingency	Bus	Voltage	Violation	Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8571	0.0529	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8571	0.0447

25 No Cherokee

Violations				Deviation			
Contingency	Bus	Voltage	Violation	Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8619	0.0481	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8619	0.0452

25 Comanchee Stress

Violations				Deviation			
Contingency	Bus	Voltage	Violation	Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8546	0.0554	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8546	0.0497

26 Peak

Violations Contingency	Bus	Voltage	Violation	Devation Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8752	0.0348	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8752	0.0375
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70279 MARTIN_1 11	0.9388	0.0026
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70483 WATERTN_TP 11	0.9399	0.0025

26 Twilight

Violations Contingency	Bus	Voltage	Violation	Devation Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8591	0.0509	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8591	0.045
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70279 MARTIN_1 11	0.9278	0.0096
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70483 WATERTN_TP 11	0.929	0.0095

26 Comanche Stress

Violations Contingency	Bus	Voltage	Violation	Devation Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.875	0.035	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.875	0.0366
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70279 MARTIN_1 11	0.9341	0.0003
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70483 WATERTN_TP 11	0.9353	0.0002

26 Pathway Stress

Violations Contingency	Bus	Voltage	Violation	Devation Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8616	0.0484	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8616	0.0427
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70279 MARTIN_1 11	0.9274	0.0016
				OPEN LINE FROM BUS 70463 [WATERTON 115.00] TO BUS 70483 [WATERTN_TP 115.00] CKT 1	70483 WATERTN_TP 11	0.9286	0.0015

26 No Cherokee

Violations Contingency	Bus	Voltage	Violation	Devation Contingency	Bus	Voltage	Violation
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8863	0.0237	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8863	0.0372

27 Peak

Violations				Deviation			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8181	0.0919	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8181	0.0922

27 Twilight

Violations				Deviation			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8247	0.0853	OPEN LINE FROM BUS 70110 [CHEROKEE_N 115.00] TO BUS 70494 [METRO_WATER 115.00] CKT 1	70494 METRO_WATER 11	0.9163	0.0026
				OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8247	0.0767

27 Comanche Stress

Violations				Deviation			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.822	0.088	OPEN LINE FROM BUS 70110 [CHEROKEE_N 115.00] TO BUS 70494 [METRO_WATER 115.00] CKT 1	70494 METRO_WATER 11	0.914	0.0038
				OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.822	0.0789

27 Pathway Stress

Violations				Deviation			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.822	0.088	OPEN LINE FROM BUS 70110 [CHEROKEE_N 115.00] TO BUS 70494 [METRO_WATER 115.00] CKT 1	70494 METRO_WATER 11	0.9134	0.0093
				OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.822	0.0807

27 No Cherokee

Violations				Deviation			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8274	0.0826	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8274	0.0843

28 Peak							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8454	0.0646	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8454	0.056
28 Twilight							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8462	0.0638	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8462	0.0651
28 Comanche Stress							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.839	0.071	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.839	0.0713
28 Pathway Stress							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8466	0.0634	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8466	0.0641
28 No Cherokee							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8499	0.0601	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8499	0.0638

2030 Clean Energy							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8238	0.0862	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8238	0.0726

2031 JTS Look Ahead							
Violations				**Deviation**			
Contingency	**Bus**	**Voltage**	**Violation**	**Contingency**	**Bus**	**Voltage**	**Violation**
OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8256	0.0844	OPEN LINE FROM BUS 70244 [LAFAYETTE 115.00] TO BUS 70444 [VALMONT_1 115.00] CKT 1	70244 LAFAYETTE 11	0.8256	0.0683

WECC
Electric Reliability and Security for the West

FERC Form No. 715 Filing
Identification and Certification Form

1. Transmitting Utility Name Public Service Company of Colorado
2. Transmitting Utility Mailing Address 1800 Larimer St., Suite 400; Denver, CO; 80202

---

3. Contact Person Name* Gilbert Flores
4. Contact Person Title Manager, Transmission Planning West
5. Contact Person Phone 303-571-7109
6. Contact Person Fax 303-294-2088
7. Contact Person Email Gilbert.Y.Flores@XcelEnergy.com
8. Designation of reporting agent for 2024 Filing (check the appropriate item below)
   a. X WECC is the designated reporting agent for all the required FERC Form No. 715 information for the transmitting utility named on Line 1 above. By checking this option, you must submit to WECC all transmitting-utility-specific information required by FERC.
   b. ____ WECC is the designated reporting agent for WECC information required by FERC Form No. 715 for the transmitting utility named on Line 1 above. By checking this option, the transmitting utility should ensure that all transmitting-utility-specific information required by FERC is submitted directly to FERC.
9. Certification by an authorized official of the transmitting utility of the accuracy of the transmitting utility's WECC information and transmitting-utility-specific information included in the WECC 2024 filing.
   a. Certifying Official Signature* Stephen Martz Digitally signed by Stephen Martz Date: 2024.03.18 23:26:02 -06'00'
   b. Certifying Official Name* Stephen Martz
   c. Certifying Official Title Vice President, Integrated Planning

---

* Transmitting utility employee

Part II – Power Flow Base Cases

PSCo is a member of the Western Electricity Coordinating Council (WECC). WECC will submit the most current version of approved Power Flow Data Bases on behalf of PSCo.

Part II has not changed since the last submission.

Part III – Maps and Diagrams

The WECC Map of Principal Transmission Lines, and the WECC Map of Planned Facilities Through 2034 and Possible Transmission Beyond This Period, are being filed on PSCo's behalf by the WECC.

PSCo has enclosed the following information of its system:

- Transmission Ownership of Colorado 2024
- PSCo Substation One-Line Diagram Index

Part IV – Transmission Reliability Criteria

The WECC requires its member utilities to adhere to the Reliability Criteria approved by its members. These criteria are filed on behalf of PSCo by WECC. PSCo believes these criteria constitute an adequate standard for internal planning and has not adopted supplemental or additional criteria, except as discussed below.

Steady State Planning Criteria

Limits	System Intact Condition	Post-Contingency Condition
Transmission Line Loading	100% of Continuous Rating	100% of Continuous Rating for single contingency
Transformer Loading	100% of Continuous Rating	100% of 8-hour rating
Bus Voltage	0.95 to 1.05 per unit	0.90 to 1.10 per unit

PSCo also adheres to the criteria agreed upon by the Colorado Coordinated Planning Group (CCPG) for transient stability as well as for identifying potential cascading and/or uncontrolled separations/islanding events.

For planning studies, PSCo adheres to NERC, WECC, and Company Reliability Standards and Criteria. Operationally, PSCo tries to maintain a system voltage profile ranging from 1.02 or higher at generator high side bus to 1.0 or higher at load buses in the Denver-metro area. PSCo has developed a standard rating methodology per NERC's standards for substation facilities and transmission lines.

Part IV has not changed since the last submission.

Part V – Assessment Practices

PSCo uses WECC base cases for studies. Generally, the cases are modified to reflect more recent information. In 2023, studies were performed to evaluate system performance through the year 2034. This included various seasonal heavy and light load scenarios as well as different generation dispatch scenarios.

In addition to a standard load and resource portfolio, scenarios were created to model heavy power transfers into the Denver Metro area to evaluate transmission paths internal to the PSCo system for planning purposes. For example, generation interconnection studies in the Midway area south of Denver used a heavy south-to-north transfer by increasing generation south of the metro area and decreasing generation north of the metro area. Likewise, generation interconnection studies in the Missile Site area east of Denver used a heavy east-to-west transfer by increasing generation east of Denver and decreasing generation north of the metro area. Standard planning practices include system analysis for expected peak loading and maximum system power transfers.

To create power flow models, PSCo allocates the company peak load forecast down to individual substation transmission busloads. The reactive (MVAR) busloads are determined from the last seasonal analysis, which uses actual transformer meter readings adjusted to the high side of the distribution transformers. Various power flow cases may be used in the assessment, and may include summer and winter peak cases as well as off-peak or light load cases.

Part VI – Performance Evaluation

The PSCo system is comprised of several zones for planning and study purposes. The majority of the load within PSCo's control area lies within the Denver-Boulder metropolitan area. The PSCo transmission system is bounded by transfer path interfaces, referred to as 'TOTs'. These interfaces are defined in the most recent WECC path-rating catalog that is filed by WECC on PSCo's behalf. The

interfaces that frame PSCo include TOTs 2A, 3, 5, and 7.

PSCo regularly performs analysis of system performance as a normal course of business, and adheres to WECC and NERC reliability criteria. System studies model both near-term (within the next five years) and longer-range (10-year) scenarios. Generally, summer peak loading conditions are modeled. However, since some zones within Colorado are winter peaking, sensitivity studies are done using winter peak loading models. PSCo participates in joint study efforts with the Colorado Coordinated Planning Group (CCPG), which includes members from Tri-State Generation & Transmission, Black Hills Energy, Western Area Power Administration, Platte River Power Authority, Colorado Springs Utilities, Basin Electric Power Cooperative, and others in the Rocky Mountain region. As part of the Rocky Mountain Operational Study Group, PSCo performs annual Total Transfer Capability (TTC) studies of TOT 7, and reviews studies of TOTs 1A, 2A, 3 and 5 to ensure the WECC paths are operated within transfer limits.

PSCo meets requirements by the Colorado Public Utilities Commission (CPUC) to perform comprehensive analysis of its system, and provides status reports on a regular basis. Those reports include the Rule 3627 10-Year Transmission Plan, which is filed in February every even year, and includes recommended and planned transmission and generation projects.

Improvement and Mitigation Projects

The following projects have been implemented, or are planned, in an effort to improve system performance as well as mitigate transmission constraints.

Ault – Cloverly 230/115kV Transmission New transmission and substation facilities at 230kV and 115kV voltage levels will replace 44kV system in the area. To accommodate load-growth and for reliability.	In-Svc Date:	2024
Avery Substation New distribution substation located in Weld County. The new substation will tap Platte River Power Authority (PRPA) Timberline – Carey 230kV transmission line. For reliability.	In-Svc Date:	2022
Avon – Gilman 115kV Transmission Line New 115 kV line between Avon and Gilman substations. Also includes a new capacitor bank installation at Vail Substation. Line would be operated normally open but used for emergency backup. For reliability.	In-Svc Date:	2027

Bluestone Substation Phase- I: Bluestone Valley 69 kV Switching station tapping the DeBeque – Cameo 69 kV line. Phase- II: The 230kV portion of the Bluestone Valley Substation project will include tapping the Rifle – Parachute 230 kV line and installing a 230/69 kV transformer to interconnect the 230 kV and 69 kV voltages. For reliability.	In-Svc Date:	Ph. I: In-Service 2019 Ph. II: 2023
CEPP Voltage/Reactive Support A series of network voltage control devices on the PSCo network needed to accommodate added renewable generation. For resource accommodation and reliability.	In-Svc Date:	2022
Colorado's Power Pathway New 345 kV transmission facilities built out to Southeast Colorado to access renewable energy in the region.	In-Svc Date:	Canal Crossing – Goose Creek 2025 Goose Creek – May Valley 2025 Fort St. Vrain – Canal Crossing 2026 May Valley – Tundra 2027 Tundra – Harvest Mile 2027
Comanche Substation – Generation Interconnect (CEPP bid 077) Upgrades to Comanche substation to accommodate the Company's CEP portfolio of generation.	In-Svc Date:	2022
Greenwood – Denver Terminal 230kV Transmission Rebuilding or upgrading existing facilities and transmission corridors to 230kV to accommodate the planned addition of renewable resources. For resource accommodation and reliability.	In-Svc Date:	2023
Leetsdale – Elati 230 kV Circuit 5283 Underground Transmission Line Upgrade Build approximately 20 miles of new 230/115 kV transmission and three new substations to replace portions of Public Service's existing 44 kV transmission network in Weld County to increase reliability, load-serving capability and resource interconnection capability in northern Colorado.	In-Svc Date	2027
Mirasol Switching Station (formerly, Badger Hills Substation) New 230 kV Mirasol Switching Station tapping one Comanche – Midway 230 kV line. For interconnection of developing resources.	In-Svc Date	2022
Northern Colorado Area Plan: Ault – Husky – Graham Creek – Cloverly Replace 44 kV sub-transmission system with 230 kV transmission system (operated at 115 kV) between Ault – Husky – Graham Creek – Cloverly transmission network. For reliability, load growth and resource accommodation.	In-Svc Date:	2024

Sandstone Switching Station Construct a new switching station in Pueblo County as a scope change to Colorado's Power Pathway Project to address engineering and siting challenges with the original scope of the planned expansion of the Tundra Switching Station.	In-Svc Date	2027
Stagecoach Switching Station A new 230 kV switching station to connect GI-2014-9, a 70 MW solar generation facility. The requested Point of Interconnection (POI) for GI-2014-9 is a tap on the Comanche – Midway 230 kV line.	In-Svc Date:	2025
Tundra Switching Station (Formerly CEPP Switching Station Bid X645) Construct new 345 kV switching station to integrate generation.	In-Svc Date:	2022
Distribution Planning Substations New distribution substations – Barker, Berkley, Blue Spruce, Dove Valley, Gray Street, Poder (formerly Stock Show), Lowry, New Castle, North Sheridan, Sandy Creek, Solterra, Superior, Wellington, and Wilson. These substations are driven by load growth in their respective areas. The transmission portion of these projects include an in-and-out line tap, which interconnects the new distribution substation(s) and the associated equipment. For reliability.	In-Svc Date:	Poder 2026; Barker 2027

Generation Resource Changes

Overview of recently added generation, current plans for new generation, and planned generation retirements within the PSCo system are included in the table below.

Name	Net MW	Type	PSCo Deliver Point Bus	ISD
Thunderwolf (Formerly CEP 5 Bid No. x647)	200/100	Solar/Battery	Mirasol 230 kV	2023
Neptune (Formerly CEP 6 Bid No. x645)	250/125	Solar/Battery	Tundra 345 kV	2023
Arriba (Bronco Plains II)	200	Wind	Shortgrass 345 kV	2023
Comanche 2 (Retirement)	-325	Coal	Comanche 230 kV	2025

Name	Net MW	Type	PSCo Deliver Point Bus	ISD
Cherokee 4 (Retirement)	-300	Gas	Cherokee	2027
Comanche 3 (Retirement)	-780	Coal	Comanche 345 kV	2031

Dictionary of Bus Names – 2024

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
ADOBE	230	70268		ADOBE 230 (PSCo GVREA Substation)
AIR_LIQ	115	70027		AIR LIQUIDE 115
AIR_LIQ_TP	115	70531		AIR LIQUIDE TAP 115
ALLISON	115	70023		ALLISON 115
ALMA	230	70032		ALMA 230
ALAMOSA	69	70024		ALAMOSA STEAM 69 (PSCo)
ALMSA_TM	69	70026		ALAMOSA TERMINAL 69
ALMSA_TM	115	70025		ALAMOSA TERMINAL 115
ALMSACT1	13.8	70485	464	ALAMOSA COMBUSTION TURBINE UNIT #1 13.8 (PSCo)
ALMSACT2	13.8	70486	464	ALAMOSA COMBUSTION TURBINE UNIT #2 13.8 (PSCo)
AMATLAS	230	79250		AMERICAN ATLAS 230
AMES	115	79257	6207	AMES HYDRO 115
ANADARKO	115	70238		ANADARKO 115
ANADARKO_T	115	70219		ANADARKO 115 TAP
ANTONITO	69	70029		ANTONITO 69.0
ARAPAHOE_A	115	70036		ARAPAHOE A 115
ARAPAHOE_B	115	70037		ARAPAHOE B 115
ARAP_Gen	115	70035		ARAPAHOE 115
ARAP5&6	13.8	70553	55200	ARAPAHOE UNITS #5 & #6 13.8 (Southeast Generation)
ARAP7	13.8	70554	55200	ARAPAHOE UNIT #7 13.8 (Southeast Generation)
ARAPAHOE	230	70038		ARAPAHOE 230
ARGO	115	70039		ARGO 115
ARRIBA_W1	0.69	70443	66014	ARRIBA WIND COLLECTOR 1
ARRIBA_W1_1	34.5	70633		ARRIBA COLLECTOR #1 34.5 BUS #1
ARRIBA_W1_2	34.5	70445		ARRIBA COLLECTOR #1 34.5 BUS #2
ARRIBA_W2	0.69	70442	66014	ARRIBA WIND COLLECTOR 2
ARRIBA_W2_1	34.5	70634		ARRIBA COLLECTOR #2 34.5 BUS #1
ARRIBA_W2_2	34.5	70446		ARRIBA COLLECTOR 2 34.5 BUS #2
ARRIBA_WF	345	70659		ARRIBA 345
ARROWHLK	115	70475		ARROWHEAD LAKE 115
ARSENAL	115	70040		ARSENAL 115
ARVADA_PS	230	70041		ARVADA 230
ASPEN_PS	115	70541		ASPEN 115 (HCEA)
AVERY_PS	230	70862		AVERY 230
AVON	115	79092		AVON 115 (HCEA)
BEAVER_CK_P	230	70399		BEAVER CREEK PSCo (EAST) 230
BANCROFT	115	70045		BANCROFT 115
BARR_LAKE	230	70047		BARR LAKE 230
BASALT	13.8	71985		BASALT 13.8 SVD
BASALT	115	79003		BASALT 115
BASALT	230	79004		BASALT 230

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
BASALT_DST	115	70540		BASALT DISTRIBUTION 115
BEAVER_CK_N	115	70398		BEAVER CREEK SOUTH 115
BEAVER_CK_S	115	70397		BEAVER CREEK NORTH 115
BEAVER_CK_W	115	79006		BEAVER CREEK 115
MIDDLE_FORK	230	70357		BENCH 230
BERGEN_PK	115	70050		BERGEN PARK 115
BERTHOUD	115	70534		BERTHOUD 115
BIGHORN_S	0.63	70878	63770	BIGHORN SOLAR PV
BIGHORN_S_1	34.5	70877		BIGHORN SOLAR 34.5
BIGHORN_S_2	34.5	70876		BIGHORN SOLAR 34.5
BIGHORN_S_3	230	70875		BIGHORN SOLAR 230
BLANCA_PEAK	115	70937		BLANCA PEAK 115
BLUE_RIVER	115	70052		BLUE RIVER 115
BLUE_RIVER	230	70053		BLUE RIVER 230
BLUESTONE	230	70264		BLUESTONE 230
BLUESTONE	69	70981		BLUESTONE 69
BLUSPRU_GENS	230	70520		BLUE SPRUCE 230
BUENA_VST_T	115	70056		BUENA VISTA TAP 115
BOULDER_TM1	115	70059		BOULDER TERMINAL 115
BOONE	13.8	71981		BOONE 13.8 SVD
BOONE	230	70061		BOONE 230
BOULDER_CN2	115	70058		BOULDER HYDRO 115
BOULDER_HYD	115	70492		BOULDER HYDRO 115
BOULDER_TRM2	115	70033		BOULDER TERMINAL 2 115
BOULDER_TRM3	115	70034		BOULDER TERMINAL 3 115
BRECKRDG	230	70064		BRECKENRIDGE 230
BRICK_CT_CR	115	70546		BRICK CENTER 115 (PSCo/CORE)
BRICKCTR	230	70545		BRICK CENTER 230 (PSCo/CORE)
BRONCO_W1	0.69	70753	63803	BRONCO PLAINS WIND COLLECTOR 1
BRONCO_W2_1	34.5	70752		BRONCO PLAINS
BRONCO_W1_1	34.5	70751		BRONCO PLAINS
BRONCO_W2	0.69	70749	63803	BRONCO PLAINS WIND COLLECTOR 2
BRONCO_PLNS	345	70750		BRONCO PLAINS
BROOMFIELD	115	70065		BROOMFIELD 115 BUS #1
BRUSH_SW_E	115	70006		BRUSH COLO POWER PARTNERS 115
BRUSH_SW_W	115	70005		BRUSH COLO POWER PARTNERS 115
BUCKLEY1	230	70067		BUCKLEY 230 BUS #1
BUCKLEY2	230	70046		BUCKLEY 230 BUS #2
BURL PSC	115	73034	6619	BURLINGTON PSCo 115
CABCRKA	13.8	70069	467	CABIN CREEK HYDRO UNIT A 13.8 (PSCo)
CABCRKB	13.8	70070	467	CABIN CREEK HYDRO UNIT B 13.8 (PSCo)
CABIN_CK	115	70071		CABIN CREEK 115
CABIN_CK	230	70072		CABIN CREEK 230
CAERUS_S1	230	70430	N/A	CAERUS SOLAR 230
CALIFORNIA	115	70073		CALIFORNIA 115
CALIFORN_TP	115	70074		CALIFORNIA TAP 115

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
CAMEO	13.8	71989		CAMEO 13.8 SVD
CAMEO	69	70076		CAMEO 69
CAMEO	230	70078		CAMEO 230
CAPITOL_HL	115	70087		CAPITOL HILL 115
CARBONDALE	115	70089		CARBONDALE 115
CASTLRCK_TP1	115	70020		CASTLE ROCK TAP 1 115
CASTLRCK_TP2	115	70021		CASTLE ROCK TAP 2 115
CASTL_RK_CR	115	70091		CASTLE ROCK 115 (PSCo/CORE)
CEDAR2_STAT1	0.48	70828		CEDAR CREEK DSTAT #1
CEDAR2_STAT2	0.48	70829		CEDAR CREEK DSTAT #2
CEDAR2_W1	0.66	70825	57210	CEDAR CREEK 34.5 BUS #2A (Unit W1)
CEDAR2_W2	0.69	70826	57210	CEDAR CREEK 34.5 BUS #2B (Unit W2)
CEDAR2_W3	0.66	70827	57210	CEDAR CREEK 2 GEN (W3)
CEDAR2W1	34.5	70830		CEDAR CREEK 2 34.5 (W1)
CEDAR2W2	34.5	70831		CEDAR CREEK 2 34.5 (W2)
CEDAR2W3	34.5	70832		CEDAR CREEK 2 34.5 (W3)
CEDARCK_SYD	230	70821		CEDAR CREEK 230
CEDARCK_1A	34.5	70823	56371	CEDAR CREEK 34.5 BUS #1A (Unit W1)
CEDARCK_1B	34.5	70824	56371	CEDAR CREEK 34.5 BUS #1B (Unit W2)
CEDARCK_CAP	230	70822		CEDAR CREEK CAPACITOR BANK
CEDARCK2	230	70833		CEDAR CREEK 230
CEDARCK2A	34.5	70834		CEDAR CREEK 2 A BUS 34.5
CEDARCK2B	34.5	70835		CEDAR CREEK 2 B BUS 34.5
CEDAR_PT	230	70678		CEDAR POINT 230
CEDARPT_GEN	230	70679		CEDAR POINT GENERATORS BUS
CEDARPT_W1	0.69	70670	57315	CEDAR POINT 1 GEN (W1)
CEDRPT_W1_1	34.5	70672		CEDAR POINT 1 34.5
CEDRPT_W1_2	34.5	70674		CEDAR POINT 1 34.5 (Reactor)
CEDRPT_W1_3	230	70676		CEDAR POINT 1 230
CEDARPT_W2	0.69	70671	57315	CEDAR POINT 2 GEN (W2)
CEDRPT_W2_1	34.5	70673		CEDAR POINT 2 34.5
CEDRPT_W2_2	34.5	70675		CEDAR POINT 2 34.5 (SVD)
CEDRPT_W2_3	230	70677		CEDAR POINT 2 230
CF&IFURN	230	70094		CF&I FUNANCE 230
CF&ISE1	69	70095		CF&I SOUTHEAST 69 BUS #1
CF&ISE1	115	70096		CF&I SOTHEAST 115 BUS #1
CF&ISE2	69	70097		CF&I SOUTHEAST 69 BUS #2
CF&ISE2	115	70098		CF&I SOUTHEAST 115 BUS#2
CHATFLD	230	70100		CHATFIELD 230
CHEROK2	15.5	70104	469	CHEROKEE UNIT #2 15.5 (PSCo)
CHEROK4	22	70106	469	CHEROKEE UNIT #4 22 (PSCo)
CHEROKEE	230	70107		CHEROKEE 230
CHEROKEE_N	115	70110		CHEROKEE 115 NORTH BUS
CHEROKEE_S	115	70108		CHEROKEE 115 SOUTH BUS
CHEROKEE5	18	70145	469	CHEROKEE UNIT #5 18
CHEROKEE6	18	70146	469	CHEROKEE UNIT #6 18

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
CHEROKEE7	18	70147	469	CHEROKEE UNIT #7 18
CHEYRDG_E	345	70730		CHEYENNE RIDGE, EAST
CHEYRDG_W	345	70632		CHEYENNE RIDGE WEST
CHEYRGE_W1	0.69	70733	62952	CHEYENNE RIDGE EAST WIND COLLECTOR 1
CHEYRGE_W1_1	34.5	70732		CHEYENNE RIDGE EAST
CHEYRGE_W13	34.5	70731		CHEYENNE RIDGE EAST
CHEYRGE_W2	0.69	70736	62952	CHEYENNE RIDGE EAST WIND COLLECTOR 2
CHEYRGE_W2_1	34.5	70735		CHEYENNE RIDGE EAST
CHEYRGE_W2_2	34.5	70734		CHEYENNE RIDGE EAST
CHEYRGW_W1	0.69	70739	62952	CHEYENNE RIDGE WEST WIND COLLECTOR 1
CHEYRGW_W1_1	34.5	70738		CHEYENNE RIDGE WEST
CHEYRGW_W1_2	34.5	70737		CHEYENNE RIDGE WEST
CHEYRGW_W2	0.69	70742	62952	CHEYENNE RIDGE WEST WIND COLLECTOR 2
CHEYRGW_W2_1	34.5	70741		CHEYENNE RIDGE WEST
CHEYRGW_W2_2	34.5	70740		CHEYENNE RIDGE WEST
CHEYRGE_W3	0.69	70775	62952	CHEYENNE RIDGE WEST WIND COLLECTOR 3
CHEYRGE_W3_1	34.5	70776		CHEYENNE RIDGE WEST
CHEYRGW_CTRL	345	70778		CHEYENNE RIDGE WEST
CHAMBERS	115	70538		CHAMBERS 115
CHAMBERS	230	70539		CHAMBERS 230
CLARK	230	70112		CLARK 230
CLIFTON	230	70113		CLIFTON 230
CLIMAX	115	70114		CLIMAX 115
CLOVERLY	115	70903		CLOVERLY 115
CO_GRN	230	70700		COLORADO GREEN WIND FARM 230
CO_GRN_E	34.5	70701		COLORADO GREEN EAST 34.5 kV BUS #2
CO_GRN_W	34.5	70702		COLORADO GREEN WEST 34.5 kV BUS #2
CO_GRN_E	0.58	70708	56173	COLORADO GREEN EAST WIND FARM 34.5
CO_GRN_E_1	34.5	70707		COLORADO GREEN EAST 34.5 kV BUS #1
CO_GRN_W	0.58	70256	56173	COLORADO GREEN WEST WIND FARM 34.5
CO_GRN_W_1	34.5	70709		COLORADO GREEN EAST 34.5 kV BUS #1
COBBLAKE	115	73600		COBBLAKE 115
COBBLKTP	115	73044		COBBLAKE TAP 115
COCENTER	69	70118		CO CENTER 69 (Town of Center Tap)
ALAMOSA_PV	34.5	70933	57368	COGENTRIX SOLAR UNIT #1 34.5 (COGENTRIX)
COLLINS_ST	115	70902		COLLINS STREET 115
COMAN_2	24	70120	470	COMANCHE UNIT #2 24 (PSCo)
COMAN_3	27	70777	470	COMANCHE UNIT #3 24 (PSCo)
COMAN_S1	0.42	70934	59656	COMANCHE PV
COMAN_S1_1	34.5	70940		COMANCHE SOLAR 34.5
COMAN_S1_2	34.5	70941		COMANCHE SOLAR 34.5
COMAN230_S1	230	70942		COMANCHE SOLAR 230

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
COMANCHE_1	115	70121		COMANCHE 115 BUS #1
COMANCHE_2	115	70123		COMANCHE 115 BUS #2
COMANCHE	230	70122		COMANCHE 230
COMANCHE	345	70654		COMANCHE 345
CONIFER_CR	115	70124		CONIFER 115
CONOCO	115	70126		CONOCO 115
COOLEYMA	230	70535		COOLEY MESA 230 (HCEA)
COORS_RCL	115	70127		COORS RECYCLING 115
COPOWPRO_NUG	115	70482		COLORADO POWER PROJECT 115
CRAIG_YV	230	70009		CRAIG TRANSFER 230
CRYSTLPS	115	79018		CRYSTAL PSCo 115
DAKOTA	230	70141		DAKOTA 230
DANIEL_PK	13.8	71984		DANIELS PARK 13.8 SVD
DANIEL_PK	115	70138		DANIELS PARK 115
DANIEL_PK	230	70139		DANIELS PARK 230
DANIEL_PK	345	70601		DANIELS PARK 345
DAVIS_PS_TP	115	70190		DAVIS 115
DEBEQUE	69	70140		DEBEQUE 69
DEER_CK	115	70142		DEER CREEK 115
DEL_NORTE	69	70143		DEL NORTE 69
DENVER_TM_1	115	70148		DENVER TERMINAL 115 BUS #1
DENVER_TRM_2	115	70144		DENVER TERMINAL 115 BUS #2
DENVER_TM	230	70149		DENVER TERMINAL 230
DERBY_2	115	70153		DERBY 115 BUS #1
DERBY_1	115	70154		DERBY 115 BUS #2
DILLON	115	70155		DILLON 115
DILLON	230	70156		DILLON 230
DIVIDE	115	70157		DIVIDE 115
EAST_1	115	70162		EAST 115 BUS #1
EAST_2	115	70171		EAST 115 BUS #2
ELATI1	230	70163		ELATI 230 BUS #1
ELDORADO	115	70164		ELDORADO 115
ENGLE_WD_TP	115	70165		ENGLEWOOD BUS #3 LINE TAP 115.0
ENGLEWD1	115	70166		ENGLEWOOD 115 BUS #1
ENGLEWD2	115	70167		ENGLEWOOD 115 BUS #2
ENGLEWD3	115	70168		ENGLEWOOD 115 BUS #3
ENNIS	115	70169		ENNIS 115
FAIRGRNDS	115	70081		FAIRGROUNDS 115
FED_CTR	115	70172		FEDERAL CENTER 115
FED_CTR_TP	115	70173		FEDERAL CENTER TAP 115
FEDERHT1	115	70175		FEDERAL HEIGHTS 115 BUS #1
FEDERHT23	115	70174		FEDERAL HEIGHTS 115 BUS #2
FITZ_SIMONS	115	70537		FITZSIMMONS 115
FOIDELCK	230	79091		FOIDEL CREEK 230
FRUITA	13.8	70180	471	FRUITA UNIT #1 13.8 (PSCo)
FRUITA	69	70183		FRUITA 69

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
FTGARLND	69	70187		FT GARLAND 69
FT_LUPTN_12	13.8	70188	8067	FT LUPTON UNITS #1 & #2 13.8 (PSCo)
FT_LUPTON_1	115	70191		FT LUPTON 115 BUS #1
FORT_LUPTON2	115	70090		FT LUPTON 115 BUS #2
FT_LUPTON	230	70192		FT LUPTON 230
FTNVAL_GENS	230	70595		FOUNTAIN VALLEY 230
FTNVL1&2	13.8	70577	55453	FOUNTAIN VALLEY UNITS #1 & #2 13.8 (Fountain Valley Power LLC)
FTNVL3&4	13.8	70578	55453	FOUNTAIN VALLEY UNITS #3 & #4 13.8 (Fountain Valley Power LLC)
FTNVL5&6	13.8	70579	55453	FOUNTAIN VALLEY UNITS #5 & #6 13.8 (Fountain Valley Power LLC)
FULTONTS	115	70194		FULTON TRI-STATE 115
GEORG1&2	2.3	70195	472	GEORGETOWN HYDRO UNITS #1 &#2 2.3 (PSCo)
GEORGETN	25	70196		GEORGETOWN 25
GEORGETN	115	70197		GEORGETN 115
GILCREST	115	70198		GILCREST 115
GILMAN	115	70199		GILMAN 115
GLDNWST_W1	0.69	70663	59974	GOLDEN WEST WIND COLLECTOR #1 0.69
GLDNWST_W_2	34.5	70661		GOLDEN WEST WIND SUB BUS 1 34.5
GLDNWST_W_1	34.5	70662		GOLDEN WEST WIND SUB BUS 2 34.5
GLENNPS	230	70200		GLENN PUBLIC SERVICE 230
GLENWOOD	69	70201		GLENWOOD SPRINGS 69 (CITY OF GLENWOOD SPRINGS)
GODFREY	115	70202		GODFREY TAP 115
GOLDEN_WEST	230	70660		GOLDEN WEST WIND SUB BUS 230
UTE_GRND_JN	345	79036		GRAND JUNCTION 345
UTE_GRND_JN	69	70214		GRAND JUNCTION (Ute) 69
UTE_GRND_JN	115	79034		GRAND JUNCTION (Ute) 115
UTE_GRND_JN	138	79035		GRANDJUNCTION (Ute) 138
GRAND_JT	230	70205		GRAND JUNCTION (Ute) 230
GRANDJ_PS	230	70206		GRAND JUNCTION PSCo 230
GRAY_STREET	115	70208		GRAY ST 115
GREELEY	115	70209		GREELEY 115
GREEN_VLY	230	70048		GREEN VALLEY 230
GREENWOOD_1	230	70212		GREENWOOD 230 BUS #1
GREENWOOD_2	230	70189		GREENWOOD 230 BUS #2
GSANDHIL_PV	34.5	70931	57377	GREATER SANDHILL SOLAR UNIT#1 34.5
GUNBARRE1	230	70213		GUNBARREL 1 230
GUNBARREL_2	230	70211		GUNBARREL 2 230
HAGERMAN_TAP	230	70111		HAGERMAN TAP 230
HARRISON_P1	115	70215		HARRISON 115 BUS #1
HARRISON_PS2	115	70182		HARRISON 115 BUS #2
HARTSELT	230	70927		HARTSEL 230
HARVEST_MI	230	70596		HARVEST MILE SUB 230
HARVEST_MI	345	70597		HARVEST MILE SUB 345
HAVANA1	115	70216		HAVANA 115 BUS #1

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
HAVANA2	115	70217		HAVANA 115 BUS #2
HAYDEN1	18	79040	525	HAYDEN UNIT#1 18 (A73)
HAYDEN2	22	79041	525	HAYDEN UNIT#2 22 (A73)
HENDRSN	115	70218		HENDERSON PSCo 115
HIGH_PT	230	70497		HIGH POINT TAP 115
HOGBACK	115	70224		HOGBACK 115
HOMELAKE	69	70228		HOMELAKE 69
HOMESTEAD	230	70513		HOMESTEAD 230
SLVS_IBRDRLA	34.5	70932	57317	GE SOLAR UNIT#1 34.5
HOPKINS	69	70267		HOPKINS 69
HOPKINS	115	70231		HOPKINS 115
HOPKINS	230	70232		HOPKINS 230
HORIZON	230	70233		HORIZON 230
HAPPY_CNYN	115	70115		HAPPY CANYON 115 (PSCO IREA)
HUSKY	115	70901		HUSKY 115
HUSKY	230	70898		HUSKY 230
IDAHO_SPGS	230	70237		IDAHO SPRINGS 230
IMBODEN	230	70526		IMBODEN 230
ISABELLE	230	70544		ISABELLE 230
JBS_BEEF	44	70645		JBS BEEF 44
JEWELL1	230	70512		JEWELL 230 BUS #1
JEWELL2	230	70239		JEWELL 230 BUS #2
JOHNSTOWN_1	115	70240		JOHNSTOWN 115 BUS#1
JOHNSTOWN_2	115	70246		JOHNSTOWN 115 BUS#2
JORDAN	230	70241		JORDAN 230
KEENESBURG	230	70820		KEENESBURG 230
KELIM	115	70008		KELIM 115
KENDRICK	115	70242		KENDRICK 115
KERBERCK	69	70509		KERBER CREEK 69
LACOMBE	230	70324		LACOMBE 230
LAFAYETTE	115	70244		LAFAYETTE 115
LAKEWOOD_1	115	70251		LAKEWOOD 115 BUS #1
LAKEWOOD_2	115	70252		LAKEWOOD 115 BUS #2
LAMAR_SWYD	230	70254		LAMAR CO 230
LAMAR_DC	230	70560	Not Available	LAMAR DC TIE 230
LEADVIL1	115	70257		LEADVILLE 115 BUS #1
LEADVIL2	115	70258		LEADVILLE 115 BUS #2
LEETSDALE	230	70260		LEETSDALE 230 BUS#1
LEETSDALE_1	115	70259		LEETSDALE 115 BUS#1
LEETSDALE_2	115	70282		LEETSDALE 115 BUS#2
LEGGETT	230	70261		LEGGETT 230
LEMON_GLCH	230	70533		LEMON GULCH (IREA) 230
LEPRINO_PS	115	70805		LEPRINO 115
LEPRINO_TAP	115	70116		LEPRINO TAP 115
LEYDEN_TP	115	70262		LEYDEN 115
LIMON1	345	70625		LIMON I WIND BUS 345

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
LIMON1_W	34.5	70635	58126	LIMON I WIND UNIT#1 34.5
LIMON2	345	70626		LIMON II WIND BUS 345
LIMON2_W	34.5	70636	58127	LIMON II WIND UNIT#1 34.5
LIMON3	345	70627		LIMON 345
LIMON3_W	34.5	70637	59083	LIMON III WIND UNIT#1 34.5
LITTLET1	115	70263		LITTLETON 115 BUS #1
LAKE_GEORGE	115	70419		LAKE GEORGE 115
LOOKOUT_1	115	70265		LOOKOUT 115 BUS #1
LOOKOUT_2	115	70066		LOOKOUT 115 BUS #2
LOOKOUT	230	70266		LOOKOUT 230
LOUISVILLE	115	70269		LOUISVILLE 115
LUCERNE_PS	115	70899		LUCERNE 115
MALTA	115	70273		MALTA 115
MALTA	230	70274		MALTA 230
MALTA_T1	13.8	71982		MALTA 13.8 SVD #1
MALTA_T2	13.8	71983		MALTA 13.8 SVD #2
MANCHEF1	16	70314	55127	MANCHIEF UNIT #1 15.2 (Manchief Power Co LLC)
MANCHEF2	16	70315	55127	MANCHIEF UNIT #2 15.2 (Manchief Power Co LLC)
MANCHIEF_NUG	230	70349		MANCHIEF 230
MAPLETO1	115	70276		MAPLETON 115 BUS #1
MAPLETO2	115	70277		MAPLETON 115 BUS #2
MARCY	230	70278		MARCY 230
MARTIN_1	115	70279		MARTIN 115 BUS #1
MARTIN_2	115	70280		MARTIN 115 BUS #2
MARTIN_TP	115	70484		MARTIN TAP 115
MAYFLOWER	115	70281		MAYFLOWER 115
MEADOW_HLS	230	70283		MEADOW HILLS 230
MEARSJCT	69	70507		MEARS JUNCTION 69
MIDWAY_PS	13.8	71996		MISSILE SITE 13.8 (SVD)
MIDWAY_PS	115	70285		MIDWAY PSCo 115
MIDWAY_PS	230	70286		MIDWAY PSCo 230
MIDWAY_PS	345	70465		MIDWAY PSCo 345
MILL	115	70287		MILL 115
MIRASOL	230	70652		MIRASOL 230
MIRGEJCT	69	70505		MIRAGE JUNCTION TAP 69
MISS_SITE	230	70623		MISSILE SITE 230
MISS_SITE	345	70624		MISSILE SITE 345
MITCHELL_CK	69	70288		MITCHEL CREEK 69
MOFFAT	69	70289		MOFFAT 69
MONACO_12	230	70481		MONACO 230
MONFORT	115	70290		MONFORT 115
MONROEPS	230	70291		MONROE PSCo 230
MOONGLCH	230	70574		MOONGULCH 230
MOSCA	69	70292		MOSCA 69
MISS_SITE	13.8	71997		MISSILE SITE 13.8 (SVD)

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
MT_HARRIS	138	70525		MOUNT HARRIS 138
MTNBREEZE	230	70819		MOUNTAIN BREEZE
MTNBRZ_W1	0.69	70818	62840	MOUNTAIN BREEZE WIND COLLECTOR 1
MTNBRZ_W2	0.69	70817	62840	MOUNTAIN BREEZE WIND COLLECTOR 2
MTNBRZ_WTG_1	34.5	70816		MOUNTAIN BREEZE 34.5 COLLECTOR 1
MTNBRZ_WTG_2	34.5	70815		MOUNTAIN BREEZE 34.5 COLLECTOR 2
MURPHY	230	70551		MURPHY CREEK 230
NCAR	115	70295		NATIONAL CENTER FOR ATMOSPHERIC RESEARCH 115
NEPTUNE	345	70754		NEPTUNE 345
NEPTUNE_B1	0.48	70756	63731	NEPTUNE BESS
NEPTUNE_S1	0.66	70758	63731	NEPTUNE PV
NEPTUN_S1_1	34.5	70757		NEPTUNE 34.5
NEPTUN_SB1	34.5	70755		NEPTUNE 34.5
NEW_CASTLE	69	70296		NEWCASTLE 69
NIWOT	230	70297		NIWOT 230
NORTH_PS	115	70298		NORTH PSCo 115
NREL	115	70170		NATIONAL RENEWABLE ENERGY LABORATORY 115
OIL_SHALE	69	70302		OIL SHALE 69
ALAMOSA_TP	69	70186		ROMEO TAP (OLD #16) 69
ATER_TAP	69	70511		OLD #40 ½ TAP 69
ORCHARD	230	70313		ORCHARD 230
OTERO_TP	115	70304		OTERO TAP 115
OXCART	69	70600		OXCART 69
P.VALLEY	115	70307		PLATTE VALLEY 115
PALMER_LK	115	70308		PALMER 115
PARACHUTE	230	70309		PARACHUTE 230
PAWNEE	345	70598		PAWNEE 345
PAWNEE	22	70310	6248	PAWNEE UNIT #1 22 (PSCo)
PAWNEE	230	70311		PAWNEE 230
PAWNEE_T2	13.8	71998		PAWNEE 13.8 (SVD)
PAWNEE_T3	13.8	71999		PAWNEE 13.8 (SVD)
PEETZ	115	73150		PEETZ 115
PICADILLY	230	70530		PICADILLY 230
PLAINS_NUG1	230	70431		PLAINS END 230 BUS #1
PLAINS_NUG2	230	70433		PLAINS END 230 BUS #2
PLAINVW_TP	115	70300		PLAINVIEW TAP 115
PLNENDG1_1	13.8	70580	55650	PG&E PLAINS END NUG 13.8
PLNENDG1_2	13.8	70587	55650	PG&E PLAINS END NUG 13.8
PLNENDG2_1	13.8	70585	56516	PG&E PLAINS END NUG 13.8
PLNENDG2_2	13.8	70586	56516	PG&E PLAINS END NUG 13.8
PLAINS_END	230	70570		PG&E PLAINS END SW. STATION 230.0
PONCHA	13.8	71994		PONCHA SVD 13.8
PONCHA	69	70326		PONCHA 69
PONCHA_E	115	70327		PONCHA EAST 115 BUS
PONCHA_W	115	77642		PONCHA WEST 115 BUS

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
PONCHA_PS	230	70393		PONCHA 230 PSCO
PORTAL	115	70328		PORTAL 115
POWHATON	230	70532		POWHATON 230
PRAIRIE_1	230	70331		PRAIRIE 230 BUS#1
PRAIRIE_3	230	70323		PRAIRIE 230 BUS#3
PRONGHORN	345	70628		RUSH CREEK 1
PTARMGN	230	70057		PTARMIGAN 230
PTZLOGN	230	70711		PEETZ LOGAN 230 (2007)
PTZLOGN1	34.5	70710	56563	PEETZ LOGAN UNIT #1
PTZLOGN2	34.5	70712	56563	PEETZ LOGAN UNIT #2
PTZLOGN3	34.5	70713	56563	PEETZ LOGAN UNIT #3
PTZLOGN4	34.5	70714	56563	PEETZ LOGAN UNIT #4
QF_B4-4T	13.8	70499	10682	QF BRUSH 4 13.8 BUS (Colo Energy Mgmnt LLC – Brush IV, UNITS GT4 & GT5)
QF_B4D4T	12.5	70556	10682	QF BRUSH 4D 12.5 BUS (Colo Energy Mgmnt LLC – Brush IV D, UNIT ST4)
QF_BCP2T	13.8	70498	10682	QF BRUSH COGENERATION PARTNERS 13.8 UNITS ST2 & GT3
QF_CPP1T	13.8	70500	10682	QF COLORADO POWER PARTNERS 13.8 BUS (UNITS GT1 & GT2)
QF_CPP3T	13.8	70501	10682	QF COLORADO POWER PARTNERS 13.8 BUS (UNIT ST1)
QUAKER1	115	70340		QUAKER 115 BUS #1
QUAKER_2	115	70341		QUAKER 115 BUS #2
QUAKER_TP	115	70342		QUAKER TAP 115
QUINCY	230	70343		QUINCY 230
RALSTON1	115	70345		RALSTON 115 BUS #1
RALSTON2	115	70346		RALSTON 115 BUS #2
RAY_LEWI	115	70312		RAY LEWIS 115 (TSGT SUBSTATION)
RDGCREST	34.5	70723	55741	RIDGE CREST 115 UNIT #1
RDGCREST	115	70722		RIDGE CREST 115
ROMEO_TAP	69	70552		TAP FOR SLVREC & TSGT WAVERLY 69
RIDGE_1	115	70354		RIDGE 115 BUS #1
RIDGE_2	115	70226		RIDGE 115 BUS #2
RIDGE_3	115	70227		RIDGE 115 BUS #3
RIDGE	230	70355		RIDGE 230
RIFLE_UTE	69	70359		RIFLE UTE 69
RIFLE_UTE	138	79056		RIFLE UTE 138
RIFLE_UTE	13.8	71988		RIFLE UTE 13.8 SVD
RIFLE_UTE	230	79057		RIFLE UTE 230
RIFLE_UTE	345	79058		RIFLE UTE 345
RIFLE_PS	230	70358		RIFLE PSCo 230
RIOGRAND	69	70360		RIO GRANDE 69
RIOGRD_TP	69	70361		RIO GRANDE TAP 69
RIVERDALE	230	70362		RIVERDALE 230
RMEC	230	70590		ROCKY MOUNTAIN ENERGY CENTER 230
RMEC1	15	70588	55835	RMEC UNIT #1 15
RMEC2	15	70589	55835	RMEC UNIT #2 15

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
RMEC3	23	70591	55835	RMEC UNIT #3 23
ROARNGFK	69	70363		ROARING FORK 69
ROBINSON_RK	115	70364		ROBINSON RACK 115
ROMEO	69	70367		ROMEO 69
ROSEDALE	115	70368		ROSEDALE 115
RUSHCK1_W1	0.69	70767	60619	RUSH CREEK WIND UNIT 1
RUSHCK1_W1_1	34.5	70766		RUSH CREEK WIND UNIT 1 34.5
RUSHCK1_W1_2	34.5	70765		RUSH CREEK WIND UNIT 1 34.5
RUSHCK1_W1W2	345	70764		RUSH CREEK WIND UNIT 1+3 345
RUSHCK1_W2	0.69	70770	60619	RUSH CREEK WIND UNIT 3
RUSHCK1_W2_1	34.5	70769		RUSH CREEK WIND UNIT 3 34.5
RUSHCK1_W2_2	34.5	70768		RUSH CREEK WIND UNIT 3 34.5
RUSHCK2_W3	0.69	70771	60619	RUSH CREEK WIND UNIT 2
RUSHCK2_W3_1	34.5	70772		RUSH CREEK WIND UNIT 2 34.5
RUSHCK2_W3_2	34.5	70773		RUSH CREEK WIND UNIT 2 34.5
RUSSELL	230	70369		RUSSELL 230
SAGUACHE	69	70506		SAGUACHE 69
SANDOWN	115	70377		SANDOWN 115
SANLSVLY	69	70376		SAN LUIS VALLEY 69
SANLSVLY	115	70374		SAN LUIS VALLEY 115
SANLSVLY	230	70375		SAN LUIS VALLEY 230
SANTA_FE	230	70527		SANTA FE 230
SARGENT	69	70380		SARGENT 69
SARGENT	115	70379		SARGENT 115
SEMPER	115	70382		SEMPER 115
SHERIDAN	115	70384		SHERIDAN 115
SHORTGRASS	345	70630		SHORTGRASS SWITCHING STATION
SHOSHA&B	4	70385	476	SHOSHONE UNITS A & B 4 (PSCo)
SHOSHONE	69	70386		SHOSHONE 69
SHOSHONE	115	70387		SHOSHONE 115
SILT_USBR	69	70388		SILT USBR 69
SILVSADL	230	70609		SILVER SADDLE 230
SIMMS	230	70543		SIMMS 230
SKYRANCH	230	70392		SKYRANCH 230
SMELTER	115	70394		SMELTER 115
SMOKY_HL_N	115	70395		SMOKY HILL NORTH 115 BUS
SMOKY_HILL_S	115	70125		SMOKY HILL SOUTH 115 BUS
SMOKY_HL	230	70396		SMOKY HILL 230
SMOKY_HL	345	70599		SMOKY HILL 345
SMOK_R1	13.8	71990		SMOKY HILL 13.8 REACTOR 1
SMOK_R2	13.8	71991		SMOKY HILL 13.8 REACTOR 2
SNOWMASS	115	70542		SNOWMASS 115
SODA_LAKES	115	70400		SODA LAKES 115
SODA_LAKES	230	70018		SODA LAKE 230
SOUTH_TAP	115	70401		SOUTH 115 BUS #1
SOUTH	115	70402		SOUTH 115 BUS #2

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
SPINDLE	230	70592		SPINDLE HILL 230
SPINDLE_NUG	230	70468		SPINDLE NUG 230
SPNDLE1	18	70593	56445	SPINDLE HILL UNIT #1
SPNDLE2	18	70594	56445	SPINDLE HILL UNIT #2
SPNGCAN1_230	230	70718		SPRING CANYON 1 230
SPRNGCAN	230	73579		SPRING CANYON 1 230
SPRG_CN1_2	34.5	70720		SPRING CANYON 1 34.5
SPRG_CN1_3	34.5	70719		SPRING CANYON 1 34.5
SPRNGCAN1_W1	0.57	70721	56320	SPRING CANYON 34.5 WIND FARM
SPRG_CN2_2	34.5	70716		SPRING CANYON 2 34.5
SPRG_CN2_3	34.5	70717		SPRING CANYON 2 34.5
SPRNGCAN2_W2	0.69	70715	58769	SPRING CANYON 34.5 WIND FARM
SPRUCE	230	70528		SPRUCE 230
SPRUCE1	18	70562	55645	SPRUCE UNIT #1 (Blue Spruce Energy Center PSCo)
SPRUCE2	18	70563	55645	SPRUCE UNIT #2 (Blue Spruce Energy Center PSCo)
ST.VR_2	18	70406	6112	FORT ST.VRAIN 2 18 (PSCo)
ST.VR_3	18	70407	6112	FORT ST.VRAIN 3 18 (PSCo)
ST.VR_4	18	70408	6112	FORT ST.VRAIN 4 18 (PSCo)
ST.VR_5	18	70950	6112	FORT ST. VRAIN 5 18 (PSCo)
ST.VR_6	18	70951	6112	FORT ST. VRAIN 6 18 (PSCo)
ST.VRAIN	22	70409	6112	FORT ST.VRAIN 22 (PSCo)
FT_ST_VRAIN	230	70410		FORT ST.VRAIN 230
STEAMBT	230	79065		STEAMBOAT 230
STKGULCH	230	70299		STARKEY GULCH 230
SULLIVAN_1	230	70417		SULLIVAN 230 BUS #1
SULLIVAN_2	230	70365		SULLIVAN 230 BUS #2
SULPHUR	115	70523		SULPHUR 115
SULPHUR	230	70524		SULPHUR 230
SUMMIT1	115	70418		SUMMIT 115 BUS #1
SUMMIT2	115	70420		SUMMIT 115 BUS #2
SUMTAP2	115	70421		SUMMIT 115 BUS #2 TAP
SUNCOR_AULT	44	70803		SUNCOR_AULT 44
SUN_MTN	230	70856		SUN MOUNTAIN 230
SUNMTN_S1	0.63	70859	65032	SUN MOUNTAIN PV
SUNMTN_S1_1	34.5	70858		SUN MOUNTAIN 34.5
SUNMTN_S1_2	34.5	70857		SUN MOUNTAIN 34.5
SUNPOWER	34.5	70935	60008	SUNPOWER SOLAR 34.5
BOULDER_CN1	115	70423		SUNSHINE 115
SUNSHINE	115	70424		SUNSHINE TAP 115
SURREY_RG	230	70284		SURREY RIDGE 230 (PSCo)
TARRYALL	115	70426		TARRYALL 115
TARRYALL	230	70427		TARRYALL 230
TECH_CENTER	230	70428		TECH CENTR 230
THNDWLF_B1	0.48	70761	63776	THUNDERWOLF BESS
THNDWLF_S1	0.66	70763	63776	THUNDERWOLF PV

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
THNDWLF_S1_1	34.5	70762		THUNDERWOLF 34.5
THNDWLF_SB1	34.5	70760		THUNDERWOLF 34.5
THORNTON	115	70099		THORNTON 115
THUNDERWOLF	230	70759		THUNDERWOLF 230
TITAN_S1	0.63	70616	61811	TITAN SOLAR (Unit S1)
TITAN13.8	13.8	70619		TITAN SOLAR 13.8
TITAN230	230	70618		TITAN SOLAR 230
TITAN34.5	34.5	70620		TITAN SOALR 34.5
TITANS1	34.5	70617		TITAN SOLAR 34.5
TOLLGATE	230	70491		TOLLGATE 230
TOWER	230	70432		TOWER 230
TUNDRA	345	70653		TUNDRA 345
TBI_GEN	0.58	70704	56460	TWIN BUTTES I WIND COLLECTOR
TWNBT1_1	34.5	70706		TWIN BUTTES I 34.5 BUS #1
TWNBT1_2	34.5	70703		TWIN BUTTES I 34.5 BUS #2
TWNBUTTE	230	70705		TWIN BUTTES I 230
TWNLAKES	115	70434		TWIN LAKES 115
TWN_LAK_TP	115	70435		TWIN LAKES TAP 115
UINTAH	13.8	70437		UINTAH 13.8 (A73)
UINTAH	69	70436		UINTAH 69
UINTAH	230	70438		UINTAH 230
UNA_ORCH	69	70109		UNA ORCHARD 69
UNIVERS1	115	70441		UNIVERSITY 115 BUS #1
VAIL	115	79066		VAIL 115.0
VALMNT7	13.8	70557	55207	VALMON UNIT #7 13.8 (Southeast Generation)
VALMNT8	13.8	70558	55207	VALMON UNIT #8 13.8 (Southeast Generation)
VALMONT_1	115	70444		VALMONT 115 BUS #1
VALMONT_2	115	70440		VALMONT 115 BUS #2
VALMONT	230	70447		VALMONT 230
VALMNT6	13.8	70448	477	VALMONT UNIT #6 13.8 (PSCo)
VASQUEZ	115	70450		VASQUEZ 115
VILLA_GROVE	69	70508		VILLA 69
VINELAND	69	70454		VINELAND 69
WASHINGTON	230	70461		WASHINGTON 230
WATERTN_TP	115	70483		WATERTON TAP 1 115
WATERTON	13.8	71995		WATERTON SVD 13.8
WATERTON	115	70463		WATERTON 115
WATERTON	230	70464		WATERTON 230
WATERTON	345	70466		WATERTON 345
WATERTON_DCP	230	70959		WATERTON DISTRIBUTION 230
WHEELER_PS	230	70356		WHEELER PSCo 230
WELD_PS	13.8	71992		WELD 13.8 SVD
WELD_PS	115	70470		WELD PSCo 115
WELD_PS	230	70471		WELD PSCo 230
WEST_PS	230	70480		WEST PSCo 230
WINDSOR	230	70474		WINDSOR 230

NAME	KV	BUS-NO	EIA Facility Code	DESCRIPTION
WOLCOTT_1	115	79068		WOLCOTT 115 BUS #1
WOLCOTT_2	115	77643		WOLCOTT 115 BUS #2
WOLCOTT	230	79069		WOLCOTT 230
WOODLAND_PK	115	70476		WOODLAND PARK 115

Introduction

1. **Title**: **Transmission System Planning Performance**

2. **Number**: TPL-001-WECC-CRT-4

3. **Purpose**: To facilitate coordinated near-term and long-term transmission planning within the Western Interconnection, and to facilitate the exchange of the associated planning information for normal and abnormal conditions.

   This document applies to all transmission planning studies conducted within the Western Interconnection.

4. **Applicability**:

   4.1. Functional Entities:

   4.1.1. Planning Coordinator

   4.1.2. Transmission Planner

   4.2. Facilities

   4.2.1. This document applies to Bulk Electric System (BES) Facilities.

   4.2.2. The following buses are specifically *excluded* from this WECC Criterion:

   4.2.2.1. Non-BES buses,

   4.2.2.2. Line side series capacitor buses,

   4.2.2.3. Line side series reactor buses,

   4.2.2.4. Dedicated shunt capacitor buses,

   4.2.2.5. Dedicated shunt reactor buses,

   4.2.2.6. Metering buses, fictitious buses, or other buses that model point of interconnection solely for measuring electrical quantities; and

   4.2.2.7. Other buses specifically excluded by each Planning Coordinator or Transmission Planner internal to its system.

5. **Effective Date**: July 1, 2023

Requirements and Measures

WR1. Each Transmission Planner and Planning Coordinator shall use the following *default* base planning criteria:

1.1. Steady-state voltages at all applicable Bulk-Electric System (BES) buses shall stay within each of the following limits:

1.1.1. 95 percent to 105 percent of nominal[1] for P0[2] event (system normal pre-contingency event powerflow).

1.1.2. 90 percent to 110 percent of nominal for P1-P7 events (post-contingency event powerflow).

1.2. Post-Contingency steady-state voltage deviation at each applicable BES bus serving load shall not exceed 8 percent for P1 events.

1.3. Following fault clearing, the voltage shall recover to 80 percent of the pre-contingency voltage within 20 seconds of the initiating event for all P1 through P7 events, for each applicable BES bus serving load. (See Rationale regarding BES bus serving load.)

1.4. Following fault clearing and voltage recovery above 80 percent, voltage at each applicable BES bus serving load shall neither dip below 70 percent of pre-contingency voltage for more than 30 cycles nor remain below 80 percent of pre-contingency voltage for more than two seconds, for all P1 through P7 Single-Line to Ground fault events.

1.5. For Contingencies without a fault (P2.1 category event), voltage dips at each applicable BES bus serving load shall neither dip below 70 percent of pre-contingency voltage for more than 30 cycles nor remain below 80 percent of pre-contingency voltage for more than two seconds.

1.6. All oscillations that do not show positive damping within 30 seconds after the start of the studied event shall be deemed unstable.

WM1. Each Transmission Planner and Planning Coordinator will have evidence that it used the base criteria in its planning assessment specified in Requirement WR1.

[1] Refer to the Rationale section for use of the term "nominal."
[2] P0 through P7 refers to the categories of contingencies identified in Table 1 of NERC Standard TPL-001-X, Transmission System Planning Performance Requirements, or its successor.

WR2. Each Transmission Planner and Planning Coordinator shall use the following *default* criteria to identify the potential for Cascading or uncontrolled islanding.

- When a post contingency analysis results in steady-state facility loading that is either more than a known BES facility trip setting, or exceeds 125 percent of the highest seasonal facility rating for the BES facility studied. If the trip setting is known to be different than the 125 percent threshold, the known setting should be used.
- When either unrestrained successive load loss occurs, or unrestrained successive generation loss occurs.

WM2. Each Transmission Planner and Planning Coordinator will have evidence that it used the indicators of Requirement WR2 to identify the potential for Cascading or uncontrolled islanding.

WR3. Each Transmission Planner and Planning Coordinator shall use the following *default* criteria when identifying voltage stability:

3.1. For transfer paths, all P0-P1 events shall demonstrate a positive reactive power margin at a minimum of 105 percent of transfer path flow.

3.2. For transfer paths, all P2-P7 events shall demonstrate a positive reactive power margin at a minimum of 102.5 percent of transfer path flow.

3.3. For load areas, all P0-P1 events shall demonstrate a positive reactive power margin at a minimum of 105 percent of forecasted peak load.

3.4. For load areas, all P2-P7 events shall demonstrate a positive reactive power margin at a minimum of 102.5 percent of forecasted peak load.

WM3. Each Transmission Planner and Planning Coordinator will have evidence that it used the minimum criteria identified in Requirement WR3 to identify voltage stability.

WR4. Each Transmission Planner and Planning Coordinator that uses planning criteria *different than the default* planning criteria in WR1, WR2, and WR3 shall:

4.1 Document the different criteria to include each of the following:

4.**1.1** A narrative explaining why the different criteria was used.

4.**1.2** A narrative explaining that the use of the different criteria will not result in violations of equipment ratings, instability, uncontrolled islanding, or Cascading on its own and adjacent systems.

4.2 Notify adjacent Transmission Planners and Planning Coordinators that criteria different from WR1 was used.

4.3 Make the different criteria available within 30 days of a request.

WM4. Each Transmission Planner and Planning Coordinator that uses planning criteria different than the default base planning criteria in WR1, WR2, and WR3 will have evidence documenting the different criteria, a narrative explaining why the different criteria was used, and evidence of public notice and availability of the criteria, as required in WR4.

Version History

Version	Date	Action	Change Tracking
1	March 6, 2008	WECC Planning Coordination Committee (PCC) approved TPL-(001 thru 004)-WECC-1-CR.	Reliability Subcommittee translates existing WECC components of NERC/WECC Planning Standards into a CRT.
1	April 16, 2008	WECC Board of Directors (Board) approved	No substantive changes
2	October 13, 2011	PCC approves	Clarifies "corridor"
2	December 1, 2011	Board approved	No substantive change
2	September 5, 2012	Board changed designation	Approved a nomenclature change from "CRT" to "RBP"
2.1	August 6, 2013	Errata	WM2 Measure moved to WM3. WM3 Measure moved to WM4. WM4 Measure moved to WM2.
2.1	December 5, 2013	Board approved	Developed as WECC-0100, on October 8, 2013, the Ballot Pool retired WR1, WR2, WR4 and WR5 of TPL-(012 through 014)-WECC-RBP-2 coincident with the October 17, 2015, Effective Date of NERC TPL-001-4, Transmission System Planning Performance requirements. (See 18 CFR Part 40, Docket RM-12-1-000 and RM13-9-000, FERC Order 786, issued October 17, 2013.) Table W-1, WECC Disturbance-Performance Table of Allowable Effects on Other Systems, Table W-1 Notes, Figure W-1, and Footnotes 1-3 were also retired along with their supporting WECC Requirements, WR1, WR2, and WR5. On December 5, 2013, the Board ratified that decision.
2.1	June 25, 2014	Board changed designation	Changed from regional Business Practice (RBP) to Criterion (CRT). No other changes.
2.2	January 14, 2016	Errata	Retired WECC Requirements WR1, WR2, WR4, and WR5 and their subsets were removed from the document. WR3 was renumbered to WR1.
2.3	September 20, 2016	Errata	Sub-parts of the 4.2 Facilities section impacted by the retirement of WR1, WR2, WR4 and WR5 of TPL-(012 through 014)-WECC-RBP-2 were removed.
3	September 21, 2016	Board approved	This document addresses: 1) the substance of its preceding versions, 2) requirements imposed by NERC TPL-001-4, Transmission System Planning Performance Requirements, Requirements R5 and R6, and 3) the substance of Table W-1 retired from Version 2.1. The Effective Date was approved as "the later of January 1, 2016, or the Effective Date of TPL-001-4, Transmission System Planning Performance, Requirements R2-R6 and R8, subject to approvals." Because the effective date of the NERC requirements has already been triggered the document was effective immediately on approval by the Board.
3.1	December 6, 2016	Errata	The spelling error in Section 4.2.2.6 "quantizies" was corrected to read "quantities." In WM2, the phrase "the criteria was applied" was replaced with "the criterion was applied."
3.2	June 18, 2019	Errata	Converted to newest template. In Version 3.2: 1) bulleting in 4.2 Facilities was corrected, 2) at 4.2.2.7, "their" was replaced with "its", 3) use of "X%" was changed to "X percent" throughout, 4) use of "are/is allowed" was changed to "can" throughout, 5) WR4, "as long as" was replaced with "if", "in excess" was replaced with "more than", 6)

			Version History syntax was corrected, 7) Rationale section, "with the exception of the 500 kilo-volt class" changed to "except the 500 kilo-volt class", Rationale section (last page) "don't" was changed to "do not", 8) Rationale section at WR4, second bullet "Prepared" replaced with "prepared" and at the next to the last paragraph, "time frame" was replaced with "period".
4	June 14, 2023	Board approved	The following changes were made to Version 4. Purpose: "WECC" replaced with "Western Interconnection", planning criteria verbiage was deleted. Facilities: "excluded" was italicized, Requirement WR1: "unless otherwise" qualifier was deleted, WR1.3, a reference was added to the Rationale section, WR1.4, "Single-Line to Ground fault" qualifies the specified event, previous WR2 and WR3 deleted, new WR2 italicizes "default", passive language was deleted, bullet 2 was deleted, new WR3: replaces "minimum" with "default", new WR4: replaces "study" with "planning", replaces "base" with "default", adds a requirement to document and communicate studies. Rationale: WR1 narrative was simplified, WR1.1 and WR1.2 were embellished, WR1.3 and WR1.4 narrative clarifies application to "(FIDVR"), WR2 deletes reference to "Peak Reliability", WR3 clarifies the role of the Transmission Planner and Coordinator, WR4 clarifies distinction between "different" and "default". Footnote 2: "or its successor" was added. Previous footnote 3 deleted as superfluous. Measures and references were updated accordingly.

Attachments or Other Reference Material

Though not part of this WECC Criterion, the reader may refer to the following documents for historic background:

- WECC Guide to WECC/NERC Planning Standards 1.D: *Voltage Support and Reactive Power*, prepared by: Reactive Reserve Working Group (RRWG), Under the auspices of Technical Studies Subcommittee (TSS); Approved by TSS, March 30, 2006. Specific emphasis might be focused to Section 2.2 Voltage Stability.
- The applicable Reliability Coordinator's Systems Operating Limits Methodology.
- White Paper WECC-0100 TPL-001-WECC-CRT-3 (CRT) Transmission System Planning Performance Proposed Transient Voltage Response Rationale for CRT Requirements R1.3 and R1.4", dated July 24, 2015, augmented by IEEE Standard 1668.
- Voltage Stability Criteria, Undervoltage Load Shedding Strategy, and Reactive Power Reserve Monitoring Methodology", dated May 1998. The voltage stability criteria recommendation that is the basis for Requirement WR3 was developed under the WECC Reactive Reserve Work Group (RRWG) and documented in the report.

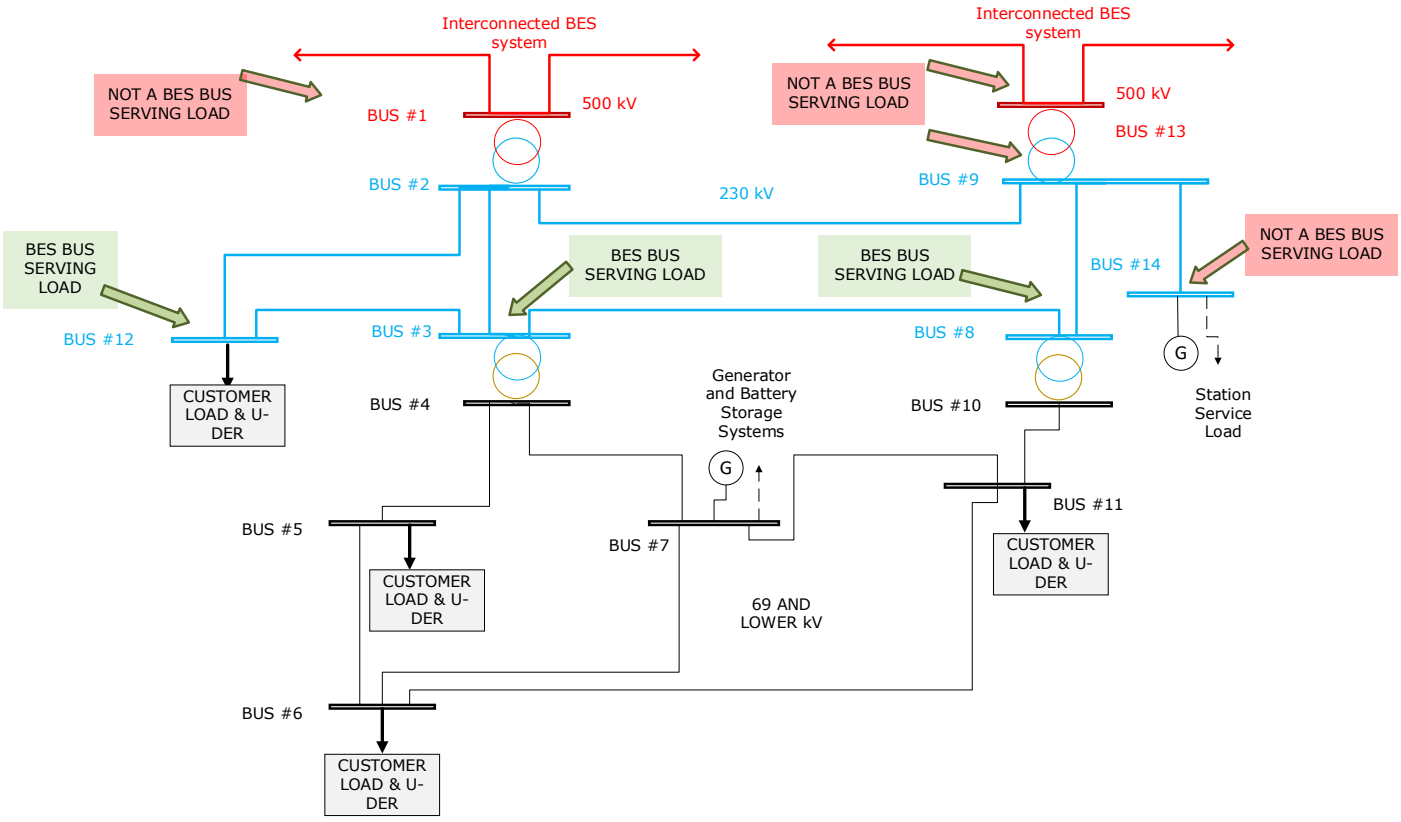
Rationale

General Application

Nothing in this document is to be interpreted as allowing third-party actions to impute liability on another. Each applicable entity is responsible for adherence to this WECC Criterion based solely on its own actions.

A BES bus that is serving load is the bus with direct transformation to a non-BES bus (the non-BES bus may be radial or networked) that serves customer load. Station-service and other substation loads are excluded.

For example, this definition meets the intent of having the criteria apply to BES Buses 3, 8 and 12 but not to BES buses 1, 2, 9, 13, and 14. (See below.)



1

Requirement WR1

WR1 is designed to state the default base planning criteria the system must meet. WR1 does not prohibit the use of more stringent criteria; rather, it sets the minimum threshold. See WR4.

In the context of Requirement WR1, the word "nominal" carries its common definition and could be, for example, either the base voltage or the operating voltage as established in the entity's Planning Assessment. This means that nominal may have a varying definition or use from one entity to the next.

An entity has the option to specify its nominal voltage different from 525 kV for the 500-kV system.

If an entity does not specify what is nominal, the default use of the term nominal defaults to the kilo-volt class that is specified in the WECC Base Case, except the 500-kilovolt class, in which case the default nominal would be specified as 525 kilovolts.

Requirement WR1.1 and WR1.2

WR1.1 describes the ceiling and floor of the *magnitude* of voltage allowed at any of the applicable BES buses both under normal operating conditions and after a P1 event (and other P events). WR1.2 describes the *change* in voltage that is allowed between pre/post P1 events. WR1.1 and WR1.2 are independent of one another; one does not guarantee the other thus requiring two sets of criteria.

For instance,

a) A BES bus at 0.95 p.u. pre-contingency voltage may encounter a contingency that drops the voltage to 0.88 p.u. => would violate WR1.1.2 (<0.9 p.u.) but not WR1.2 (<8% drop).
b) Another BES bus at 1.05 p.u. pre-contingency encounters a contingency that drops the voltage to 0.92 p.u. => would violate WR1.2 (> 8%) but not WR1.1.2 (>0.9 p.u.)."

Requirement WR1.1.2 refers to the post-automatic equipment adjustment effect prior to manual adjustment.

Requirement WR1.2

In developing WR1.2, the drafting team was aware that eight percent is not the only practical percentage for use. Historically, stakeholders reported successfully using percentages between five and ten whereas others reported being under a regulatory mandate to use eight percent. To accommodate both positions the team selected the eight percent.

By default, only automatic post-contingency actions occurring in the studied timeframe are considered when calculating voltage deviation. This would include, among other things, capacitor or reactor switching. For purposes of WR1.2, automatic generally means a programmed response not manually initiated.

For P2-P7, there is no low or high voltage deviation requirement. It is implied that P2 through P7 events do not require a voltage deviation beyond meeting the requirements in WR1.1.2.

Requirement WR1.3 and WR1.4

WR1.3 is intended to identify potential Fault-Induced Delayed Voltage Recovery (FIDVR) events (See Illustration WR1.3). This differentiates WR1.3 from WR1.4.

Illustrations WR1.3 and WR1.4 are illustrative only and are not intended to depict all possible voltage trajectories.

WR1.4 is intended to describe normal voltage recovery and is not designed to address FIDVR (see Illustration WR1.4). There are no voltage performance criteria in WR1.4 for P1 through P7, Three-Phase Fault events.

Requirement WR2

Requirement WR2 is designed to establish screening criteria that when exceeded may require further investigation of instability. The Requirement is not intended to show the presence of Cascading or instability.

The term Cascading in WR2 is the NERC defined term.

In WR2 Bullet 1, the 125 percent threshold should only be used for facilities where the trip setting is not known.[3] If the trip setting is known than known settings should be used. For example, if the known trip setting is 150 percent of the continuous rating, this should take precedence over the 125 percent of the highest rating.

The specific amounts of unrestrained load loss addressed in WR2, Bullet 2 are not specified in this document. Because of the breadth of the possible permutations, the amount should be left to the sound engineering judgment of the planning entity.

Requirement WR3

The intent of Requirement WR3 is to ensure the voltage stability of transfer paths as well as the system as a whole during peak load or peak transfer conditions. A margin on real power flow is used as a test for voltage stability. A positive reactive power margin can be demonstrated by a valid steady state power flow solution.

WR3 acknowledges that the Transmission Planner and Planning Coordinator are in the best position to self-determine which transfer paths and load areas are most critical for study.

WR3 does not require studying each transfer path and load area, nor does it supersede NERC transmission system planning performance requirements addressing the criteria or methodology used to identify system instability.

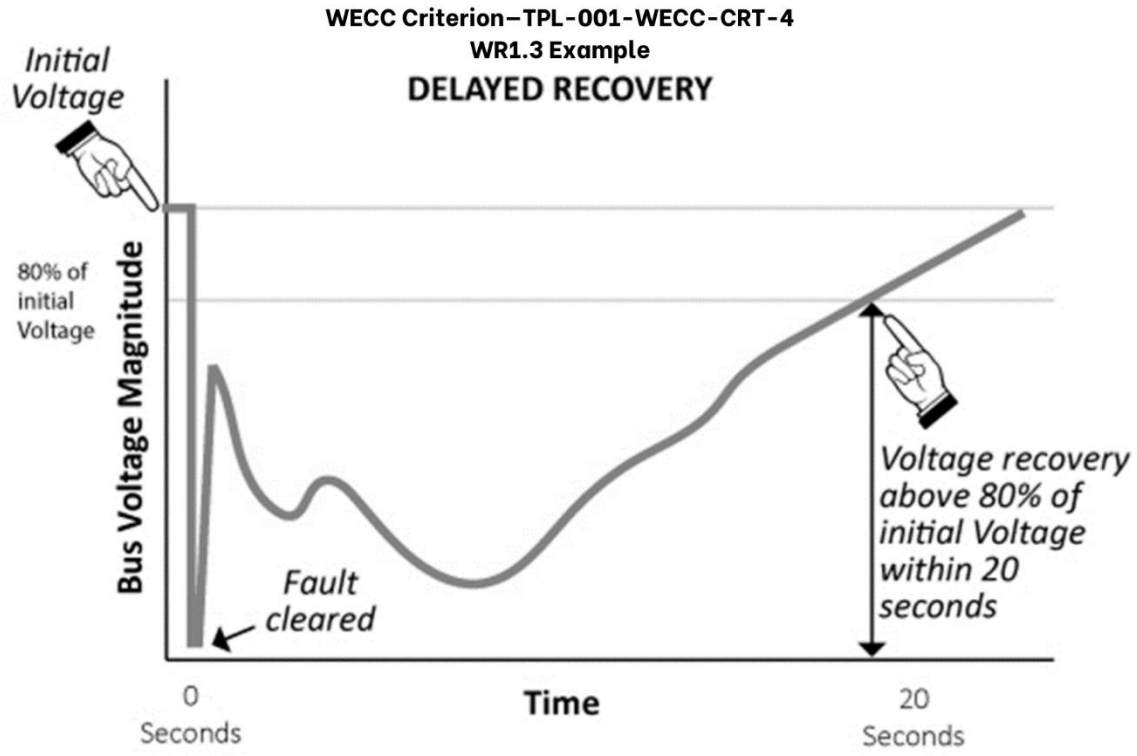
Power flow solutions refer to post contingency conditions where the actions of reactive devices and load tap changers should be studied for the appropriate period being studied.

There is a higher likelihood of occurrence of a P0 to P1 category event; therefore, a higher margin (105%) is used. For P2–P7, there is a lower likelihood of occurrence; therefore, the lower margin (102.5%) is used.

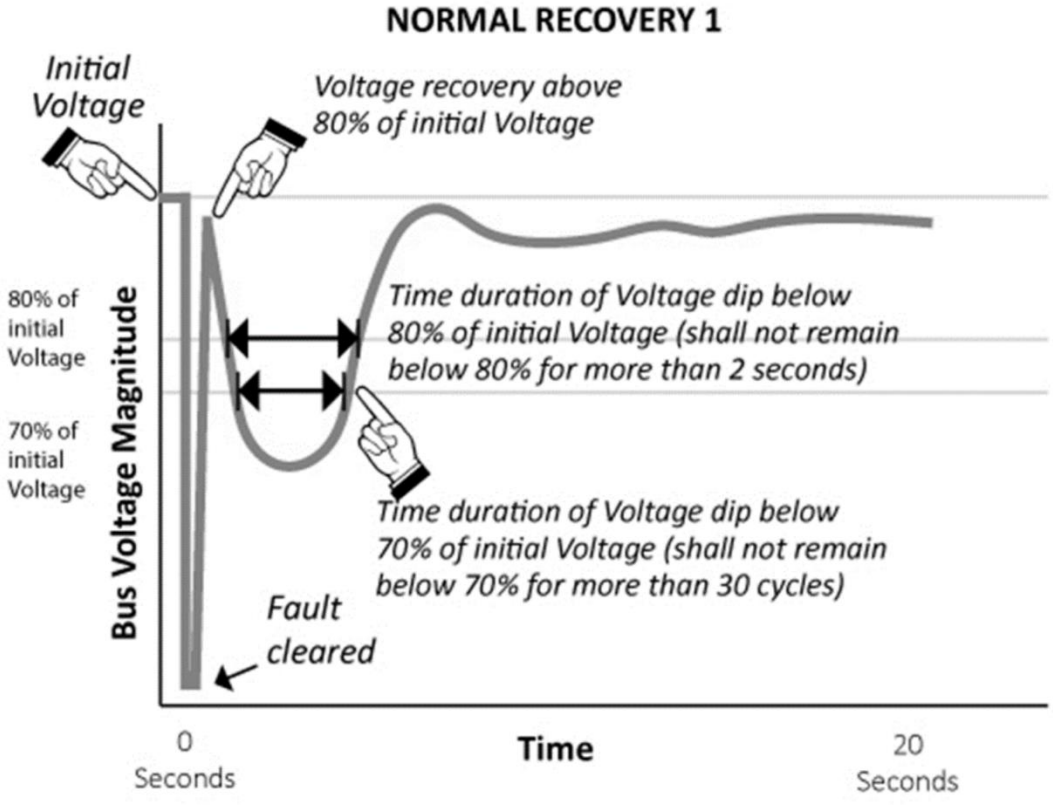
Requirement WR4

WR4 does not change the WR1, WR2, and WR3 defaults; rather, WR4 allows for a different approach without changing the defaults.

[3] The values in WR2 have their historic roots in the Peak Reliability Coordinator Systems Operating Limits Methodology.


WECC Criterion–TPL-001-WECC-CRT-4
WR1.3 Example
DELAYED RECOVERY
Initial Voltage
80% of initial Voltage
Bus Voltage Magnitude
Fault cleared
Voltage recovery above 80% of initial Voltage within 20 seconds
0 Seconds
Time
20 Seconds

WECC Criterion–TPL-001-WECC-CRT-4
WR1.4 Example



WECC Criterion–TPL-001-WECC-CRT-4
WR1.4 Example