SUMMARY OF VARIABLE NON-FUEL OPERATION AND MAINTENANCE ("O&M") COSTS

I. Background

By Decision No. C15-0292, the Colorado Public Utilities Commission ("Commission") approved a Settlement Agreement regarding Public Service Company of Colorado's ("Public Service" or the "Company") last electric rate case in Proceeding No. 14AL-0660E ("Electric Rate Case"). A component of the Settlement Agreement was the institution of a Clean Air-Clean Jobs Act Rider ("CACJA Rider"), which is implemented pursuant to C.R.S. § 40-3.2-207(3)-(4) and allows for recovery of the forecasted or actual costs associated with Eligible CACJA Projects. Eligible CACJA Projects are defined as Cherokee 5, 6, and 7 (collectively a natural gas combined cycle ("CC") plant, including interconnection equipment), the Pawnee selective catalytic reduction ("SCR") and particulate scrubber, the Hayden 1 SCR, and the Hayden 2 SCR. The CACJA Rider allows for recovery of the capital and operations and maintenance ("O&M") costs associated with Eligible CACJA Projects. Accordingly, a category of costs eligible for recovery under the CACJA Rider is variable non-fuel O&M expenses, including chemical and water expenses, and the variable O&M savings from the 2016 retirement of Cherokee 3.

The information regarding variable non-fuel O&M expense below identifies the types of variable non-fuel O&M costs that make up the variable non-fuel O&M expenses for the CACJA projects and is consistent with provisions of the Settlement Agreement that the Company "provide detailed cost information on an individual project basis and sufficient documentation to demonstrate that no costs in the CACJA Rider are also being recovered in base rates."[1]

II. Description of Variable Non-Fuel Operation and Maintenance (O&M) Costs

In general, variable non-fuel O&M at generating plants consists of the costs of consuming and handling base commodities. Base commodities are used for a variety of reasons at Company plants, but mainly for operations and to control emissions. As part of the Company's CACJA plan, emissions control technology has been added to the Hayden and Pawnee stations, and has also been installed at the new Cherokee CC plant. As a result, placing these projects in service will incrementally increase the amount of emissions control chemicals and water used at these three plants (*i.e.,* increase variable O&M costs). The base commodities used for emissions control include three principal chemicals: ammonia, lime, and sulfuric acid; water is also used for emissions control. The specific use of each is described below:

[1] Settlement Agreement, at 14, Proceeding No. 14AL-0660E (filed Jan. 23, 2015).

- **Ammonia**. Ammonia is used in SCR systems, such as those being added to the new Cherokee combustion turbines ("CTs"), as well as the Hayden and Pawnee units. A SCR system reduces the nitrogen oxides ("NOx") in boiler flue gas. The ammonia is received and handled in a liquid form, but vaporized and applied just ahead of a large catalyst inside the boiler flue gas ductwork. This is where NOx reacts with the ammonia to form nitrogen and water. Ammonia is also used for boiler water treatment. In this application, it is used directly to raise the pH of the boiler water to specific limits to reduce corrosion of the boiler steel.
- **Lime**. Lime is used to remove sulfur dioxide ("SO_2") from the flue gas. Lime and water, as well as fly ash and water, are combined and mixed to make the lime/ash water slurry used in the Spray Dry Absorber ("SDA") that is part of the SO_2 removal process of a scrubber.
- **Sulfuric Acid.** Sulfuric acid is used to control scale formation in cooling tower waters, reducing solid particle emissions from the towers. The material is received and handled in liquid form. It is then metered into the cooling tower waters, where it controls scale by maintaining the pH balance of the waters within certain limits. Minor amounts are also used in demineralizers.
- **Water.** Water is mixed with the lime and fly ash used to remove sulfur dioxide from flue gas, as described above. In addition, water is used for the heat rejection system and to turn into steam to generate additional electricity.

The discussion below describes the incremental variable non-fuel O&M expenses, for each CACJA project, for each of the base commodities listed above.

A. Pawnee Scrubber/SCR Chemical Descriptions & Uses

The chemicals used in the operation of the Pawnee SCR and scrubber are lime and ammonia. Additional variable non-fuel O&M costs at Pawnee include contract labor for lime slurry disposal. With regard to lime slurry disposal, the lime slurry mixes with flue gas and results in the formation of a by-product that requires disposal. The Company has a contract with a term that began on April 1, 2019 and runs through January 31, 2024, for lime slurry disposal at Pawnee. As a result, the 2020 lime slurry forecast was based on 2019 actuals through June plus July-December forecasted costs.

B. Hayden SCR Chemical Descriptions & Uses

The chemical used in the operation of the Hayden 1 SCR and the Hayden 2 SCR is ammonia. The Hayden 1 SCR and Hayden 2 SCR require anhydrous ammonia in the SCR units as part of the SCR process to significantly reduce NOx in the exhaust gas stream. The Company does not utilize any other chemicals in association with the Hayden 1 SCR and Hayden 2 SCR.

C. Cherokee 2X1 CC Chemical Descriptions & Uses

The chemicals used in the operation of the Cherokee 2X1 CC are sulfuric acid, ammonia, lime, water, and other chemicals.

Sulfuric acid is used at Unit 7 to control circulating (cooling) water pH to prevent condenser tube scaling (deposits) and resultant heat transfer losses. With regard to ammonia, two types of ammonia are used in the operations of the Cherokee 2x1 CC: (1) Ammonia 19% (used at Units 5 and 6 in SCRs to remove NOx from the CT exhaust gas stream); and (2) Ammonia 29% (used at Units 5, 6, and 7 to control pH in feed water and LP HRSG (low pressure heat recovery steam generator) section. Lime is used to increase waste water pH in conjunction with ferric chloride to form floc in waste water treatment. In addition, water is used when the waste heat of the combustion turbines from Units 5 and 6 are used to heat the water and turn it into steam to generate additional electricity from the steam turbine located at Unit 7.

Finally, several chemicals make up the "other chemicals" used at the Cherokee 2X1 CC. These chemicals are as follows:

- **Sodium Hypochlorite (Bleach).** Sodium hypochlorite is used at Unit 7 to control microbiological growth in the circulating water to prevent micro-bio buildup in condenser tubes and resultant heat transfer losses and under deposit corrosion.
- **FCT 4008.** FCT 4008 is a dispersant used at Unit 7 that allows circulating water pH to be controlled at higher operating limits requiring less sulfuric acid. This dispersant is primarily utilized to help lower sulfate in discharged water to the Platte River for the National Pollutant Discharge Elimination System ("NPDES") discharge limits under the Clean Water Act.
- **Defoam-18.** Defoam-18 is used at Unit 7 to break foam in any cooling tower basin, which occurs as circulating water cycles of concentration increase.
- **Sodium Hydroxide.** Sodium hydroxide is used at Units 5, 6, and 7 to control pH in a reverse osmosis ("RO") system to convert carbon dioxide to bicarbonate for second pass RO membrane rejection.
- **Carbon Dioxide.** Carbon dioxide is utilized for two different purposes at the Cherokee 2X1 CC. Carbon dioxide is used at Units 5, 6 and 7 to purge generators. Generators are filled with hydrogen during normal operation. Carbon dioxide is also used in common waste waters to lower and control the pH of treated waste water to meet the applicable NPDES discharge limits to the Platte River.
- **Ferric Chloride.** Ferric chloride is used in common waste waters, which are then used in conjunction with lime to form floc as part of waste water treatment. As discussed, waste water treatment occurs prior to discharge to the Platte River, consistent with NPDES discharge limits.
- **Hydrogen.** Hydrogen is used at the generators at Units 5, 6, and 7 to remove heat from the generator.

- **RO-503.** RO-503 is a dispersant used at Units 5, 6, and 7 to prevent the fouling of RO membranes.

There are also fees and equipment related to variable O&M costs at the Cherokee 2X1 CC. These fees and equipment include the following:

- **Mixed bed rental.** At Units 5, 6, and 7, there is a monthly rental fee for RO water polishing vessels.
- **Mixed bed swaps.** At Units 5, 6, and 7, there is a fee for swapping and regenerating mixed bed water polishing vessel resins.
- **Filter Cartridges.** At Units 5, 6, and 7, these cartridges are located immediately prior to RO system. Filters keep small particulate matter from getting to RO membranes and plugging micro-pores.
- **Hach Reagents.** At Units 5, 6, and 7, Hach reagents are used in in-line analytical monitoring instruments and to perform wet bench analytical tests of various process waters.

III. Methodology or Assumptions of Forecasted Costs

This section explains the methodology and assumptions used in forecasting the variable non-fuel O&M costs for each of the Eligible CACJA Projects. Public Service is utilizing the 2020 forecast for variable non-fuel O&M costs for the Eligible CACJA Projects for the 2020 CACJA Rider.

The 2020 forecast for variable non-fuel O&M costs for the Eligible CACJA Projects represents a reasonable baseline with respect to establishing 2020 costs. Variable non-fuel O&M costs are mainly affected by three items: (1) the cost of base commodities; (2) the amount of commodities utilized per MWh of production; and (3) plant dispatch.

IV. Overall 2020 Financial Information

The 2020 forecasted variable non-fuel O&M expenses discussed above are itemized in the following table. Table 1 below shows the forecasted cost for each Eligible CACJA Project and reflects the variable O&M savings from Cherokee Unit 3's retirement.

Table 1 - 2020 Forecasted Variable Non-Fuel O&M expenses

O&M Expense CACJA		2020 Forecast
Pawnee Scrubber/SCR		
SAP Account		
5600078	Chemicals – Lime	$1,261,405
5600082	Chemicals - Ammonia	$954,605
5600001	Lime Slurry Disposal - Operations	$155,168
	Total Pawnee	**$2,371,178**
Cherokee 2x1 CC		
SAP Account		
5600076	Chemicals - Other Chemicals	$670,240
5600078	Chemicals – Lime	$52,798
5600082	Chemicals - Ammonia	$76,224
5600083	Chemicals - Sulfuric Acid	$117,867
5600341	Water Use Costs (net of fixed)	$560,479
	Total Cherokee	**$1,477,608**
Hayden 1 SCR		
SAP Account		
5600082	Chemicals - Ammonia	$378,039
	Total Hayden 1	**$378,039**
Hayden 2 SCR		
SAP Account		
5600082	Chemicals - Ammonia	$103,865
	Total Hayden 2	**$103,865**
	Sub-Total O&M	**$4,330,690**
	Cherokee Unit 3 Commodity Costs To be Removed	**($1,418,410)**
	Total O&M	**$2,912,280**

V. Risk Factors

Several risk factors and uncertainties may result in variations between the 2020 actual costs and the forecasted 2020 costs provided in this filing. These general risk factors and uncertainties are both general and specific to certain Eligible CACJA Projects. As a general matter, commodity prices can change monthly, which can affect pricing for chemicals even where contracts are in place. An additional general matter relates to operations impacts, which include: the addition of new resources to the electric system (*e.g.,* wind resources); the dispatch of generation in a different manner than anticipated; changes to removal rates (*e.g.,* balancing air permits by injecting more

lime or ash to lower SO_2 emissions or ammonia for SCRs to lower NO_X emissions); weather; and unplanned outages (Unplanned outages are built into the generation forecast, but the actual unplanned outages may be higher or lower than estimated.). If any of the plants experience any significant maintenance issues and are offline for an extended period of time, commodities expenses could be different from forecasted levels.

Finally, an additional risk factor is that the water supplies for the Fort St. Vrain plant and Cherokee plant are connected; therefore, any change in the Fort St. Vrain water costs from those forecasted may affect the actual water costs for the Cherokee plant. In a similar vein, it has been difficult to forecast treated water use at the Cherokee plant given the significant changes occurring at the plant. Therefore, treated water use may be higher depending upon construction activities and changes to the plant.