Written Closure Plan

Comanche Station - Active CCR Landfill

Public Service Company of Colorado
Denver Colorado

October 17, 2016

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Table of Abbreviations and Acronyms

Abbreviation	Definition
ADF	Ash Disposal Facility
amsl	above mean sea level
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
cm/sec	Centimeters per Second

1.0 General Information

Comanche Station is a 1,450-megawatt coal-fired, steam turbine power plant owned and operated by Public Service Company of Colorado, an Xcel Energy company. The Station is located at 2005 Lime Road, Pueblo, Colorado 81006 approximately 3 miles south of Colorado Highway 50 in Pueblo County, Colorado.

The station's Ash Disposal Facility (ADF) is located on the southwest corner of the Comanche Station property (see **Figure 1**). The land surface elevations range from approximately 4,830 feet above mean sea level (amsl) in the southwest and northwest corners of the Site to approximately 4,800 feet amsl in the southeast corner of the Site.

The ADF is an active, coal combustion residuals (CCR) disposal unit that began construction and operation in 1987 and has remained in continuous operation since that time. The ADF is operated under an Engineering Design and Operations Plan developed pursuant to Colorado Department of Health and Environment Solid Waste Regulations.

The ADF is an approximately 280-acre engineered ash monofill consisting of eight permitted disposal cells. Approximately 38.7 acres of the ADF will be used for surface water control structures, access roads, and borrow area. The wastes accepted at the ADF consist primarily of coal ash (fly ash and bottom ash), with smaller quantities of water treatment sludge, process water pond sediment, coal impurities, and excavation soils. Cell 1 is the current active disposal area.

In accordance with 40 Code of Federal Regulations (CFR) 257 Disposal of Coal Combustion Residuals From Electrical Utilities (CCR Rule) §257.102(b), owners of CCR disposal units are required to publish a written closure plan that, *"…describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices."*

This closure plan fulfills the requirements of 40 CFR §257.102(b).

2.0 Description of Closure Plan – 257.102(b)(1)(i-iii)

The ADF consists of a total of eight permitted cells. Cell 1 was constructed with a bottom liner consisting of 18-inches of compacted clay with a permeability of $2x10^{-7}$ centimeters per second (cm/sec). Cells 2-8 will be constructed with a composite bottom liner consisting of 2 feet of compacted soil liner overlain by a 60-mil HDPE geomembrane. Cell 2 is anticipated to be constructed in 2017. The ADF has an estimated remaining 77-year life expectancy upon completion of Cell 1 and will provide CCR disposal capacity through approximately 2092, assuming current ash production rates as indicated in **Table 1** below.

PSCo will initiate closure activities as individual cells reach final grades. The facility will utilize a final cover design meeting the requirements of 40 CFR §257.

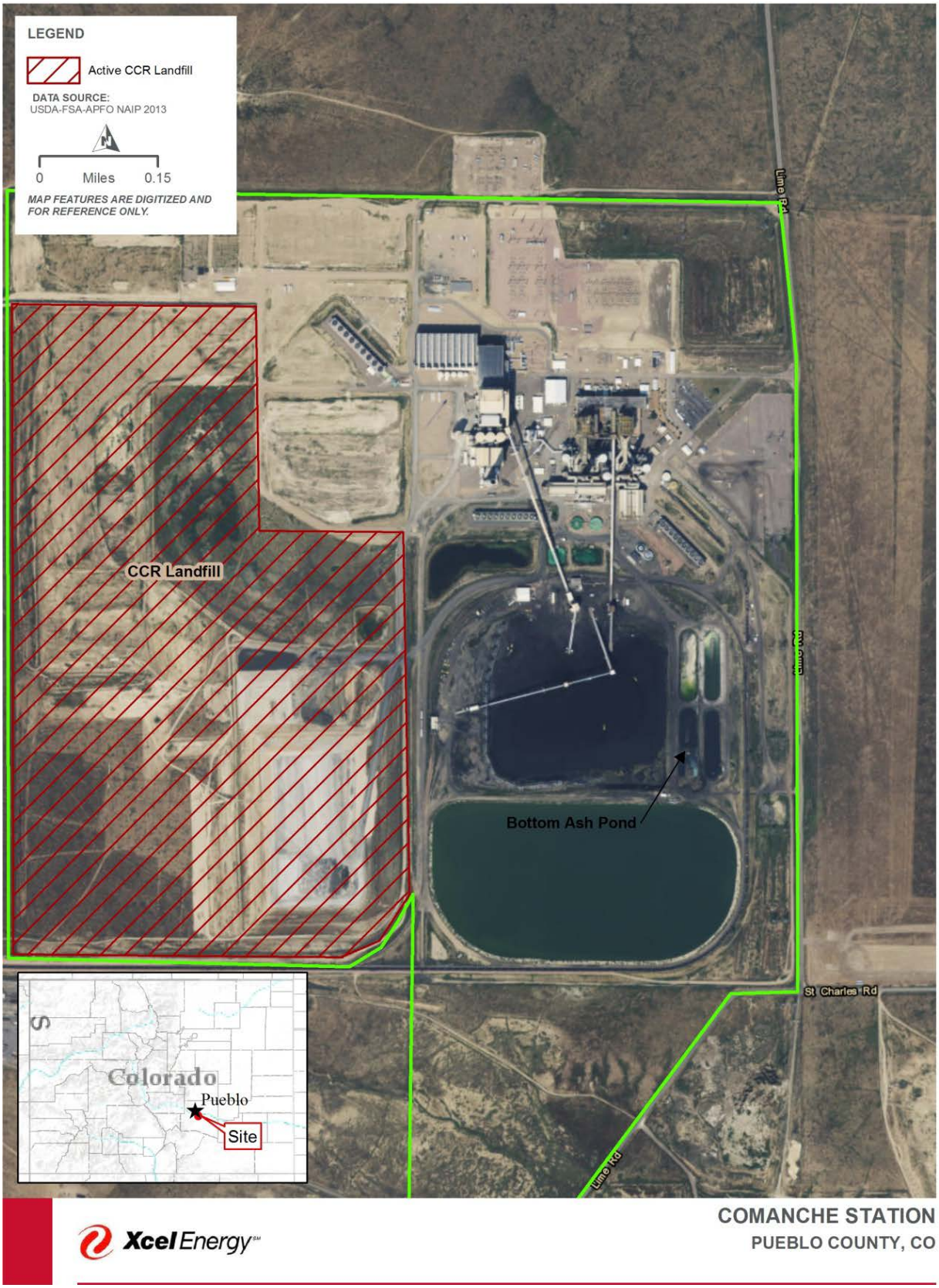

Figure 1. Comanche Power Station – CCR Landfill

Final cover will be placed on the top of each cell after the final design grade has been reached. The final cover will have a grade that promotes surface water run-off and minimizes erosion. The slope of the final cover on the top of the ADF will be no less than 5% and the final cover side slopes will be no greater than 25% (4 horizontal feet to 1 vertical foot). A 5% slope will be sufficient to convey any precipitation runoff from the top of the ADF to downchute conveyance structures located at the perimeter of the ADF. Small swales along the tops and sidewalls of the ADF will direct precipitation runoff to the downchute conveyance structures.

The ADF has been designed and constructed to include an engineered liner system and as a result will require a final cover consistent with 40 CFR 257 §102(d)(3)(i) – **Closure performance standard when leaving CCR in place** – which requires that the permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10-5 cm/sec, whichever is less.

For Cell 1, the design specification for the clay liner was 18 inches of on-site clay compacted to 95% standard proctor density, resulting in a hydraulic-conductivity value of 2×10^{-7} cm/sec. Prior to the publication of the CCR rule, Cell 1 had undergone partial closure of the exterior slopes concurrent with operations. Slopes were closed with an approved soil cover consisting of an 18-inch infiltration layer and a 6-inch erosion layer. Areas of Cell 1 that were not closed prior to publication of the CCR rule will have final cover will consist of 18-inches of compacted soils with a hydraulic-conductivity value of no greater than 2×10^{-7} cm/sec or equivalent system utilizing a geomembrane. A 6-inch erosion layer consisting of topsoil suitable to support vegetation will be applied.

Cells 2 through 8 will be constructed with a final cover system consisting of a suitable subgrade material, a geomembrane cap that is no more permeable than the liner, and a soil cover that will support vegetation, and which will be tracked and seeded.

An on-site soil borrow area is mined for soil to be used for the infiltration soil layers. The soil borrow area is located adjacent to the current active area. Construction phasing consists of borrowing soil from the next cell to be constructed for use in closure of the current cell. If needed, additional borrow materials are available north of the ADF. The on-site soils that are expected to be excavated from the Cell 2 through 8 footprints are described as consisting of unconsolidated colluvium consisting of stiff clays and silts. An evaluation of on-site soils indicates that the soils can be re-compacted to achieve a hydraulic conductivity of $1x10^{-7}$ cm/sec or less. If needed, off-site borrow areas may be utilized for compacted soil liner materials. Each new borrow source is tested prior to being used on-site.

As it is encountered, existing on-site topsoil material will be stripped and stockpiled for future use in the final cover system. After topsoil is installed, it will be tracked and seeded. Vegetative cover is an important part of the final cover system as it provides long-term stabilization of the slopes, limits erosion due to stormwater runoff, and reduces the potential for wind-blown nuisance dust.

3.0 Inventory Estimate –257.102(b)(1)(iv)

In accordance with 257.102(b)(1)(iv) an estimate of the maximum inventory of CCR ever on site over the active life of the CCR Landfill must be provided.

The majority of waste managed at the ADF is fly ash (85.0% by volume); bottom ash is also managed in the ADF and comprises 10.9% of the volume (**Table 1**). Smaller quantities (0.02% by volume) of coal impurities (pyrites, rocks, etc.) are disposed at the ADF. Lime sludge from the process water ponds (4.1% by volume) are also managed in the ADF. Small quantities of

construction excavation soils are also occasionally disposed at the ADF on a project-by-project basis.

Table 1. Summary of Waste Streams and Annual Volumes			
Waste Stream	**Annual Waste Tonnage**	**Approximate Unit Weight (lbs/CY)**	**Approximate Annual Waste Volume (CY)**
Bottom Ash	50,000	2,500	40,000
Fly Ash	300,000	1,930	311,000
Lime Sludge	14,600	1,946	15,000
Coal Impurities	100	2,597	77

When the ADF reaches final capacity in approximately 2092, the estimated final volume of CCR will be approximately 29,707,300 cubic yards.

4.0 Area Requiring Final Cover – 257.102(b)1(v)

In accordance with 40 CFR §257.102(b)(1)(v), an estimate of the largest area of the CCR unit ever requiring a final cover must be provided. The ADF's entire 280-acre CCR disposal area will receive a final cover as described herein.

PSCo will continue to install the final cover as areas reach final capacity using a "cap-as-you-go" methodology. At any given time, the largest area containing CCR that will require a final cover is estimated to be approximately 40 acres (**Table 2**).

Table 2. Summary of Final Cover Areas by Cell		
Cell Number	**Final Cover Area (Acres)**	**Approximate Year of Closure**
Cell 1	39.8	2019
Cell 2	27.1	2024
Cell 3	27.1	2033
Cell 4	26.7	2038
Cell 5	25.8	2044
Cell 6	28.6	2055
Cell 7	26.7	2073
Cell 8	30.7	2092

5.0 Schedule of Closure Activities – 257.102(b)1(vi)

Table 3. Schedule of Closure Activities		
Task	**Cell Start Date**	**Cell Finish Date (Initiation of Cell Closure)**
Written Closure Plan	October 17, 2016	October 17, 2016
Written Post-Closure Plan	October 17, 2016	October 17, 2016
Cell 1	1987	2019
Cell 2	2017	2024
Cell 3	Year 2024	Year 2033
Cell 4	Year 2033	Year 2038
Cell 5	Year 2038	Year 2044
Cell 6	Year 2044	Year 2055
Cell 7	Year 2055	Year 2073
Cell 8	Year 2073	Year 2092
Annual Inspections	Annually	Annually until 2092
Fugitive Dust Plan Updates	Annually	Annually until 2092
Post Closure Maintenance	Year 2092	Year 2122 (minimum)

6.0 Qualified Professional Engineer Certification – 257.102(b)(4) and 257.102(d)(3)

In accordance with 40 CFR §257.102(b)(4), the owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written closure plan meets the requirements of this section.

In accordance with 40 CFR §257.102(d)(3), the owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.

I, Douglas T. DeCesare, being a registered Professional Engineer, in accordance with the Colorado State Board of Licensure for Architects, Professional Engineers, and Professional Land Surveyors, do hereby certify to the best of my knowledge, information, and belief, that the information contained in this written Closure Plan dated October 17, 2016, was conducted in accordance with the requirements of 40 CFR §257.102(b) and (d), is true and correct, and was prepared in accordance with recognized and generally accepted good engineering practices.

SIGNATURE:

Colorado PE 0051341

DATE: October 14, 2016