January 25, 2023



Michelle Freeark
Arizona Electric Power Cooperative, Inc. (AEPCO)
1000 South Highway 80
Benson, Arizona 85602

Dear Ms. Freeark:

On June 13, 2022, Arizona Electric Power Cooperative, Inc. (AEPCO) notified the U.S. Environmental Protection Agency ("EPA" or "the Agency") of the facility's intent to withdraw its application, "Apache CCR Surface Impoundments Applications for Alternative Liner Demonstration" (hereafter referred to as "the Part B Application"), which was submitted in November 2020 pursuant to 40 C.F.R. § 257.71(d)(1). As part of this notification, AEPCO provided the following rationale for withdrawal:

> During the course of the data collection in support of the demonstrations, AEPCO obtained additional information which allowed us to further characterize the soils underlying the CCR-regulated facilities at Apache Station. Based on the new data, AEPCO is certifying that the surface impoundments meet the requirements of 40 C.F.R. § 257.71(a)(1)(iii) for alternative composite liner systems.

Thus, AEPCO asserts that the additional hydrogeological data collected in support of an alternate liner demonstration (ALD) under 40 C.F.R. § 257.71(d)(1) provides sufficient evidence to support certification that the units are lined with an alternative composite liner (ACL) that meets the criteria in 40 C.F.R. § 257.71(a)(1)(iii). As AEPCO acknowledges in its notification to withdrawal, a facility cannot avail itself of both of these regulatory provisions simultaneously.

**Overview**

Under EPA regulations, a composite liner must consist of two components: 1) an upper component consisting of a geomembrane liner, which must be at least 60-mil thick if constructed with high density polyethylene (HDPE), and 2) a lower component consisting of at least two feet of compacted soil with a hydraulic conductivity of no more than $1\times10^{-7}$ centimeters per second (cm/sec). 40 C.F.R. § 257.70(b). The upper liner component must be installed in direct and uniform contact with the lower liner component. 40 C.F.R. § 257.70(b)(1).

An ACL must also consist of two components: an upper component consisting of a geomembrane liner, which must be at least 60-mil thick if constructed with HDPE, and a lower component of unspecified material that must achieve a flow rate no greater than two feet of compacted soil with a hydraulic conductivity of $1\times10^{-7}$ cm/sec. 40 C.F.R. § 257.70(c)(1). If the lower component of the ACL is compacted soil, the upper component must be installed in direct and uniform contact with the compacted soil. Id. An ACL must also meet the requirements specified in § 257.70(b)(1) through (4) relating to the construction and installation of the liner system. 40 C.F.R. § 257.70(c)(3).

Many of the requirements for a composite liner and an ACL are identical. *Compare* 40 C.F.R. §§ 257.70(b) *and* 257.70(c) are identical. Both require two discrete liner components, both require an upper liner component to be a geomembrane that is at least 60 mil thick if constructed with HDPE, and both require the lower liner component to sustain a liquid flow rate less than or equal to two feet of compacted soil with a hydraulic conductivity of $1\times10^{-7}$ cm/s. The primary distinction between the two is the type of material used for the lower liner component. A standard composite liner is constructed with mechanically compacted soil, while an ACL may use another suitable material that can reliably sustain the specified flow rates.

Critically, neither regulatory provision allows for the lower component of the liner to consist of a combination of mechanically compacted clay and the subsurface conditions beneath the soil or otherwise permit consideration of the subsurface conditions beneath the composite liner to supplement a deficient component of the liner. This is clear from the text of paragraphs (b)(1)–(4), which requires construction and installation specifications for the liner system that naturally occurring or "native" soils cannot meet. For example, the regulation specifies that the "composite liner must be…placed upon a foundation or base capable of providing support to the liner and resistance to pressure gradients above and below the liner to prevent failure of the liner due to settlements, compression, or uplift." 40 C.F.R. § 257.70 (b)(3). Naturally occurring soils can serve as the foundation or base described in this provision, but they clearly had not been "placed upon" a foundation. Similarly, paragraph (4) specifies that the composite liner "must be installed to cover all surrounding earth likely to be in contact with the CCR or leachate." 40 C.F.R. § 257.70 (b)(4). The native soils that the ACL certification characterizes as part of the lower component of the ACL have never been "installed," and are actually the "surrounding earth" that the regulation requires the liner to cover. These constraints on the definition of a composite liner were part of the impetus for promulgation of the Part B Rule, which was intended to provide limited regulatory relief for existing impoundments by allowing facilities to supplement the available record for individual impoundments and demonstrate that various site-specific conditions could allow the existing designs to remain protective despite not otherwise meeting the definition of a composite liner.

AEPCO's original liner certification posted on the facility's website states that both impoundment systems (Ash Ponds 1-4 and Scrubber Pond No. 2) were constructed with a HDPE liner (60-mil on the bottom and 80-mil on side slopes) underlain by an eight-inch compacted clay layer (CCL) that was designed to have a hydraulic conductivity no greater than $1\times10^{-6}$ cm/s. The original liner certification acknowledges that both the hydraulic conductivity and the 8 inches of compacted clay do not meet the regulatory standards for a composite liner under 40 C.F.R. § 257. 70(b).

The ACL certification titled, "CCR Surface Impoundments Alternative Composite Liner Certification Ash Ponds 1-4 & Scrubber Pond No. 2" (hereafter referred to as "the ACL Certification"), asserts that the native soils identified beneath the engineered CCL are able to supplement both the thickness and the hydraulic conductivity of the CCL and result in a liner system that achieves the minimum requirements of 40 C.F.R. § 257.70(c)(1). The new certification does not contain any information about these two components or otherwise seek to revise its previous conclusions about these two components.

However, as explained above, consideration of how the native soils beneath the liner may affect long-term fate and transport of leakage from the impoundment system is not relevant to qualification for an ACL. Based on the information presented to date, it does not appear that the liners beneath Ash Ponds 1-4 and Scrubber Pond No. 2 meet the criteria for an ACL under 40 C.F.R. § 257.70(c). But even if such additional considerations were still relevant, EPA identified a number of fundamental issues with both the engineered liner and the native soils that, if accurate, would invalidate both an ACL Certification and an ALD. These are presented below in the next section.

Based on the information provided by AEPCO, these ponds would be considered to be "unlined," in accordance with 40 C.F.R. § 257.71(a)(3). Moreover, with the withdrawal of AEPCO's Part B

Application, AEPCO's deadline to cease receipt of waste in those impoundments is no longer tolled.

**Deficiency of Geomembrane Liner Component**

The ACL Certification asserts that the geomembrane liner component was designed and constructed in accordance with the requirements set forth in 40 C.F.R. §§ 257.70(b) and (c), but AEPCO provides no evidence to support this claim. In addition, the Agency's review of the liner characterization submitted as part of the Part B Application identified issues that raise major concerns about whether the geomembrane meets the standards in 40 C.F.R. §§ 257.70 (b)(1) and (c)(1). The regulation at 40 C.F.R. § 257.71(d)(1)(i)(C) requires documentation of liner construction, including all the data and analyses relied upon to determine the HDPE have the necessary physical properties to be "suitable for use." Therefore, EPA assumes the information provided in the previously submitted Part B Application is comprehensive, and that missing or incomplete information means that this data was either not collected or not considered during liner design and construction.

First, 40 C.F.R. § 257.70(b)(1) requires that the geomembrane material properties are sufficient to prevent failure due to pressure gradients (including static head and external hydrogeologic forces), physical contact with the CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation. The material properties of the HDPE used in the liner for Ash Ponds 1-4 and Scrubber Pond No. 2 are documented across three reports provided in the Part B Application titled "HPDE Liner Certifications," "HDPE Resin Certifications," and "HDPE Liner Conformance Testing" (PDF p. 1136, 1927, 1963).[1] These reports indicate that 333 rolls of HDPE were sent for laboratory testing for physical properties (e.g., thickness, density, moisture content, specific gravity), mechanical properties (e.g., puncture and tear resistance, tensile properties), and endurance properties (e.g., carbon black content and dispersion, melt index, brittleness). A total of 30 samples of resin were sent for analysis of physical properties (e.g., density) and endurance properties (i.e., carbon black content and dispersion, melt index). This battery of tests is generally in line with current recommendations for materials testing. However, the part B application provides no basis for the minimum design standards compared against these test results to determine the performance of the geomembrane liner was adequate, nor does the application otherwise explain why these design standards will ensure that the performance standards in 40 C.F.R. § 257.70(b)(1) were met provide an adequate measure of material performance. For example, the percent elongation at break reported for some samples of 60-mil HDPE (PDF p. 2126) falls below the minimum of 700% listed in the current GM13 Standard Specification for smooth HDPE.[2] In the absence of any explanation of why these material properties are nevertheless adequate, these results raise concerns about the performance of the HDPE in the field and EPA is unable to determine whether the design and construction of this liner meet relevant regulatory standards.

Second, 40 C.F.R. § 257.70(c)(1) requires that the geomembrane be installed in direct and uniform contact with the compacted soil. The construction and field performance of the HDPE liner is documented in two reports provided in the Part B Application titled "Field Seaming, Non-Destructive Test, & Destructive Test Logs" and "Geomembrane Panel Acceptance Forms" (PDF pp. 2325, 2548). These reports provide the welding rates and temperatures measured throughout the construction process and provide the results of quality assurance tests conducted on the welded HDPE. Destructive testing for peel and shear strength was conducted on samples of welded HDPE in a laboratory. Non-destructive air

[1] Given the large size of the Part B Application, associated PDF page numbers are provided to the referenced portion of the document text.

[2] Geosynthetic Institute. 2021. "GRI - GM13 Standard Specification: Test Methods, Test Properties and Testing Frequency for High Density Polyethylene (HDPE) Smooth and Textured Geomembranes." March.

pressure tests were conducted between 25 and 30 psi for 5 minutes on the liner in the field. There is no indication that any of the tests failed. The construction reports also include a signed certification by the contractor that the liner was installed, inspected, and tested in accordance with all project plans and specifications. However, the construction reports never explain or describe what "project plans and specifications" the contractor used. Nor is there any description of the "project plans and specifications" in any document in the part B application or posted on AEPCO's website. EPA therefore has no evidence that the geomembrane was installed in direct and uniform contact with the compacted soil, in accordance with 40 C.F.R. § 257.70(c)(1). For example, there is no documentation of whether any steps were taken to prevent imperfections from developing in the liner during installation. Composite liners require direct and uniform contact with the underlying compacted clay to function as intended. Inadequate quality control during installation can result in formation of waves (or wrinkles) in the liner material. Even small waves may prevent intimate contact between the geomembrane liner and underlying soil, which may in turn allow a greater amount of water to accumulate within the void space beneath wave and infiltrate into the underlying soil. Larger waves could result in high stress within the geomembrane liner, which can adversely affect the integrity of the liner over time. There is no evidence that the stress applied on the liner after waste is disposed will reliably eliminate any waves that remain after construction.[3]

For the reasons described above, there is a potential for failure of the geomembrane liner that may negate its effectiveness as a barrier. As a consequence, EPA considers that the information in both the ACL Certification and the Part B Application is insufficient to support a finding that the HDPE liner meets the requirements of 40 C.F.R. §§ 257.70(b) and (c). Based on the available information therefore, it appears that neither of the liners in the Ash Ponds 1-4 nor the Scrubber Pond No. 2 meet the criteria for an ACL.

**Deficiency of Compacted Clay Liner Component**

The Part B Application and the ACL Certification acknowledge that the CCL located immediately beneath the HDPE liner at both impoundment systems does not meet the requirements for a standard composite liner under 40 C.F.R. § 257.70(b). However, the Agency's review of the liner characterization submitted as part of the Part B Application identified additional issues beyond those acknowledged in the original liner certification that raise further concerns about the performance of this liner component. 40 C.F.R. § 257.71(d)(1)(i)(C) requires documentation of liner construction, including all the data and analyses relied upon to determine the CCL (i.e., the source material) has the necessary physical properties to be "suitable for use." Therefore, EPA assumes the information provided in the previously submitted Part B Application is comprehensive, and that missing or incomplete information means that this data was either not collected or not considered during liner design and construction.

The regulation at 40 C.F.R. § 257.70(c)(1) requires that the flow rate through the second liner component be no greater than would be achieved by two feet of compacted soil with a hydraulic conductivity of $1 \times 10^{-7}$ cm/s. The Part B Application includes copies of two reports that detail the construction of the CCL titled, "2016 Liner Design Criteria and Design Drawings" and "Laboratory and Field Permeability Test Results" (PDF p. 684, 1004). These reports indicate that an eight-inch layer of clay was compacted to at least 95% Standard Proctor maximum dry density at an unspecified optimum moisture to achieve a maximum hydraulic conductivity of $1 \times 10^{-6}$ cm/s. No documentation is provided on the specific quality assurance measures that were followed during construction. A total of 25

[3] U.S. EPA. 2002. "Assessment and Recommendations for Improving the Performance of Waste Containment Systems." EPA/600/R-02/099. Office of Research and Development. Cincinnati, OH. December.

laboratory tests and 16 field tests were conducted at some point on the compacted clay to confirm the hydraulic conductivity. Laboratory tests results ranged between $1.7\times10^{-8}$ and $9.8\times10^{-5}$ cm/s, while field tests results ranged between $3.3\times10^{-8}$ and $3.2\times10^{-6}$ cm/s (PDF p. 1005). Therefore, the information submitted calls into question any assertion that that construction of this liner component achieves even the stated design specifications, which in any event are not sufficient to meet the ACL requirements. Furthermore, as described in the following paragraphs, the Part B Application includes information that indicates the actual performance may be even worse than documented.

The Part B Application notes that the CCL was constructed to only be eight inches thick. However, the available regulatory record on the performance of soil liners is based on a minimum of 24 inches of compacted clay. The record also shows that as the thickness of a clay liner decreases, there is an increasing likelihood that non-visible cracks and other imperfections could form in the clay that would increase the overall conductivity of the liner.[4] Such imperfections may not be reliably addressed through standard quality assurance measures. EPA has acknowledged that it may still be possible to achieve a sufficiently low hydraulic conductivity with a compacted clay thickness less than 24 inches. However, demonstrating this would have required field tests during installation to confirm the performance of the liner as constructed. Such tests can be designed to measure both vertical and horizontal conductivity over a wider area than the typical sample collected for laboratory testing and so are more likely than laboratory tests to reflect heterogeneities (e.g., macropores, fissures) that can significantly increase soil permeability. The application does present field measurements collected with a BAT Geosystems AB permeameter, which is used to calculate flow from the sides of a 35 mm diameter tip that is advanced into the soil. Yet, the application provides no rationale to support a conclusion that this specific test is adequate to characterize the effective hydraulic conductivity of an eight-inch CCL. A previous review of this test conducted by the United States Department of Energy did not recommend this test for near-surface testing of hydraulic conductivity.[5] This conclusion was based on the following: 1) the test measures a very small volume of soil, 2) flow through the side of the tip can overrepresent the horizontal conductivity of the soil, and 3) smearing and other distortion of the natural soil structure as the tip is advanced can artificially lower local hydraulic conductivity in the vicinity of the probe. As a result, the actual hydraulic conductivity of the compacted clay may be considerably higher than reported from field tests.

The Part B Application also notes the existence of fissures beneath the impoundments. A referenced 1993 study concluded that groundwater withdrawal from the aquifer system beneath the site resulted in differential subsidence of the land surface and development of fissures (PDF p. 546). Notwithstanding this information, the application does not discuss the potential for fissures, subsidence, or other consequences of local groundwater extraction to disrupt the long-term integrity of the liner. Even if the fissures have not yet reached the ground surface, it is still possible that the displacement of soils in the subsurface could disrupt the integrity of the CCL through formation of localized cracks or other imperfections and lead to higher long-term hydraulic conductivity than predicted by any test.

EPA has emphasized that the effectiveness of a geomembrane liner can be negated if leachate is able to readily flow through any holes in the liner, particularly in the presence of a sustained hydraulic head. With an inadequate soil layer, performance of the composite liner would depend primarily on the size and frequency of such imperfections that form during installation and operation, which cannot be

[4] 56 FR 51060, October 9, 1991.

[5] U.S. DOE. 1994. "In Situ Testing to Determine Field-Saturated Conductivity of UMTRA Project Disposal Cell Covers, Liners, and Foundation Areas." DOE/AL/62350-100. Office of Scientific and Technical Information. Oak Ridge, TN. February.

verified while waste remains in place. For the reasons described above, EPA considers the information provided in both the ACL Certification and the Part B Application to be inadequate to determine that the HDPE liner meets all the requirements of 40 C.F.R. § 257.70(c). Based on this information, EPA believes that neither the Ash Ponds 1-4 nor the Scrubber Pond No. 2 meet the standard for an ACL. There are no standardized laboratory tests designed to simulate a liner that has been poorly designed or constructed. As a result, it is unlikely that any further laboratory data collected to support an ALD will be reliable.

**Inadequacy of Native Soils**

Both the Part B Application and ACL Certification assert the native soils beneath the engineered liner provide further protection that would allow the otherwise deficient liner system to meet the requirements of 40 C.F.R. § 257.70(c). The ACL Certification provides a summary of additional data collection efforts undertaken since submittal of the Part B Application in support of this assertion.

AEPCO collected a total of 51 soil borings from around the perimeter of the impoundments at roughly equidistant spacing. Soil cores were visually inspected and characterized for every five feet of boring. From these soil cores, a total of 126 undisturbed samples were drawn from selected intervals for laboratory testing of hydraulic conductivity. Based on these additional samples, AEPCO identified up to three distinct layers of native soil beneath the engineered liner of the two impoundment systems. The ACL Certification asserts that the compacted clay component of the engineered liner should be considered together with all of these different layers of native soil as a single liner component represented by an "effective hydraulic conductivity" over the entire depth. EPA reviewed the additional characterization of subsurface soils provided in the ACL Certification. As described in the following paragraphs, EPA finds the factual basis for AEPCO's reliance on native soils is not scientifically valid. We also find that these soils, as characterized, would be unsuitable for consideration as part of any liner system.

The fundamental purpose of composite liners installed at the base of a surface impoundment or landfill is to prevent, to the extent feasible, leakage beyond the waste boundary. To that end, the two composite liner components are designed to work in concert to minimize flow into surrounding soils. This is possible because the presence of compacted soil or other low-conductivity material immediately beneath the geomembrane serves to control the rate that leachate may flow through any holes or other imperfections that form in the geomembrane. If the upper and lower liner components were separated, the effectiveness of the geomembrane could be wholly negated. For example, EPA has previously warned that a higher conductivity leachate collection system installed in-between the two components of a composite liner is not practicable and would compromise the integrity of the liner.[6] The same would be true of a deficient CCL located between the HDPE and any lower conductivity soils. Therefore, as previously established, even if the native soils provide further separation from the groundwater table, it appears that the liner systems at Ash Ponds 1-4 and Scrubber Pond No. 2 would still be ineligible for designation as an ACL based solely on deficiencies identified with the two engineered liner components.

The ACL Certification attests that the layer of natural soil immediately beneath the engineered liner of the Scrubber Pond has an average hydraulic conductivity of $4.23 \times 10^{-5}$ cm/s (~44 ft/yr). This is over two orders of magnitude higher than specified for compacted soil and would allow for unimpeded flow through the native soil. At this rate, it would take less than a year for leachate to infiltrate through the additional 25 feet of soil in this layer. The ACL Certification relies on two deeper layers of lower

[6] 80 FR 21372, April 17, 2015.

conductivity soil, 60 feet of $3.23 \times 10^{-6}$ cm/s and 122 feet of $2.96 \times 10^{-7}$ cm/s respectively, to argue that the combined "effective conductivity" of all the different layers would be equivalent to the required performance for two feet of compacted clay. There are major concerns as to how well this approach can represent the actual performance of the soils. As previously noted, the presence of a layer of high conductivity soil in-between the geomembrane and the lower soil layers would compromise the integrity of the composite liner in the exact same way as would the presence of a leachate collection system or a deficient CCL. In fact, reliance on native soil in this way could result in fundamentally worse performance because there is no mechanism in place to collect or otherwise control leakage from the unit. For example, the high conductivity soil may allow transport of leaks a considerable distance beyond the base of the unit. It may also result in accumulation of leachate at the intersection of the soil layers, which could result in substantial lateral flow past the horizontal waste boundary. These types of situations make it even more likely that a leak will spread and encounter fractures within the soil column or other regions of higher conductivity soil that can serve as preferential flow pathways through otherwise low-conductivity soils to groundwater. Based on this information, it appears that AEPCO's approach of treating multiple discrete layers of soil as a single liner component is not sufficient to support an ACL certification.

The ACL Certification attests that all of the soil layer samples around Ash Ponds 1-4 and Scrubber Pond No. 2 have an average hydraulic conductivity higher than $1 \times 10^{-7}$ cm/s. In one instance, the soil immediately beneath the engineered liner of the Ash Pond 3 has an average hydraulic conductivity of $6.99 \times 10^{-7}$ cm/s (~3 ft/yr). With a reported 24.7 feet of soil and ponded depth of 23.5 feet, the calculated flow through this layer of soil would be higher than required for two feet of compacted soil. Therefore, this soil layer would not be suitable for consideration as part of an alternative liner. It is possible that the same is true of the soils beneath the other Ash Ponds because all reported conductivities are averages. Section 257.70(c)(1) requires the flow rate of the alternative material to be "no greater than" $1 \times 10^{-7}$ cm/s for two feet of compacted soil. Therefore, this comparison must be made based on individual measurements and not averages. This is because the rate of infiltration is not determined by average conditions over a collective area of nearly 180 acres. Leakage from the impoundments will instead preferentially flow through regions of higher conductivity. As a result, a single deficient portion of a liner can compromise the broader performance of the system. In addition, there is considerable uncertainty about the range of newly collected measurement values because the ACL Certification does not provide any underlying data. However, the well installation reports available on the facility webpage indicate that previous measurements were as high as $4.4 \times 10^{-4}$ cm/s. There is also considerable uncertainty as to whether the newly collected measurements adequately characterize subsurface conditions around this site. The Part B Application identifies the presence of a saturated intermediate formation consisting of lenses of clayey sand and gravel between the two impoundment systems (PDF p. 29) and a non-tectonic fault (or fissure) in the same general area (PDF p. 546, 555). However, the Part B Application does not fully delineate the extent of either of these geologic features relative to each other, the impoundment dimensions, or anticipated pathways for contaminant migration. Nor does the ACL Certification address these issues in its characterization of the subsurface soils. Yet both the intermediate formation and subsurface fissures (that may result in fractures or other discontinuities) can serve as preferential flow pathways within the soil column. These pathways have the potential to transmit leakage from the impoundments to specific regions of the aquifer that may be left uncharacterized if samples were collected under the assumption that the soil was relatively homogenous. For example, the 2015 well installation report available on the facility webpage noted the potential that "seepage from the scrubber pond will migrate downgradient (laterally) along permeable lenses as the seepage moves vertically through the subsurface profile." Therefore, AEPCO's approach of averaging the hydraulic conductivity measurement across a single soil layer is not a suitable basis for an ACL certification.

For the reasons described above, even if the regulations allowed consideration of subsurface conditions as a supplement to the lower component of a composite liner, EPA considers that the information provided in both the ACL Certification and the Part B Application would not support a conclusion that the native soils below the deficient liner can supplement the performance of the liner or otherwise meet the requirements of 40 C.F.R. § 257.70(c).

**Evidence of Potential Releases from Ash Ponds 1-4 and Scrubber Pond No. 2**

The regulation at 40 C.F.R. § 257.94(e) requires that if a facility detects a statistically significant increase (SSI) in the concentration of an Appendix III constituent in a downgradient compliance well (when compared to the background concentrations), within 90 days the unit must either begin assessment monitoring, as required under 40 C.F.R. § 257.94(e)(1), or successfully demonstrate a source other than the unit was the cause of the SSI. This alternative source demonstration (ASD) must be based on site-specific information showing that the SSI resulted from another source of contamination; an error in sampling, analysis, or statistical evaluation; or from natural variation in groundwater quality. *See* 40 C.F.R. § 257.94(e)(2).

Results of statistical analyses on site monitoring data were first reported in the January 2019 Groundwater Monitoring and Corrective Action Report. This report contained ASDs completed in December 2018 for SSIs of calcium, chloride, and sulfate at Ash Ponds 1-4 and for calcium, chloride, sulfate, and Total Dissolved Solid (TDS) at Scrubber Pond No. 2 that were identified following the November 2018 sampling event. The Statistical Analysis Plan was then revised in July 2019 to shift to intrawell comparisons for all constituents except fluoride based on the findings of the ASDs. Under this new Statistical Analysis Plan, updated ASDs were prepared for Scrubber Pond No. 2 in October 2019 for SSIs of calcium, chloride, and fluoride and for Ash Ponds 1-4 in December 2019 for SSIs of calcium and chloride. The most recent ASDs in November 2020 attempt to address continued SSIs for Ash Ponds 1-4 at Well K (sulfate, TDS), and Scrubber Pond No. 2 at Well E (calcium, chloride), Well G (fluoride), and Well I (fluoride) that were identified based on intrawell comparisons (PDF p. 501, 518).

The ASDs propose the alternate source is natural variability resulting from extensive offsite groundwater withdrawal that has drawn higher concentration groundwater from the nearby Wilcoxon Playa toward the impoundments. The ASDs present three primary arguments for why identified SSIs are not attributable to a potential release from the impoundments: 1) concentrations in water samples from downgradient wells plotted on Piper diagrams do not fall directly between samples from the impoundment and upgradient background wells, which is taken to demonstrate there has been no mixing between these two water sources; 2) it would not be possible for a potential release from the Scrubber Pond No. 2 to reach groundwater within the operational life of the impoundment because it would take an estimated 300 years for leachate to infiltrate through the over 270 ft of clay beneath the impoundment; and 3) higher concentrations of TDS, chloride, and sodium have been measured in the groundwater around the Wilcoxon Playa, which could support increased concentrations in site monitoring wells.

The regulations provide an ASD must affirmatively demonstrate elevated concentrations in downgradient monitoring wells resulted from a source other than the CCR impoundment. *See*, 40 C.F.R. § 257.94(e)(2). To rebut the site-specific monitoring data and analysis resulting in an SSI, an ASD requires conclusions that are supported by site-specific facts and analytical data. Merely speculative or theoretical bases for the conclusions are insufficient. In this case, as outlined in the following paragraphs, EPA finds that the rationale outlined is insufficient to demonstrate that an alternate source exists and therefore, Ash Ponds 1-4 and Scrubber Pond No. 2 should have entered into assessment monitoring.

EPA concludes that the Piper diagram comparisons of major ion chemistry provided in the ASDs are insufficient to demonstrate that the identified SSIs are from a source other than the impoundments. Piper diagrams are a visual representation of the relative proportions of certain chemicals in different water samples. Piper diagrams can be useful to visually represent, for quick comparison, groundwater samples based on chemical type, to examine how natural waters may change over time, and to evaluate whether the physical mixing of different water sources has occurred. A Piper diagram consists of three graphs: two triangular graphs, one that plots concentrations of dissolved chemicals in groundwater that are negatively charged (anion) and another that plots concentrations of dissolved chemicals in groundwater that are positively charged (cations). A third diamond-shaped graph combines information from the two triangular plots. Piper diagrams are a widely used visualization technique for groundwater data. However, their application in the context of a potential release from these impoundments relies on several assumptions that may not be valid, including: 1) that water samples collected from the impoundments accurately reflect the chemistry of potential releases, 2) that samples from upgradient background wells do not reflect leakage from the impoundments, and 3) that direct mixing of impoundment water and groundwater is the only cause of changes in measured concentrations. As detailed below, the ASDs do not provide the necessary technical information to demonstrate whether any of these assumptions are valid at this site.

1) The ASDs provide insufficient evidence to conclude that plotted samples from the impoundments accurately reflect the chemistry of potential releases to groundwater. The application does not explain where or how samples were collected from within the impoundments, which can affect the measured concentrations. For example, it has previously been observed that concentrations in surficial waters can differ from porewater intermingled with CCR at the base of an impoundment, which is generally more representative of leakage to the subsurface.[7] Additionally, these impoundment systems began operation in the mid-1990s, but the water samples were collected during only one or two sampling events in November 2018 and October 2020. These individual samples provide no indication of how the composition and leaching potential of the waste may have varied over nearly three decades due to changes in the source coal or other operational factors. Thus, it is unclear whether these samples can support any conclusions about whether there has been mixing between the impoundment and groundwater.
2) The ASDs provide insufficient evidence to conclude that plotted samples from upgradient wells accurately reflect background concentrations that were not impacted by a leakage from the impoundment. The application identifies the presence of an extraction well (Well 61) along the northern side of Scrubber Pond No. 2 that is used to supply water for irrigation. Potentiometric maps show that, when this extraction well is in operation, it results in a localized cone of depression that extends underneath the impoundment to the south and the designated background well (Well-J) to the east, resulting in an approximately 30 ft drop in water elevation within that well. The application asserts that "…when the irrigation Well-61 is active, regional aquifer Well-J is hydraulically downgradient of Scrubber Pond No. 2. Although Well-J may not be hydraulically upgradient of the CCR unit throughout the entire year, analysis of the network performance and ASDs have documented no impact by the unit" (PDF p. 38). As evidence, the application provides Piper diagrams that display the composition of water drawn from Well-J, the three downgradient wells, and the impoundment. The application concludes that because the major ion chemistry measured in

[7] U.S. EPA. 2014. "Human and Ecological Risk Assessment of Coal Combustion Residuals." RIN 2050-AE81. Office of Solid Waste and Emergency Response. Washington, DC. December.

Well-J differs from that measured in the impoundment, this indicates that the well has not been impacted by leakage from the impoundment (PDF p. 527). Based on this conclusion, the application asserts that Well-J can characterize background concentrations as accurately as a well located consistently upgradient of the impoundment (PDF pp. 38). EPA considers that the information provided in the application is insufficient to determine that placement of Well-J has not been affected by leakage from the impoundment and can characterize background groundwater quality as accurately as samples from a reliably upgradient well, as required by 40 C.F.R. § 257.91(a)(1)(i) and (ii). Differences in the chemistry between impoundment and well samples do not provide definitive evidence that a potential release has not occurred. This is because such comparisons provide no indication of the degree to which leakage from the impoundment have mixed with groundwater. Particularly in this instance, where the direction of groundwater flow is inconsistent and the well will periodically receive an influx of unaffected groundwater from further upgradient, measured concentrations may remain relatively low compared to the undiluted leachate for some time. Thus, without baseline samples collected prior to operation of the unit that are known to be uncontaminated, neither Piper diagrams nor other means of comparing the available data can support conclusions about the degree to which water chemistry at upgradient Well-J has changed since disposal in the unit has occurred. Therefore, it is not possible to conclude that the designated background well has not been affected by leakage from the impoundment based on the data provided. Furthermore, the application notes that "local pumping activities also changes the concentrations in groundwater chemistry at Well-J" (PDF p. 526). Thus, there is also evidence that groundwater extraction from nearby Well 61 may itself alter groundwater chemistry in the vicinity of Well-J. As a result, it is unclear whether samples from Well-J can support any conclusions about whether and to what degree there has been mixing between the impoundment and groundwater.

3) The ASDs provide insufficient evidence to conclude that mixing between impoundment water and groundwater should plot as a straight line. Impoundment water is open to the atmosphere and groundwater is a closed system, so these two types of water are not chemically similar. The water from an impoundment can have different properties from groundwater (e.g., pH, redox potential) and so may chemically interact with both soil and groundwater in ways that could cause an increase or decrease in dissolved concentrations (e.g., chemical precipitation out of solution, ion exchange). These types of reactions can result in substantial loss or addition of dissolved constituent mass, the magnitude of which can vary for each individual constituent. This in turn may cause samples to plot differently than expected. This would undermine the validity of the analyses presented in the ASDs, which does not account for these types of reactions.

EPA also considers that the information provided in the ASDs to be insufficient to support a conclusion that local subsurface geology would have prevented releases from reaching groundwater within the operational life of the impoundments. Theoretical calculations based on groundwater flow rates to determine whether leakage from a CCR unit could have reached compliance wells are insufficient to rebut actual, site-specific groundwater monitoring data that detected an SSI. There are a variety of reasons why such calculations may not reflect actual subsurface transport, such as the presence of unidentified preferential flow pathways within subsurface soils. For example, the transport time reported in the application is based on measurements of hydraulic conductivity collected during monitoring well installation (i.e., 0.00007 ft/day or $2.5 \times 10^{-8}$ cm/s) (PDF p. 530), but no explanation is provided for why this particular value was selected. This value happens to match the single lowest value reported in the 2015 well installation report available on the facility webpage. However, the same report also includes measurements as high as $3.4 \times 10^{-7}$ cm/s in clay and as high as $4.4 \times 10^{-4}$ cm/s in sand/silt lenses. Additionally, as documented in the ACL Certification, this value is lower than the average reported for all soil layers measured beneath the impoundment. Subsurface leaks are expected to preferentially flow through regions of higher conductivity soil. The application does not justify why the lowest measured hydraulic conductivity would be representative of clay across the entire site or why this clay would dominate subsurface transport instead of the higher conductivity sand/silt deposits. As previously discussed, neither the application nor the well installation report provides sufficient information to characterize the prevalence or connectivity of the higher conductivity sand/silt soil or the potential for secondary permeability within the soil resulting from fissures identified around the site. The potential for both higher conductivity soil and discrete preferential flow pathways at this site could lead to transport of a leak to groundwater faster than predicted by the ASDs.

Finally, EPA considers the information provided in the ASDs insufficient to conclude that a shift in the direction of groundwater flow is the source of identified SSIs. The surface impoundments were constructed in the mid-1990s, long after water withdrawal for irrigation began. Water levels collected from monitoring wells at the facility indicate there has been a consistent direction of groundwater flow from northeast to southwest for the duration of monitoring since the first water measurements at these impoundment systems were collected in June 2016. The certification by a professional engineer for these monitoring systems states that the upgradient wells accurately characterize the quality of background groundwater, as required by 40 C.F.R. § 257.91(a)(1). Therefore, it is not apparent why changes in water chemistry as a result of flow from the Wilcox Playa further to the northeast of the monitoring systems would not also be reflected in samples from the upgradient monitoring wells. Nor is it apparent how this would lead to concentrations in downgradient wells that are consistently higher than the concentrations in upgradient background wells. Given that the ASDs do not adequately demonstrate that there is an alternative source of these constituents located between the background and compliance wells, the impoundments remain a plausible source of identified SSIs.

Based on the available information it appears that the ASDs are not sufficient to demonstrate the existence of an alternative source and that AEPCO has failed to establish an assessment monitoring program for Ash Ponds 1-4 and Scrubber Pond No. 2, as required by 40 C.F.R. § 257.94(e). Based on AEPCO's own monitoring data and statistical analysis, there is evidence of potential releases from both impoundment systems. Furthermore, given that the switch to intrawell background was predicated on the presence of an upgradient alternative source that was not captured in the characterization of background groundwater quality, it does not appear that the compliance wells characterize background as accurately or more accurately than upgradient wells as required by 40 C.F.R. § 257.91(a)(1). Constituents for which SSIs were initially identified by APECO using interwell comparisons have been detected at higher elevations consistently at Ash Ponds 1-4 and Scrubber Pond No. 2 since the first sampling event in April 2016. Identified SSIs for many of the same constituents at both impoundment systems are further evidence that the liner systems of both Ash Ponds 1-4 and Scrubber Pond No. 2 are similarly deficient and have both resulted in potential releases to groundwater.

**Deficiencies in Monitoring Program may Mask Evidence of Contaminant Plume**

Additional information provided in the Part B Application raises further questions about whether the baseline groundwater samples collected for Ash Ponds 1-4 and Scrubber Pond No. 2 are of adequate quality to support assessment monitoring. This is because the Part B Application reports detection limits of 100 µg/L for cobalt and 200 µg/L for lithium. Both constituents were not detected in a majority of baseline groundwater samples based on these detection limits. The Part B Application provides no documentation of the associated quantitation limit for these constituents or explanation of why lower limits could not have been achieved for these two Appendix IV constituents.

The regulation at 40 C.F.R. § 257.93(g)(5) requires that practical quantitation limits be set at the lowest concentration level reliably achievable within specified limits of precision and accuracy available to the facility. A range of different reporting limits exists that may be used by laboratories to document whether, and at what concentration, a constituent is present. The two reporting limits relevant to the review of this application are practical quantitation limits and method detection limits. Practical quantitation limits are the lowest concentration measurable with a specified degree of certainty, while method detection limits are the lowest concentration reliably distinguishable from zero by the analytical method. Measurements between the quantitation and detection limits confirm the presence of a constituent, with reported concentrations considered to be estimated, but still valid, values.[8] Both limits are calculated using a standard deviation derived from repeated measurements of quality assurance samples. Thus, any steps taken to achieve a lower quantitation limit will also result in a lower detection limit. Elevated quantitation limits and corresponding detection limits are prohibited, in part because they can mask evidence of a potential or actual release.

The reported detection limits are substantially higher than the corresponding groundwater protection standard (GWPS) of 6 µg/L cobalt and 40 µg/L lithium. As a consequence of the high detection limits, and thus higher corresponding quantitation limits, it would not be possible to determine whether these constituents have been detected at statistically significant levels (SSLs) above their respective corresponding GWPS. As a general matter, commercial laboratories publicly advertise far lower detection limits for these two constituents with standard analytical methods. Indeed, most other Part B applicants were able to achieve detection limits for these two constituents below the relevant GWPS. Although various issues at a particular facility can push limits higher, such as interference from the sample matrix (e.g., presence of other dissolved materials), none of these issues are novel and approaches have been developed to identify and address them.[9] The fact that the application reports far lower detection limits for other Appendix IV constituents, which were likely to have been analyzed with the same analytical methods as cobalt and lithium, indicates that the high reported limits may instead be the result of improper instrument calibration or other human error. However, due to the lack of documentation about the analytical methods used or any description of efforts taken to further reduce the reporting limits, EPA is unable to determine the cause of the high limits or verify that these limits are the lowest that can be reliably achieved for the site.

For these reasons, the groundwater monitoring systems for Ash Ponds 1-4 and Scrubber Pond No. 2 do not appear to meet the requirements of 40 C.F.R. § 257.93(g)(5). As a result, it would not be possible to discern whether certain constituents have been detected at SSLs above GWPS in accordance with 40 C.F.R. § 257.95(g).

**Conclusions**

EPA finds that the information provided as part of the ACL Certification and the Part B Application is sufficient to support a conclusion that the liners for Ash Ponds 1-4 and Scrubber Pond No. 2 are not eligible for designation as an ACL, nor is it considered likely that further data collection would alter this finding. Given that AEPCO has already rescinded its application under the Part B Rule, the facility is no longer eligible for associated tolling of the closure deadline for these surface impoundments.

---

8 The Risk Assessment Guidance for Superfund generally recommends that these estimated values be considered sufficient quality to use at the reported concentration in quantitative risk analyses. See: U.S. EPA. 1989. "Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual (Part A)." EPA/540/1-89/002. Office of Emergency and Remedial Response. Washington, DC. December.

9 For example, U.S. EPA 2007. "Solutions to Analytical Chemistry Problems with Clean Water Act Methods." EPA 821-R-07-002. Office of Water. Washington, D.C. March.

**EPA Region IX**
Since AEPCO has withdrawn the Part B application, this matter has been referred to EPA Region IX's Enforcement and Compliance Assurance Division for follow-up. Your point of contact at Region IX is John Schofield at 415-972-3386, or Schofield.John@epa.gov.

If you have any questions regarding the contents of this letter, please contact Richard Huggins at 202-566-0543 or Huggins.Richard@epa.gov.

Sincerely,

CHoskinson Digitally signed by CAROLYN HOSKINSON Date: 2023.01.25 10:45:55 -05'00'

Carolyn Hoskinson, Director
Office of Resource Conservation and Recovery

Enclosures

CC:

Claire Trombadore, EPA Region IX, Director, Land, Chemicals, and Redevelopment Division
Amy C. Miller, EPA Region IX, Director, Enforcement and Compliance Assurance Division
Misael Cabrera, Director, Arizona Department of Environmental Protection