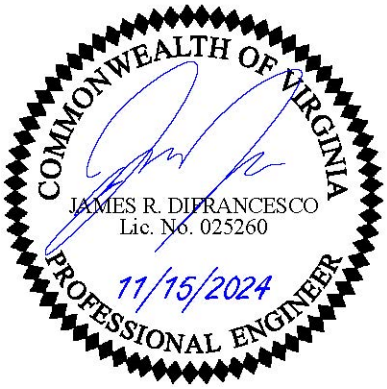
ATTACHMENT XIV – ALTERNATE LINER DEMONSTRATION

ALTERNATE LINER DEMONSTRATION

Bremo Bluff FFCP Management Facility
Solid Waste Permit 627
Fluvanna County, Virginia

Prepared for:

Dominion Energy Virginia
120 Tredegar Street
Richmond, Virginia 23219



Prepared by:
Schnabel Engineering
9800 Jeb Stuart Parkway, Suite 100
Glen Allen, Virginia 23059

Schnabel Reference No. 22130437.031

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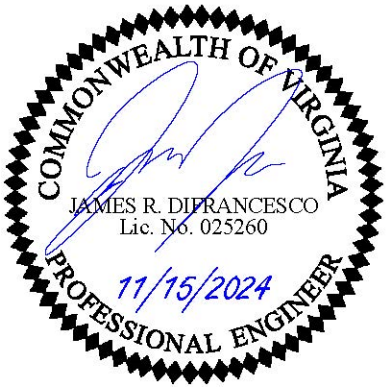
CERTIFICATION

This Alternate Liner Demonstration for the Bremo Bluff Fossil Fuel Combustion Products (FFCP) Management Facility (Facility) was prepared by Schnabel Engineering (Schnabel). The document and Certification/Statement of Professional Opinion are based on and limited to information that Schnabel has relied on from Dominion Energy and others, but not independently verified.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (CCR Rule, 40 CFR §257 Subpart D) as well as the Virginia Department of Environmental Quality's Virginia Solid Waste Management Regulations (VSWMR, 9VAC20-81).

The use of the word "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

James R. DiFrancesco	Principal / Practice Leader Solid Waste
Name	Title
Signature	November 15, 2024
	Date



1.0 INTRODUCTION

This Alternate Liner Demonstration (ALD) has been prepared for the Bremo Bluff Fossil Fuel Combustion Products (FFCP) Management Facility (Facility) located in Bremo Bluff, Virginia. The Facility will accept coal combustion residuals (CCR) previously generated at the Bremo Station (Station) and operate as a new, captive industrial landfill (CCR Unit) under the Virginia Department of Environmental Quality (DEQ) Solid Waste Permit (SWP) 627. Schnabel Engineering (Schnabel) has prepared this ALD on behalf of the Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion Energy).

The Facility is subject to the design requirements in the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (CCR Rule, 40 CFR §257 Subpart D) as well as the DEQ's Virginia Solid Waste Management Regulations (VSWMR, 9VAC20-81).

2.0 OBJECTIVE

The objective of this demonstration is to show the proposed bottom liner system is fully adequate for the CCR Unit and in full compliance with both the CCR Rule and VSWMR.

2.1 Performance Requirements

The proposed bottom liner system for the CCR Unit is in accordance with the design requirements for industrial landfills outlined in 9VAC20-81-130.J; however, this demonstration is provided to show compliance with 40 CFR §257.70. Per 40 CFR §257.70(b) for a new CCR landfill, "a *composite liner* must consist of two components; the upper component consisting of, at a minimum, a 30-mil geomembrane liner (GM), and the lower component consisting of at least a two-foot layer of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ centimeters per second (cm/s). GM components consisting of high-density polyethylene (HDPE) must be at least 60-mil thick." However, as stated in 40 CFR §257.70(c)(1), the owner or operator may elect to install an alternate composite liner provided it has a "lower component, that is not a geomembrane, with a liquid flow rate no greater than the liquid flow rate of two feet of compacted soil with a hydraulic conductivity of no more than $1x10^{-7}$ cm/s."

For the proposed alternate bottom liner system, a geosynthetic clay liner (GCL) installed directly underlying the geomembrane replaces the two-foot layer of compacted soil. This demonstration shows that the liquid flow rate through the GCL is no greater than the liquid flow rate through the prescriptive two feet of compacted soil.

2.2 Proposed Bottom Liner Descriptions

The proposed bottom liner system for the CCR Unit includes a GCL placed atop a minimum 12-inch-thick controlled subgrade and overlain by a 60-mil textured HDPE geomembrane liner. A 250-mil geocomposite drainage layer will be placed atop the geomembrane and will be overlain by an 18-inch-thick aggregate layer. A depiction of the bottom liner system is included in Attachment III of the Part B Permit Application (Design Plans).

3.0 METHODOLOGY AND ASSUMPTIONS

In accordance with 40 CFR §257.70(c)(2), the following equation, derived from Darcy's Law for gravity flow through porous media, was used to determine liquid flow rates to verify equivalency.

$$\frac{Q}{A} = q = k\left(\frac{h}{t} + 1\right)$$

Where:

Q = flow rate [cubic centimeters per second (cm^3/s)]
A = surface area of the liner [squared centimeters (cm^2)]
q = flow rate per unit area [cubic centimeters per second per squared centimeter ($cm^3/s/cm^2$)]
k = hydraulic conductivity of the liner (cm/s)
h = hydraulic head above the liner [centimeters (cm)]
t = thickness of the liner (cm)

Per 40 CFR §257.70(d)(1), the leachate system must be designed and operated to maintain a leachate depth of less than 30 cm over the bottom liner. Thus, hydraulic head above the liner was assumed to be 30 cm, the maximum allowable. GCLs typically range in thickness from 7 to 10 millimeters (mm) according to the Geosynthetic Research Institute's Technical Paper "Design Considerations for Geosynthetic Clay Liners (GCLs) in Various Applications." The low end of this range was chosen as it will conservatively result in a more restrictive hydraulic conductivity in the GCL.

4.0 CALCULATIONS

The maximum allowable unit flow was calculated for the prescriptive two feet of compacted soil liner. The results are shown below in Table 1.

Table 1: Maximum Allowable Flow Rate per Unit Area

Liner Type	Thickness, t (cm)	Hydraulic Head, h (cm)	Hydraulic Conductivity, k (cm/s)	Flow Rate per Unit Area, q ($cm^3/s/cm^2$)
Two Feet Compacted Soil	60.96	30	$1x10^{-7}$	$1.49x10^{-7}$

Using the maximum allowable flow rate per unit area calculated for the two feet of compacted soil, a maximum allowable hydraulic conductivity for the GCL was determined. Results are shown in Table 2.

Table 2. Maximum Allowable GCL Hydraulic Conductivity

Liner Type	Thickness, t (cm)	Hydraulic Head, h (cm)	Flow Rate per Unit Area, q ($cm^3/s/cm^2$)	Hydraulic Conductivity, k (cm/s)
GCL	0.7	30	$1.49x10^{-7}$	$3.4x10^{-9}$

5.0 CONCLUSION

A GCL with a minimum thickness of 7 mm and a maximum hydraulic conductivity of 3.4 $x10^{-9}$ cm/s will provide an equivalent liquid flow rate as two feet of compacted soil with a maximum hydraulic conductivity of $1x10^{-7}$ and complies with the requirements in the CCR Rule and VSWMR. A GCL with a maximum hydraulic conductivity of $3.4x10^{-9}$ cm/s will be used in the bottom liner system, as required in Attachment VII of the Part B Permit Application (Technical Specifications).