Coal Combustion Residuals Landfill
Alternative Composite Liner Design Certification

Laramie River Station Landfill

Prepared for
Basin Electric Power Cooperative

Prepared by
Barr Engineering Co.

January 2026

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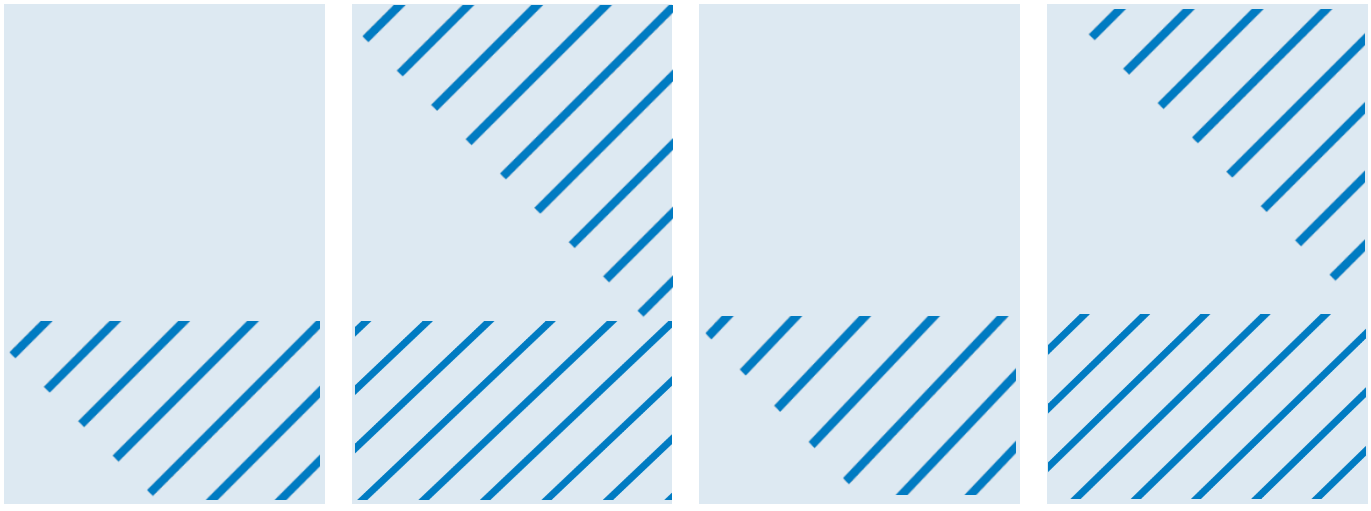
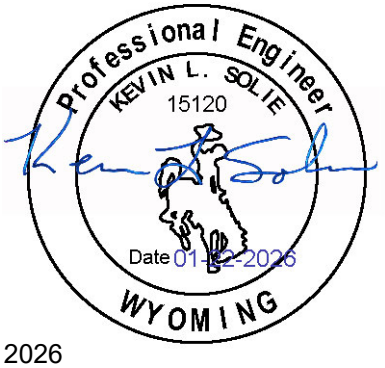


Certification

I hereby certify that I, or my agent, have examined the facility plans and specifications, and, being familiar with the provisions of 40 CFR 257 Subpart D and Wyoming Department of Environmental Quality, Division of Solid and Hazardous Waste Management, Chapter 18 rules, attest that this Coal Combustion Residuals alterative composite liner design is in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR § 257.70.



Kevin L. Solie
Wyoming PE #: 15120

January 22, 2026
Date

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1 Introduction

Laramie River Station (LRS) is a coal-fired power plant consisting of three units. The power plant, owned Missouri Basin Power Pool (MBPP) and operated by Basin Electric Power Cooperative (BEPC), is located northeast of Wheatland in Platte County, Wyoming. Fly ash, flue gas desulfurization (FGD) waste, and bottom ash generated at LRS are disposed at the onsite landfill, regulated as a coal combustion residuals (CCR) landfill under Permit No. 20.066 issued by the Wyoming Department of Environmental Quality (WDEQ). CCR management is subject to Federal Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments per 40 CFR 257 Subpart D.

The existing CCR landfill was constructed in 9 phases (Cells 1-9) under Permit No. 20.066. Cell 10 will be a lateral expansion of the CCR landfill and will include an alternative composite liner comprised of a geosynthetic clay liner (GCL) overlain by a geomembrane liner. Accordingly, this certification was developed to satisfy the requirements of 40 CFR § 257.70 (Design criteria for the lateral expansion of a CCR landfill) as they apply to BEPC's proposed Cell 10.

2 Liner System Design

The Cell 10 alternative composite liner system is configured as follows (from the top down for each component):

- Base
  - 12-inch drainage layer
  - protective geotextile
  - 60-mil high density polyethylene (HDPE) geomembrane barrier layer
  - Geosynthetic Clay Liner (GCL)
  - Prepared Subgrade
- Side Slopes
  - 60-mil HDPE geomembrane barrier layer; and
  - Geosynthetic Clay Liner (GCL)
  - Prepared Subgrade

3 Liner System Performance

The composite liner design must meet the requirements of 40 CFR § 257.70(c) as described below:

> ***§ 257.70(c)(1) - An alternative composite liner must consist of two components; the upper component consisting of, at a minimum, a 30-mil GM, and 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/sec. GM components consisting of high density polyethylene (HDPE) must be at least 60-mil thick. If the lower component of the alternative liner is compacted soil, the GM must be installed in direct and uniform contact with the compacted soil.***

The Cell 10 composite liner system includes a 60-mil HDPE geomembrane layer overlying a GCL. The geosynthetic liner components will be installed in direct and uniform contact with a prepared subgrade. The prepared subgrade will be moisture conditioned, compacted, and smooth rolled to ensure intimate contact with the GCL barrier layer. Construction quality testing will be performed in accordance with the Construction Quality Assurance Manual and documented in the construction documentation report.

> ***§ 257.70(c)(2) - The Owner or Operator must obtain certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority that the liquid flow rate through the lower component of the alternative composite liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of $1x10^{-7}$ cm/sec. The hydraulic conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted methods. The liquid flow rate comparison must be made using Equation 1 of this section, which is derived from Darcy's Law for gravity flow through porous media.***

$$(Eq.\ 1) \quad \frac{Q}{A} = q = k(\frac{h}{t} + 1)$$

Hydraulic conductivity tests were performed in accordance with ASTM D6766 utilizing CETCO Resistex 300DN9 and SOLMAX CAR Plus 3 using samples of pond water (CCR leachate) from the facility. The results of the hydraulic conductivity tests were utilized to confirm the liquid flow rate through the GCL would be less than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec. Accordingly, the GCL component of the Cell 10 composite liner system meets the liquid flow rate requirements prescribed in the rule.

> ***§ 257.70(c)(3) - The alternative composite liner system must meet the requirements specified in paragraphs (b)(1) through (4) of this section***
>
> ***The composite liner must be:***
>
> ***§ 257.70(b)(1) – Constructed of materials that have appropriate chemical properties and sufficient strength and thickness 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.***

Material manufacturers completed chemical compatibility testing using the GCL and samples of liquids (CCR leachate) from various impoundments at LRS. Hydraulic conductivity tests were performed in accordance with ASTM D6766 utilizing CETCO Resistex 300DN9 and SOLMAX CAR Plus 3 and samples of CCR leachate from the facility. The testing determined that both tested GCLs had appropriate chemical properties to prevent failure due to physical contact with the CCR or leachate to which it would be exposed to. The results of the chemical compatibility testing were also utilized to determine that the flow rate through the GCL would be less than the flow rate through two feet of compacted soil with a hydraulic conductivity no greater than 1 x 10^{-7} cm/sec.

> ***§ 257.70(b)(2) - Constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on the slopes;***

Interface friction analysis of the composite liner components was performed during the design of the composite liner system for Cell 10 and determined to be adequate.

§ 257.70(b)(3) - 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 settlement, compression, or uplift; and

Cell 10 will be constructed on stable foundation materials as determined in the WDEQ solid waste management facility permit application.

§ 257.70(b)(4) - Installed to cover all the surrounding earth likely to be in contact with the CCR or leachate.

All the CCR material shall be contained within the lined area of the landfill. An intermediate ditch is included in the permit drawings along the permit boundary to contain stormwater that has come into contact with CCR within the lined limits of the landfill.

4 Summary and Conclusion

Based on the plans and specifications, the Cell 10 liner system meets the requirements for an alternative composite liner as requirements of § 257.70(b)(1) – (4).