Certification per 40 CFR §257.70(e), *Design criteria for new CCR landfills*
Chesterfield Fossil Fuel Combustion Products Management Facility – SWP #609
Chester, Virginia

The following certification for the Chesterfield Power Station Fossil Fuel Combustion Products Management Facility (FFCPMF) is required under 40 CFR §257.70(e), *Design criteria for new CCR landfills* of the *Disposal of Coal Combustion Residuals From Electric Utilities* rule *(CCR rule)*. The FFCPMF meets the definition of "new CCR landfill" under the CCR rule. Pursuant to 40 CFR §257.70(e), a professional engineer must certify that the new CCR landfill is designed with a composite liner that meets the requirements of §257.70(b), or an alternate composite liner that meets the requirements of §257.70(c), and a leachate collection and removal system that meets the requirements of §257.70(d). Demonstration of these requirements was made in the Solid Waste Permit (SWP) Part B application, which was approved by the Virginia Department of Environmental Quality with issuance of Solid Waste Permit SWP #609.

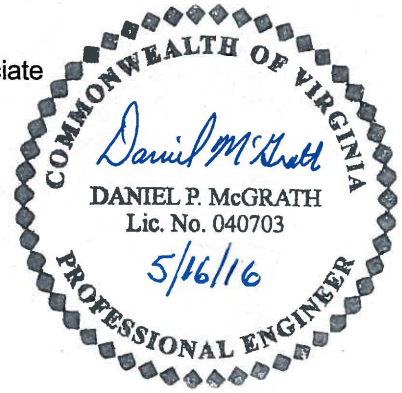
In addition, a professional engineer must certify that the liquid flow rate through the lower component of the alternative composite liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/sec. The attached calculation worksheet demonstration is made in accordance with *Equation 1* in §257.70(c)2.

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 the alternate composite liner and leachate collection and removal system for the FFCPMF meet the requirements of §257.70(c) and (d), respectively, of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015.

As used herein, the word "certification" shall mean an expression of the Engineer's professional opinion to the best of his or her information, knowledge, and belief, and does not constitute a warranty or guarantee by the Engineer.

GOLDER ASSOCIATES INC.

Daniel McGrath, P.E.
Project Manager and Associate



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Golder Associates Richmond, Virginia	Subject: Liquid flow rate through GCL vs compacted clay - demonstration required by 257.70 (c) 2				
	Job No: 152-0610	Made by:	DPM	Date:	4/21/2016
		Checked:	KAL		
	Ref:	Reviewed:	JRD	Sheet 1	of 1

Objective Determine the flow rate per unit area for the "standard" soil component of the composite liner system compared to the "alternate" non-geomembrane component.

Method

where "Standard" soil component consists of a two-foot layer of compacted clay with a hydraulic conductivity of no more than $1x10^{-7}$ centimeters per second (cm/s)

"Alternate" component consists of a Geosynthetic Clay Liner (GCL) with a hydraulic conductivity of $1x10^{-9}$ cm/s

q = flow rate per unit area ($cm^3/s/cm^2$)

k = hydraulic conductivity of the liner (cm/s)

h = hydraulic head above the liner (cm)

t = thickness of the liner (cm)

and where $q = k\left(\frac{h}{t} + 1\right)$ Equation 1 from 257.70 (c) 2

Calculations Compute q for a range of hydraulic heads (h) and compare results

	Compacted Clay	GCL	
k	1.00E-07	1.00E-09	cm /s
t	60	0.6	cm
h (cm)	**Clay q**	**GCL q**	
2	1.03E-07	4.33E-09	
4	1.07E-07	7.67E-09	
6	1.10E-07	1.10E-08	
8	1.13E-07	1.43E-08	
10	1.17E-07	1.77E-08	
12	1.20E-07	2.10E-08	
14	1.23E-07	2.43E-08	
16	1.27E-07	2.77E-08	
18	1.30E-07	3.10E-08	
20	1.33E-07	3.43E-08	
22	1.37E-07	3.77E-08	
24	1.40E-07	4.10E-08	
26	1.43E-07	4.43E-08	
28	1.47E-07	4.77E-08	
30	1.50E-07	5.10E-08	

Conclusions The flow rate per unit area (q) for hydraulic heads (h) ranging from 2 to 30 centimeters is consistently lower for the GCL material than for the compacted clay material. This demonstrates that the GCL is an acceptable alternative to the two-foot compacted soil layer.

References

1. 40 CFR 257.70 *Design Criteria for new CCR landfills*