DESIGN CRITERIA FOR NEW CCR LANDFILLS AND ANY LATERAL EXPANSION OF A CCR LANDFILL - 40 CRF §257.70

SITE INFORMATION			
Site Name/Address		Pawnee Station / 14940 Morgan County Road 24 Brush, CO 80723	
Owner Name/Address		Public Service Company of Colorado / 1800 Larimer St., Suite 1300, Denver, CO 80202	
CCR Unit		East Landfill	
Regulatory Requirement	40 CRF §257	**Design Criteria**	§257.70

DESIGN CRITERIA REPORT §257.70	
§257.70(a)(1) - Designed, constructed, operated, and maintained with a composite liner meeting the requirements of §257.70(b) or an alternative composite liner meeting the requirements of §257.70(c), and a leachate collection removal system that meets §257.70(d)	Alternative composite liner system utilized meeting the requirements of §257.70(c) as detailed below. Liner design and construction specifications also approved by the Colorado Department of Public Health and Environment (CDPHE), per an Engineering Design and Operations Plan (EDOP) developed pursuant to state solid waste regulations (Colorado Code of Regulations, 1007-2, Part 1 Regulations Pertaining to Solid Waste Sites and Facilities).
§257.70(a)(1) – Prior to Construction of an overfill, the underlying surface impoundment must meet the requirements of §257.102(d)	Not Applicable
§257.70(b) – Composite liner system design criteria	See §257.70(b)(1-) below
§257.70(b)(1) – Liner must be constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients, physical contact with the CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation.	Applicable per §257.70(c)(3) for alternative composite liner design. The liner system is constructed with 18-inches of protective cover soil, a 300 mil thick drainage geocomposite, a 60 mil HDPE textured geomembrane, underlain by a polymer enhanced GCL and 12 inches of compacted soil liner. The polymer enhanced GCL has been evaluated for compatibility with site specific leachate in accordance with ASTM D6766 resulting in a maximum hydraulic conductivity of 4.5×10^{-8} cm/s. The proposed alternative liner system has been demonstrated to be equivalent or better than the system required by the Colorado Solid Waste regulations. All geosynthetic components of the alternative liner system will be in conformance with recognized industry standards including GRI-GC8, GRI-GM14, and GRI-GCL 3.
§257.70(b)(2) – Liner must be constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding of the upper component including on slopes.	Applicable per §257.70(c)(3) for alternative composite liner design. State approved construction specifications require interface friction tests to be completed in accordance with ASTM D5321 for components within the alternative composite liner design. The proposed geoembrane will be textured on both sides in order to provide sufficient shear strength with the adjacent non-woven geotextiles of the drainage geocomposite. Stability analyses using published values and actual test results from specified materials indicated suitable factors of safety for resistance to sliding of the upper component.

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§257.70(b)(3) – 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 settlement, compression, or uplift.	Applicable per §257.70(c)(3) for alternative composite liner design. State approved construction specifications require the subgrade to be free of vegetation, sticks, roots, foreign objects and debris. The specifications also require the subgrade to be proof-rolled with a pneumatic tire vehicle of at least 20-tons GVW. Existing subgrade material strength was evaluated for settlement due to estimated loading from the completed landfill and predicted settlement was found to be insignificant.
§257.70(b)(4) – Liner must be installed to cover all surrounding earth likely to be in contact with the CCR or leachate.	Applicable per §257.70(c)(3) for alternative composite liner design. Alternative composite liner system has been designed to cover all surrounding earth likely to be in contact with CCR or leachate.
§257.70(c)(1) – Alternative liner system must consist of two components: upper component consisting of minimum 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 $1x10^{-7}$ cm/s. GM components consisting of HDPE must be at least 60-mil thick.	The State approved alternative composite liner design is comprised of a 60-mil HDPE textured geomembrane over a geosynthetic clay liner (GCL) over a 12-inch soil layer compacted to $1x10^{-5}$ cm/s maximum permeability. The GCL has been evaluated for compatibility with site specific leachate in accordance with ASTM D6766 resulting in a maximum hydraulic conductivity of $4.5x10^{-8}$ cm/s. The performance of the entire system is equivalent or better than the prescribed composite liner system (§257.70(b)).
§257.70(c)(2) – Professional Engineer (PE) certification that the liquid flow rate through the lower component of the alternative liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of $1x10^{-7}$ cm/s. The conductivity of any alternative to the two feet of compacted soil must be determined using recognized and generally accepted methods.	The alternative composite liner design (as described in (§257.70(c)(1) above) and the prescribed composite liner system (§257.70(b)) were each modeled and compared using a Hydrologic Evaluation of Landfill Performance (HELP) model. Results of the HELP model showed 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 HELP model is included as an Attachment to the EDOP and is on file with CDPHE. PE certification is provided below.
§257.70(c)(3) – The alternative composite liner system must meet the requirements of §257.70(b)(1-4).	Criteria and demonstrations provided above.
§257.70(d) – The leachate collection and removal system must be designed constructed, operated, and maintained to collect and remove leachate from the landfill during the active life and post-closure period.	See §257.70(d)(1-3) below.
§257.70(d)(1) – Leachate system designed and operated to maintain less than a 30-cm depth	Leachate collection system calculations were performed to size the pipes to accommodate both the design leachate flows and the flow generated by the 25-year, 24-hour storm event with the Cell in an open condition prior to the placement of CCR. The design

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of leachate over the alternative composite liner	leachate flows were modeled to accurately represent leachate generation rates during the active life of the landfill. The results of the HELP model showed peak head of 0.022-inches (0.056-cm) on the alternative composite liner, significantly less than the 30-cm limit. The HELP model is included as an Attachment to the EDOP which is on file with CDPHE. The leachate sump and pumping system is designed to remove leachate as it accumulates within the sump, as measured by a pressure transducer, and will maintain less than 30-cm of leachate on the base liner system.
§257.70(d)(2) – Leachate system constructed of materials that are chemically resistant to the CCR and any non-CCR waste managed in the CCR unit and the leachate expected to be generated, and of sufficient strength and thickness to prevent collapse under the pressures exerted by overlying waste, waste cover materials, and equipment used at the CCR unit	The leachate collection system is comprised of HDPE pipe which is chemically inert with the leachate developed from the anticipated waste material. Piping within the leachate collection system network and within the sumps is surrounded by angular stone to assist with transmitting leachate into the pipes and toward the sump. The leachate collection pipes will be SRD 11 rated HDPE pipe and will resist buckling and crushing from the weight of liner, waste and cover materials, with a factor of safety of over 3.0. The leachate collection system calculations are included as an attachment to the EDOP which is on file with CDPHE.
§257.70(d)(3) – Leachate system is designed and operated to minimize clogging during the active life and post-closure care period.	Leachate collection stone required by construction specifications is required to be free of fines and stone sizes that pass through sieve sizes that are less than the perforation diameters of the leachate pipe. The stone is also required to have less than 15% carbonate content by weight which limits the risk of carbonate deterioration of the stone. Carbonate deterioration would result in the potential for additional fines being introduced into the system.
§257.70(e) – Obtain a certification from a qualified PE that the design of the alternative composite liner and the leachate collection and removal system meets the requirements of §257.70	PE certification provided below.

CERTIFICATION §257.70

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In accordance with §257.70(c)(2) and §257.70(e), the owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer attesting the following:

1. liquid flow rate through the lower component of the alternative liner is no greater than the liquid flow rate through two feet of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/s, and
2. the design of the alternative composite liner and the leachate collection and removal system meets the requirements of §257.70

I hereby certify that the liner for the Pawnee Station East Landfill meets the design criteria of 40 CFR §257.70 and that I am a duly registered Professional Engineer under the laws of the State of Colorado.

Matthew M Rohr, PE 0053467 July 23, 2018

My license renewal date is October 31, 2019