J.H. Campbell Generating Facility

Dry Ash Landfill Cell 5 Expansion - Documentation of Design Criteria for Landfill Expansion

Pursuant to:
40 CFR 257.70

Submitted to:

Consumers Energy Company
1945 Parnall Road
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Submitted by:

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18101379

December 2018

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.70]

I hereby certify that, having review the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.70 (40 CFR 257.70), I attest that this Documentation of Design Criteria for a Landfill Expansion Report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards and with the requirements of 40 CFR 257.70.

Golder Associates Inc.

Signature

December 5, 2018

Date of Report Certification

Tiffany D. Johnson, P.E.

Name

6201049160

Professional Engineer Certification Number

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APPENDICES

1.0 INTRODUCTION

The J.H. Campbell Generating Facility (JH Campbell) Dry Ash Landfill is an existing coal combustion residual (CCR) landfill owned and operated by Consumers Energy Company (CEC) in Port Sheldon Township, Ottawa County, Michigan. The landfill is constructed and operated in conformance with its State Solid Waste Landfill Construction Permit and is licensed by the State of Michigan as a Type III low hazard industrial waste landfill. On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the CCR Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) ("CCR RCRA Rule") to regulate the beneficial use and disposal of CCR materials generated at coal-fired electrical power generating complexes. Section 257.70 of the CCR RCRA Rule requires the owner or operator of a new landfill or expansion to an existing landfill to document that the composite liner system (or, if applicable, alternative composite liner) and leachate collection system meet the criteria outlined in Section 257.70. The CCR RCRA Rule defines a lateral expansion of a CCR unit as a horizontal expansion of the waste boundaries of an existing CCR landfill or existing CCR surface impoundment made after October 19, 2015. The JH Campbell Dry Ash Landfill was not constructed to its permitted waste boundary prior to October 19, 2015. As a result, each of the remaining cells (Cells 5-9) will be considered lateral expansions of a CCR unit. Per 257.70(e), prior to construction of the CCR landfill or any lateral expansion of the CCR landfill, the owner or operator must obtain a certification from a qualified professional engineer or obtain approval from the Participating State Director or approval from EPA where EPA is the permitting authority that the design of the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system meet the requirements of 257.70. This report serves as certification that the JH Campbell Dry Ash Landfill Cell 5 Expansion was designed in accordance with the following:

- Title 40 CFR 257.70
- Construction Quality Assurance (CQA) Plan - Revised (Golder 2018a)
- The State of Michigan Part 115 Administrative Rules
- Approved Construction Permit Number 0299 [Michigan Department of Natural Resources (MDNR 1993)]
  - Construction Permit upgrade documentation (Golder 2018b)
  - Construction Permit update approval letter [Michigan Department of Environmental Quality (MDEQ) 2018]

The construction permit update approval letter by MDEQ (Participating State Director) satisfies requirements pursuant to 257.70(e) and allows initiation of construction for the JH Campbell Dry Ash Landfill Cell 5 Expansion.

2.0 DESIGN OVERVIEW

The JH Campbell Dry Ash Landfill Cell 5 Expansion is located west of the existing Cell 4 limits and south of the existing Cell 1 limits. The total plan area is approximately 305,000 square feet (7.0 acres).

The layers or components of the designed liner system for the JH Campbell Dry Ash Landfill Cell 5 Expansion from bottom to top are:

- In situ material cut to grade or structural fill
- 60-mil-thick textured high-density polyethylene (HDPE) secondary geomembrane liner
- Single sided geocomposite on the floor and double sided geocomposite on the side slope
- Geosynthetic clay liner (GCL
- 60-mil-thick textured HDPE primary geomembrane liner
- Single sided geocomposite drainage layer on the floor and a 10 ounce per square yard (oz/sy) geotextile on the side slope
- Leachate collection and removal system consisting of HDPE piping a minimum 12-inch-thick sand protective layer on the floor and a 12-inch thick sand drainage layer in the side slope.

Figures 1 and 2 depict the layers designed for the JH Campbell Dry Ash Landfill Cell 5 Expansion floor and side slopes, respectively.

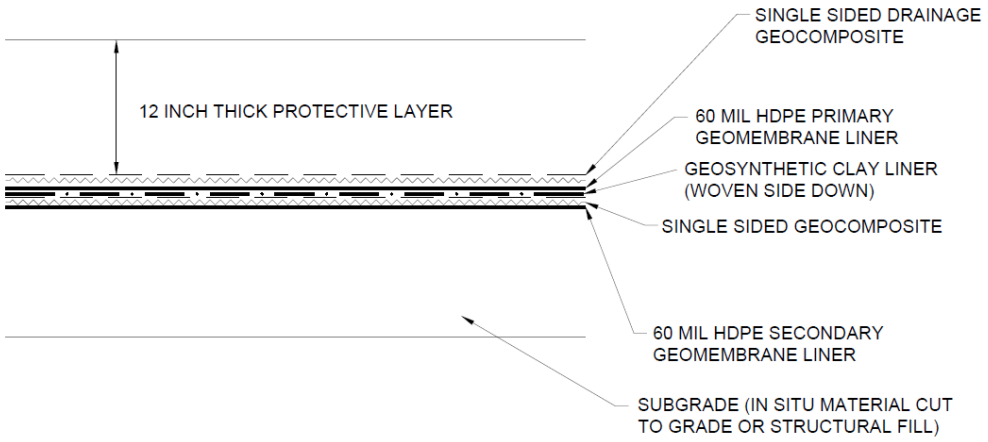


Figure 1: Cell 5 Liner System - Floor

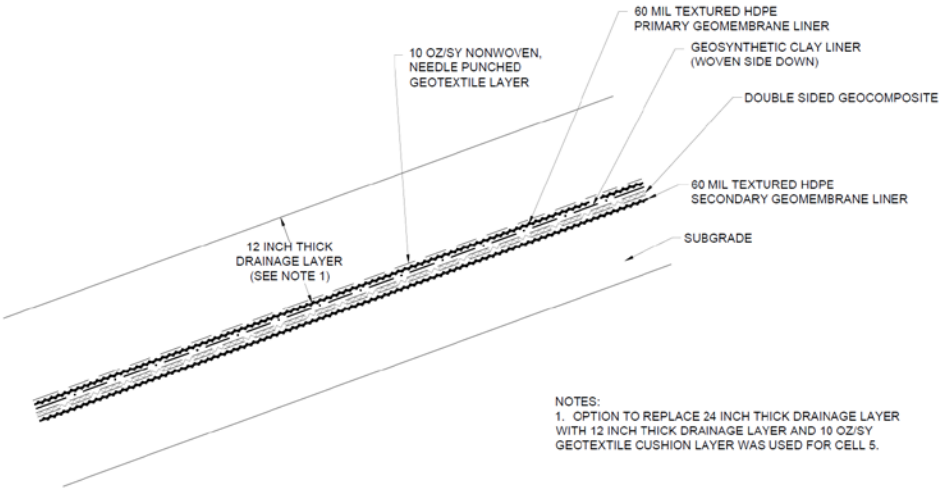


Figure 2: Cell 5 Liner System - Side Slope

3.0 DESIGN CRITERA PER 40 CFR 257.70

The JH Campbell Dry Ash Landfill Cell 5 Expansion is a horizontal landfill expansion to an existing CCR landfill as defined by the CCR RCRA Rule. The JH Campbell Dry Ash Landfill Cell 5 Expansion was designed to meet the alternative composite liner requirements pursuant to 257.70(c) with a leachate collection and removal system pursuant to 257.70(d). As a result, a written closure plan in not required pursuant to 257.70(a)(2) for overfills.

3.1 40 CFR 257.70(b)

The JH Campbell Dry Ash Landfill Cell 5 Expansion was designed to meet the alternative composite liner requirements per 257.70(c). However, under the requirements of 257.70(c)(3), the alternative composite liner system must meet the requirements specified in 257.70(b)(1) through 257.70(b)(4).

Per 257.70(b)(1), the composite liner system must be constructed of materials having appropriate chemical properties and sufficient strength and thickness to prevent failure due to pressure gradients, physical contact with CCR or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation. The Puncture Resistance of Geomembrane calculations presented in the permit upgrade (Golder 2018b) evaluate these design criteria to prevent failure and satisfies the requirements of 257.70(b)(1).

Per 257.70(b)(2), the composite liner system must be constructed of materials that provide appropriate shear resistance of the upper and lower component interface to prevent sliding. The Slope Stability Analysis calculation presented in the construction permit upgrade (Golder 2018b) evaluates these design criteria to prevent failure and satisfies the requirements of 257.70(b)(2).

Per 257.70(b)(3), the composite liner system 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 due to settlement, compression, or uplift. The Settlement Analysis presented in the construction permit upgrade (Golder 2018b) evaluates these design criteria to prevent failure and satisfies the requirements of 257.70(b)(3).

Per 257.70(b)(4), the composite liner system must be installed to cover all surrounding earth likely to be in contact with the CCR or leachate. The composite liner system was designed to cover surrounding earth likely to be in contact with CCR or leachate within the existing CCR landfill solid waste boundary (Golder 2018b) and satisfies the requirements of 257.70(b)(4).

3.2 40 CFR 257.70(c)

Under 257.70(c), if the owner or operator of a CCR landfill elects to install an alternative composite liner, the requirements outlined in 257.70(c)(1) through 257.70(c)(3) must be followed. Per 257.70(c)(2), the owner or operator of a CCR landfill must obtain certification from a qualified professional engineer proving that the composite liner system meets the flow rate requirements of 257.70(c)(1). The flow rate comparison must be made using Equation 1, which is derived from Darcy's Law for gravity flow through porous media.

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

Equation 1

Per 257.70(c)(3), the alternative composite liner system must meet the requirements specified in 257.70(b)(1) through 257.70(b)(4), which are presented above in Section 3.1.

The JH Campbell Dry Ash Landfill Cell 5 Expansion was constructed having an upper liner system component of 60-mil HDPE geomembrane and a lower component of GCL. A flow rate comparison was performed for the GCL following Equation 1 of 257.70(c)(1), and it was determined that the flow rate through the GCL is less than that of two feet of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. The Equivalency Calculations for the GCL are provided in Appendix A and satisfy that the alternative composite liner system meets the flow rate requirements of 257.70(c)(2). Section 3.1 of this report demonstrates that the alternative composite liner system also meets the requirements specified in 257.70(b)(1) through 257.70(b)(4).

3.3 40 CFR 257.70(d)

Under 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 care period.

Per 257.70(d)(1), the leachate system must be designed and operated to maintain less than a 30-centimeter depth of leachate over the composite liner or alternative composite liner system. The Leachate Mounding calculations and HELP Model presented in the construction permit upgrade (Golder 2018b) confirm that less than 30 centimeters of leachate are anticipated over the alternative composite liner system, which satisfies the requirements of 257.70(d)(1).

Per 257.70(d)(2), the leachate collection system must be constructed of materials that are chemically resistant to the CCR, any non-CCR waste managed in the CCR unit, and the leachate expected to be generated. Additionally, the leachate collection system must be constructed with materials that have 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 Landfill Pipe Crushing calculations in the construction permit upgrade (Golder 2018b) demonstrate that the leachate collection system is chemically resistant to CCR and of sufficient strength and thickness to prevent collapse and satisfies the requirements of 257.70(d)(2).

Per 257.70(d)(3), the leachate collection system must be designed and operated to minimize clogging during the active life and post-closure care period. The Filtration Fabric Clogging calculation in the construction permit upgrade (Golder 2018b) demonstrates that the soils and geotextile selected for the design of the leachate collection system satisfies the requirements of 257.70(d)(3).

3.4 40 CFR 257.70(e)

Under 257.70(e), prior to construction of the CCR landfill or any lateral expansion of the CCR landfill, the owner or operator must obtain a 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 design of the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system meet the requirements of this section.

The construction permit upgrade (Golder 2018b) was approved by MDEQ on June 20, 2018 (MDEQ 2018) and satisfies the requirements of 257.70(e).

3.5 40 CFR 257.70(f)

Per 257.70(f), upon completion of construction of the CCR landfill or any lateral expansion of the CCR landfill, the owner or operator must obtain a 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 design of the composite liner (or, if applicable, alternative composite liner) and the leachate collection and removal system have been constructed in accordance with the requirements of this section.

The Cell 5 Construction Documentation Report (Golder 2018c) was submitted to MDEQ for review and approval on September 24, 2018. Once approval is received, it will be placed in the operating record to satisfy the requirements of 257.70(f).

3.6 40 CFR 257.70(g)

Under 257.70(g), the owner or operator of the CCR unit must comply with the recordkeeping requirements specified in 257.105(f), the notification requirements specified in 257.106(f), and the internet requirements specified in 257.107(f).

This certification report must be placed in the facility's operating record in accordance with 257.105(f), and the report must be made available on the facility's publicly accessible internet site in accordance with Section 257.107(f). When the information has been placed in the operating record and on the publicly accessible internet site, the State Director for MDEQ must be notified in accordance with 257.106(f).

4.0 CONCLUSIONS AND SUMMARY

This report has been prepared in general accordance with normally accepted civil engineering practices to fulfill the requirements of 40 CFR 257.70. Based on Golder's review of the design documents and CQA services provided during construction, the JH Campbell Dry Ash Landfill Cell 5 Expansion satisfies the requirements presented in 257.70(a) though 257.70(f). This report must be placed in the facility's operating record and made available on the facility's publicly accessible internet site to comply with 257.70 (g).

Sincerely,

GOLDER ASSOCIATES INC.

Tiffany Johnson, P.E.
Associate, Senior Consultant

Matt Wachholz, P.E.
Senior Consultant

5.0 REFERENCES

Golder Associates Inc. March 2018a. J.H. Campbell Dry Ash Landfill, Construction Quality Assurance Plan.

Golder Associates Inc. March 2018b. J.H. Campbell Dry Ash Landfill, Construction Permit Upgrade Request, Cells 5 through 9.

Golder Associates Inc. September 2018c. J.H. Campbell Ash Storage Landfill Cell 5 Construction Documentation Report.

Michigan Department of Environmental Quality (MDEQ). June 2018. Construction Permit number 0299 - upgrade approval letter.

Michigan Department of Natural Resources (MDNR). December 1993. Construction Permit Number 0299.

State of Michigan. 1994. Part 115, Solid Waste Management of the Natural Resources and Environmental Protection Act, PA 451, as amended.

Environmental Protection Agency (EPA). July 2018. Code of Federal Record Title 40 Part 257 Subpart D. as amended.

APPENDIX A

Geosynthetic Clay Liner Equivalency

Geosynthetic Clay Liner Equivalency

Date:	11/16/2018	**Made by:**	BAB
Project No.:	18101379	**Checked by:**	HAD
Subject:	GCL Equivalency Calculation	**Reviewed by:**	TDJ
Project Short Title:	CEC JHC Cell 5		

1.0 OBJECTIVE

Per 40 CFR 257.70, demonstrate that the liquid flow rate through a geosynthetic clay liner (GCL) is less than or equal to the liquid flow rate through two feet of compacted clay liner having a hydraulic conductivity of 1x10-7 centimeters per second (cm/sec) (Ref. 1) . For these calculations, the upper component of the liner system will be 60-mil High Density Polyethylene (HDPE) textured geomembrane, see Figure 1. Appendix D of the current construction permit application calculated less than 0.25 inches of leachate head over the geomembrane liner (Reference 3). For these equivalency calculations, a maximum 5 inches of head has been conservatively assumed.

2.0 GIVENS/ASSUMPTIONS

1) Hydraulic head above the liner is less than or equal to 5 inches;
2) CETCO (Manufacturer) product information for Bentomat ST. (Ref. 2) ;
3) The GCL is fully hydrated, with a permeability of $5x10^{-9}$ cm/sec;
4) GCL thickness of 240 mil;
5) The compacted clay liner has a permeability of $1x10^{-7}$ cm/sec;
6) GCL does not become thinner from storage, transportation, handling, installation, trafficking by vehicles, etc.

3.0 METHODS

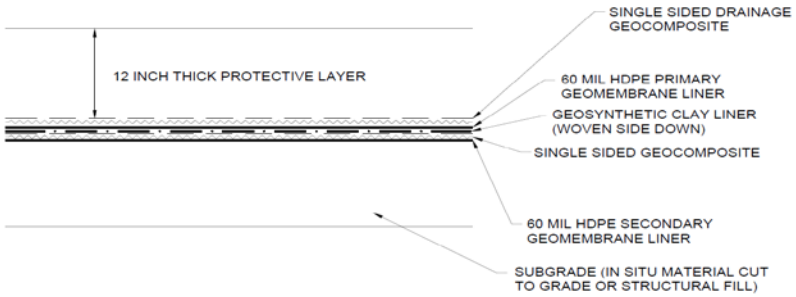
Use the following equation, derived from Darcy's Law for gravity flow through porous media, to calculate the liquid flow rate through the GCL and compacted clay liner (Reference 1).

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

Where:

Q= flow rate (cm^3/sec)
A= surface area of the liner (cm^2)
q= flow rate per unit area (cm^3/sec/cm^2)
k= hydraulic conductivity of the liner (cm/sec)
h= hydraulic head above the liner (cm)
t= thickness of the liner (cm)

Figure 1: Cell 5 Liner System



4.0 CALCULATIONS

A) FLOW RATE THROUGH COMPACTED CLAY LINER

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

Where:

k=	1×10^{-7}	cm/sec	(Ref. 1)
h=	12.7	cm	(5 inches of head)
t=	60.96	cm	(2 feet)

q= 1.21E-07 $cm^3/sec/cm^2$

B) FLOW RATE THROUGH GEOSYNTHETIC CLAY LINER

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

Where:

k=	5×10^{-9}	cm/sec	(Ref. 2)
h=	12.7	cm	(5 inches of head)
t=	0.6096	cm	(240 mil)

q= 1.09E-07 $cm^3/sec/cm^2$

The flow rate through the GCL (240 mil) is less than the flow rate through the compacted clay liner.

5.0 CONCLUSIONS

The flow rate through a layer of GCL is less than that of the flow rate through the compacted clay liner and meets the requirements established in § 257.70 of 40 CFR Part 257 (Ref. 1) for the lower component of a composite liner system.

6.0 REFERENCES

1) Hazardous and Soil Waste Management System; Disposal of Coal and Combustion Residuals From Electric Utilities, 80 Fed. Reg. 21474 (Apr. 17, 2015) (to be codified at 40 C.F.R. pts. 257 & 261).
2) CETCO, Bentomat ST Certified Properties.
3) Appendix D - Leachate Calculations, Leachate Mounding, JH Campbell CCR Storage Facility-Permit Upgrade.

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