PLANT McDONOUGH-ATKINSON
CCR SURFACE IMPOUNDMENT
(CCR UNIT AP-1)
COBB COUNTY, GEORGIA
PART B SECTION 2 – ENGINEERING REPORT

FOR

Georgia Power

Revision 02 – February 2022

GOLDER
MEMBER OF WSP

Engineering Design Report

Plant McDonough-Atkinson
CCR Unit AP-1 Closure and Advanced Engineering

Submitted to:

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Executive Summary

Golder Associates Inc. (Golder) has compiled supporting calculations for the closure and advanced engineering design of CCR Unit AP-1 for Plant McDonough-Atkinson (Plant McDonough), owned and operated by Georgia Power Company (Georgia Power). This report provides a narrative of the closure design presented in the Closure Plan Drawings in Part A of this permit application under the following main categories:

- Geotechnical Design
- Final Cover System
- Surface Water Management
- Perimeter Barrier Wall Design (Selected Advanced Engineering Method)

This report and the appended detailed calculations are intended to meet the requirements of the Georgia Solid Waste Management Rules for Coal Combustion Residuals (391-3-4-.10) and to support the presented Closure Plan Drawings.

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1.0 INTRODUCTION

Golder Associates Inc. (Golder), Southern Company Services (SCS) and Georgia Power Company (Georgia Power) have prepared design calculations to support the design and permitting of CCR Unit AP-1 at Plant McDonough-Atkinson (Plant McDonough or “the site”). Plant McDonough is a power generating facility, owned and operated by Georgia Power, and historically operated as a coal fired facility, utilizing coal combustion residual (CCR) surface impoundments for the storage of CCR material on-site. In 2011, Plant McDonough ceased coal-fired electric generating activities, and subsequently ceased placing CCR in the units, resulting in AP-1 becoming an inactive CCR surface impoundment prior to closure construction activities. In January 2016, closure activities were initiated for the unit, consisting of consolidating and capping, with CCR excavation in limited areas and closure in place as CCR Unit AP-1. At the time of this submittal, installation of the final cover system for AP-1 has been substantially completed and closure construction activities are ongoing, including advanced engineering methods presented in the Closure Plan Drawings in Part A Section 9 of this Permit Application.

Closure activities for AP-1 are being completed following the closure design. The overall closure design objectives consist of the following key aspects:

- A stable containment system under expected final conditions
- Perimeter containment berms that are used to contain the CCR materials once the grades of the closed unit rise above the perimeter berm elevation
- A final cover system to minimize infiltration of surface water into the unit during long term conditions
- A surface water management system used to control runoff from the units and direct it to the designed outlet structures
- A subsurface perimeter barrier wall used to provide subsurface flow inhibition around the closed CCR Unit.

The Closure Plan Drawings provide detailed grading and associated details depicting the closure design that are used as a basis for the design approach. Closure design calculations are included as appendices to this report. This document provides a summary of the various calculations and a brief narrative on the design details for each closure design element. Key design elements include the following:

- Geotechnical Design
- Final Cover System
- Surface Water Management
- Perimeter Barrier Wall (Advanced Engineering) Design

Each design element contains several design calculations, and these are discussed in more detail in this report.

2.0 GEOTECHNICAL DESIGN

2.1 General

A key element of the closure design is associated with the geotechnical stability of the closed unit both during closure construction and during post-closure. There are various elements related to the assessment of the geotechnical stability and performance of the units:

- Geotechnical material properties
- Global slope stability and settlement of the unit under final conditions

This geotechnical design discussion presents Golder's stability evaluation of the containment berms (dikes) surrounding CCR Unit AP-1 at Plant McDonough related to the requirements in the State of Georgia Solid Waste Management Rule 391-3-4-.10 and 40 CFR 257 the US EPA's Final Rule on the Disposal of Coal Combustion Residuals (CCR; EPA Rule).

This report presents the calculated geotechnical stability and settlement of the final closure condition of Unit AP-1, including the barrier wall designed as part of the advanced engineering methods for the Unit. As previously described, CCR materials have been excavated from limited perimeter areas, and the unit is being closed in place. In accordance with the Georgia solid waste permitting requirements, the following conditions were assessed:

- Storage Pool
- Surcharge Pool
- Seismic Loading Conditions
- Post-Seismic Liquefaction Conditions (when liquefaction susceptible materials are present)

Additionally, the integrity of the final cover system has also been evaluated for anchor trench and veneer stability requirements, as further discussed in Section 4.2:

- Veneer Stability Analysis (where applicable, i.e. at the gravel access road locations)
- Anchor Trench Requirements

2.2 Slope Stability Assessment Methodology

Stability safety factors were evaluated for each of the loading scenarios using the computer program SLIDE 7.0 Version 7.031 (2018). As required by the EPA rule, a general limit equilibrium (GLE) method (Morgenstern and Price) was used to calculate factors of safety, and the factor of safety is calculated by dividing the resisting forces by the driving forces along the critical slip surface.

Stability was evaluated along three cross-sections for AP-1 as depicted in Figure 1 of the Slope Stability Analysis Package (Appendix B). Subsurface stratigraphy at each cross-section was developed based on a combination of historic and recent subsurface investigations at the site and with reference to the geologic and hydrogeologic site conditions as presented in the Hydrogeological Assessment Report (Rev. 03 September 2021). Geotechnical material properties were developed for the earthen dams (dikes), foundation soils, and impounded materials from this site-specific data and Golder's greater breadth of experience with similar materials. The Material Properties Calculation Package (Appendix A) provides details on the geotechnical explorations and evaluation of geotechnical data.

The water levels used in stability analyses are reflective of long-term post-closure conditions.

2.2.1 Storage Pool Conditions

Golder modeled the long-term stability for the storage pool conditions (which consist of no permanent storage pool above the post-closure capped condition of AP-1) using the long-term water level at post-closure conditions, per the results of the three-dimensional numerical groundwater modeling with results presented in Appendix B of this Engineering Report. The long-term post-closure groundwater conditions are summarized in Appendix A of the Hydrogeological Assessment Report (HAR Revision 03) presented in Part B Section 1 of this Permit Submittal.

2.2.2 Surcharge Pool Conditions

For the surcharge pool scenario, Golder considered the impact of the 100-year, 24-hour rain event for Atlanta, GA. This event was calculated to cause temporary water flow on top of the pond cap in drainage channels. Water within these channels was calculated to rise to a depth of approximately 0.3 to 0.7 ft. The table below summarizes the water depths for each cross-section analyzed.

Section	Channel Flow Depth (ft) 100 Year 24 Hour Event
A	0.3
B	0.7
C	0.7

For further details related to the routing of surface water refer to the hydraulic and hydrology storm water routing calculations detailed in Section 4 below.

2.2.3 Seismic Loading Conditions

Factors of safety for stability under seismic loading conditions were calculated based on the earthquake hazard corresponding to a probability of exceedance of 2% in 50 years (2,475-year return period). Golder used the Bray and Travasarou displacement-based seismic slope stability screening method (Bray and Travasarou 2009) to evaluate the seismic stability. For this method, a pseudo-static coefficient corresponding to an allowable displacement of six inches (15 cm) is applied as a horizontal force in the static stability model. The pseudo-static coefficient for the above stated criteria was calculated to be 0.029g. Details on the calculation of the pseudo-static coefficient are available in the Seismic Hazard Calculation Package (Appendix C).

2.2.4 Post-Seismic Liquefaction Loading Conditions

The State of Georgia Solid Waste Management Rule, referencing CCR Rule §257.73(e)(iv), the CCR Rule specifies a required factor of safety of 1.2 against liquefaction for pond impoundment structures. Golder completed an evaluation of the liquefaction susceptibility of the site soils which will remain saturated in the long term as presented in the Liquefaction Assessment Calculation Package (Appendix D). The calculated factor of safety against liquefaction is above 1.2 for all materials analyzed except for portions of the impounded ash originally placed sluiced. Thus, post liquefaction stability was evaluated using a reduced post-liquefaction strength for such materials (modeled as a post liquefaction strength ratio of 0.08). For additional details on the liquefaction analysis, please refer to Appendix D.

2.3 Slope Stability Assessment Results

The table below presents the results of the slope stability analyses for the AP-1 dikes. For all cases analyzed, the calculated factors of safety are in excess of those required by the State of Georgia Solid Waste Management Rule, referencing CCR Rule Sections § 257.73(e)(i) to (iv). The detailed stability results are presented in Figures 2 through 4 of Appendix B.

Long-Term Post-Closure Stability Analysis Results				
Analysis Case	Storage Pool	Surcharge Pool	Seismic	Post Liquefaction
Rule Section	§ 257.73(e)(i)	§ 257.73(e)(ii)	§ 257.73(e)(iii)	§ 257.73(e)(iv)
Target Factor of Safety	1.5	1.4	1.0	1.2
Cross-Sections	**Factor of Safety**			
A-A	1.6	1.6	1.6	1.6
B-B	1.6	1.6	1.3	1.6
C-C	1.5	1.5	1.4	1.6

2.4 Geotechnical Analysis Conclusions

Golder evaluated the slope stability of dikes surrounding AP-1 at Plant McDonough in accordance with the EPA Rule on the Disposal of Coal Combustion Residuals. Specifically, the containment berms (dikes) were evaluated for stability in the following loading scenarios:

- Storage Pool
- Surcharge Pool
- Seismic Loading Conditions
- Post-Seismic Liquefaction Conditions (when liquefaction susceptible materials are present)

For each loading case, the cross section analyzed under this study were found to meet the target factor of safety presented in the governing rules. Additionally, Golder performed veneer stability for the gravel access road on the final cover.

- Settlement Analysis

Long-term settlement potential for AP-1 was calculated and used to evaluate the potential for grade reversals or other settlement induced issues. In general, CCR is much less susceptible to long term settlement than typical municipal solid waste (MSW) and Construction & Demolition (C&D) waste masses and as such liner components and drainage grades are less prone to settlement induced issues in CCR closures. The settlement evaluations for the closed AP-1 conditions consider settlement following closure from dewatering of the CCR and minimal post capping settlement (less than a few inches) across the pond, with a maximum calculated post capping settlement predicted to be 0.43 ft in the northwest area of AP-1, as detailed in Appendix E.

- Veneer Stability Analysis

Long-term and short-term veneer stability analyses were performed for the critical access road conditions applicable to the CCR Unit closures on site (noting the AP-1 closure grades are lower and generally shallower than the AP-3/4 closure grades), including incorporation of equipment acceleration on the roads and were found to meet the required factors of safety as detailed in Appendix G.

- Anchor Trench Analysis

Closure cover liner anchorage was evaluated, and 2 feet deep by 2 feet wide anchor trenches were evaluated to be adequate for the closure as detailed in Appendix H.

3.0 FINAL COVER SYSTEM

3.1 General

The closure of Unit AP-1 was designed with a final cover system that consists of two options for the final cover configuration of the unit. Each cover system option proposed consists of an 18-inch minimum layer of prepared and compacted subgrade material and incorporates a geosynthetic final cap.

Option 1 consists of a ClosureTurf™ geosynthetic cap system utilizing a variety of infill options dependent on the designed closure area. The ClosureTurf™ final cover system consists of:

- 18-inch thick (min.) layer of compacted CCR or earthen subgrade material
- 40-mil minimum Agru linear low-density polyethylene (LLDPE) geomembrane
  - 40-mil MicroSpike® LLDPE geomembrane is utilized for closure areas with final cover surface slopes of less than 10 degrees (10°); or
  - 50-mil Super Gripnet® LLDPE geomembrane (or 50-mil MicroDrain® LLDPE geomembrane) is utilized with spikes down for cover slope areas greater than 10 degrees (10°)
- ClosureTurf™ (combined 8 ounce per square yard (oz/yd²) geotextile and engineered turf layer)
- Turf Infill or Overlying Protective Layer Options
  - Sand infill (0.5-inch minimum) typical design; or
  - Sand infill (0.5-inch minimum) with Armorfill E application; or
  - Hydrobinder® infill (0.75 inch minimum); or
  - Rock or Articulated Concrete Block (ACB) armoring overlying a geosynthetic separation and protection layer.

The Super Gripnet® and MicroSpike® will serve as a flexible membrane liner (FML) barrier to infiltration and are designed such that drainage to convey stormwater off of the FML areas is maintained between the geomembrane and the geotextile of the ClosureTurf™ layer.

Option 2 consists of a closure layer as required for CCR unit closures in §257.102(d)(3)(i) consisting of the following layers:

- 18-inch thick (min.) infiltration layer of compacted material with a minimum hydraulic conductivity of 1 x 10^{-5} centimeters per second (cm/s)
- 6-inch vegetative soil layer with grassy vegetation

The 6-inch vegetative layer of Option 2 is designed to support vegetation over the final cover system. Both final cover system options are designed to overlay the full limits of permanently stored CCR and the interior surfaces of the adjacent containment dike berms. Surface water diversion berms consisting of compacted material are graded into the final cap grading side slopes and are designed to be overlain by the final cover system.

Details of the final cover system options are presented in the Closure Plan Drawings for Unit AP-1 in Part A of this Permit Application.

3.2 Alternative Final Cover Design

As indicated in Section 3.1, the final cover system designed for AP-1 consists of a ClosureTurf™ geosynthetic cap system utilizing a variety of infill options as delineated in the Closure Design Plans. As part of the closure design, Golder completed an evaluation of the percolation potential and liner performance for the final cover system designed for AP-1 in comparison to a CCR unit final cover system (State of Georgia Solid Waste Management Rule, referencing CCR Rule §257.102(d)(3)(i)). The analysis presents estimates and ranges of the anticipated drainage collected from the final cover system as well as percolation estimates through the geomembrane cover. The performance for the designed final cover system, consisting of ClosureTurf™, demonstrates equivalent or superior performance to a traditional soil cover system, as per regulatory requirements (State of Georgia Solid Waste Management Rule, referencing CCR Rule 257.102(d)). Additional detail on the cover equivalency calculations can be found in Appendix F.

3.3 Veneer Stability Analysis

Veneer stability analyses were performed for the final cover system at locations where the final cover system is overlain by another material. For the AP-1 ClosureTurf™ final cover system, these are the locations of access roads where a nominal 6-inch gravel layer is placed on the top of a separation and cushion geosynthetic over the Closure Turf™. Veneer stability factors of safety were calculated using the Koerner and Soong method (Koerner and Soong 1998). The maximum slope percent of the access road is 10 percent. Veneer stability analysis was conducted assuming the height of the slope to be the difference between the highest elevation and the lowest elevation of the access road. It should be noted that most of the slopes at the closed units will be shorter than the maximum slope, and thus will be less critical than accounted for in this analysis.

Golder analyzed that both static and equipment loading scenarios meet the required factors of safety. Details on the calculation of the veneer stability analyses and veneer stability analysis methodology, as well as loading specifications are included in the Veneer Stability Analysis Calculation Package (Appendix G).

3.4 Final Cover Anchor Trench

The ClosureTurf™ final cover system is designed to cover the AP-1 final CCR limits following capping of the CCR material. Appendix H presents the calculated requirements for runout length and anchor trench width and depth for appropriate protection against being compromised by wind and water. An anchor trench with 2 ft depth and 2 ft width is calculated to be adequate for the range of proposed anchorage conditions.

4.0 SURFACE WATER MANAGEMENT

4.1 General

The surface water management system for Unit AP-1 includes several controls for stormwater management at the CCR Unit. The AP-1 system manages the stormwater runoff from the closed landfill surface and select surrounding areas, totaling approximately 41.7 acres of contributing area. Stormwater is routed over the closure system through a system of landfill downslope channels and perimeter channels to two outfall points.

The AP-1 closure system provides attenuation of the inflow design flood as detailed in Section 4.2, which outlines a comprehensive calculation package for the stormwater management system that consists of a series of ditches, and culverts for routing to one of two outfall structures for discharge.

4.2 Surface Water Management Analysis

Appendix I includes a comprehensive surface water management calculation for Unit AP-1. The calculation package estimates run-off for storm events under final development conditions for the unit to the stormwater management system's two stormwater attenuation ponds and corresponding discharge structures – the North Pond and South Pond. Type II rainfall distribution was used for all modeling efforts, and all structures were designed based on the discharge from the 100-year, 24-hour storm event.

Details of the hydrologic analysis are included in the calculation package provided in Appendix I. Watersheds were delineated to route to the North or South attenuation ponds through a series of flat bottom, or trapezoidal, ditches ranging from 2 to 8 ft bottom length conveying flows ranging from 2 to 55 cubic feet per second (cfs); these are designed as either Hydroturf® or riprap lined channels. Four downchutes convey water from the top deck of AP-1 to the perimeter ditches, and ultimately to the North Pond and South Pond. Culverts for road and berm crossings have also been designed and are summarized in Appendix I. The North and South ponds are designed to allow for temporary retention to attenuate the runoff inflow hydrograph and reduce the peak discharge to less than the estimated pre-development discharge, as required by Georgia stormwater guidelines and the requirements for inactive CCR surface impoundments. The stormwater management design includes the following:

- Downchutes for surface water conveyance
- Trapezoidal perimeter channels for surface water conveyance
- Culverts for road and berm crossings at the northwest, southeast, and east perimeter road
- North and South attenuation ponds, for retention of water following storm events and designed to fully drain through piped conveyance systems and outlet structures to provide for controlled gravity stormwater conveyance into rip rap aprons
  - North Pond totals 6.1 acre-feet cumulative storage volume
  - South Pond totals 2.3 acre-feet cumulative storage volume
- Auxiliary overflow spillways at the North and South attenuation ponds

5.0 BARRIER WALL

A subsurface perimeter barrier wall, selected as the advanced engineering method for CCR Unit AP-1, is designed to fully encompass AP-1. The perimeter barrier wall is designed to divert groundwater flow around the CCR material and inhibit groundwater flow in the CCR material. The barrier wall ranges in design depth between

8 and 75 feet, with an average depth of nominally 50 ft, and designed to terminate at the top of partially weathered rock (PWR) as identified in the Closure Plan Drawings.

Design for the barrier wall consists of a soil-bentonite slurry mix to form a continuous, and low permeability barrier to attenuate groundwater flows into and from the unit. Performance requirements of the wall consist of a maximum hydraulic conductivity of 1 x 10^{-7} cm/sec. Additional performance requirements are presented the CCR Unit AP-1 Construction Quality Assurance (CQA) Plan in Part A Section 5 of the Permit Application.

The long-term slope stability of the proposed dikes presented in Section 2 of this Engineering Report and supported by the calculations presented in Appendix B were performed including the barrier wall, and for each loading case, the proposed dikes with barrier wall were calculated to meet or exceed the target factors of safety.

6.0 CLOSING

This engineering design report provides a summary of key calculations for the design of the final closure for Plant McDonough's CCR Unit AP-1. Appendices to this report include calculations as discussed herein.

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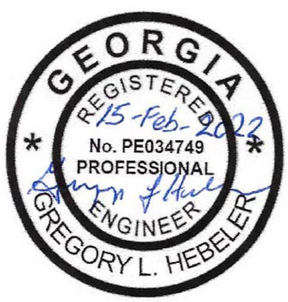

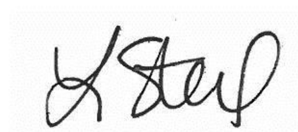

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