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Coal Combustion Residuals Closure Plan -

Virginia Electric and Power Company
Chesterfield Power Station
Upper (East) Pond
Chesterfield County, Virginia

GAI Project Number: C150035.00

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Prepared by: GAI Consultants, Inc.
Richmond Office
4198 Cox Road, Suite 114
Glen Allen, Virginia 23060

Prepared for: Virginia Electric and Power Company
5000 Dominion Boulevard
Glen Allen, Virginia 23060

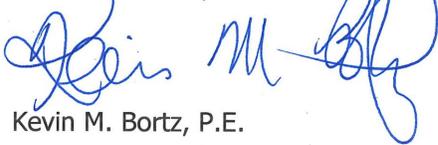
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1.0 Certification/Statement of Professional Opinion

This CCR Closure Plan for the Upper (East) Pond at the Dominion Chesterfield Power Station located in Chesterfield County, Virginia (hereinafter referred to as the CCR Closure Plan) was prepared by GAI Consultants, Inc. (GAI) pursuant to the Scope of Services dated January 25, 2015, agreed to and authorized by Dominion. This Statement of Professional Opinion is based on information available to GAI at the time the CCR Closure Plan was prepared and GAI's technical understanding of the United States Environmental Protection Agency's (EPA'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 (40 CFR 257 Subpart D) (CCR Rule), and adopted by Virginia effective January 27, 2016, and associated public guidance and/or interpretation provided by the EPA and obtained by GAI as of the date of the CCR Closure Plan. 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 CCR Closure Plan has been prepared in accordance with good and accepted engineering practices exercised by other engineers practicing in the same discipline(s) under similar circumstances and at the time and place the CCR Closure Plan was prepared, and with 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. It is my professional opinion based on my understanding of the technical requirements of the CCR Rule and good and accepted engineering practices that the design of the final cover system as set forth in the CCR Closure Plan meets the technical requirements and/or intent of the CCR Rule (40 CFR 257, Section 257.102(d)(3)(iii)). This Statement of Professional Opinion is not and shall not be interpreted or construed as a guarantee, warranty or legal opinion.

GAI Consultants, Inc.



Kevin M. Bortz, P.E.

Assistant Engineering Manager

Date 10/13/2016



2.0 Acronyms

2003 Closure Plan	Revised Closure Plan, Upper (East) Pond, September 2003, VPDES Permit No. VA0004146
CCB	Coal Combustion Byproducts
CCR	Coal Combustion Residuals
CCR Closure Plan	Upper (East) Pond CCR Closure Plan
CCR Rule	"Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" 40 CFR 257 Subpart D (2015)
CFR	Code of Federal Regulations
CQA	Construction Quality Assurance
DCR	Virginia Department of Conservation and Recreation
Dominion	Virginia Electric and Power Company d/b/a Dominion
EPA	United States Environmental Protection Agency
GDN	Geocomposite Drainage Net
GAI	GAI Consultants, Inc.
LLDPE	Linear Low-Density Polyethylene
LWP	Lower (West) Pond
PMF	Probable Maximum Flood
Station	Dominion Chesterfield Power Station
Schnabel	Schnabel Engineering, Inc.
UEP	Upper (East) Pond
VAC	Virginia Administrative Code
VDEQ	Virginia Department of Environmental Quality
VPDES	Virginia Pollutant Discharge Elimination System
VPDES Permit	Virginia Pollutant Discharge Elimination System Permit No. VA0004146

3.0 Introduction

This Coal Combustion Residuals Closure Plan (CCR Closure Plan) provides the method and design for closure of the Upper (East) Pond (UEP) impoundment located at the Chesterfield Power Station (Station) in Chesterfield County, Virginia. The UEP is currently being closed in accordance with the Revised Closure Plan, Upper (East) Pond, September 2003 (2003 Closure Plan), modified in 2015, which is incorporated into the Station's Virginia Department of Environmental Quality (VDEQ) Virginia Pollutant Discharge Elimination System Permit No. VA0004146 (VPDES Permit).

The closure of the UEP will be completed under the Virginia Solid Waste Management Program, and will comply with the United States Environmental Protection Agency's (EPA's) "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (CCR Rule), which was published in the Federal Register on April 17, 2015 (with an effective date of October 19, 2015) (40 CFR 257 Subpart D) and incorporated into the Virginia Waste Management Regulations on January 27, 2016 (*see* 9 VAC 20-81-800 *et seq.*) and Virginia's Solid Waste Management Regulations (VSWMR).

This CCR Closure Plan conforms to the requirements of Section 257.102(b) of the CCR Rule and applicable sections of the VSWMR.

3.1 Regulatory Background

The UEP is classified as a dam (Inventory Number 04145) and is regulated by the Virginia Department of Conservation and Recreation (DCR), Division of Dam Safety and Floodplain Management, under 4 VAC-50-20.

This CCR Closure Plan was created from a module in the Station's January 2016 application submittal for VDEQ Solid Waste Permit Number 619. Drawings referenced within this CCR Closure Plan are included in the application submittal. Closure of the UEP will be in accordance with the CCR Rule and applicable sections of the VSWMR.

3.2 Site Description

The Station, including the UEP, is owned by Virginia Electric and Power Company d/b/a Dominion Virginia Power (Dominion). The UEP is located on Dominion property at the Chesterfield Power Station in Chesterfield County, Virginia, and is bounded by the Old Channel of the James River on the south, Henricus Historical Park on the east, and Aiken Swamp on the north. Another Dominion CCR storage impoundment, the Lower (West) Pond (LWP), also known as the Lower Ash Pond, is located northwest of the UEP.

The UEP was constructed by Dominion in 1984 as a component of the facility's wastewater treatment system, serving as a settling pond for wastewater containing coal combustion byproducts (CCB), which include CCR. CCR result from the combustion of coal for the purpose of generating steam and include fly ash, bottom ash, boiler slag, and flue gas desulfurization materials. Other materials stored in the UEP are listed in the application submittal for VDEQ Solid Waste Permit Number 619. The UEP is constructed of earthen dikes, with a 20-foot minimum crest width at approximate elevation of 41 feet. The area bounded by the top of the dikes is approximately 112 acres.

A CCR fugitive dust control plan has been implemented for the Station in accordance with the CCR Rule (Section 257.80) and will be amended to incorporate closure activities.

3.3 Closure Description

The UEP will be closed with the CCR material in place. After CCR is placed to the final design grades, the area will be capped with a 40 mil linear low-density polyethylene (LLDPE) geomembrane and covered with a final cover consisting of an 18-inch thick soil protective cover layer and 6-inch thick vegetative support layer (collectively referred to as the engineered cover system).

A proposed closure sequence is shown on Sheet 3 of the CCR Closure Plan Drawings and is anticipated to consist of:

- Initiation of closure construction in Area 1, by installing the LLDPE in advance of drainage channels that will be installed in these regions.
- Closure of Area 2, by grading the area to the necessary subgrade and installing the engineered cover system.
- Closure of Area 3, upgradient of Area 2.
- Closure of Area 4A in two regions. A portion will be upgradient of Area 3, and the remaining portion will be located at the eastern end of the site. Area 4A at the eastern end of the site will provide subgrade material to achieve grades needed upgradient of Area 3, and will also provide for closure of part of the eastern end of the site.
- Closure of Area 4B, the UEP perimeter channels.
- Area 5A will consist of the construction of the emergency spillway and associated temporary diversion of runoff around the site stormwater sediment pond.
- Area 5B will consist of regrading and closure of the site stormwater sediment pond.

The closure sequence is dependent upon CCR placement volume in the UEP (see Section 5.1.2).

3.4 Maintenance and Runoff Minimization

The UEP Closure Plan will minimize maintenance, runoff, and the potential for release of waste materials by closing the UEP through the construction of an engineered cover system (see Section 6.1).

The engineered cover system will minimize the exposure of CCR to the environment. Runoff from the closed UEP will be directed to lined drainage channels and discharged through a storm drainage system, minimizing the potential for erosion of the cover system. With the exception of lined drainage channels and gravel access roads, the closed UEP will be covered with a vegetative soil layer to minimize the runoff volume released from the site. Stormwater runoff from the closed UEP will not come into contact with or contain CCR material.

4.0 Closure Timeframe

A proposed construction sequencing for the additional CCR placement is described in Sheet 3 of the CCR Closure Plan Drawings and outlined in Section 3.3. Sequenced construction is necessary as the UEP will continue to receive CCR through 2017. The major estimated project milestones include:

- ▶ April 2016 – Mobilize contractor and continue closure activities under the 2003 Closure Plan, as modified in 2015.
- ▶ September 2016 – Begin CCR grading activities. -
- ▶ April 2017 – Commence CCR closure of Areas 1 and 2. -
- ▶ July 2017 – Complete CCR closure of Areas 1 and 2, begin CCR closure of Area 3. -
- ▶ November 2017 – Complete CCR closure of Area 3, begin CCR closure of Area 4. -
- ▶ April 2018 – Complete CCR closure of Area 4, begin CCR closure of Area 5. -
- ▶ December 31, 2018 – Complete CCR closure of Area 5 and the entire UEP, including the stormwater sediment pond.
- ▶ December 31, 2019 – Complete CCR closure certification of entire UEP area.

The closure timeframe is dependent upon CCR placement volume in the UEP (see Section 5.1.2).

5.0 Preparation for Closure of Surface Impoundment

5.1 Site Configuration

5.1.1 CCR Placement

To achieve final closure grades within the UEP, CCR placement will be sequenced as shown on Sheet 3 of the Closure Plan Drawings. CCR is placed with typical side slopes of three horizontal to one vertical (3:1). Technical requirements for CCR placement, including lift thickness and compaction requirements, are included in the application submittal for VDEQ Solid Waste Permit Number 619.

After placement and compaction, the CCR material will be capped with the LLDPE liner and then covered with soil and vegetated. Benches are constructed every 25 vertical feet of placement height on the 3:1 slopes. The west end of the UEP is designed with 33 percent maximum slopes and a two percent minimum top slope (to prevent ponding). The east side of the UEP will be graded to allow for construction of the stormwater conveyance channel network to direct flow to VPDES Outfall 005. The UEP final closure configuration is shown on Sheet 4 of the CCR Closure Plan Drawings.

5.1.2 Estimated CCR Volume

The total volume of material in the Upper East Pond (UEP) at the time of final closure is estimated to be 14.3 million cubic yards.

The total volume of CCR that will be placed in the UEP is variable and is dependent upon Station operations, outages, electricity demand, weather, fuel and other factors. Due to this uncertainty, after closure is complete a record drawing will be developed and submitted to the VDEQ to show the actual volume of CCR placed in the UEP.

5.2 Stabilization and Free Liquids

Section 257.53 of the CCR Rule defines free liquids as liquids that readily separate from the solid portion of a waste under ambient temperature and pressure. Section 257.102(d)(2) requires that free liquids be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues, and that the remaining CCR be stabilized sufficient to support the final cover system.

For operations covered under the 2003 Closure Plan, CCR is dewatered by removing and stacking the CCR within the limits of the LWP, and subsequently placing the CCR in the UEP in accordance with the requirements in the VPDES Permit. After issuance of VDEQ Solid Waste Permit Number 619, CCR will be dewatered, placed, graded, and compacted in the UEP in accordance with the requirements of the permit. The CCR will be stabilized to sufficiently support the final cover system.

In the CCR Closure Plan, free liquids are considered to include ponded water or water that separates from the CCR through processes such as rim ditching or compaction during closure activities. Water ponded on the surface of the CCR impoundment will be removed and the CCR dewatered to a depth determined by a qualified professional engineer for a stable surface for the installation of the engineered cover system. The treatment of the dewatering discharge is covered by the VPDES permit for the Station.

The UEP stormwater sediment pond is a clay-lined temporary basin located within the limits of the UEP. The stormwater sediment pond will remain in service during closure construction until the engineered cover system is installed over the active placement area of the UEP. Water in the stormwater sediment pond will be removed and the pond will be filled, graded, and stabilized for installation of the final engineered cover system.

5.3 Structures and Equipment

Demolished structures and equipment that do not remain in place will be disposed of off-site. Other structures and equipment will be abandoned in place through processing to avoid any voids in the final closed areas.

6.0 UEP Closure

6.1 Engineered Cover System

The CCR Closure Plan includes the installation of an engineered cover system meeting the requirements of Section 257.102(d)(3) of the CCR Rule. The engineered cover system will be placed over all CCR material within the UEP. The maximum area to be capped and covered with the engineered cover system is estimated to be approximately 112 acres.

The engineered cover system will consist of the following (listed from bottom to top):

- A prepared CCR or soil subgrade, or a nonwoven cushion geotextile placed over natural soils stripped of vegetation;
- A 40-mil LLDPE geomembrane, meeting the requirements of CCR Rule Section 257.102(d)(3), which will serve as the infiltration layer;
- A Geocomposite Drainage Net (GDN) with non-woven, needle punched geotextile heat bonded to both sides;
- Eighteen inches of a soil protective cover layer; and
- Six inches of a soil vegetative support layer.

Cap drains will be installed on benches, beneath channels, and along the closed UEP surface at specified locations. The cap drains will carry water infiltrated through the soil portion of the cover system and conveyed through the GDN system. Four-inch pipes will be installed as laterals along the benches and closed surfaces, and six-inch pipes will be installed as headers beneath all channels. Cap drains will be installed beneath all channels, as the channel installation creates a low point in the subgrade. No direct connection will be made between cap drains and surface drainage channels.

Protective linings such as concrete, fabric-formed concrete drainage channels, or crushed stone road surfacing will be identified and installed in specific locations. At these locations, the thickness of the protective covering will contribute towards the overall thickness of the final cover. Vegetation is not necessary in locations where a protective covering is installed.

6.2 Final Slopes

Final slopes at the closed UEP will be 33 percent maximum and 2 percent minimum. The 33 percent slope areas will feature benches every 25 vertical feet. Slope stability analyses are discussed in Sections 6.4.2 and 6.4.3.

6.3 Runoff Controls

Runoff from within the UEP will be conveyed towards a drainage channel system and ultimately to the location of Outfall 005. The UEP is classified as a dam (Inventory Number 04145) and is regulated by the Virginia DCR, Division of Dam Safety and Floodplain Management, under 4 VAC-50-20. The drainage channels and spillway to Outfall 005 will be designed to meet the appropriate dam design storm as required by DCR. Stormwater channels will be lined with either concrete, fabric-formed concrete, or vegetated turf reinforcement mat.

Channel designs are based on the Probable Maximum Flood (PMF) event.

The existing UEP stormwater sediment pond will remain in service as the primary erosion and sedimentation control feature for the UEP until the engineered cover system is installed over the active placement area of the UEP. The stormwater sediment pond will then be dewatered, filled, and covered with the engineered cover system.

6.4 Settlement, Subsidence, Stability, and Displacement

Geotechnical Design and Analyses were performed in accordance with the requirements of Section 257.73(e)(1) of the CCR Rule. Geotechnical Design and Analyses include:

- Cap system design;
- GDN design;
- Anchor trench design;
- Geotextile design;
- Slope stability analysis;
- Bearing capacity analysis; and
- Settlement.

6.4.1 Cap System and Components Design

The cap system for the closed UEP is described in Section 6.1 of this CCR Closure Plan. The cap system and its individual components achieve factors of safety compliant with the CCR Rule.

6.4.2 CCR Slope Stability

In 2014, Schnabel Engineering Inc. (Schnabel), under contract to Dominion, conducted a slope stability evaluation of the UEP, focusing on the south CCR slope. Soil properties were based on information from past studies conducted by Schnabel for the UEP. For the geometry of the section that was evaluated for stability, Schnabel used an existing condition of CCR placed up to elevation 80 feet, and a final condition of CCR placed up to elevation 130 feet. The factor of safety determined by Schnabel for the static condition was 1.9, which meets the factor of safety required by the CCR Rule.

GAI updated the Schnabel seismic analysis with 2014 seismic coefficients. The factor of safety determined from the updated analysis was 1.3, which meets the factor of safety required by the CCR Rule.

Comparing the condition of the Schnabel analysis to the CCR Closure Plan, under the CCR Closure Plan the maximum final CCR grade is at approximate elevation 138 feet on the western edge of the UEP, which is equivalent to the elevation used in the Schnabel analyses. In addition, the current CCR placement procedures and final cover system will lead to a lower groundwater elevation than that considered by Schnabel (confirmed by Schnabel borings). The Schnabel stability analyses can be considered appropriate for the closed UEP.

6.4.3 Dike Slope Stability

In the 2003 Closure Plan, GAI evaluated the dike slope stability and determined that the maximum height of CCR at the eastern end of the site, in the UEP's north and south embankments, should be limited to the top of the UEP dike, at an approximate elevation of 41 feet. For the CCR Closure Plan, the stability of these areas was re-evaluated, with parameters modified from the 2003 analyses to account for current phreatic conditions, information contained in previous Schnabel geotechnical reports, and updated seismic coefficients.

Sections 257.73(e)(1)(i) and (iii) of the CCR Rule require a static factor of safety of 1.50 and a seismic factor of safety of 1.00. The GAI calculations are summarized in Table 1. Both factors of safety for dike slope stability are met.

Table 1
Dike Slope Stability, Eastern End of UEP

Criteria	CCR Rule Requirements	Northern Embankment	Southern Embankment
Static Factor of Safety	1.5	1.5	2.5
Seismic Factor of Safety	1.0	1.0	1.7

Closure activities do not affect the factor of safety values.

6.4.4 Bearing Capacity

Section 370.A.2 of the VDEQ Regulations requires stabilizing the, “remaining waste residues to a bearing capacity necessary to support the final cover.” The bearing capacity of the CCR material was analyzed using soil parameters estimated from laboratory tests of on-site samples obtained from Historical Field Investigations monitored by Schnabel Engineering Inc. and a groundwater elevation of 35 feet (summarized in the Schnabel report Upper Pond Stability Evaluation, 2014).

Calculations indicate that the ultimate bearing resistance of the CCR material is expected to be 2,700 pounds per square foot (psf), which represents the bearing capacity for approximately one inch of settlement based on the estimated CCR fill volume. The final cover system is expected to contribute pressure to the CCR material of approximately 240 psf.

6.4.5 Settlement

Settlement analyses indicate that an estimated maximum 1.25 inches of settlement may occur along the top surface of the closed UEP. With this settlement, the overall minimum slope of 2 percent will not be affected.

6.5 Universal Soil Loss Demonstration

The UEP will be stabilized after closure with vegetation or with durable surfaces such as concrete and fabric-formed concrete channel linings and gravel road surfacing. The Revised Universal Soil Loss Equation was used to estimate soil loss after closure. Based on the characteristics of the soils planned for use in UEP closure, soil loss was estimated to be 0.09 tons per acre per year for the most erodible soil available after a full stand of vegetation is established, compared to the DEQ requirement for a maximum 2.0 tons per acre per year.

Immediately after closure, before vegetation is established, the predicted soil loss is 17 tons per acre per year for the most critical condition. Excessive soil loss and sedimentation will be prevented by:

- Sequencing closure to minimize the amount of bare cover soil exposed;
- Providing localized erosion and sediment control features downgradient of disturbed areas; and
- Maintaining the use of the existing UEP stormwater sediment pond as an erosion and - sedimentation control feature until upgradient areas are stabilized. -

6.6 - Toe Drain System

The UEP currently utilizes a toe drain system to collect water at the outside toe of the UEP dikes. Water collected in the system is routed to the UEP stormwater sediment pond and discharged through VPDES Permit Outfall 005. Water collected in the toe drain system will be routed to a Low Volume Wastewater Treatment System (LVWWTs) for treatment prior to discharge. The existing toe drain system will be modified to enable pumping to the new LVWWTs.

6.7 - Henricus Historical Park

Henricus Historical Park, owned by Chesterfield County, is adjacent to the UEP. An area of approximately 1.8 acres within the boundaries of the UEP may be beneficially repurposed as public overflow parking after CCR Closure. In addition to the proposed engineered cover system, the parking areas will also be constructed with a vegetated, reinforced paver to protect the cap system and final cover system. Barricades and fencing will be utilized to prevent public access to restricted areas in the UEP. Parking areas will be secured against public access when the Park is closed.

7.0 - CCR Closure Implementation

7.1 - Security

Signs will be posted at the locking gates at UEP access points and unauthorized entrance will be prohibited. Vehicle access to the restricted areas of the site will be controlled by bar gates secured with lock and key. Vehicle access adjacent to the gate will be denied by physical barriers (surface water channels, post barricades, or severe slopes).

7.2 - Notification

Within 30 days of VDEQ's final approval of the closure, deed notations will be implemented according to Section 257.102(i) of the CCR Rule and Section 160.D.5 of the VDEQ Solid Waste Regulations. Within 30 days of recording the notation, a notification stating that the deed notation has been recorded will be prepared and placed in the Facility's operating record and posted on Dominion's publically accessible internet site.

7.3 - Certification

In accordance with Section 257.102 (h) of the CCR Rule, within 30 days of the completion of the closure activities, certification will be provided indicating that closure occurred in accordance with this CCR Closure Plan. A certification will also be provided indicating that closure occurred in accordance with 9 VAC-20-81-160.D.5.d.

8.0 - Opinion of Probable Estimated Cost for the CCR Closure Plan

An opinion of probable estimated cost for the UEP CCR Closure is \$29,401,000.

9.0 References

40 CFR 257, Subpart D—*Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments*. 2015.

4 VAC-50-20, *Impounding Structure Regulations*. 2012.

9 VAC-20-81, *Solid Waste Management Regulations*. 2011.

Virginia Department of Environmental Quality. *Application for Solid Waste Permit Number 619*. 2016.

Virginia Department of Environmental Quality. *Closure and Post-Closure Care Plans for Solid Waste Disposal and Management Facilities*. 2012.

Virginia Department of Environmental Quality. *Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0004146*.