Periodic Structural Stability Assessment

Bremo Power Station CCR Surface Impoundment: North Ash Pond

Submitted to:

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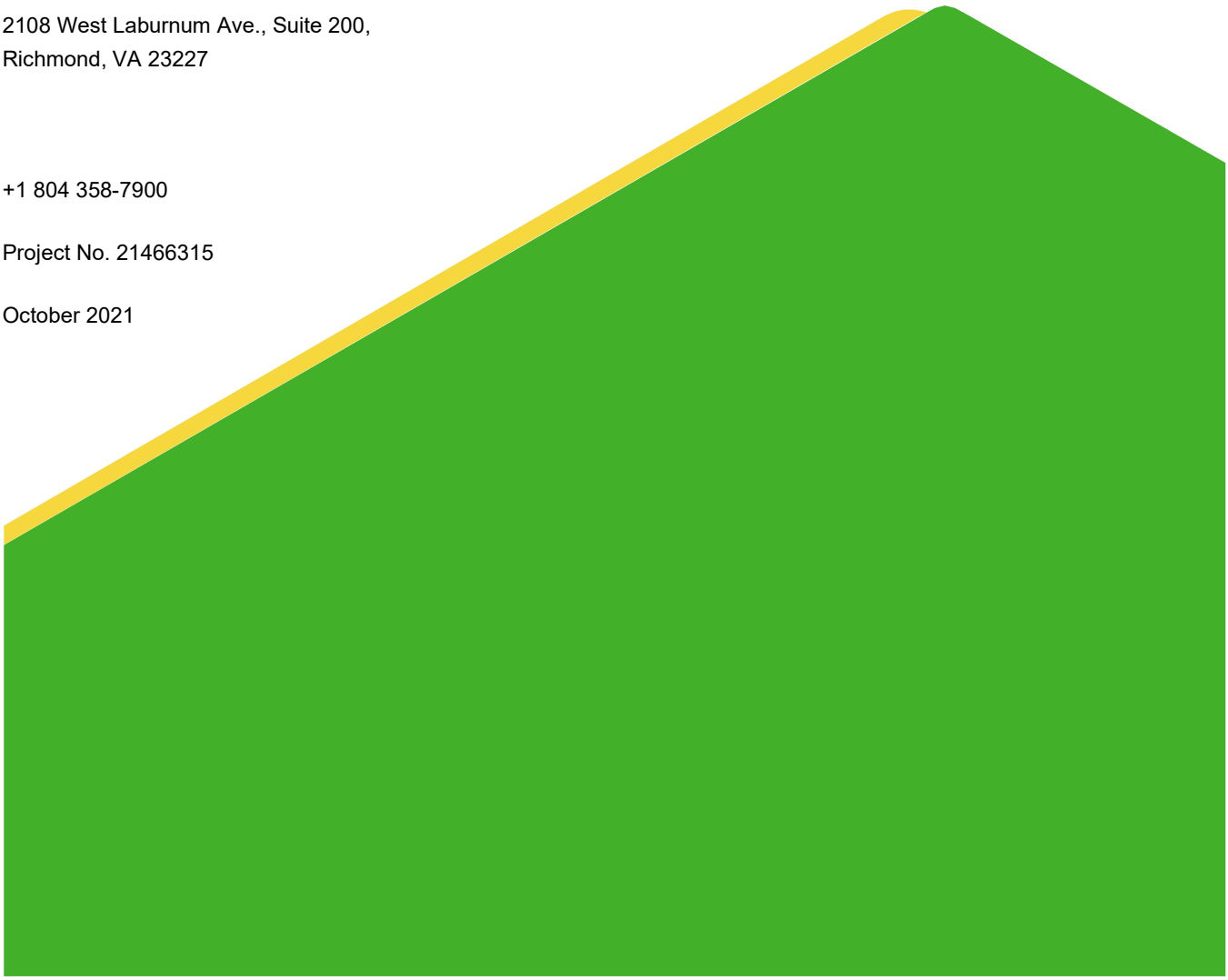
October 2021



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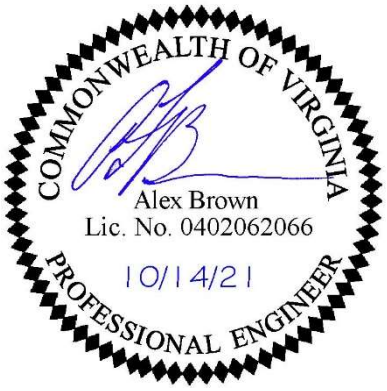
1.0 CERTIFICATION

This Structural Stability Assessment for the Bremo Power Station's North Ash Pond was prepared by Golder Associates Inc. (Golder). The document and Certification/Statement of Professional Opinion are based on and limited to information that Golder has relied on from Dominion and others, but not independently verified, as well as work products produced by Golder.

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 this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.73(d) 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 [40 CFR §257.73(d)].

The use of the word "Certification" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Alex Brown, PE	Senior Project Geotechnical Engineer
Print Name	Title
	10/14/2021
Signature	Date



2.0 INTRODUCTION

This periodic Structural Stability Assessment (Assessment) was prepared for the Bremo Power Station's (Station) existing Coal Combustion Residuals (CCR) surface impoundment known as the North Ash Pond (NAP). This Structural Stability Assessment was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.73(d).

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is located in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an existing CCR surface impoundment, the NAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (40 CFR §257; the CCR rule). The NAP is also regulated as a dam by the Virginia Department of Conservation and Recreation (DCR) with Inventory Number 065020 (DCR Dam Permit).

3.0 PURPOSE

This periodic Assessment is prepared pursuant to the requirements in the CCR Rule, § 257.73(d)(1) [40 CFR § 257.73(d)(1)]. The initial Structural Stability Assessment was completed on October 17, 2016, and is required to be updated every five (5) years pursuant to 40 CFR 257.73(f)(3).

4.0 STRUCTURAL STABILITY ASSESSMENT REQUIREMENTS

In accordance with § 257.73(d)(1), the owner or operator of a CCR surface impoundment must conduct periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

- Stable foundations and abutments;
- Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
- Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
- Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;
- A single spillway or a combination of spillways that is designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the 1,000-year flood;
    - All spillways must be either of non-erodible construction and designed to carry sustained flows or Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;
- Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure; and
- For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

5.0 STRUCTURAL STABILITY ASSESSMENT

5.1 Foundation and Abutments

The Station lies in a geologically stable area with no active (Holocene) faults, karst (limestone, dolomite, or marble) potential, or other geologic conditions of concern. The NAP is constructed on natural soils that consist of a typical Piedmont residual, saprolitic soil profile, formed from in-place weathering of rock. Piedmont soils consist of fine sandy silts (ML) and silty sands (SM), with occasional coarse materials that include coarser sands and angular gravel pieces derived from seams of resistant materials (mainly quartz), as well as the lower saprolites and upper disintegrated rock. Several areas within the NAP foundation were excavated, exposing disintegrated rock, and used to construct the dikes. Material properties within the NAP foundation and abutments were interpreted based on subsurface data and site reconnaissance taken from previous Golder investigations, analyses, and reports included in Golder's February 2017 Geotechnical Design Report (Golder, 2017).

Golder's assessment of embankment stability in the Periodic Safety Factor Assessment (Golder, 2021a) show that the NAP meets the minimum factor of safety requirements in the CCR Rule § 257.73(e)(1).

The NAP was constructed by damming a steeper drainage feature in the rising natural hillside. The embankment extends primarily across the mouth of the feature (about 1,000 feet long) and is over 100 feet high. The embankment extends along the western ridge of the feature, where it is much lower, generally less than 20 feet high. Embankment materials were borrowed from several large borrow areas within the NAP area.

The NAP embankment was constructed on Piedmont rock and disintegrated rock. CCR that existed underneath the toe of the NAP was removed through excavation in 2017 and 2018. Stability during the NAP toe excavation project was provided through a temporary toe support system designed by Schnabel Engineering, which was included in Golder's March 2017 Virginia Department of Conservation and Recreation (DCR) Impounding Structure Design Report for the North Ash Pond.

Additionally, the NAP has been routinely inspected and monitored by Station and Dominion personnel in accordance with the requirements in the DCR Dam Permit. Areas of concern are evaluated by professional engineers with corrective actions implemented and documented.

5.2 Slope Protection

The NAP dike was built at slopes of 2.5H:1V or flatter, with benches on the upstream and downstream sides. The dike is provided with seepage controls in the form of blanket drains that limit the risk of softening of the embankment surface that could make maintenance difficult and/or increase erosion and stability concerns. In addition, the vegetation on the dike is maintained to prevent brush, trees, clumping of weeds, etc. that would concentrate flow and lead to the development of erosion rills.

Dominion performs annual inspections in accordance with the requirements of the DCR Dam Permit with the most recent inspections on June 25, 2020 (Virginia Electric and Power Company, 2020) and June 17, 2021 (Virginia Electric and Power Company, 2021). Dominion evaluates the vegetation on the slopes of the impoundment embankment as part of the annual inspections. The slope vegetation for the upstream slope and downstream slopes of the embankment were observed to be well maintained.

5.3 Compaction of Dikes

The following tables summarize the primary geotechnical laboratory results and basic cone penetrometer testing (CPT)-based interpretations (Table 1), and secondary laboratory data (Table 2) from the NAP dike laboratory soil tests and CPTs completed during the 2015 geotechnical exploration program.

Table 1: Summary of Primary Geotechnical Testing Data for the NAP Embankment Soil Fills

Property	Number of Tests	Minimum	Maximum	Average	Median
Depth Range (feet)	-	9.5	114.5	63.6	62.1
Water Content (%)	10	14	29	22	22
Gravel (> 4.75 millimeters) (%)	10	0	8	3	2
Sand (%)	10	39	67	57	61
Fines (< 0.075 millimeters) (%)	10	30	59	40	37
Specific Gravity	0	-	-	-	-
Liquid Limit (LL) (%)	5	32	46	40	42
Plastic Limit (PL) (%)	5	26	35	30	28
Plasticity Index (PI)	5	3	16	10	11
Non-plastic Results	5	None of the 5 Atterberg tests completed (i.e., LL, PL, and PI) returned non-plastic results			

Table 2: Summary of Secondary Geotechnical Data for the NAP Embankment Soil Fills

Property		Number of Points	Minimum	Maximum	Average	Median
Drilling	Standard Penetration Test (SPT) N (blows per foot, bpf)	46	7	31	18.5	18
CPT Based	*Peak φ' (°)*	2538	20.7	47.5	34.0	34.1
	Su (ton per square foot, tsf)		0.7	15.5	4.3	3.9
	SPT N_{60} (bpf)		5	100	29	27
	Normalized CPT Tip Resistance (Qtn)		1.9	521.7	58.1	31.6

As seen in the above results tables, the NAP dike generally consists of a mix of fine sandy silt (ML) and silty fine sand (SM) materials that show consistencies in line with a well compacted and competent fill material.

As mentioned above, the toe of the North Pond embankment was excavated during the removal of CCR from the East Ash Pond. As part of those excavation activities a temporary tie back wall was constructed to brace the North Pond Embankment. Schnabel Engineering designed the support of excavation (SOE) system that was used during these excavation activities (Schnabel, 2016).

No visible indications of weakened embankment (e.g., tension cracks, elevated groundwater, groundwater seeps, sinkholes, etc.) have been observed at the North Pond over the past five years during routine and annual inspections.

The NAP dike is homogeneous and well compacted, with preferential drainage paths occurring through the disintegrated rock and rock in the NAP bottom and dike abutments, as indicated by controlled drainage in the abutments and variation in water levels in wells screened through the dike. Slope stability analyses presented in the Safety Factor Assessment (Golder, 2021a) present the embankment to be stable.

5.4 Vegetated Slopes

As required by § 257.73(d)(1)(iv), vegetation on slopes and surrounding areas are not to exceed a height of six inches above the slope of the dike. Current operations at the NAP call for grass to be mowed 2-3 times per year to control vegetation height. The vegetated slopes are operated and maintained to be stable and to provide for visual observation of any instability. The 2020 and 2021 annual inspections (Virginia Electric and Power Company, 2020; Virginia Electric and Power Company, 2021) noted that the upstream and downstream slopes of the embankment have been mowed.

5.5 Spillways

The NAP's former principal spillway, an intake tower with weir and 24-inch diameter pipe, has been abandoned in place by grouting. The current principal spillway consists of a pumping system that manages non-contact stormwater collected in the NAP below elevation 328 feet above mean sea level (ft amsl). The emergency spillway, located on the west side of the NAP, is available for discharge should water accumulate to the crest of the spillway. The existing emergency spillway is a trapezoidal-shaped, broad-crested spillway that is built into the road surface along the top of the NAP embankment. It has a width of 200 feet and a crest elevation of 330.7 ft amsl. The spillway has an effective depth of 3.3 feet and is predominantly vegetated with an existing access road along its length that is surfaced with well-compacted gravel. The size and capacity of the emergency spillway are adequate to convey the runoff from the inflow design flood without overtopping the embankment or eroding the spillway. The analysis of the spillway capacity is included in Appendix A of the Inflow Design Flood Control System Plan (Golder, 2021b).

5.6 Hydraulic Structures

The former principal spillway and toe drain collection system pass through the dike of the NAP. The former principal spillway was a 24-inch diameter pipe connected to a concrete riser structure that is anchored within the main dike segment. The former spillway structure was abandoned in place by grouting. The existing internal drainage controls for the NAP dike consist of 6-inch toe drains which are maintained. There is no known record or knowledge of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris associated with the former principal spillway and toe drain collection systems.

5.7 Adjacent Water Bodies

The NAP embankment is located approximately 900 feet from the James River. The face of the dam adjoins the East Pond (EP) at an approximate elevation of 234 ft amsl. The bottom of the EP's emergency spillway is at an approximate elevation of 232 ft amsl. The water surface elevation of the James River resulting from the 100-year storm event is approximately 228 ft amsl. Therefore, the flood from the 100-year storm event will not overtop the EP's spillway, thus providing 100-year flood protection to the NAP embankment.

6.0 CORRECTIVE MEASURES

No structural stability deficiencies were identified, so no corrective measures are required.

7.0 CONCLUSIONS

Based on known site conditions, review of available information, and the current analyses performed for the NAP embankment, the NAP surface impoundment design, construction, operations, and maintenance procedures are consistent with good engineering practices for the volume of CCR and CCR wastewater that is impounded and meets the requirements of 40 CFR 257.73(d).

8.0 REFERENCES

Golder Associates. Virginia Department of Conservation and Recreation Impounding Structure Geotechnical Design Report Supporting Documents. March 2016.

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Schnabel Engineering, LLC. 2016. Geotechnical Data Report Support of Excavation Design. November 30, 2016.

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Virginia Electric and Power Company. Annual Inspection Report for Virginia Regulated Impounding Structures, Bremo Power Station North Ash Pond Dam. June 2020.

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