INITIAL HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

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INITIAL HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

Bremo Power Station CCR Surface Impoundment: West Ash Pond

Dominion Energy℠

Submitted To: Bremo Power Station
1038 Bremo Bluff Road
Bremo Bluff, VA 23022

Submitted By: Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227

April 2018

Project No. 15-20347

Golder Associates

Table of Contents

Tables

Figures

Appendices

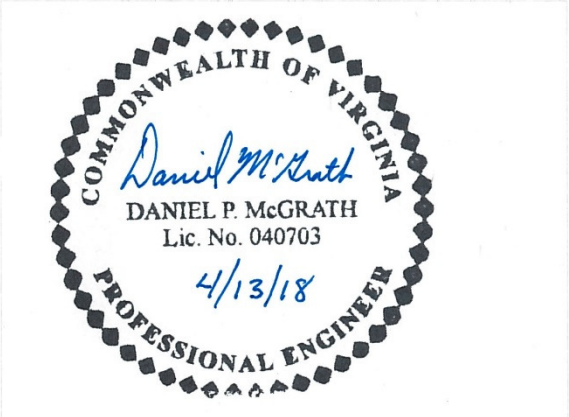
1.0 CERTIFICATION

This Initial Hazard Potential Classification Assessment for the Bremo Power Station's West 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 Energy 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(a)(2) 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(a)(2)], as well as with the requirements in §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016 with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word "certification" and/or "certify" 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.

Daniel McGrath	Associate and Senior Consultant
Print Name	Title
Daniel McGrath	4/13/18
Signature	Date



2.0 INTRODUCTION

This Initial Hazard Potential Classification Assessment was prepared for the Bremo Power Station's (Bremo) inactive Coal Combustion Residuals (CCR) surface impoundment, the West Ash Pond. This Initial Hazard Potential Classification Assessment was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.73(a)(2) and 40 CFR §257.100(e)(3)(v).

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 inactive CCR surface impoundment, the WAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR rule).

This analysis details the purpose, data sources, method of analysis, and development of a figure showing the inundation level expected downstream given a breach event occurs at the WAP. The potential inundation areas were compared with various map sources to determine what, if any, effect on downstream structures could be expected from a breach of the impoundment. This evaluation covers the current condition of the pond, as surveyed at the end of 2017. All elevations stated in this report are in feet relative to the North American Vertical Datum of 1988 (NAVD-88).

3.0 PURPOSE

This certification is required under 40 CFR §257.100(e)(3)(v) and 40 CFR §257.73(a)(2), *Periodic Hazard Potential Classification Assessments*, regarding the hazard potential classification assessment of the WAP, for the purpose of recommending a hazard potential classification.

Sources of data used in the analysis included:

1) United States Geological Survey (USGS) topographical map (Arvonia quad sheet 2013);
2) Statistical rainfall data from NOAA Atlas 14 (NOAA's Precipitation Frequency Data Server);
3) Maps and aerial photos of area roads and structures from the Google Earth Pro;
4) Aerial survey of the WAP and surrounding areas performed by H&B Surveying and Mapping, LLC, dated December 2017;
5) Flood map information from the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel # 51065C0260C dated 5/16/2008. (Accessed through ArcGIS – FEMA's National Flood Hazard Layer mapping system);
6) Web Soil Survey 2.1, Natural Resources Conservation Service (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm)

4.0 ASSESSMENT

4.1 Description of the Impounding Structure

The 17-acre impoundment is located west of the Bremo Power Station and is bounded on the south side by a railroad embankment and the James River, on the north side by Bremo Road, on the west by undeveloped wooded areas, and on the east by low-lying areas of Hollman Creek with the Bremo Power Station beyond. The WAP was constructed partially by excavation and embankment construction, such that the bottom of the pond is below the surrounding terrain. The pond was constructed in the late 1970's and used for sluiced CCR until the Station's conversion to natural gas in 2014. The upstream and downstream sideslopes are 2 horizontal to 1 vertical (2H:1V). The effective embankment height is 19 feet. CCR removal activities are substantially complete and the pond bottom is irregular, with depths as low as elevation 200.

The existing spillway structure is a square concrete intake tower located in the southeast corner of the pond. The tower structure is approximately 5'-6" in width and has a lowest weir opening (stoplog) at elevation of approximately 226.14 feet. The outlet pipe is a 42-inch diameter corrugated metal pipe with an inlet invert elevation of 209.15 feet. Under normal conditions, the water level is kept low enough such that stormwater flow does not reach the lowest discharge elevation. Stormwater that enters the pond is pumped to the on-site treatment system.

Figure 1 - December 2017 West Ash Pond Aerial Photo

4.2 Drainage Area and Hazard Analysis Area Descriptions

The drainage area for the WAP consists entirely of the pond area only (17.1 acres). There are no other contributing drainage areas due to the pond's elevated construction. A Runoff Curve Number (CN) as defined by the Natural Resource Conservation Service (NRCS) of 91 was used for the hydraulic model.

The lower portion of the WAP is excavated into natural terrain and the surrounding areas outside the pond are uphill from the pond. The perimeter ground elevation outside of the pond is approximately 16 feet above the bottom of the pond (elevation 216) and 10.4 feet above the modeled high water level (elevation 205.6); therefore, a breach event with a water release during the 1,000-year event is improbable. There are no occupied structures downstream of the impoundment.

4.3 Method of Analysis

To model the flows into and out of the impoundment, a numerical model was created using the Hydraulic Engineering Center's Hydrologic Modeling System (HEC-HMS) Version 4.2.1 to generate the anticipated runoff hydrograph from the 24-hour, 1,000-year storm event. Table 1 outlines the resulting inflow and outflow for the non-breach scenario analysis.

Table 1: West Ash Pond HEC-HMS Output

West Ash Pond		
Q_{in} (CFS)	Max Hw (Ft El*)	Q_{out} (CFS)
269.4	205.6	0

*Top of berm elevation = 234.0 feet

Modeling of the existing WAP for the 1,000-year event shows the calculated high water elevation to be 205.6 feet, which indicates the pond does not overtop the embankment. Due to the CCR excavation, this high water elevation is below the elevation of the outside toe of the embankment all around the perimeter of the pond. A breach of the embankment would have an uphill gradient to escape the pond; therefore, a breach and release from the WAP is considered highly improbable and therefore was not modeled.

A "sunny day" breach is assumed to be due to the piping of soils through the embankment when the water level in the reservoir is at its normal pool elevation; however, there typically is not a normal pool in the WAP, so this evaluation was not performed. A seismic analysis was not performed, nor were other sudden failure type scenarios considered, as this evaluation is for the potential downstream impacts due to an embankment breach during the design storm event (1,000-yr event).

4.4 Spillway Adequacy

If a structural embankment failure does not occur, the existing pond is capable of receiving and storing the runoff volume from the 1,000-year event without overtopping the embankment and without a discharge. The pond would have 28.4 feet of freeboard.

5.0 HAZARD CLASSIFICATION

Pursuant to 40 CFR §257.73, a CCR unit is classified as a Significant Hazard Potential where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant Hazard Potential classification impoundments are often located in predominantly rural or agricultural areas, but could be located in areas with population and significant infrastructure. The potential inundation zone downstream of the WAP embankments does not contain occupied structures, nor is it regularly occupied by plant personnel.

6.0 CONCLUSIONS

The results of this analysis show a breach of this impounding structure during the modeled storm event is highly improbable. There are no potential downstream impacts to manmade structures, and failure or mis-operation would be unlikely to result in loss of human life. Environmental damage from a potential release would be the likeliest result, as the pond is not officially closed. Therefore, the WAP in its current condition is assigned a hazard potential rating of “Significant” for this reason under 40 CFR §257.73.

APPENDIX A - Figures

Figure 2 – West Ash Pond 1,000-Yr Event High Water Elevations

Figure 3 – 100-Yr Flood Map (FIRM)

LEGEND

- DOMINION PROPERTY BOUNDARY
- EX. TOPOGRAPHIC CONTOURS (2' INTERVALS)
- EX. UNPAVED ROAD
- EX. RAILROAD
- EX. TREE LINE
- EX. FENCE
- EX. OVERHEAD UTILITY LINE
- CREEK/STREAM CENTERLINE
- COMPUTED EXTENTS OF 1,000-YR HIGH WATER

NOTES

1. MONTHLY EXCAVATION SURVEY PREPARED BY H&B SURVEYING AND MAPPING LLC. TOPOGRAPHY COLLECTED ON DECEMBER 29, 2017.

80 0 80 160
SCALE FEET

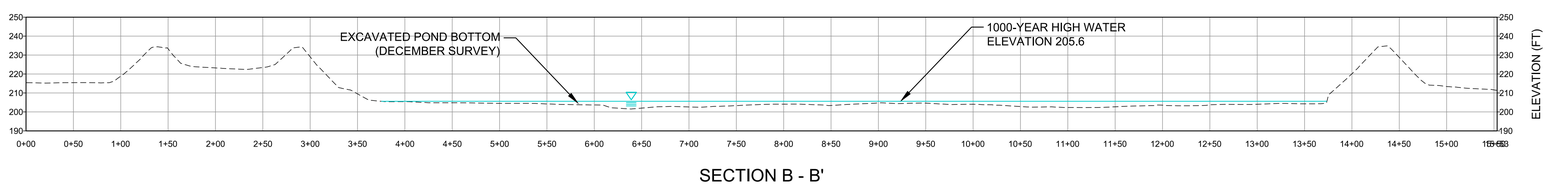
BREMO ROAD

METALS POND

MW-1 MW-2 MW-3 MW-12 MW-13

LIMITS OF WAP EXCAVATION (16.8 AC)

B B'



SECTION B - B'

40 0 40
SCALE FEET

80 0 80
SCALE FEET

REV.	MM/DD/YY	DESCRIPTION	DESIGN	CADD	CHECK	REVIEW
			DPM	ABR	SDRM	DPM

GOLDER ASSOCIATES INC.
2108 WEST LABURNUM AVENUE
SUITE 200
RICHMOND, VA 23227
(804) 358-7900
www.golder.com

CLIENT
DOMINION ENERGY
BREMO POWER STATION
FLUVANNA COUNTY, VIRGINIA

CONSULTANT

PROJECT
CCR SURFACE IMPOUNDMENT CLOSURE
WEST ASH POND EXCAVATION

TITLE
1000-YEAR EVENT MODELED HIGH WATER ELEVATIONS

PROJECT NO.
15-20347QA

REV.
0

FIGURE
2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI D

0 1 in

Path: G:\Plan Production Data Files\Drawing Data Files\15-20347QA\E - Misc Drawings\Civil 3d\Working\1,000 Year Event WAP.dwg

APPENDIX B

West Ash Pond Hydraulic Modeling Analysis

CALCULATIONS

Date:	April 17, 2018	**Made by:**	KAL
Project No.:	15-20347	**Checked by:**	SDRM
Subject:	West Ash Pond Breach Analysis	**Reviewed by:**	DPM

Project: **BREMO WEST ASH POND – EXISTING CONDITION**

The purpose of this evaluation is to determine the hydraulic performance of the existing West Ash Pond CCR impoundment at the Bremo Power Station during the 1,000-year storm event and an associated embankment breach event. This evaluation is in support of the "Significant" hazard potential classification as defined in §257.53 of the *CCR Rule*.

1.0 CALCULATIONS

1.1 Pond Storage Volume

The West Ash Pond storage volume was computed based on the existing conditions, as surveyed in December 2017, being fully excavated. The ash has been excavated, and available water storage was based on the post-excavation surface contours. The bottom of the pond is at elevation 200, which is approximately 16 feet below the surrounding topography outside the pond. The maximum available storage in the pond is 421.6 acre-feet at elevation 234.0. Overtopping occurs above elevation 234.0. Attachment 1 contains the stage-storage rating table used in the HMS model. Typically, the water level in the pond is kept pumped down to a very low level in support of the excavation activity. For this model, the existing (starting) water level was set at elevation 200 feet.

1.2 Outlet Design and Capacity

The existing spillway structure is a square concrete intake tower located in the southeast corner of the pond. The tower is 5'-6" in width and has a weir opening (stoplog) at an elevation of approximately 226.14 feet. The outlet pipe is a 42-inch diameter corrugated metal pipe with an inlet invert elevation of 209.15 feet. Under normal conditions, the water level is kept low enough such that stormwater flow does not reach the discharge elevation. Stormwater that enters the pond is pumped to the on-site treatment system.

1.3 Storm Routing Calculations

The West Ash Pond stormwater system analysis was performed using the US Army Corps of Engineers Hydrologic Engineering Center's Hydraulic Modeling System (HEC-HMS) software package (ref #1). The direct drainage area to the West Ash Pond is 17.1 acres, consisting of the pond area only. There is no other contributing drainage area to the pond.

Design Storm

Per §257.82(a)(3)(ii), the impoundment is required to adequately manage flow resulting from the 24-hour, 1,000-year storm event. The 24-hour, 1,000-year storm event precipitation quantity was obtained from the Precipitation Frequency Data Server (PFDS, ref #2) for Bremo Bluff, Virginia, and is 12.1 inches.

Breach Event

Modeling of the high water elevation of the pond during the 1,000-year event during a non-breach scenario shows the high water elevation to be 205.6. This high water elevation within the pond is

approximately 10.4 feet lower than the outside toe of the embankment. A breach of the embankment would have an uphill gradient in any direction to escape the pond; therefore, a breach and release from the West Ash Pond is considered highly improbable and therefore was not modeled.

HMS Model Input

Figure 1 illustrates the connectivity of the stormwater elements and the data inputs as modeled in HEC-HMS. The 17.1-acre drainage area was modeled with a runoff Curve Number (CN) of 91 and a Lag Time of 3.6 minutes.

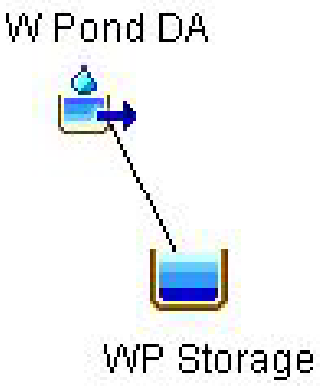


Figure 1 – West Ash Pond HEC-HMS Model

HMS Model Output

The following table summarizes the results of the HEC-HMS analysis for the 1,000-year storm event.

Table 1: West Ash Pond HEC-HMS Output

West Ash Pond		
Q_{in} (CFS)	Max Hw (Ft El*)	Q_{out} (CFS)
269.4	205.6	0

* Top of berm elevation = 234.0 feet

2.0 CONCLUSIONS

Based on the calculations presented herein, the existing West Ash Pond at the Bremo Power Station can accept and store the 1,000-year event without overtopping or causing an unregulated discharge due to a breach event.

3.0 REFERENCES

1) U.S. Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) release 4.2.1
2) Precipitation Frequency Data Server (NOAA Atlas 14) https://hdsc.nws.noaa.gov/hdsc/pfds/

4.0 ATTACHMENT

1) West Ash Pond Stage-Storage Rating Tables

West Ash Pond Grades as of 12/31/17

Elevation	Area (SF)	Volume, ft^3	AC-FT	Total
234	742,645	1,473,741	33.83	421.57
232	731,113	1,449,186	33.27	387.74
230	718,094	1,423,290	32.67	354.47
228	705,217	1,397,739	32.09	321.80
226	692,543	1,372,217	31.50	289.71
224	679,695	1,345,650	30.89	258.21
222	665,980	1,316,395	30.22	227.32
220	650,447	1,283,098	29.46	197.10
218	632,693	1,247,287	28.63	167.64
216	614,639	1,203,397	27.63	139.01
214	588,851	1,132,122	25.99	111.38
212	543,574	1,047,627	24.05	85.39
210	504,299	960,339	22.05	61.34
208	456,439	860,369	19.75	39.29
206	404,455	615,056	14.12	19.54
204	219,901	203,963	4.68	5.42
202	19,897	32,245	0.74	0.74
200	12,623	0	0	0

Contours as of December 2017

Existing West Ash Pond Concrete Riser Structure Rating Table, flows in CFS

Elevation	Weir 1	Weir 2 (O)	Weir 2 (W)	Combined	Culvert Outlet	Riser Rating
226	0.00	0.00	0.00	0.00	181.50	0.00
226.25	0.66	0.00	0.00	0.66	183.00	0.66
226.5	3.92	0.00	0.00	3.92	184.40	3.92
226.75	8.65	0.00	0.00	8.65	185.90	8.65
227	14.48	0.00	0.00	14.48	187.40	14.48
227.25	21.23	0.00	0.00	21.23	188.80	21.23
227.5	28.79	0.00	0.00	28.79	190.30	28.79
227.75	37.08	0.00	0.00	37.08	191.70	37.08
228	46.04	0.00	0.00	46.04	193.10	46.04
228.25	55.63	0.00	0.00	55.63	194.50	55.63
228.5	65.80	0.00	0.00	65.80	195.90	65.80
228.75	76.53	0.00	0.00	76.53	197.30	76.53
229	87.79	0.00	0.00	87.79	198.70	87.79
229.25	99.54	0.00	0.00	99.54	200.00	99.54
229.5	111.79	0.00	0.00	111.79	201.40	111.79
229.75	124.49	0.00	0.00	124.49	202.70	124.49
230	137.64	0.00	0.00	137.64	204.10	137.64
230.25	151.23	0.00	0.00	151.23	205.40	151.23
230.5	165.24	0.00	0.00	165.24	206.70	165.24
230.75	179.65	0.00	0.00	179.65	208.10	179.65
231	194.46	0.00	0.00	194.46	209.40	194.46
231.25	209.66	0.00	0.00	209.66	210.70	209.66
231.5	225.23	0.00	0.00	225.23	211.90	211.90
231.75	241.17	0.00	0.00	241.17	213.20	213.20
232	257.47	0.00	0.00	257.47	214.50	214.50
232.25	274.12	0.00	0.00	274.12	215.80	215.80
232.5	291.11	0.00	0.00	291.11	217.00	217.00
232.75	308.45	0.00	0.00	308.45	218.30	218.30
233	326.11	0.00	0.00	326.11	219.50	219.50
233.25	344.10	0.00	0.00	344.10	220.80	220.80
233.5	362.40	0.00	0.00	362.40	222.00	222.00
233.75	381.03	47.67	1.56	382.58	223.20	223.20
234	399.95	92.65	11.45	411.40	224.40	224.40

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 56 2 2616 2000

solutions@golder.com
www.golder.com

Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227 USA
Tel: (804) 358-7900
Fax: (804) 358-2900

Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity