STRUCTURAL STABILITY ASSESSMENT

CFR 257.73(d)

Bottom Ash Pond Complex
Cardinal Plant
Brilliant, Ohio

October, 2016

Prepared for: Cardinal Operating Company - Cardinal Plant

Brilliant, Ohio

Prepared by: Geotechnical Engineering Services

American Electric Power Service Corporation

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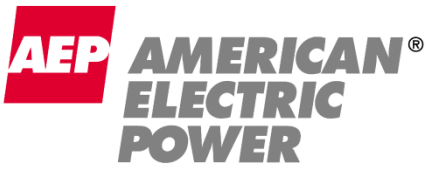

GERS-16-135

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BOTTOM ASH COMPLEX
CARDINAL PLANT

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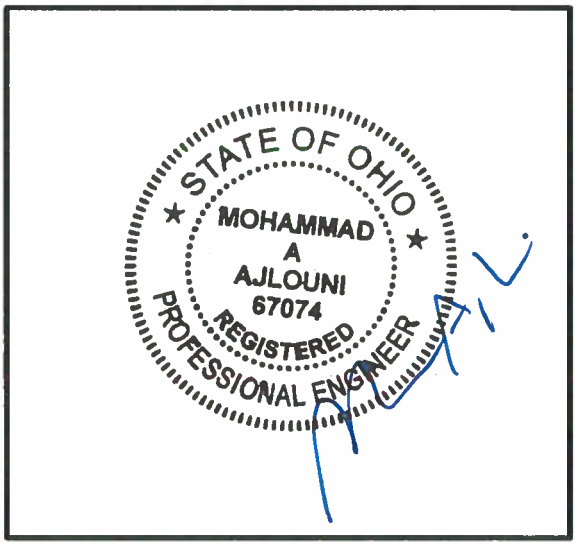

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

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1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(d) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the initial assessment as per the Rule.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The Cardinal Power Plant in Wells Township, Jefferson County, near the town of Brilliant in eastern Ohio. The Cardinal Power Plant is owned by Buckeye Power and AEP Generation Resources (GENCO) a unit of American Electric Power. is operated by Cardinal Operating Company. The facility operates two surface impoundments for storing CCR; the Bottom Ash Pond (BAP) Complex and Cardinal Fly Ash Reservoir II (FAR II) Dam. The focus of this report is the Bottom Ash Pond Complex.

The BAP complex is comprised of diked embankments on the east and west sides while the north and south sides of the BAP are incised. The complex consists of two separate ponds, the larger bottom ash pond and the smaller recirculation pond. The entire crest length is just over a mile, and the nominal crest width is 20 feet. The north end of the pond has been partially filled in with ash and the exact limits of the pond are poorly defined.

The pond complex was originally developed as part of the construction of Units 1 and 2 in the 1960s. The crest of the dikes forming the original pond was at El. 658.0. However, the pond complex was raised to a crest elevation of 970.0 and extensively modified in 1974 as part of the construction of Unit 3.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

Based on the historical cross-sections extending through both the Bottom Ash Pond and the Recirculation Pond from the vertical expansion, the original ash pond embankments along the Ohio River ranged in height from 4 to 6 feet above the bottom of the ash pond.

A subsurface investigation was conducted in 2009 and the strength parameters of the foundation as well as the embankment were defined based on laboratory tests or correlations to known strengths based on blow counts. Table 1 lists the material properties for the foundation material.

The original ground surface at the site is generally located between El. 645 and 655. Near surface soils generally consist of a layer of alluvium silt, clay and fine sand (organic in some locations) over glacial outwash deposits of variable thickness overlying the bedrock surface. The alluvium clays and silts were deposited in the backwater of the Ohio River, while the outwash materials typically consist of sand, gravel and silt deposits deposited during the last ice age. Based on geological literature, the glacial outwash extends to the bedrock surface, estimated to be roughly 50 to 60 feet below the natural ground surface at the pond. The upper most bedrock consists of shale and/or sandstone belonging to the Conemaugh Group of Pennsylvanian Age. The soils were screened for liquefaction potential and found to be non-liquefiable.

Table 1 Strength Parameters for main Natural/constructed zones.

Layer	γ_m	c'	φ'
	pcf	psf	degrees
Newer Embankment Fill	125	0	31
Original Embankment Fill	125	100	30
Alluvium Silt/Clay	125	0	30
Organic Clayey Silt	125	0	30
Loose Glacial Outwash Sand/Gravel	115	0	29
MDe Glacial Outwash Sand/Gravel	120	0	34

4.0 SLOPE PROTECTION 257.73(d)(1)(ii)

[Describe the slope protection measures on the upstream and downstream slopes.]

The Bottom Ash Complex was designed and constructed with soil embankment covered with a layer of bottom ash built up along the inboard slopes providing further protection. The outboard slopes primarily consist of grass vegetation with portions of the outboard slope protected by coarse riprap.

Operation and maintenance of the aggregate primarily includes periodic spraying for vegetation control. Grassed slopes are mowed regularly. Any erosion or slips that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

The BAP complex embankments have maximum height of approximately 25 feet and are constructed of compacted clay on a slope ranging from 2.5:1 (2.5 feet horizontal, 1 foot vertical). The elevation at the top of the embankment around the perimeter of the BAP is approximately 670 feet msl, and the normal operating level is approximately 665 feet msl. The embankment fill materials dike ranged from hard silty Clay to fine and coarse gravel, overlying native material. The interior bottom elevation of the BAP Complex is approximately 645 feet msl.

The pond complex was originally developed as part of the construction of Units 1 and 2 in the 1960s. The crest of the dikes forming the original pond was at El. 658.0. However, the pond complex was raised to a crest elevation of 970.0 and extensively modified in 1974 as part of the construction of Unit 3.

No construction specifications are available for the Bottom Ash Pond. Recent borings through the embankment indicate that the embankment material is a medium stiff to very stiff sandy lean clay and representative of a compacted earthen material. A stability analysis of the diking system was also conducted which demonstrates that the facility has a factor of safety great than minimum values required by the CCR rule.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative areas are mowed to facilitate inspections and maintain the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

The Bottom Ash Complex has been determined to be a Significant Hazard potential CCR impoundment. Based on this hazard classification the design flood is determined by section 257.82(a)(3) to be the 1000-year storm. An analysis was performed for the 50% Probable Maximum Flood (PMF), which looks at 50% of the runoff from PMP storm of 33 inches in 24 hours. This produces significantly more runoff than the 1000-year storm and therefore exceeds the requirements of section 257.82(a)(3).

The Cardinal Bottom Ash Complex is comprised of diked embankments on three sides which directs storm water away from the impoundment and limits runoff to that which falls directly on the pond surface. The area of the pond is approximately 24.3 acres. The pond also receives pumped inflow from plant facilities and stormwater collection areas.

Discharge to the Ohio River is through a principal spillway located at the south end of the recirculation pond (a drop outlet and a 36”-pipe). During normal operation, there is no discharge to the river; rather all flows are re-circulated into the plant via the pump station located on the west side of the re-circulation pond.

Based on the flood routing, the calculated peak discharge from the dam is 67.7 cfs at a maximum pool elevation of 668.1 feet NGVD.

8.0 BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

The discharge pipe does not show any sign of corrosion or deterioration based on an exterior visual inspection.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The downstream slope of the Bottom Ash Complex is not expected to be inundated from any adjacent water bodies.