McElroy's Run Impoundment
Structural Stability Assessment Report

Allegheny Energy Supply Company, LLC
A FirstEnergy Company
Pleasants Power Station
Pleasants County, West Virginia

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Prepared for:
Allegheny Energy Supply Company, LLC
A FirstEnergy Company
800 Cabin Hill Drive
Greensburg, Pennsylvania 15601

Prepared by:
GAI Consultants, Inc.
Murrysville Office
4200 Triangle Lane
Export, Pennsylvania 15632-1358

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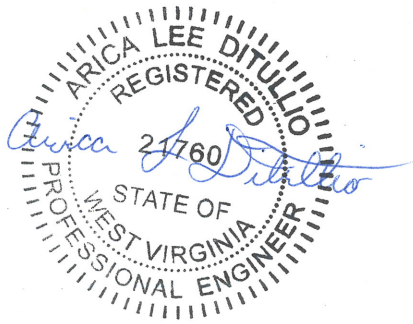
Certification/Statement of Professional Opinion

The Structural Stability Assessment for the McElroy's Run Impoundment was prepared by GAI Consultants, Inc. (GAI). The Assessment Report was based on certain information that, other than for information GAI originally prepared, GAI has relied on, but not independently verified. Therefore this Certification/Statement of Professional Opinion is limited to the information available to GAI at the time the Assessment Report was written. On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the State of West Virginia, that the Assessment 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, and at the time and in the same locale. It is my professional opinion that the Structural Stability Assessment was prepared consistent with the requirements of the United States Environmental Protection Agency's Federal Coal Combustion Residuals (CCR) Rule 40 CFR § 257.73(d), published in the Federal Register on April 17, 2015 with an effective date of October 19, 2015.

The use of the words "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not to be interpreted or construed as a guarantee, warranty or legal opinion.

Arica L. DiTullio, P.E.
Engineering Manager



1.0 Purpose

Pursuant to the Federal Coal Combustion Residuals (CCR) Rule 40 CFR § 257.73(d)(1), each CCR impoundment is required to conduct an initial and periodic structural stability assessment to establish whether the CCR unit can safely store the maximum volume of CCR and wastewater.

2.0 Introduction

The Pleasants Power Station (Station) is a coal-fired electric generating station located near the community of Willow Island in Pleasants County, West Virginia (WV). The Station consists of two generating units which are capable of producing 1,300 megawatts of electricity.

CCRs generated at the Station are placed in the McElroy's Run CCR surface impoundment (Impoundment), which is located approximately one-half mile east-southeast of the Station. The Impoundment is a captive facility that receives flue gas desulfurization scrubber by-product generated at the Station, effluent from the recirculation system through Sedimentation Ponds 1 and 2 of the adjacent landfill and their underdrains, and waste materials collected primarily as a result of general house-cleaning maintenance and/or repair at the Pleasants Power Station.

The dam of the Impoundment is approximately 243 feet (ft) high with a maximum storage of approximately 20,000 acre-ft. The crest of the dam is at elevation (El.) 900 ft, with El. 887.00 ft as the permitted final level of CCR and recommended normal operating pool level. The Impoundment area is approximately 253 acres. The Pleasants Landfill, which accepts coal ash waste from the Station, abuts the dam of the impoundment.

3.0 Information Review

GAI Consultants, Inc. (GAI) reviewed the documents listed under the References section, which includes:

- Prior Dam Safety Assessments;
- Design and as-built drawings; and
- Surveys.

The documents were reviewed to determine if the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

3.1 Stable Foundations

Stability of foundations and abutments can be assessed by observing site conditions during inspections, monitoring vertical and horizontal slope movements with survey monuments, performing slope stability analyses, and determining susceptibility to liquefaction.

Five survey monuments were installed in March of 1997 in the upstream slope of the embankment slightly below the crest near El. 900 ft. The monuments were installed when the embankment reached its maximum height, which is essentially the "end of construction case" for the original water impounding embankment. The most recent embankment survey was performed on March 30, 2015. The monuments were observed to have settled about 0.16 to 0.3 ft since installation in 1997. The monuments moved between 0.2 to 0.4 ft in a downstream direction (laterally) in the same time period. The majority of the aforementioned movement occurred within four to six years after completion of construction, with minimal movement occurring since that time. Neither the survey monuments nor visual evidence from field observations show any indication of deep-seated slide movement.

GAI performed stability analyses in 2016 (*Safety Factor Assessment Report*) to determine if the impoundment construction and operation satisfies the safety factors listed in § 257.73(e). The analyses were conducted assuming the maximum volume of impounded wastewater and CCR. The calculated static safety factor under the long-term, maximum storage pool and maximum surcharge pool loading conditions exceeded the minimum of 1.50 and 1.40, respectively stated in the Rule. The calculated seismic safety factor exceeded the minimum of 1.00 stated in the Rule.

Foundation soils in the valley of the McElroy's Dam embankment consist of alluvial and residual soils. These soils are clayey and cohesive, and thus are not susceptible to liquefaction. However, pockets of sandy soil exist within the site soils; therefore, liquefaction analyses were performed at four test boring locations by GAI in 2010 and updated in 2016. GAI determined that the sandy soils are not susceptible to liquefaction. Similarly, analyses were performed on the fly ash in the embankment, and it was determined that the fly ash in the embankment is not susceptible to liquefaction. The calculated safety factors in both cases exceeded the minimum of 1.20 stated in § 257.73(e).

A visual inspection of the Dam was performed on September 7, 2016 as part of the annual WV state inspection. During the inspection, GAI personnel did not identify any signs of distress or malfunction that would affect the structural condition of the Impoundment. No releases of CCR were observed during this 2016 inspection.

3.2 Slope Protection

The downstream embankment of McElroy's Run dam is vegetated to protect against erosion. The Pleasants Landfill is constructed on a portion of the downstream embankment and extends up the face of the dike. The landfill benches are built to direct stormwater off the face of the landfill while minimizing the possibility of erosion.

The upstream embankment is armored with riprap (18-inch thickness) in the area of the operational water level to protect the face from wave erosion.

3.3 Dike Compaction

Per the CCR rule, "EPA recognizes that it would be highly difficult for owners or operators of older units to certify with any certainty that the unit's construction meets the specific numeric compaction criteria found in the ASTM standards." Borings drilled (2010) through the embankment indicated that the density of fly ash increased with depth. Correlations of Standard Penetration Test resistance (i.e. N-value) obtained during drilling to density of in-place material indicate that the estimated relative density of the embankment ranges from 75 percent near the crest of the embankment to 100 percent at increasing depths. From this and the results of the aforementioned stability analyses, it can be concluded that the compaction of the embankment satisfies the range of loading conditions present at the impoundment.

3.4 Vegetated Slopes

On December 2, 2015, GAI performed a visual inspection of McElroy's Run Impoundment. As part of this inspection, GAI evaluated the vegetation on the slopes of the impoundment embankment. The McElroy's Run Landfill buttresses the lower portion of the impoundment's embankment. Due to the unique structure of the buttressed impoundment, only vegetation along the day lit portion of the impoundment embankment could be viewed. GAI found that the vegetation on the impoundment dike was well-trimmed. Minimal weed growth was observed, and no signs of tree growth were observed.

3.5 Spillway Capacity

The McElroy's Dam is a high hazard potential CCR surface impoundment. Per § 257.73(d)(1)(v)(B), a high hazard potential CCR surface impoundment must manage flow following the peak discharge from a probable maximum flood (PMF).

The principal spillway consists of a decant tower (Decant Tower No. 2) connected to a 36-inch diameter concrete pipe barrel that passes under the dam and dry ash landfill. Primary discharge through the principal spillway is controlled by a two-ft by two-ft square opening at El. 890 ft. There is a series of similar gates in the decant tower spaced at five-ft vertical increments, up to El. 890 ft, but all gates below El. 885 ft are located within the impoundment and have been permanently closed. The intake gate at El. 885 ft is normally closed, but is operated to facilitate discharge of runoff from storm events. The principal spillway outlet channel is constructed from fabricform, and it is a non-erodible construction designed to withstand sustained flow per § 257.73(d)(1)(v)(A). The emergency spillway is 20 ft in width with a crest at El. 893.5 ft. The emergency spillway is concrete lined, has an approach lined with stone rip-rap, and an outlet protected with grouted rip-rap.

The PMF was calculated in the Inflow Design Flood Control System Plan (IDFCSP). In the IDFCSP it was estimated that flow through the emergency spillway would be approximately 100 cubic ft per second (cfs) during the PMF event. The hydraulic capacity of the emergency spillway is estimated to be approximately 9,000 cfs, so the Dam will be able to control the PMF through the combination of spillways without overtopping the embankment.

3.6 Underlying Hydraulic Structures

The principal spillway outfall barrel, a 3,600 ft-long, 36-inch diameter precast concrete pipe, is located under the dam. The principal spillway discharges downstream of the Pleasants Landfill to a channel that leads to McElroy's Creek. Decant Towers Nos. 1 and 2 connect to the principal spillway; however, Decant Tower No. 1 has been completely sealed so that discharge is only possible through Decant Tower No. 2. The principal spillway pipe was inspected on December 11-12, 2014 by using robotics outfitted with cameras to observe the interior of the pipe. The principal spillway was considered to be in good condition.

Decant Tower No. 2 was observed in the same time period. The exterior and interior of the Decant Tower were observed to be in good condition, and recommendations for continued observation, repair and maintenance were made (*Results from Structural Condition Assessment of Principal Spillway Pipe and Decant Tower,* dated February 2015).

A siphon float (12-inch diameter) is used as the primary discharge from the impoundment. The siphon float is used to maintain the normal operating pool level at El. 887 ft. The siphon discharges to either the Station for use as make-up water or to a permitted outfall to the Ohio River.

3.7 Adjacent Water Bodies

The downstream slope of the McElroy's Run embankment abuts the Pleasants Landfill, and cannot be inundated by an adjacent water body; thus, a structural stability analysis with adjacent water bodies was not performed.

4.0 Corrective Measures

No deficiencies were detected in the structural stability analysis of McElroy's Run dam.

5.0 Conclusion

GAI reviewed previous structural stability analyses and relevant drawings and surveys for this Structural Stability Assessment. Based on the analyzes conducted for the conditions outlined in the CCR Rule, the McElroy's surface impoundment design, construction, and operations and maintenance is consistent with good engineering practices for the volume of CCR and wastewater contained in the impoundment.

6.0 References

CHA Tech Services, LLC. 2010.
Assessment of Dam Safety, Coal Combustion Surface Impoundments (Task 3), Final Report, April 2010.

D'Appolonia. 1979.
McElroy's Run Disposal Site, Slope Stability Analysis. Drawing No. 101-6514-137, February 1979.

D'Appolonia. 1981.
McElroy's Run Disposal Site, Phase II Construction Field Moisture-Density Relationship and Grain Size Analyses. Drawing No. 101-6514-176, August 1981.

Electric Power Research Institute. 2009.
Coal Ash: Characteristics, Management and Environmental Issues, September 2009.

GAI Consultants, Inc. 2010.
Responses to Address the Recommendations of the EPA Concerning Pleasants Power Station (McElroy's Run CCB Disposal Site). Rep. N.p.: n.p., 2010.

GAI Consultants, Inc. 2016.
Inflow Design Flood Control System Plan, October 2016.

GAI Consultants, Inc. 2016.
Initial Hazard Potential Classification Assessment Report, October 2016.

GAI Consultants, Inc. 2016.
McElroy's Run Impoundment Safety Factor Assessment Report, October 2016.

GAI Consultants, Inc. 2015.
Results from Structural Condition Assessment of Primary Spillway Pipe and Decant Tower, Pleasants Power Station, February 2015.

GAI Consultants, Inc. 2009.
Stability Analyses of McElroy's Run Embankment; March, 2009.

GAI Consultants, Inc. 1996.
As-Built Construction Sequence, Drawing No. 101-6514-196, GAI Drawing No. 81-237-F13, October 1996.

GAI Consultants, Inc. 2015.
McElroy's Run CCB Impoundment Riprap Erosion Repair, July 2015.

Pleasants Power Station McElroy's Run Disposal Site Embankment Survey; April, 2015. Provided by FirstEnergy Corp.