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REPORT ON
INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 5
J.M. STUART ELECTRIC GENERATING STATION
ABERDEEN, OHIO

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Dayton Power & Light Company
Aberdeen, Ohio

File No. 40373-347
October 2016

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12 October 2016
File No. 40373-347

Dayton Power & Light Company
P.O. Box 468
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Attention: Mr. Craig Spangler
Leader, Commodities

Subject: Initial Periodic Structural Stability Assessment
Pond 5
J.M. Stuart Electric Generating Station
Aberdeen, Ohio

Mr. Spangler:

Enclosed please find our report on the Initial Periodic Structural Stability Assessment for the Dayton Power & Light (DP&L) Company Pond 5 Coal Combustion Residuals (CCR) surface impoundment located at J.M. Stuart Electric Generating Station in Aberdeen, Ohio.

This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of DP&L in accordance with the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(d).

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Pond 5 surface impoundment; 2) visit the site to observe Pond 5; 3) evaluate whether the design, construction, operation, and maintenance of Pond 5 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our assessment including recommendations.

Thank you for inviting us to complete this assessment and please feel free to contact us if you wish to discuss the contents of the report.

Sincerely yours,
HALEY & ALDRICH, INC.

Steven F. Putrich, P.E.
Vice President

Enclosures

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1. General

1.1 AUTHORITY

Haley & Aldrich, Inc. (Haley & Aldrich) has been contracted by Dayton Power & Light Company (DP&L) to perform the Initial Periodic Structural Stability Assessment for the DP&L Pond 5 Coal Combustion Residuals (CCR) surface impoundment located at J.M. Stuart Electric Generating Station (JMSS) in Aberdeen, Ohio. This work was completed in accordance with the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(d).

1.2 PURPOSE OF STRUCTURAL STABILITY ASSESSMENT

The purpose of this Initial Structural Stability Assessment was to document whether the design, construction, operation, and maintenance of Pond 5 are consistent with recognized and generally accepted good engineering practices.

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Pond 5 surface impoundment; 2) visit the site to observe Pond 5; 3) evaluate whether the design, construction, operation, and maintenance of Pond 5 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our evaluation, including recommendations.

2. Description and Operation of Pond 5

2.1 DESCRIPTION OF POND 5

Pond 5 is a Coal Combustion Residuals (CCR) surface impoundment located just to the west of the J.M. Stuart Station power plant. The pond was designed by Ebasco Services Incorporated and constructed in the early 1970s.

The impoundment receives sluiced bottom ash, cooling tower and FGD blow-down, and liquid collected in area drains located at the plant. These influents are initially discharged into settling bays that are actively excavated within the filled eastern portion of Pond 5 as previously excavated settling bays become filled. After primary settling of solids, decant from the bays flows through five HDPE pipes which penetrate the previously filled area/berm that separates the eastern (filled) portion and the western (liquid filled) portion of Pond 5. Discharge from the HDPE pipes enters Pond 5 where secondary settling occurs.

Pond 5 is bounded by earthen embankments which have a total length of approximately 4,200 ft and maximum embankment height of 41 feet. The pond has an area of 41.1 acres at the crest and a volume of approximately 1,100 acre-feet, including the filled eastern portion of the impoundment.

The Pond 5 decant structure is located at the west end of the impoundment and consists of a steel sheet pile structure equipped with a skimmer. Water entering the structure flows through a 60-inch diameter corrugated metal pipe to the nearby treatment building where it is filtered and then discharged to the discharge canal, a man-made canal to the north of Pond 5 which flows to the Ohio River. There is an emergency spillway inside the treatment building consisting of a 17-1/2 foot wide overflow weir. When actuated, the overflow weir causes flow to bypass the filters, sending it directly to the discharge canal.

In response to seepage observed on the exterior slopes of Pond 5, URS Corporation was authorized by DP&L in 2001 to perform subsurface explorations and engineering analyses to determine the cause of the seepage, and to conduct an alternatives analysis to identify potential remedial options to control the seepage and improve long-term stability of the Pond 5 slopes. The results of URS' study were presented in their report dated April 20, 2001 (Reference 17).

In 2010, BBCM performed additional field investigations, laboratory testing, and engineering analyses to further assess the seepage and recommend remedial measures for controlling the seepage. Results of the BBCM study were presented in their report dated April 1, 2010 (Reference 2). BBCM recommended that an inverted filter (i.e., drainage blanket) be installed on the exterior slopes in areas where seepage was observed.

In June 2010, BBCM issued construction drawings for the inverted filters (Reference 3) which were installed and continue to function today.

2.2 OPERATION, MAINTENANCE AND INSPECTION

Pond 5 is operated, maintained and inspected by DP&L personnel in accordance with DP&L's "Operation Maintenance and Inspection (OM&I) Manual" dated April 2014 (Reference 11).

DP&L has developed impoundment inspection forms and DP&L personnel are conducting 7-day inspections of Pond 5 in accordance with EPA's Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257.83. In addition, the OM&I manual calls for annual visual inspections and semi-annual operational inspections to be performed by DP&L personnel, as well as inspections following heavy rain events. Five-year inspections are performed by Ohio Department of Natural Resources Dam Safety personnel.

Maintenance of the impoundment includes regular mowing of grass, seeding of thinly vegetated areas, control of woody growth, repair of erosion and riprap as needed, and backfilling of animal burrows.

Operation includes regulating and monitoring wastewater discharge from the plant to Pond 5, regulating water levels in the pond, operating and maintaining the filters in the treatment building, and monitoring and controlling discharges to the discharge canal.

3. Structural Stability Assessment

3.1 REVIEW OF EXISTING INFORMATION

For this assessment, Haley & Aldrich reviewed multiple sources of information including: 1) report on the Initial Annual Inspection performed by DP&L in accordance with 40 CFR §257.83, dated December 21, 2015, 2) previous impoundment inspection reports by ODNR, CHA (on behalf of EPA), CEC, and DP&L, 3) OM& I manual, 4) Emergency Action Plan, 5) topographic plans and aerial photos, 6) construction drawings, 7) subsurface information, 8) geotechnical laboratory test results, 9) seepage and slope stability evaluations, 10) correspondence, and 11) a variety of other information in addition to verbal information provided by DP&L during our assessment. Our review included, but was not limited to the references listed in Appendix A.

3.2 SITE VISIT AND FIELD OBSERVATIONS

On 17 March 2016, Haley & Aldrich visited J.M. Stuart Station to observe conditions at Pond 5, and to meet with DP&L personnel to discuss operations and maintenance of the impoundment. Prior to the site visit, we reviewed previous inspection reports including the above-referenced Initial Annual Inspection Report by DP&L, and several previous inspection reports referenced above and listed in Appendix A.

3.3 STRUCTURAL STABILITY ASSESSMENT

In accordance with 40 CFR §257.73(d), the owner or operator of a CCR surface impoundment must conduct initial and periodic structural stability assessments to determine whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

Haley & Aldrich reviewed the information provided to us and visited the site to observe Pond 5. Based on our review of available information and observations during our 17 March 2016 site visit, we have concluded the following in accordance with 40 CFR §257.73(d):

1. *§257.73(d)(1)(i): Stable foundations and abutments.*

   As part of their 2001 study on seepage observed on the Pond 5 exterior slopes, URS Corporation performed seven test borings in the Pond 5 embankments. The borings ranged in depth from 14.2 to 46 feet below ground surface. Five of the borings were drilled from the crest of the embankments. The other borings were drilled on the south exterior slope and at the south exterior toe of slope. Standpipe piezometers were installed in four of the borings. An inclinometer was installed in one boring to monitor potential movements of the embankment. In addition, geotechnical laboratory testing was performed on selected samples obtained from the borings.

   Underlying the embankment fill, the URS borings encountered foundation soils generally consisting of medium stiff to very stiff interbedded silty CLAY and fine SAND, loose silty fine SAND to sandy SILT, and medium stiff to very stiff CLAY with sand.

Based on the results of the URS test borings, geotechnical test results, impoundment inspection reports, and observations during our 17 March 2016 site visit, Pond 5 was judged to have stable foundations. The Pond 5 embankments have not exhibited signs of excessive settlement, global instability or other signs of inadequate foundation support.

2. *§257.73(d)(1)(ii): Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown.*

   The Pond 5 interior slopes are generally protected with riprap, stone or bottom ash within the zone of wave action and are vegetated with grass on the upper portion of the slope. Based on observations during our 17 March 2016 site visit, the slope protection on the interior slopes was judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown.

   The exterior slopes are generally well vegetated with grass. At the time of our site visit, the grass was thin in some areas on the slope and at the toe of slope, likely due to excessive moisture and being very early in the growing season. In the five areas where the drainage blanket was installed to control seepage, slope protection consists of riprap and crushed stone.

   Based on our observations during our site visit, Pond 5 was judged to have adequate slope protection on both the exterior and interior slopes.

3. *§257.73(d)(1)(iii): Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit.*

   Based on URS's April 2001 report, the Pond 5 embankments were constructed from naturally occurring alluvial deposits varying from clays and silts to sands and gravels. URS indicated these soils were obtained from local borrow sources, hauled to site, and placed and compacted in the embankments.

   The URS test borings drilled from the crest of the embankments encountered between 37 and 42 feet of fill. The embankment fill generally consisted of medium stiff to very stiff lean CLAY to silty CLAY with varying amounts of sand. Some borings encountered layers of sand within the embankment fill. The sand was generally described as medium dense to dense SAND with varying amounts of silt and gravel.

   Based on the standard penetration test results and other information in the URS boring logs, and our review impoundment inspection reports as well as observations during our 17 March 2016 site visit, it is our opinion that the fill soils used to construct the Pond 5 embankments were mechanically compacted during construction.

4. *§257.73(d)(1)(iv): 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.*

   At the time of our 17 March 2016 site visit, the grass on the Pond 5 exterior slopes was generally less than 6 inches in height, however, there were areas where tall grasses and brush up to approximately 2 feet in height existed, primarily along the edges and within the inverted filters. On

the interior slopes, some limited areas contained grasses that were up to approximately 1 ft in height.

5. *<u>§257.73(d)(1)(v)(A):</u> Spillway Erosion Protection – All spillways must be either: (1) Of non-erodible construction and designed to carry sustained flows; or (2) Earth- of grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.*

   The Pond 5 spillway consists of a steel sheet pile structure with skimmer located at the west end of the impoundment as described in 3.3.7 below. The structure has surface rust on it but is in serviceable condition. No evidence of erosion was observed.

6. *<u>§257.73(d)(1)(v)(B):</u> Spillway Capacity – The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a: (1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or (2) 1000-year flood for a significant hazard potential CCR surface impoundment; or (3) 100-year flood for a low hazard potential CCR surface impoundment.*

   The spillway at Pond 5 is located in the western embankment and overflows to the Treatment Building. After filtering in the treatment building, the water is discharged to the Ohio River. Because the impoundment was classified as Significant Hazard Potential, the spillway capacity was analyzed using the 1,000-year rainfall event (Reference 18) in conjunction with HydroCAD v10.0. The spillway was found to have adequate capacity to convey the 1,000-year rainfall event while maintaining greater than 1.0 ft of impoundment berm freeboard.

7. *<u>§257.73(d)(1)(vi):</u> 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.*

   Pond 5 has only one hydraulic structure. The decant structure located at the west end of the pond conveys flow from Pond 5 to the treatment building through a 60-inch diameter corrugated metal pipe. The pipe is buried within the west and north embankments between the decant structure and the treatment building and does not penetrate through the embankment. The condition of the buried pipe is not known other than the ends which have no visible defects.

   It is understood that previous outlet structures that existed at various locations around Pond 5 have been decommissioned and grouted. Only the existing sheet pile decant structure is currently operating.

8. *<u>§257.73(d)(1)(vii):</u> 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.*

   On the north and west sides of Pond 5, the exterior slope borders the discharge canal with the toe of slope at approximately El. 490. On the south side of Pond 5, the exterior slope borders the Ohio River with the toe of slope at approximately El. 500.

Since the level of the discharge canal is controlled by the level in the Ohio River, the north and west exterior slopes are subject to inundation when the Ohio River rises above El. 490. The south exterior slope is subject to inundation when the level of the river rises above approximately El. 500.

Based on information obtained from the National Oceanic and Atmospheric Administration (NOAA), since construction of Pond 5 in the early-1970s, the level of the Ohio River in the vicinity of J.M Stuart Station has exceeded El. 490 a total of 27 times and exceeded El. 500 a total of 16 times. In 1997, the river reached El. 511, approximately 11 feet higher than the exterior toe of slope.

Historically, over the past 100+ years since records have been maintained, the water level in the Ohio River at J.M. Stuart Station has exceeded El. 490 at least 42 times and exceeded El. 500 a total of 31 times. The highest level ever recorded at J.M. Stuart Station was El. 526 in 1937.

To account for the unlikely event the Ohio River experiences a significant low pool or sudden drawdown occurrence, a representative rapid drawdown analysis was performed to simulate the potential impact on the Pond 5 slopes. The results demonstrated that Pond 5 will maintain adequate slope stability under this condition.

9. <u>§257.73(d)(2) – Deficiencies and Recommendations:</u>

During our 17 March 2016 site visit, Haley & Aldrich noted an area at the east end of the north exterior slope where seepage was exiting the slope. At this location, the slope had slumped within an area approximately 20 feet in width (across the slope) and 12 feet in height (up and down slope), producing a 2-foot high scarp at the top of the slumped area. The area was located just east of the easternmost inverted filter and approximately half-way down the slope.

Following our 17 March 2016 site visit, DP&L repaired the area of the slump and installed an inverted filter in this area using the same design as previously used on other portions of the Pond 5 exterior slopes. After construction of the inverted filter was completed, Haley & Aldrich visited the site to observe the repair and judged it to be satisfactory. Therefore, based on observations of Pond 5 during our 18 March 2016 and subsequent site visit, as well as our review of available subsurface information, impoundment inspection reports, construction records, design reports, geotechnical test results and other information, Pond 5 is judged to have no structural stability deficiencies.

4. Conclusions/Certification

Based on our review of the information provided to us and observations during our 17 March 2016 site visit, it is our opinion that the design, construction, operation, and maintenance of Pond 5 at J.M. Stuart Station is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded in Pond 5.

Professional Engineer Certification

I certify that the Periodic Structural Stability Assessment for DP&L's Pond 5 at the J.M. Stuart Electric Generating Station was conducted in accordance with the requirements of §257.73(d) of the USEPA's Final CCR Rule.

Signed: _____
Consulting Engineer

Print Name: Steven F. Putrich
Ohio License No.: 67329
Title: Vice President
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal and date:

TOPO SOURCE: USGS TOPOGRAPHIC MAPS
RUSSELLVILLE, DECATUR, WEST UNION, MAYSVILLE EAST, MAYSVILLE WEST , MANCHESTER ISLANDS - OHIO
MAYS LICK, ORANGEBURG, TOLLESBORO - KENTUCKY
QUADRANGLES (2013)

HALEY ALDRICH

DAYTON POWER & LIGHT COMPANY
J. M. STUART GENERATING STATION
745 U.S. ROUTE 52
ABERDEEN, OHIO

POND 5
PROJECT LOCUS

APPROXIMATE SCALE: 1" = 10 000'
OCTOBER 2016

FIGURE 1

LUCAS, ANDY Printed: 6/16/2016 3:08 PM Layout: PROJECT LOCUS
G:\40373_DP&L\CAD-JMSS\GLOBAL\FIGURES\STRUCTURAL STABILITY ASSESSMENT\POND 5\40373_FIG-1-PROJECT LOCUS.DWG

LEGEND

- EXISTING PROPERTY LINE
- EXISTING PROCESS PIPES
- EXISTING STORMWATER PIPES
- EXISTING GRAVEL ROAD
- NORMAL OPERATING WATER
- APPROXIMATE POND 5 BOUNDARY
- TYPICAL OPERATING WATER LEVEL

NOTES

1. AERIAL IMAGERY PROVIDED BY GOOGLE EARTH PRO. PHOTO TAKEN ON 4 APRIL 2016.

0 200
SCALE IN FEET

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J.M. STUART STATION
ABERDEEN, OHIO

POND 5
SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

LUCAS, ANDY Printed: 6/17/2016 9:49 AM Layout: SITE PLAN
G:\40373_DP&L\CAD-JMSS\GLOBAL\FIGURES\STRUCTURAL STABILITY ASSESSMENT\POND 5\40373_FIG-2_SITE PLAN.DWG

APPENDIX A

References

References

1. BBC&M Engineering, Inc., “Ponds 3A, 5, 6 & 7 Slope Stability Investigation, J.M. Stuart Station, Aberdeen, Ohio,” dated May 2010.

2. BBC&M Engineering, Inc., “Ash Pond 5 Seepage Assessment, J.M. Stuart Station, Aberdeen, Ohio,” dated April 1, 2010.

3. BBC&M Engineering, Inc., “Construction Drawings for the Ash Pond 5 Slope Improvements,” dated June 2010.

4. Civil & Environmental Consultants, Inc., “Coal Ash Impoundment Inspection Report, DP&L J.M. Stuart Station,” dated April 30, 2009.

5. CHA, “Assessment of Dam Safety, Coal Combustion Surface Impoundment (Task 3) Final Report,” dated March 26, 2010.

6. Commonwealth Associates, Inc., Drawing No. 300-12-1328 – Sheet 1 of 3, titled, “Wastewater Treatment Bldg Intake and Discharge Pipes,” dated 13 December 1979.

7. Commonwealth Associates, Inc., Drawing No. 300-12-1328 – Sheet 2 of 3, titled, “Wastewater Treatment Bldg Intake Structure,” dated 13 December 1979.

8. Commonwealth Associates, Inc., Drawing No. 300-12-1328 – Sheet 3 of 3, titled, “Wastewater Treatment Bldg Intake Details,” dated 13 December 1979.

9. Dayton Power & Light Company, “J.M. Stuart Station Ash Pond 5 Annual Inspection,” dated December 21, 2015.

10. Dayton Power & Light Company - Various weekly, monthly and annual impoundment inspection reports – Various dates

11. Dayton Power & Light Company, “Operation Maintenance and Inspection Manual, Ash Impoundment Dike, Stuart Electric Generating Station - Pond 3A, 5, 6, 7 & 10,” dated April 8, 2014.

12. Dayton Power & Light Company, “Emergency Action Plan - Pond 3A, 5, 6, 7 & 10,” dated May 2013.

13. Ebasco Services Incorporated, Drawing 300-13-1143, titled “Ash Pond Plan,” dated 27 November 1969.

14. Ohio Department of Natural Resources, “Dam Safety Inspection Report – J.M. Stuart Station Ash Pond No. 5,” dated October 27, 2009.

15. Ohio Department of Natural Resources, “Dam Safety Inspection Report – J.M. Stuart Station Ash Pond No. 5,” dated June 27, 2013.

16. Soil & Material Engineers Inc. (S&ME), “Ash Pond 5 Embankment Evaluation, J.M Stuart Station, Aberdeen, Ohio,” dated January 9, 1985.

17. URS Corporation, “Bottom Ash Pond 5B Evaluation and Alternatives Analysis,” dated April 20, 2001.

18. US Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Weather Service, “NOAA Atlas 14 Point Precipitation Frequency Estimates: OH,” dated August 27, 2014.