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11687 Lebanon Road, Cincinnati OH 45241

October 17, 2016
File: 175534017
Revision 0

Ohio Valley Electric Corporation
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

RE: Initial Structural Stability Assessment
Boiler Slag Pond
EPA Final Coal Combustion Residuals (CCR) Rule
Kyger Creek Station
Cheshire, Gallia County, Ohio

1.0 PURPOSE

This letter documents Stantec's certification of the initial structural stability assessment for the Ohio Valley Electric Corporation (OVEC) Kyger Creek Station's Boiler Slag Pond. Based on this assessment, the Boiler Slag Pond is in compliance with the structural stability requirements in the EPA Final CCR Rule at 40 CFR 257.73(d).

2.0 INITIAL STRUCTURAL STABILITY ASSESSMENT

As described in 40 CFR 257.73(d), documentation is required on how the Boiler Slag Pond has been designed, constructed, operated, and maintained according to the structural stability requirements listed in the section. The combined capacity of all spillways must also be designed, constructed, operated, and maintained to adequately manage flow from the 1,000-year storm event based upon a hazard potential classification of "significant."

3.0 SUMMARY OF FINDINGS

The attached report presents the initial structural stability assessment of the Boiler Slag Pond. The results show that the impoundment meets the structural stability requirements set forth in 40 CFR 257.73(d)(1)-(2).

4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stan A. Harris, being a Professional Engineer in good standing in the State of Ohio, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;

Re: **Initial Structural Stability Assessment**
Boiler Slag Pond
EPA Final Coal Combustion Residuals (CCR) Rule
Kyger Creek Station
Cheshire, Gallia County, Ohio

2. that the information contained herein is accurate as of the date of my signature below; and

3. that the initial structural stability assessment for the OVEC Kyger Creek Station's Boiler Slag Pond meets the requirements specified in 40 CFR 257.73(d)(1)-(2).

SIGNATURE ______________________ DATE 10/17/16

ADDRESS: Stantec Consulting Services Inc.
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Cincinnati, Ohio 45241

TELEPHONE: (513) 842-8200

ATTACHMENTS: Kyger Creek Boiler Slag Pond Initial Structural Stability Assessment Report

STATE OF OHIO
STAN A. HARRIS
53083
REGISTERED
PROFESSIONAL ENGINEER
10/17/16

Initial Structural Stability Assessment

Kyger Creek Station
Boiler Slag Pond
Cheshire, Gallia County, Ohio

Prepared for:
Ohio Valley Electric Corporation
Piketon, Ohio

Prepared by:
Stantec Consulting Services Inc.
Cincinnati, Ohio

October 17, 2016

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1.0 PROJECT BACKGROUND

On April 17, 2015 the "Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (EPA Final CCR Rule) was published in the Federal Register. Stantec Consulting Services, Inc. (Stantec) was contracted by the Ohio Valley Electric Corporation (OVEC) to analyze the structural stability of the Kyger Creek Station's Boiler Slag Pond (BSP) evaluate its compliance with §257.73 of the EPA Final CCR Rule.

As required by §257.73 of the EPA Final CCR Rule, an initial structural integrity evaluation is required by October 17, 2016 and must include an initial structural stability assessment for each existing CCR surface impoundment that meets the conditions of paragraph (b) as follows:

1. Has a height of five feet or more and a storage volume of 20 acre-feet or more or
2. Has a height of 20 feet or more.

2.0 UNIT DESCRIPTION

The Kyger Creek Station is located on the north shore of the Ohio River downstream of Cheshire, Ohio. The station consists of five coal-fired electric generating units, each nominally rated at 217 megawatts. The Kyger Creek Station is directly accessible from State Route 7.

The Boiler Slag Pond is located south of the station adjacent to the Ohio River. It part of the Bottom Ash Complex, composed of the Boiler Slag Pond and the Clearwater Pond. Constructed in 1955, the complex was created by building a perimeter dike to enclose an area of approximately 40 acres. A splitter dike separates the Bottom Ash Complex into two ponds with the Boiler Slag Pond at 30.1 acres and the Clearwater Pond at 9.39 acres. Boiler slag is sluiced to the north end of the Boiler Slag Pond for settling. Overflow is conveyed through an outlet structure at the Boiler Slag Pond's south end into the Clearwater Pond for polishing. Water discharges into the Ohio River through a NPDES-permitted outlet structure in the southeastern end of the Clearwater Pond (AEPSC, 2016). The Boiler Slag Pond is bounded by State Route 7 to the west, a substation to the north, the Ohio River to the east, and Kyger Creek and agricultural land to the south.

The subsections under §257.73(d) address conditions of appurtenances categorized as embankments, spillways, or hydraulic structures. Sections 2.1 to 2.3 below provide descriptions of the individual unit elements that fall within these appurtenance categories. Appendix A includes a plan view of the Kyger Creek Station.

Note that all elevations included in this document and appendices are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29).

2.1 EMBANKMENTS

2.1.1 BSP Perimeter Dike

The BSP Perimeter Dike was built between 1954 and 1955 during construction of the Kyger Creek Station. The dike encompasses the entire Bottom Ash Complex. The splitter dike between the two ponds was built in 1980. The rolled earth dike is approximately 5,800 feet long with a maximum height of 41 feet. The crest wide is estimated as 20 feet with an elevation of 582 feet (CHA, 2009). The interior embankment has a slope of 2.25H:1V, while the exterior slope is 2.5H:1V to 3H:1V. The bottom of the ponds is at elevation 541 feet (Terracon, 2014).

2.2 SPILLWAYS

2.2.1 Primary Spillway System

The configuration of the primary spillway system for the Bottom Ash Complex is documented by CHA (2009) and by construction drawings (AEPSC, 2016). The Boiler Slag Pond discharges into the Clearwater Pond through a reinforced concrete intake structure composed of a 36-inch pipe with a 42-inch by 39-inch riser at elevation 557.0 feet. Water entering the intake structure is discharged into the Clearwater Pond through a 30-inch diameter reinforced concrete pipe near the western end of the splitter dike. The outlet invert for this discharge pipe is elevation 551.0 feet (Terracon, 2014; CHA, 2009). A similar reinforced concrete intake structure and discharge pipe are located in the southeastern portion of the Clearwater Pond to discharge into the Ohio River (CHA, 2009).

2.3 HYDRAULIC STRUCTURES

Other than the primary spillway described above, no hydraulic structures are located at the SFAP.

3.0 FOUNDATIONS AND ABUTMENTS (§257.73(d)(1)(i))

Per §257.73(d)(1)(i), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with stable foundations and abutments. The Boiler Slag Pond has the following features that fall within this requirement:

- BSP Perimeter Dike

Assessment of the foundations and abutments associated with these features was completed considering the following criteria related to the EPA Final CCR Rule:

- Review inspection reports of the facility, considering frequency of inspections, and if the inspections included review and/or assessment of features including cracking, settlement, deformation, or erosion of the foundations/abutments. Inspections should indicate that there are no significant signs of tension cracking, settlement, depressions, erosion, and/or deformations at the crest, slope, and toe of the structure.

- Confirm that an assessment of seepage conditions of the foundation, with considerations of heave and vertical exit gradient, has been performed. Verify that the seepage assessment follows appropriate methodologies (such as USACE EM 1110-2-1901) and that the foundations exhibit acceptable performance (e.g. FS for piping greater than or equal to 3.0).

3.1 BSP PERIMETER DIKE

3.1.1 Background

The Boiler Slag Pond is formed by a perimeter dike system; therefore, there are no natural abutments. The station is in an unglaciated area of Ohio on the Marietta Plateau. Alluvium covers the site with a thickness of 16 to 40 feet. It is clay interbedded with sand lenses. Glacial outwash deposits of variable thickness lie between the alluvium and bedrock. Bedrock is estimated at elevation 494 to 497 feet. It is a shale and sandstone of Pennsylvanian-age Conemaugh Group (Terracon, 2014).

DLZ (2011) encountered bedrock refusal at elevation 499 feet, noting a soft to medium hard gray siltstone interbedded with shale. Foundation soils were a soft to medium stiff lean clay from the ground surface to approximately elevation 530 feet. The clay layer had lenses of silt and varying amounts of fine to medium sand. A medium dense to dense granular layer was encountered from elevation 531.2 to 513.8 feet.

3.1.2 Assessment

A qualified person performs inspections of the Boiler Slag Pond weekly, monthly, quarterly, and annually. Regular site inspections have been conducted and documented for the Boiler Slag Pond from 1985 to 2016. These inspections include observations related to foundation and abutment conditions with respect to observable cracking, settlement, depressions, erosion, and deformation.

AEPSC (2015) noted no signs of new sloughing, depressions or areas of wetness and no seeps. No significant settlement, misalignment, potholes, or noticeable sign of distress was noted. No bulging or settlement, seepage or wet areas were observed on the exterior slope.

CHA (2009) observed no slumps or bulges in the interior or exterior slopes. Occasional erosion rills were noted in the bottom ash interior slope. The exterior embankment toe was probed along State Route 7 and noted to be relatively firm. Vegetation obscured portions of the slopes, but no scarps, sloughs, toe bulges were noted were the slope was visible. The eastern portion of the perimeter dike along the Ohio River exhibited some vegetation loss and erosion rills on the exterior slope at the time of the field visit.

A seepage analysis for the original dike construction is not available. As part of the geotechnical exploration in 2011, DLZ noted that the piezometer data indicates very low phreatic surfaces through the perimeter dike and at the downstream toe. Groundwater levels were generally 12 to 24 feet below the impounded water level below the perimeter dike of the surface impoundments. This was assumed to be based on rapid hydraulic head dissipation in the clay soil consistent with very low permeability laboratory test results. At the downstream toes of the perimeter dikes, groundwater was typically 5 to 22 feet below the ground surface. DLZ concluded that seepage of water through or under the dams should not be a concern (2011).

3.1.1 Conclusion

Based on the assessment of the foundation and abutments for the BSP Perimeter Dike, the EPA Final CCR Rule-related criteria listed above have been met.

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

Per §257.73(d)(1)(ii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown. The Boiler Slag Pond has the following features that fall within this requirement:

- BSP Perimeter Dike

Assessment of the slope protection associated with these features was completed considering the following criteria related to the EPA Final CCR Rule:

1. *Regular (weekly) inspections for erosion. Inspections should show there are no significant signs of deterioration in the slope protection configuration of the Item.*

2. *Appropriate slope protection shall be provided based on anticipated flow velocities. [Hydrologic/hydraulic calculations of flow velocities on the slope of the Item for the appropriate erosive forces. Some common slope protection measures include: riprap, gabions, paving (concrete or asphalt), or appropriate vegetative cover.]*

3. *If slope protection is riprap, filter layer(s) under the riprap shall be designed according to established filter criteria. However, existing riprap cover may be evaluated based on performance and observations during inspections.*

4.1 BSP PERIMETER DIKE

4.1.1 Background

Slope protection for the BSP Perimeter Dike consists of grass on the exterior slopes. The toes of the north and eastern slope also contain trees and brush. The interior slope is bottom ash lined. The splitter dike is bottom ash lined. Flow from the primary spillway's discharge pipe is adequately dissipated through a gradual pipe slope and discharge elevation into the receiving stream (AEPSC, 2015).

4.1.1 Assessment

As reported by the CHA (2009), regular drive-by inspections are performed with a checklist inspection quarterly, and an annual inspection by AEPSC. The spillway is regularly visited to take water quality samples, while the instrumentation in the dams are read monthly. Areas of erosion are prioritized for appropriate repairs. Regular site inspections performed by a registered professional engineer have been conducted and documented for the Boiler Slag Pond from 1985 to 2016. Site inspection reports generally indicate appropriate maintenance of slope protection features of the dam.

The exterior slope of the BSP Perimeter Dike is vegetated with maintained grass. Trees and brush are present at the toe of slope. The interior slope of the pond is bottom ash due to the current operational nature of the Bottom Slag Pond. The interior slopes are redressed to maintain slope integrity and address areas of erosion.

4.1.1 Conclusion

Based on the assessment of the slope protection for the BSP Perimeter Dike, the EPA Final CCR Rule-related criteria listed above have been met.

5.0 EMBANKMENT DIKE COMPACTION (§257.73(d)(1)(iii))

Per §257.73(d)(1)(iii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit. The Boiler Slag Pond has the following features that fall within this requirement:

- BSP Perimeter Dike

Assessment of the dike compaction associated with these features was completed considering the following criteria related to the EPA Final CCR Rule:

1. Documentation showing the dike was mechanically compacted. Acceptable documentation may include construction drawings, field notes, construction photographs, correspondences, or any evidence showing the dike was mechanically compacted during construction.

2. If no construction documentation is available specific data from geotechnical explorations of dike may be used. Geotechnical borings with continuous SPTs may be used to assess compaction of the dike. Appropriate methodology correlating blow counts and compaction (density) should be used.

5.1 BSP PERIMETER DIKE

5.1.1 Background

The Bottom Ash Complex was designed by Sargent Lundy Engineers of Chicago, Illinois and constructed by George B. Herring & Sons, Inc. of Mansfield, Ohio. Arthur and Leo Casagrande of Cambridge, Massachusetts were also retained during the construction phase and reportedly made a number of site visits as the embankment and appurtenances were being built. Only limited design drawings exist for the BSP Perimeter Dike. Technical memoranda and letters between the Casagrande firm and the plant during the design and construction of the plant and other structures do exist. Construction photos are available showing period-appropriate large construction equipment working on the site. Subsurface explorations of the dike were also available that provided SPT data used in the assessment.

5.1.1 Assessment

Historical construction photographs, technical memoranda, and letters provide documentation of compaction requirements related to the construction of the BSP Perimeter Dike. Construction criteria related to dike embankment materials and dike compaction as noted on this documentation include:

- A discussion proposed dike materials and the need for proper moisture control and compaction in thin layers with heavy, rubber-tired equipment slightly on the dry side of optimum (A. Casagrande, 1952).

Two previous geotechnical explorations were available to review as part of this assessment (DLZ, 2011 and DLZ, 2015). Each was a geotechnical exploration and slope stability evaluation of the BSP Perimeter dike. The programs included drilling and laboratory testing.

DLZ (2011) stated that results of the subsurface investigations indicated subsurface conditions were similar for the Boiler Slag Pond and the South Fly Ash Pond. Embankment fill was stiff to very stiff lean clay with varying amounts of silt and fine sand. Standard penetration testing within the borings indicated blow count N_{60} values ranging from 5 to 30 with an average of 13. The N_{60} values have been adjusted to account for hammer efficiency and field procedures. Based on laboratory testing results, DLZ assigned the embankment clay fill drained shear strength parameters of 100 psf cohesion and an internal friction angle of 32 degrees with a wet unit weight of 125 pounds per cubic foot (pcf). Correlating these results using NAVFAC DM-7.2 indicate that appropriate compaction exists within the embankment of the WBSP Perimeter Dike (NAVFAC, 1986).

5.1.2 Conclusion

Based on the assessment of the embankment dike compaction for the BSP Perimeter Dike, the EPA Final CCR Rule-related criteria listed above have been met.

6.0 VEGETATED SLOPES (§257.73(d)(1)(iv))

Per §257.73(d)(1)(iv), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with vegetated slopes of dikes and surrounding areas, except for slopes which have an alternate form or forms of slope protection. The Boiler Slag Pond has the following features that fall within this requirement:

- BSP Perimeter Dike

Assessment of the vegetated slopes associated with these features was completed considering the following criteria related to the EPA Final CCR Rule:

1. Regular inspection records showing vegetative cover sufficient to prevent surface erosion while allowing an unobstructed view to visually inspect the slope.

6.1 BACKGROUND

The BSP Perimeter Dike is vegetated along the exterior slope. Trees and brush are present at the toe of slope. The interior slope of the pond is bottom ash due to the current operational nature of the Bottom Ash Complex.

6.2 ASSESSMENT

Slope protection for the BSP Perimeter Dike exterior slope consists of grass or riprap with trees and brush present at the toe of slope. Bottom ash lines the interior of the dike due to the operational nature of the Boiler Slag Pond. Erosion is addressed as a maintenance concern. Erosion of clay dike soils is not visible (AEPSC, 2016).

6.3 CONCLUSION

Based on the assessment of the vegetated slopes for the BSP Perimeter Dike, the EPA Final CCR Rule-related criteria listed above have been met.

7.0 SPILLWAY CONDITION AND CAPACITY(§257.73(d)(1)(v))

Per §257.73(d)(1)(v), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with a single spillway or combination of spillways that meet the condition and capacity requirements as outlined in this section of the EPA Final CCR Rule. The combined capacity of all spillways are to be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in this section. The Boiler Slag Pond has the following features that fall within this requirement:

- Boiler Slag Pond Primary Spillway System

Assessment of the spillway condition and capacity associated with these features was completed considering the following criteria related to the EPA Final CCR Rule:

1. Outlet channel must be of non-erodible material designed to carry sustained flow velocities based on the required flood events. [Estimate flow velocities and select appropriate material using hydraulic analysis for the following flood events: PMF (high hazard potential unit), 1000-year flood (Significant hazard unit), 100-year flood (low hazard potential unit).]

2. Must adequately manage flow during and following the peak discharge. [Estimate size of outlet structure based of hydraulic analysis for the following flood events: PMF (High hazard potential unit), 1000-year flood (Significant hazard potential unit), and 100-year flood (low hazard potential unit).]

3. Must be structurally stable. [Assess stability of structure using stability and stress analyses according to an appropriate methodology. Some acceptable methodologies may include: EM 1110-2-2400, EM 1110-2-2100, ACI 350, etc.]

4. Must maintain structural integrity. [Structural integrity may be warranted by periodic inspections of existing conduits. Inspections must show no significant presence of deformation, distortions, cracks, joint separation, etc.]

5. Must be free from significant amounts of obstruction and anomaly which may affect the operation of the hydraulic structure [Perform periodic pipe inspections to detect deterioration, deformation, distortion, bedding deficiencies, and sediment, and debris accumulations.]

7.1 PRIMARY SPILLWAY SYSTEM

7.1.1 Background

The Boiler Slag Pond is classified as a significant hazard structure requiring the combined capacity of all spillways be adequate to manage the flow during and following the peak discharge from a 1000-year flood.

7.1.2 Assessment

7.1.2.1 Spillway Capacity

The Inflow Design Flood Control System Plan for the Boiler Slag Pond demonstrates the Boiler Slag Pond meets the capacity requirements outlined in §257.73(d)(1)(v) of the EPA Final CCR Rule. During the October 2015 annual dam and dike inspection, the overflow discharge pipe was flowing unobstructed into the Clearwater Pond. No spalling or deterioration of the concrete structure was observed. The spillway intake structure in the Clearwater Pond and outfall into the Ohio River were also in good functioning condition with no signs of deterioration. The wooden trestle supporting the discharge pipe through the splitter dike and the discharge pipe entering the Clearwater Pond were in poor condition at the time of the site visit (AEPSC, 2015). The overflow discharge pipe structure is being redesigned as part of 2016 maintenance operations.

7.1.2.2 Structural Stability

The Boiler Slag Pond overflows into a reinforced concrete intake structure at the southwestern end of the splitter dike separating the pond from the Clearwater Pond. The intake structure is rectangular in shape with a 24-inch by 39-inch cross section. Flow discharges through a 30-inch concrete pipe at elevation 557 feet into the Clearwater Pond (CHA, 2009).

The primary spillway intake structure for the Clearwater Pond is also rectangular in shape with a 24-inch by 39-inch cross section. Flow discharges through a 30-inch concrete pipe at elevation into the Ohio River (CHA, 2009). The outlet is a reinforced concrete head wall.

The Bottom Ash Complex's spillway system is inspected monthly during water quality sampling and annually as part of the dam and dike inspection. Physical condition, flow through the pipe, and maintenance concerns are noted and addressed. For the spillway intake structure connecting the Boiler Slag and Clearwater Ponds, video camera inspections of the structure were performed in 2015 and March 2016. The outlet of the spillway structure was video inspected in 2013 and 2015. A root was removed from the reinforced concrete pipe in November 2015.

7.1.3 Conclusion

Based on the assessment of the Bottom Ash Complex Primary Spillway System condition and capacity for the Boiler Slag Pond, the EPA Final CCR Rule-related criteria listed above have been met.

8.0 SUDDEN DRAWDOWN ASSESSMENT (§257.73(d)(1)(vii))

Per §257.73(d)(1)(vii), the initial structural stability assessment must document whether the unit has been designed, constructed, operated, and maintained with downstream slopes that can be inundated by an adjacent water body (such as a river, stream, or lake) to determine is structural stability is maintained during low pool or sudden drawdown of the adjacent water body. The following features from Kyger Creek Station fall within this requirement:

- BSP Perimeter Dike

Assessment of the sudden drawdown associated with these features was completed considering the following criteria related to the CCR rule:

1. Maintain slope stability during sudden drawdown of adjacent water body.

Guidance provided by the USEPA (2015) described the basis of the CCR Rule's factor of safety criteria and methodology as EM 1110-2-1902 (USACE, 2003) or other appropriate methodologies. Table 3-1 of EM 1110-2-1902 (USACE, 2003) recommends a required minimum factor of safety of 1.1 for maximum surcharge pool under rapid drawdown conditions.

8.1 PERIMETER DIKES

8.1.1 Background

The Boiler Slag Pond has potential sudden drawdown loading from the Ohio River and Kyger Creek. A sudden drawdown slope stability analysis of the downstream slope is required under the CCR Rule §257.73(d)(1)(vii). The sudden drawdown slope stability analysis was performed based on the static safety factor assessment discussed in DLZ (2015).

8.1.2 Assessment

8.1.2.1 Material Properties

DLZ performed a geotechnical exploration in 2010 to characterize the dikes of the South Fly Ash Pond and the Boiler Slag Pond (DLZ 2011). A laboratory testing program was performed to determine the pertinent soil parameters for stability analyses. The strength parameters derived using the laboratory data and used in this sudden drawdown slope stability evaluation are presented in Table 1. The results of the laboratory testing and derivation of the strength parameters can be found in DLZ (2011 and 2015).

Table 1 Strength Parameters for Stability Analysis

Soil Horizon	Unit Weight (pcf)	Effective Stress Strength Parameters		Total Stress Strength Parameters	
		c' (psf)	ϕ' (degrees)	c (psf)	ϕ (degrees)
Embankment Clay Fill	125	100	32	350	20
Stiff to Very Stiff Clay	125	100	32	500	16
Soft to Medium Stiff Clay	125	100	28	300	16
Dense Sand/Gravel (Boiler Slag Pond)	125	0	30	0	35

8.1.2.2 Critical Cross Section Selection

Slope stability analyses were available from DLZ (2011 and 2015). Five cross sections from the Boiler Slag Pond (including the Clearwater Pond) were analyzed under static, steady-state conditions using the maximum surcharge pool. The five sections that were analyzed were labeled Sections 1 through 5 and are shown below in Figure 1.

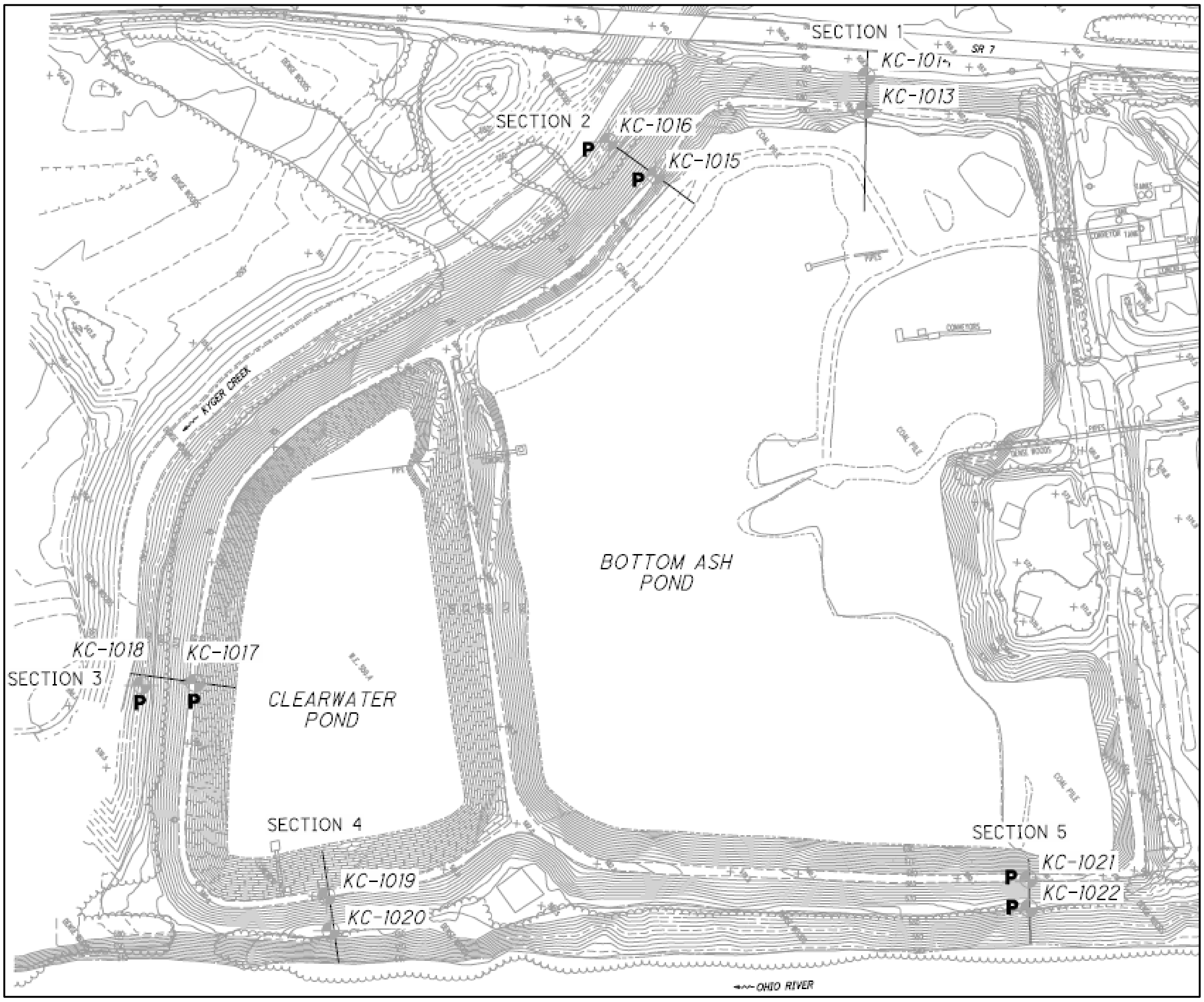

Figure 1 Kyger Creek Station Boiler Slag Pond – Plan View of Cross Sections *(DLZ, 2015)*

The summary of the slope stability results from DLZ (2015) is listed in Table 2. The pond levels were set at the 50% PMF elevation (559.3 feet for the Boiler Slag Pond and 558.6 feet for the Clearwater Pond). The tailwater was set near the surface of the toe.

Table 2 Static Slope Stability Results

Facility	Cross Section	Maximum Surcharge Pool Factor of Safety
Boiler Slag Pond	1	2.54
Boiler Slag Pond	2	1.71
Clearwater Pond	3	1.85
Clearwater Pond	4	2.55
Boiler Slag Pond	5	1.83

This analysis indicate that Section 2 is the critical cross section. A sudden drawdown stability analysis was performed for Section 2 of the Boiler Slag Pond based on the proposed water levels discussed in Section 8.1.2.3.

8.1.2.3 Water Levels

Kyger Creek Station's CCR surface impoundments are classified as significant hazard. Under the EPA Final CCR Rule, the inflow design flood for a significant hazard potential CCR surface impoundment is the 1,000-year flood (§257.82(a)(3)(ii)). A rainfall amount for the 1,000-year storm event (5.61 inches) was obtained from the "Precipitation Frequency Atlas of the United States, NOAA Atlas 14" using a precipitation event duration of 6 hours (Bonnin et al, 2016).

DLZ (2015) presents the hydrologic and hydraulic data for the Boiler Slag Pond assuming the 50-percent probable maximum flood (PMF) event for the maximum storage pool. A rainfall depth for the six-hour, 1 square mile probable maximum precipitation (PMP) of 19 inches was used in the analysis (DLZ, 2015 and AWA, 2013).

The sudden drawdown analysis has been performed assuming a maximum surcharge pool within the surface impoundment equal to the 50- percent PMF and a long-term maximum storage pool equal to the operating pool elevation reported in DLZ (2015).

Tailwater for the model is Kyger Creek, which flows into the Ohio River. The 100-year flood level for the Ohio River was used for the tailwater flood pool elevation (FEMA, 2011). The normal pool for the Ohio River was determined from the elevations provided by Ohio River Valley Water Sanitation Commission (ORSANCO) for Ohio River navigational dams (ORSANCO, 2016). Table 3 lists the headwater and tailwater elevations used for analysis.

Table 3 Kyger Creek Station Water Elevations for Stability Modeling

CCR Rule Criteria	Headwater Boiler Slag Pond Elevation (feet)	Tailwater Ohio River Elevation (feet)
Long-term maximum storage pool loading condition	557.0	538.0
Maximum surcharge pool loading condition	559.3	572.2

8.1.2.4 Analysis Methodology

Stantec performed the sudden drawdown slope stability analyses using the GeoStudio 2007, Version 7.23 software package developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada (GEO-SLOPE International, Ltd., 2007). This package includes the SLOPE/W module for slope stability analysis. The analyses were performed in accordance with the recommendations and criteria outlined in the USACE Design Manuals EM 1110-2-1902 "Slope Stability" (USACE, 2003) and in the Stantec Engineer's Certification of Safety Factor Assessment Report (Stantec, 2015).

8.1.2.5 Acceptance Criteria

A minimum factor of safety is not explicitly specified within the EPA Final CCR Rule §257.73(d)(1)(vii). In the CCR Rule discussion, USACE (2003) is considered the basis for the slope stability analyses. Table 3-1, Minimum Required Factors of Safety: New Earth and Rock-Fill Dams, requires a factor of safety of 1.1 for a rapid drawdown condition from maximum surcharge pool (USACE, 2003).

8.1.2.6 Analysis Results

The slope stability assessments presented in this report are focused on the potential for slope failures of significant mass, which could directly impact potential release of water and CCR materials from the South Fly Ash Pond or the Boiler Slag Pond. The search for a critical slip surface in the slope stability assessments is thus restricted to consider only potential surfaces where the depth (measured at the base of at least one slice) is more than ten feet vertically below the ground surface. Table 4 summarizes the sudden drawdown safety factor evaluation results at the Boiler Slag Pond. The results of the analyses are included in Appendix B.

Table 4 Factor of Safety Assessment Results

Facility	Cross Section	EPA Final CCR Rule Criteria	Recommended Factor of Safety Criteria	Calculated Factor of Safety
Boiler Slag Pond	2	Sudden Drawdown	1.1	1.2

8.1.3 Conclusion

Based on the assessment of the sudden drawdown for the BSP Perimeter Dike, the EPA Final CCR Rule-related criteria listed above have been met.

9.0 REFERENCES

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Appendix A PLAN VIEW OF KYGER CREEK STATION

Appendix B SUDDEN DRAWDOWN ASSESSMENT

APPENDIX A
PLAN VIEW OF KYGER CREEK STATION

2070206 2073487

334645

331364

2070206 2073487

334645 331364

Figure No.
A-1

Title
Plan View of Kyger Creek Station

Client/Project
Kyger Creek Station - Structural Stability
South Fly Ash Pond and Boiler Slag Pond

Project Location 175534017
Cheshire
Gallia County, OH

Prepared by AP on 2016-10-13
Technical Review by JH on 2016-10-13
Independent Review by SH on 2016-10-13

0 300 600 Feet
1:3,600 (At original document size of 11x17)

Notes
1. Coordinate System: NAD 1983 StatePlane Ohio South FIPS 3402 Feet
2. Ohio Statewide Imagery Program (OSIP) - 2014

Stantec OVEC IKEC

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APPENDIX B
SUDDEN DRAWDOWN ASSESSMENT

Ohio Valley Electric Corporation
Kyger Creek Station
Boiler Slag Pond
Cheshire, Ohio
Section 2

Sudden Drawdown

Existing Geometry
Sudden Drawdown
Undrained, Sudden Drawdown Strengths

Material Type	Unit Wt.	Effective Cohesion	Effective Friction Angle	Total Cohesion	Total Friction Angle
Embankment Clay Fill	125 pcf	100 psf	32 °	350 psf	20 °
Soft to Medium Stiff Clay	125 pcf	100 psf	28 °	300 psf	16 °
Dense Sand/Gravel	125 pcf	0 psf	30 °	0 psf	35 °

Note:
The results of this analysis are based on available subsurface information, field and laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions between the borings.