Big Rivers
ELECTRIC CORPORATION

Your Touchstone Energy® Cooperative

Green Station CCR Surface Impoundment

Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Structural Integrity Criteria for Existing CCR Surface Impoundments
Initial Structural Stability Assessment

October 11, 2016

Prepared By:

ASSOCIATED ENGINEERS, INC.
2740 North Main St. • Madisonville, KY 42431
Phone: (270) 821-7732 • Fax: (270) 821-7789

Project ID: 160028A

Big Rivers Electric Corporation
Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Structural Integrity Criteria for Existing CCR Surface Impoundments
Initial Structural Stability Assessment

CCR Surface Impoundment Information

Name:	Green Station CCR Surface Impoundment
Operator:	Sebree Generating Station
Address:	9000 Highway 2096 Robards, Kentucky 42452
CCR Unit Identification Number:	Kentucky State Dam Inventory System ID No. 0980

Qualified Professional Engineer

Name:	David A. Lamb
Company:	Associated Engineers, Inc.
Kentucky P.E. Number:	17822

Regulatory Applicability

As part of the § 257.73 Structural integrity criteria for existing CCR surface impoundments requirements, an owner or operator of an existing CCR surface impoundment must no later than October 17, 2016:

Conduct initial structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

1. Stable foundations and abutments;

2. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

3. Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

4. 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;

5. A single spillway or a combination of spillways configured as specified in the final rule. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in the final rule and all spillways must be either of non-erodible construction and designed to carry sustained flows; or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected. The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or 1000-year flood for a significant hazard potential CCR surface impoundment; or 100-year flood for a low hazard potential CCR surface impoundment;

6. 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; and

7. 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.

From: VI. Development of the Final Rule - Technical Requirements

In order to ensure the proper upkeep and operation of the CCR unit, the owner or operator must demonstrate that the CCR surface impoundment has been designed, constructed, operated and maintained to provide structural stability. Specifically, the final rule requires the owner or operator to demonstrate that the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and water that can be impounded therein. Specifically, the final rule focuses on the critical structural aspects of the CCR surface impoundment that EPA identified in the proposed rule, and identifies the minimum elements that a professional engineer must provide engineering details on or otherwise address. Consistent with the proposal, these demonstrations must be certified by a qualified professional engineer.

In addition to implementing adequate slope protection against erosion, which is a structural stability requirement applicable to all CCR units, the owner or operator of a CCR surface impoundment exceeding the specified size threshold (height of five feet or more and a storage volume of 20 acre-feet or more; or a height of 20 feet or more) must demonstrate that the unit, including any vertical and lateral expansions, is constructed with ‘‘stable foundations and abutments.’’ A stable foundation is an essential element of surface impoundment construction and prevents differential settlement of the embankment which can result in adverse internal stresses with the embankment cross-section.

Consistent with general engineering construction methodologies, the structural stability assessment also requires the owner or operator to determine whether the CCR surface impoundment has been mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit. Compaction of a dike or embankment is considered essential, as the compaction of soils leads to an increase in density and subsequently strength. Soil mechanics theory has established that the density of a soil corresponds to the moisture content and strength of the soil. The rule requires the owner or operator make this determination for all dikes of a CCR surface impoundment.

The owner or operator must also design, construct, operate, and maintain the CCR surface impoundment spillway or spillways with appropriate material so as to prevent the degradation of the spillway, as well as to ensure that the CCR surface impoundment has adequate spillway capacity to manage the outflow from a specific inflow design flood. In addition, a demonstration must be made that the CCR surface impoundment has been designed, constructed, operated, and maintained with inflow design flood controls and/or spillway capacity to manage peak discharge during and following inflow design floods. This demonstration is required to ensure the CCR surface impoundments will have adequate hydrologic and hydraulic capacity to prevent such failures as overtopping and excessive internal seepage and erosion. Spillways must be designed to withstand discharge from the inflow design flood without losing their structural form and leading to discharge issues, such as erosion or overtopping of the embankment. This requirement is covered in more detail in the hydrologic and hydraulic capacity requirements for CCR surface impoundments section of this rule.

EPA is not requiring a facility to include any demonstration relating to the potential for rapid, or sudden, drawdown loading condition. Rapid or sudden drawdown is a condition in earthen embankments in which the embankment becomes saturated through seepage in an extended high pool elevation in the reservoir. A threat to the embankment emerges when the reservoir pool is drawn down or lowered at a rate significantly higher than the excess poor water pressure within the embankment can diminish. Typically, rapid drawdown scenarios are considered for embankments with reservoirs used for water supply and management, emergency reservoirs, or agricultural supply, in which the reservoir is rapidly discharged from the structure.

A second consideration regarding rapid drawdown, however, is the rapid drawdown of a water body adjacent to the slope of the CCR surface impoundment which may periodically inundate the slope. Many CCR surface impoundments are located in areas in which the downstream slope of the CCR surface impoundment runs down to a lake, stream, or river. In such instances, rapid drawdown must be considered for the stability of the downstream slope of the embankment in the event of a rapid drawdown in the lake, stream, or river pool elevation or stage. Because the water ponded against the downstream slope of the CCR surface impoundment provides a stabilizing load on the slope of the CCR surface impoundment, the rapid or gradual loss of this stabilizing force must be considered in the analysis of the CCR surface impoundment. The rule, therefore, requires that existing and new CCR surface impoundments and any lateral expansions of such units with a downstream slope that can be inundated by an adjacent water body, such as rivers, streams, or lakes, be constructed with downstream slopes that will maintain structural integrity in events of low pool or rapid drawdown of the adjacent water body. This ensures that the structural integrity of the downstream slope of the CCR surface impoundment will be maintained, even though the conditions of an adjacent surface water body may be outside the owner or operator's control.

Description of Impoundment

An aerial photo of the CCR unit is provided as Attachment A and an excerpt from U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps showing the location of the CCR unit is provided as Attachment B.

The CCR unit has been in place for 40 plus years and is used for the placement of coal combustion residual material; currently slurried bottom ash. The immediate watershed that drains to the CCR unit, and in which the CCR unit is considered to be located, is unnamed and 54.13 acres in size. The unnamed watershed discharges from the CCR impoundment outflow structure and is routed to the Green River.

The CCR unit is a combined incised/earthen embankment structure. Embankments form the west, south and east sides of the impoundment and the north side is incised. The Green River is located approximately 400 feet east of the structure. Due to surface relief, only the toe area of the south dike is potentially subject to flooding. The predominant features were small stream valleys draining eastward to the Green River. Most of the central portion of the south dike was constructed on a subdued ridge. The toe of the outboard slope intersected a lower drainage area. Underlying preconstruction soils consisted of Loring-Grenada, Loring-Zanesville-Wellston (Henderson County) and Loring-Wellston-Zanesville (Webster County) soil associations which are generally characterized as well drained to moderately well drained soils on nearly level to sloping uplands.

The west dike is generally less than five feet in height and the south dike reaches a maximum height of 19.5 feet. The east dike reaches a maximum height of approximately eight feet and is buttressed with a secondary parallel embankment that serves as a 40-foot wide roadway. The Burns and Roe, Inc. Engineering and Consultants June 30, 1978 site grading plans show the original construction layout and ground contours for the impoundment site. Bottom ash has been placed above the normal pool along the inboard side, essentially creating reclaimed land

Depth of impounded water and CCR is 16 feet and 46 feet (at respective locations of maximum impounded water and CCR depths). Elevation of impounded water and CCR is 394 feet and 408 feet, respectively, above mean sea level. These approximate depths and respective elevations are based on the most recent (December 2015) flight derived topographic contours and bathymetric survey data.

The remaining storage capacity is approximately 172,000 cubic yards (if CCR can be placed to the elevation of the current water surface). This volume was calculated based on the maximum allowable storage volume and the current volume of CCR stored in the facility based on the most recent bathymetric survey.

The approximate volume of impounded water and CCR is 981,000 cubic yards (approximate water volume is 172,000 cubic yards and approximate CCR volume is 809,000 cubic yards). This volume was calculated based on the maximum storage capacity, the current amount of CCR stored in the facility based on the most recent bathymetric survey, and the best available as-built data for the structure construction prior to placement of CCR.

The impoundment discharge consists of two corrugated steel pipes, each 24 inches in diameter. The pipe intakes are through a concrete common headwall collection structure with a variable height steel debris deflector on each pipe intake.

Results of the Initial Structural Stability Assessment

The initial structural stability assessment has been completed and documents whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. Slope stability analyses were performed using Rocscience Inc. Slide geotechnical software. Slide provides numerical tools to analyze the stability of embankments using limit equilibrium methods.

The assessment documents whether the CCR unit has been designed, constructed, operated, and maintained with:

1. Stable foundations and abutments;

   The 2015 Annual Inspection indicates that the Green CCR impoundment exhibits stable foundations and abutments. No related deficiencies were observed during the annual inspection.

2. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

   The 2015 Annual Inspection indicates the Green CCR impoundment exhibits mostly adequate slope protection from erosion, wave action and any effects if sudden drawdown could occur. No related deficiencies were observed during the annual inspection.

3. Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

   Quality assurance and/or testing reports describing the compaction methods and results during embankment construction are not available. A geotechnical exploration was performed to meet the requirements of 40 CFR §257.73(e); the exploration included Standard Penetration Testing (SPT) and acquisition of undisturbed soil samples. Based on the field results and laboratory analyses, the materials within the embankment are sufficient to withstand the anticipated loading conditions.

4. 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;

   The 2015 Annual Inspection indicates the Green CCR impoundment embankment exhibits vegetation mostly greater a height of six inches above the slope of the dike. The Utility Solid Waste Activities Group, et al. has petitioned the USEPA to remand this requirement from the final rule because it is not practical and in remanding the provision, there is no reasonable probability of adverse effects on human health or the environment. USEPA has agreed that the requirement should be remanded.

5. A single spillway or a combination of spillways configured as specified in the final rule. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in the final rule and all spillways must be either of non-erodible construction and designed to carry sustained flows; or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected. The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or 1000-year flood for a significant hazard potential CCR surface impoundment; or 100-year flood for a low hazard potential CCR surface impoundment;

   The impoundment has a single spillway structure. The spillway is comprised of two 30-inch corrugated metal pipes with a dual-pipe concrete headwall. The impoundment was analyzed for a 1000-year/24-hour storm event using SCS methodologies and a Type II rainfall distribution. Precipitation depth during the design storm was acquired from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates database. Based on the analysis, the spillway structure can manage the flow from the design storm without overtopping the embankment. The analysis was based on the current impoundment configuration, storm water flows, process water flows, and contents volume.

6. 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; and

   The 2015 Annual Inspection indicates the hydraulic structures underlying the base of the Green impoundment 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. No related deficiencies were observed during the annual inspection.

7. 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.

   Due to the configuration and location of the impoundment, stability is not anticipated to be significantly affected by low river pool conditions. Although a portion of the downstream slope of the impoundment embankment is located below the 100-year flood elevation of the Green River and may experience encroachment of the adjacent water body during a flood event, stability is not anticipated to be affected by sudden drawdown. A rapid drawdown analysis was completed to assess the downstream slope of the impoundment during such an event and the analysis resulted in an acceptable factor of safety demonstrating that the slope will maintain structural stability during a sudden drawdown.

<u>Sources of Information</u>

Geotechnical and other information provided by Associated Engineers, Inc.

Engineering design drawings and other information provided by Big Rivers Electric Corporation

United States Geological Survey U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps

Professional Engineer Certification [Per 40 CFR § 257.73]
Green CCR Impoundment Initial Structural Stability Assessment

I hereby certify that myself or an agent under my review has prepared this Initial Structural Stability Assessment (Assessment), and being familiar with the provisions of the final rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under subtitle D of the Resource Conservation and Recovery Act (RCRA), attest that this Assessment has been prepared in accordance with good engineering practices and meets the intent of 40 CFR Part 257.73. To the best of my knowledge and belief, the information contained in this Assessment is true, complete, and accurate.

David A. Lamb

David A. Lamb P.E.

State of Kentucky License No. 17822

STATE OF KENTUCKY
DAVID A. LAMB
17822
LICENSED PROFESSIONAL ENGINEER

Date: 10/11/16

Attachment A. Aerial Photo of the Green CCR Surface Impoundment

Attachment B. Topographic Map showing the Green CCR Surface Impoundment

Big Rivers
ELECTRIC CORPORATION

Your Touchstone Energy® Cooperative

Reid/HMPL Station CCR Surface Impoundment

Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Structural Integrity Criteria for Existing CCR Surface Impoundments
Initial Structural Stability Assessment

October 11, 2016

Prepared By:

ASSOCIATED ENGINEERS, INC.
2740 North Main St. • Madisonville, KY 42431
Phone: (270) 821-7732 • Fax: (270) 821-7789

Project ID: 160027A

Big Rivers Electric Corporation
Disposal of Coal Combustion Residuals (CCR) from Electric Utilities Final Rule
Structural Integrity Criteria for Existing CCR Surface Impoundments
Initial Structural Stability Assessment

CCR Surface Impoundment Information

Name:	Reid/HMPL Station CCR Surface Impoundment
Operator:	Sebree Generating Station
Address:	9000 Highway 2096 Robards, Kentucky 42452
CCR Unit Identification Number:	Kentucky State Dam Inventory System ID No. 0855

Qualified Professional Engineer

Name:	David A. Lamb
Company:	Associated Engineers, Inc.
Kentucky P.E. Number:	17822

Regulatory Applicability

As part of the § 257.73 Structural integrity criteria for existing CCR surface impoundments requirements, an owner or operator of an existing CCR surface impoundment must no later than October 17, 2016:

Conduct initial structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:

1. Stable foundations and abutments;

2. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

3. Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

4. 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;

5. A single spillway or a combination of spillways configured as specified in the final rule. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in the final rule and all spillways must be either of non-erodible construction and designed to carry sustained flows; or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected. The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or 1000-year flood for a significant hazard potential CCR surface impoundment; or 100-year flood for a low hazard potential CCR surface impoundment;

6. 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; and

7. 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.

From: VI. Development of the Final Rule - Technical Requirements

In order to ensure the proper upkeep and operation of the CCR unit, the owner or operator must demonstrate that the CCR surface impoundment has been designed, constructed, operated and maintained to provide structural stability. Specifically, the final rule requires the owner or operator to demonstrate that the design, construction, operation, and maintenance of the CCR surface impoundment is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and water that can be impounded therein. Specifically, the final rule focuses on the critical structural aspects of the CCR surface impoundment that EPA identified in the proposed rule, and identifies the minimum elements that a professional engineer must provide engineering details on or otherwise address. Consistent with the proposal, these demonstrations must be certified by a qualified professional engineer.

In addition to implementing adequate slope protection against erosion, which is a structural stability requirement applicable to all CCR units, the owner or operator of a CCR surface impoundment exceeding the specified size threshold (height of five feet or more and a storage volume of 20 acre-feet or more; or a height of 20 feet or more) must demonstrate that the unit, including any vertical and lateral expansions, is constructed with ‘‘stable foundations and abutments.’’ A stable foundation is an essential element of surface impoundment construction and prevents differential settlement of the embankment which can result in adverse internal stresses with the embankment cross-section.

Consistent with general engineering construction methodologies, the structural stability assessment also requires the owner or operator to determine whether the CCR surface impoundment has been mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit. Compaction of a dike or embankment is considered essential, as the compaction of soils leads to an increase in density and subsequently strength. Soil mechanics theory has established that the density of a soil corresponds to the moisture content and strength of the soil. The rule requires the owner or operator make this determination for all dikes of a CCR surface impoundment.

The owner or operator must also design, construct, operate, and maintain the CCR surface impoundment spillway or spillways with appropriate material so as to prevent the degradation of the spillway, as well as to ensure that the CCR surface impoundment has adequate spillway capacity to manage the outflow from a specific inflow design flood. In addition, a demonstration must be made that the CCR surface impoundment has been designed, constructed, operated, and maintained with inflow design flood controls and/or spillway capacity to manage peak discharge during and following inflow design floods. This demonstration is required to ensure the CCR surface impoundments will have adequate hydrologic and hydraulic capacity to prevent such failures as overtopping and excessive internal seepage and erosion. Spillways must be designed to withstand discharge from the inflow design flood without losing their structural form and leading to discharge issues, such as erosion or overtopping of the embankment. This requirement is covered in more detail in the hydrologic and hydraulic capacity requirements for CCR surface impoundments section of this rule.

EPA is not requiring a facility to include any demonstration relating to the potential for rapid, or sudden, drawdown loading condition. Rapid or sudden drawdown is a condition in earthen embankments in which the embankment becomes saturated through seepage in an extended high pool elevation in the reservoir. A threat to the embankment emerges when the reservoir pool is drawn down or lowered at a rate significantly higher than the excess poor water pressure within the embankment can diminish. Typically, rapid drawdown scenarios are considered for embankments with reservoirs used for water supply and management, emergency reservoirs, or agricultural supply, in which the reservoir is rapidly discharged from the structure.

A second consideration regarding rapid drawdown, however, is the rapid drawdown of a water body adjacent to the slope of the CCR surface impoundment which may periodically inundate the slope. Many CCR surface impoundments are located in areas in which the downstream slope of the CCR surface impoundment runs down to a lake, stream, or river. In such instances, rapid drawdown must be considered for the stability of the downstream slope of the embankment in the event of a rapid drawdown in the lake, stream, or river pool elevation or stage. Because the water ponded against the downstream slope of the CCR surface impoundment provides a stabilizing load on the slope of the CCR surface impoundment, the rapid or gradual loss of this stabilizing force must be considered in the analysis of the CCR surface impoundment. The rule, therefore, requires that existing and new CCR surface impoundments and any lateral expansions of such units with a downstream slope that can be inundated by an adjacent water body, such as rivers, streams, or lakes, be constructed with downstream slopes that will maintain structural integrity in events of low pool or rapid drawdown of the adjacent water body. This ensures that the structural integrity of the downstream slope of the CCR surface impoundment will be maintained, even though the conditions of an adjacent surface water body may be outside the owner or operator's control.

Description of Impoundment

An aerial photo of the CCR unit is provided as Attachment A and an excerpt from U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps showing the location of the CCR unit is provided as Attachment B.

The CCR unit has been in place for 40 plus years and is used for the placement of coal combustion residual material; currently slurried bottom ash. The immediate watershed that drains to the CCR unit, and in which the CCR unit is considered to be located, is unnamed and 25.45 acres in size. The unnamed watershed discharges from the CCR impoundment outflow structure and is routed to the Green River.

The CCR unit is a combined incised/earthen embankment structure. Embankments form the west, south and east sides of the impoundment and the north side is incised. The original terrain on which the pond was constructed generally sloped toward the west. Although the Green River is located less than 0.5 miles from the site, the structure does not extend significantly into the floodplain. Underlying preconstruction soils consisted of Loring-Grenada, Loring-Zanesville-Wellston (Henderson County) and Loring-Wellston-Zanesville (Webster County) soil associations which are generally characterized as well drained to moderately well drained soils on nearly level to sloping uplands.

The embankment reaches its greatest relief of approximately 42 feet on the west side. The Burns & McDonnell Engineering Co. October 8, 1971 design drawings show the inboard slope and central core portion of the dike to be constructed of compacted soil fill and the outboard slope to be consisted of sand fill. A sand blanket drain was designed for the outboard third of the base of the dike for the majority of the length and the plans show a crushed limestone drainage layer with a minimum thickness of 18 inches topped with a minimum six inches thick sand layer which extends across the entire width of the dike cross section in the southwest corner. The plans also show a cut-off trench in the original ground below dike crest and extending for the entire length of the dike.

Depth of impounded water and CCR is 16 feet and 39 feet (at respective locations of maximum impounded water and CCR depths). Elevation of impounded water and CCR is 426 feet and 440 feet, respectively, above mean sea level. These approximate depths and respective elevations are based on the most recent (December 2015) flight derived topographic contours and bathymetric survey data.

The remaining storage capacity is approximately 85,000 cubic yards (if CCR can be placed to the elevation of the current water surface). This volume was calculated based on the maximum allowable storage volume and the current volume of CCR stored in the facility based on the most recent bathymetric survey.

The approximate volume of impounded water and CCR is 767,000 cubic yards (approximate water volume is 85,000 cubic yards and approximate CCR volume is 682,000 cubic yards). This volume was calculated based on the maximum storage capacity, the current amount of CCR stored in the facility based on the most recent bathymetric survey, and the best available as-built data for the structure construction prior to placement of CCR.

The impoundment discharge consists of a rectangular concrete drop structure with a variable height steel debris skimmer. The pool elevation can be controlled by adding or removing stop logs. The discharge structure connects to a 24-inch diameter smooth walled metal pipe underground conveyance.

Results of the Initial Structural Stability Assessment

The initial structural stability assessment has been completed and documents whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein. Slope stability analyses were performed using Rocscience Inc. Slide geotechnical software. Slide provides numerical tools to analyze the stability of embankments using limit equilibrium methods.

The assessment documents whether the CCR unit has been designed, constructed, operated, and maintained with:

1. Stable foundations and abutments;

   The 2015 Annual Inspection indicates that the Reid/HMPL CCR impoundment exhibits stable foundations and abutments. No related deficiencies were observed during the annual inspection.

2. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

   The 2015 Annual Inspection indicates the Reid/HMPL CCR impoundment exhibits mostly adequate slope protection from erosion, wave action and any effects if sudden drawdown could occur. No related deficiencies were observed during the annual inspection.

3. Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

   Quality assurance and/or testing reports describing the compaction methods and results during embankment construction are not available. A geotechnical exploration was performed to meet the requirements of 40 CFR §257.73(e); the exploration included

Standard Penetration Testing (SPT), penetrometer testing and acquisition of undisturbed soil samples. Based on the field results and laboratory analyses, the materials within the embankment are sufficient to withstand the anticipated loading conditions.

4. 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;

   The 2015 Annual Inspection indicates the Reid/HMPL CCR impoundment embankment exhibits vegetation mostly greater a height of six inches above the slope of the dike. The Utility Solid Waste Activities Group, et al. has petitioned the USEPA to remand this requirement from the final rule because it is not practical and in remanding the provision, there is no reasonable probability of adverse effects on human health or the environment. USEPA has agreed that the requirement should be remanded.

5. A single spillway or a combination of spillways configured as specified in the final rule. The combined capacity of all spillways must be designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the event specified in the final rule and all spillways must be either of non-erodible construction and designed to carry sustained flows; or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected. The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or 1000-year flood for a significant hazard potential CCR surface impoundment; or 100-year flood for a low hazard potential CCR surface impoundment;

   The impoundment has a single spillway structure. The spillway is comprised of a concrete riser structure with a 24-inch spillway pipe. The water elevation in the impoundment is controlled by stop logs in the concrete riser structure. The impoundment was analyzed for a 1000-year/24-hour storm event using SCS methodologies and a Type II rainfall distribution. Precipitation depth during the design storm was acquired from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates database. Based on the analysis, the spillway structure can manage the flow from the design storm without overtopping the embankment. The analysis was based on the current impoundment configuration, storm water flows, process water flows, and contents volume.

6. 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; and

   The 2015 Annual Inspection indicates the hydraulic structures underlying the base of the Reid/HMPL CCR impoundment 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. No related deficiencies were observed during the annual inspection.

7. 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.

   Due to the configuration and location of the impoundment, stability is not anticipated to be significantly affected by low river pool conditions. Because the lowest elevation of the downstream toe of impoundment embankment is located above the 100-year flood elevation of the Green River stability is not anticipated to be affected by sudden drawdown.

<u>Sources of Information</u>

Geotechnical and other information provided by Associated Engineers, Inc.

Engineering design drawings and other information provided by Big Rivers Electric Corporation

United States Geological Survey U.S. Geological Survey (USGS) 7.5 minute Robards and Delaware topographic quadrangle maps

Professional Engineer Certification [Per 40 CFR § 257.73]
Reid/HMPL CCR Impoundment Initial Structural Stability Assessment

I hereby certify that myself or an agent under my review has prepared this Initial Structural Stability Assessment (Assessment), and being familiar with the provisions of the final rule to regulate the disposal of coal combustion residuals (CCR) as solid waste under subtitle D of the Resource Conservation and Recovery Act (RCRA), attest that this Assessment has been prepared in accordance with good engineering practices and meets the intent of 40 CFR Part 257.73. To the best of my knowledge and belief, the information contained in this Assessment is true, complete, and accurate.

David A. Lamb

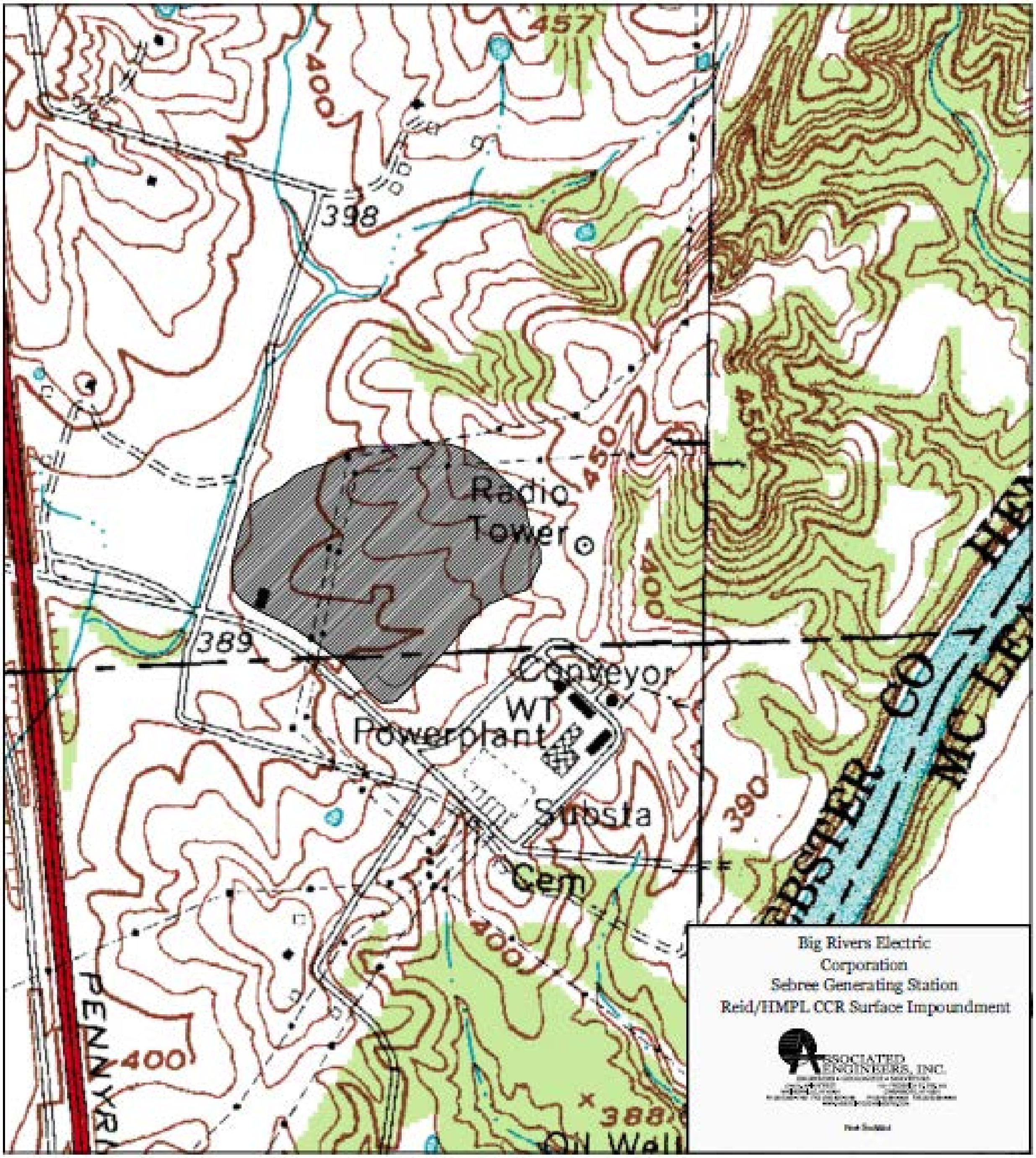
David A. Lamb P.E.

State of Kentucky License No. 17822

STATE OF KENTUCKY DAVID A. LAMB 17822 LICENSED PROFESSIONAL ENGINEER

Date: 10/11/16

Attachment A. Aerial Photo of the Reid/HMPL CCR Surface Impoundment



Attachment B. Topographic Map showing the Reid/HMPL CCR Surface Impoundment