# Table of Contents

1 Introduction ................................................................................................................ 1-1  
   1.1 Purpose ............................................................................................................... 1-1  
   1.2 Regulatory Requirements .................................................................................... 1-1  
   1.3 Brief Description of Impoundment ....................................................................... 1-2  
      1.3.1 Design and Construction ....................................................................... 1-2  
      1.3.2 Outlet Structures ................................................................................... 1-2  
   1.4 Assessment Approach ......................................................................................... 1-2  

2 Structural Stability Assessment ............................................................................... 2-1  
   2.1 Foundations and Abutments ................................................................................ 2-1  
   2.2 Slope Protection .................................................................................................. 2-1  
   2.3 Dike Compaction ................................................................................................. 2-1  
   2.4 Spillways ............................................................................................................. 2-2  
   2.5 Stability and Structural Integrity of Hydraulic Structures ...................................... 2-2  
   2.6 Downstream Slope Inundation/Stability ............................................................... 2-2  
   2.7 Structural Stability Deficiencies ........................................................................... 2-3  

3 Limitations .................................................................................................................. 3-1  

4 Certification Statement .............................................................................................. 4-1  

5 References.................................................................................................................. 5-1  

# Tables

Table 1-1 – CCR Rule Cross Reference Table  
Table 2-1 – Summary of Sudden Drawdown Safety Factor Assessment

# Appendices

Appendix A Figure 1 – Location Map
1 Introduction

1.1 Purpose

The purpose of this Initial Structural Stability Assessment Report is to document whether the Fly Ash Impoundment at KCP&L Greater Missouri Operations Company (KCP&L GMO) Sibley Generating Station meets the requirements of 40 CFR §257.73(d) of the Coal Combustion Residuals (CCR) Rule. The Fly Ash Impoundment is an existing CCR surface impoundment as defined by 40 CFR §257.53.

1.2 Regulatory Requirements

In accordance with the CCR Rule, this assessment documents whether the design, construction, operation, and maintenance of the Fly Ash Impoundment 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 Fly Ash Impoundment has been designed, constructed, operated, and maintained in accordance with 40 CFR §257.73(d) referenced below. The periodic assessment must also identify any structural stability deficiencies associated with the Fly Ash Impoundment in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

This Initial Structural Stability Assessment Report must be completed no later than October 17, 2016. Periodic structural stability assessments shall be prepared every five years. The date of completing the initial assessment is the basis for establishing the deadline to complete the first periodic assessment.

Regulatory Citation: 40 CFR §257.73(d) Periodic structural stability assessments. (1) The owner or operator of the CCR unit must conduct initial and periodic 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:

(i) Stable foundations and abutments;

(ii) Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;

(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

(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;

(v) A single spillway or a combination of spillways configured as specified in paragraph (d)(1)(v)(A) of this section. 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 paragraph (d)(1)(v)(B) of this section.

(A) All spillways must be either:
(1) Of non-erodible construction and designed to carry sustained flows; or

(2) Earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.

(B) 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.

(vi) 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

(vii) 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.

(2) The periodic assessment described in paragraph (d)(1) of this section must identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

1.3 Brief Description of Impoundment

The Sibley Generating Station is a coal-fired power plant located near Sibley in Jackson County, Missouri. The Station is located east of Sibley and is bordered to the north by the Missouri River. The Fly Ash Impoundment is located approximately 0.5 miles east of the station. A site Location Map showing the area surrounding the station is in Figure 1 of Appendix A.

1.3.1 Design and Construction

The original construction of the impoundment was substantially completed in 1977. Earthen embankments were constructed to create the impoundment. The embankment is approximately 2,800 feet long, a maximum of 15 feet high, and has 3 to 1 (horizontal to vertical) side slopes covered with grassy vegetation. The embankment crest elevation is 725.0 feet (unless otherwise noted, all elevations in this plan are in the NGVD29 datum), and the crest width is 20 feet. The surface area of the impoundment as measured from the centerline of the impoundment embankment is approximately 17.8 acres. The impoundment water has a surface area of approximately 11.8 acres at the normal operating level of 722.3 feet.

1.3.2 Outlet Structures

Water discharges from the impoundment through an intake structure and an outlet structure located at the southeast corner of the impoundment. The concrete intake structure is located in the water on the interior slope of the eastern embankment. The structure has a weir submerged during normal operating conditions which allows water to flow into the structure. Water is then discharged into the outlet structure on the exterior slope of the east embankment. The outlet structure has several chambers, each with their own outlet device. Runoff discharges the site through the permitted NPDES outfall into a tributary that ultimately leads to the Missouri River.

1.4 Assessment Approach

An initial structural stability assessment was performed to document that the design, construction, operation, and maintenance of the impoundment 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 analyses used subsurface information collected from recent and historic subsurface investigations and laboratory testing data, reviews of engineering drawings, site inspections by AECOM and KCP&L personnel, AECOM inspections of hydraulic structures, and geotechnical evaluations conducted by AECOM. The following sections summarize the evaluations performed and the results from the analyses.

**Table 1-1** cross references 40 CFR §257.73(d) with the assessment section.

<table>
<thead>
<tr>
<th>Report Section</th>
<th>Title</th>
<th>CCR Rule Reference</th>
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<tr>
<td>2.1</td>
<td>Foundations and Abutments</td>
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<td>2.2</td>
<td>Slope Protection</td>
<td>§257.73 (d)(1)(ii)</td>
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<td>2.3</td>
<td>Dike Compaction</td>
<td>§257.73 (d)(1)(iii)</td>
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<td>Spillways</td>
<td>§257.73 (d)(1)(v)(A) and (B)</td>
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<td>Stability and Structural Integrity of Hydraulic Structures</td>
<td>§257.73 (d)(1)(vi)</td>
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<td>2.6</td>
<td>Downstream Slope Inundation/Structural Stability</td>
<td>§257.73 (d)(1)(vii)</td>
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<tr>
<td>2.7</td>
<td>Structural Stability Deficiencies</td>
<td>§257.73 (d)(2)</td>
</tr>
</tbody>
</table>
2 Structural Stability Assessment

Regulatory Citation: 40 CFR §257.73(d)(1); Conduct initial and periodic 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.

An initial structural stability assessment has been performed to document that the design, construction, and operation of the Fly Ash Impoundment is consistent with good engineering practices. The results of the structural stability assessment are discussed in the following sections.

2.1 Foundations and Abutments

CCR unit has been designed, constructed, operated, and maintained with stable foundations and abutments.

The stability of the foundations was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed to evaluate slip surfaces passing through the foundations. The Fly Ash Impoundment is an enclosed impoundment with dikes (embankments) and does not have abutments.

Based on this evaluation, stable foundations were designed and constructed at the Fly Ash Impoundment, and operational and maintenance procedures are appropriate to maintain the stable conditions. Therefore, the Fly Ash Impoundment meets the requirements presented in §257.73(d)(1)(i).

2.2 Slope Protection

CCR 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 adequacy of slope protection was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. In addition, since the impoundment is located adjacent to the Missouri River, slope stability analyses were conducted to evaluate the effects of sudden drawdown. These analyses are discussed in Section 2.6.

Based on this evaluation, adequate slope protection was designed and constructed at the Fly Ash Impoundment, and operational and maintenance procedures are appropriate to protect against surface erosion, wave action, and the adverse effects of sudden drawdown. Therefore, the Fly Ash Impoundment meets the requirements in §257.73(d)(1)(ii).

2.3 Dike Compaction

CCR 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 density of the dike materials was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed by AECOM to evaluate slip surfaces passing through the dikes over the range of expected loading conditions as defined within the section §257.73.

Based on this evaluation, the original design and construction of the Fly Ash Impoundment included sufficient dike compaction. The operational and maintenance procedures at the Fly Ash Impoundment are appropriate for
maintaining compaction of the dikes. Therefore, the Fly Ash Impoundment meets the requirements in §257.73(d)(1)(iii).

2.4 Spillways

CCR unit has been designed, constructed, operated, and maintained with a single spillway or a combination of spillways configured as specified in paragraph (A) and (B):

(A) all spillways must be either: (1) of non-erodible construction and designed to carry sustained flows; or (2) earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;

(B) 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
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/outfall structure was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM²,³. Additionally, hydrologic and hydraulic analyses were completed to evaluate the capacity of the spillway/outfall structure relative to inflow estimated for the 100-year flood event for the low hazard potential Fly Ash Impoundment⁵.

Based on this evaluation, the spillway/outfall structure was designed and constructed from non-erodible material and adequately manages flow during peak discharge conditions resulting from a 100-year flood event. The operational and maintenance procedures at the Fly Ash Impoundment are appropriate for maintaining the functionality of the spillway/outfall structure. Therefore, the Fly Ash Impoundment meets the requirements in §257.73(d)(1)(v)(A) and (B).

2.5 Stability and Structural Integrity of Hydraulic Structures

CCR unit has been designed, constructed, operated, and maintained with 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.

The structural stability and integrity of the hydraulic structures were evaluated by reviewing design drawings, operational and maintenance procedures, closed-circuit television pipe video, and conditions observed in the field by AECOM²,³.

Based on this evaluation, the spillway/outfall structure was designed and constructed and are operated and maintained in a manner where they are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris. Additionally, the spillway/outfall structure maintains structural integrity during the expected range in loading conditions. Therefore, the Fly Ash Impoundment meets the requirements in §257.73(d)(1)(vi).

2.6 Downstream Slope Inundation/Stability

CCR unit designed, constructed, operated and maintained with, 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.

The downstream slope of the Fly Ash Impoundment is susceptible to inundation by the Missouri River during periods of flooding. Slope stability analyses were conducted to evaluate the impacts of sudden drawdown of the river on the downstream slope of the impoundment. The analyses showed that the computed safety factor is appropriate for the conditions analyzed⁶. A summary of results from the analyses is listed in Table 2-1.
Table 2-1 – Summary of Sudden Drawdown Safety Factor Assessment

<table>
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<th>Loading Condition</th>
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<td>Sudden Drawdown</td>
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<td>1.32</td>
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* As Factor of Safety criteria for this analysis case is not included in the USEPA CCR §257.73(e) regulation, a minimum Factor of Safety of 1.30 was used for this loading condition. This minimum safety factor is listed in USACE EM 1110-2-1902* guidance for drawdown from normal pool (maximum storage pool).

Based on this evaluation, the Fly Ash Impoundment was designed, constructed, and is operated with downstream slopes that can maintain structural stability during low pool of the adjacent Missouri River and during sudden drawdown of the river. Therefore, the Fly Ash Impoundment meets the requirement of §257.73(d)(1)(vii).

2.7 Structural Stability Deficiencies

* Identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures. If a deficiency or a release is identified during the periodic assessment, the owner or operator unit must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken

No structural stability deficiencies were identified. Consequently, the Fly Ash Impoundment meets the requirements of §257.73(d)(2), so no corrective actions are required.
3 Limitations

Background information, design basis, and other data have been furnished to AECOM by KCP&L GMO, which AECOM has used in preparing this report. AECOM has relied on this information as furnished, and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM’s understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as observed by AECOM or provided by KCP&L GMO. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the findings, and revise the report if necessary.

This development of the Initial Structural Stability Assessment Report was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.
4 Certification Statement

**CCR Unit:** KCP&L GMO Sibley Generating Station, Fly Ash Impoundment

I, Brian D. Linnan, being a Registered Professional Engineer in good standing in the State of Missouri, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the Initial Structural Stability Assessment Report dated October 11, 2016, which includes all pages in Sections 1 and 2, was conducted in accordance with the requirements of 40 CFR § 257.73(d).

______________________________
Brian D. Linnan

*Printed Name*

______________________________
October 11, 2016

*Date*

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Kansas City, Missouri 64108
1-816-561-4443
5 References


Appendix A
Figures
About AECOM

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