HALEY ALDRICH

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REPORT ON

INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 001 – CELL 001
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
Clifton Hill, Missouri

File No. 128064-003
October 2016

HALEY & ALDRICH, INC.
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17 October 2016
File No. 128064-003

Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
5693 Highway F
Clifton Hill, Missouri 65244

Attention: Ms. Kim Dickerson
Senior Environmental Analyst

Subject: Initial Periodic Structural Stability Assessment
Pond 001 - Cell 001
Thomas Hill Energy Center
Clifton Hill, Missouri

Ms. Dickerson:

Enclosed please find our report on the Initial Periodic Structural Stability Assessment for the Associated Electric Cooperative, Inc. (AECI) Pond 001 - Cell 001 (Cell 001) coal combustion residuals (CCR) Surface Impoundment located at the Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri.

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

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Cell 001 surface impoundment; 2) visit the site to observe Cell 001; 3) evaluate whether the design, construction, operation, and maintenance of Cell 001 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our assessment including recommendations.

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

Sincerely yours,
HALEY & ALDRICH, INC.

Steven F. Putrich, P.E.
Project Principal

Enclosures

Cc: Mark Brownstein-Haley & Aldrich

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List of Figures

1. General

1.1 AUTHORITY

Haley & Aldrich, Inc. (Haley & Aldrich) has been contracted by Associated Electric Cooperative, Inc. (AECI) to perform the Initial Periodic Structural Stability Assessment (Assessment) for the AECI Pond 001 – Cell 001 (Cell 001) coal combustion residuals (CCR) surface impoundment located at Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri. This work was completed in accordance with the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(d).

1.2 PURPOSE OF STRUCTURAL STABILITY ASSESSMENT

The purpose of this Initial Structural Stability Assessment was to document whether the design, construction, operation, and maintenance of Cell 001 are consistent with recognized and generally accepted good engineering practices.

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Cell 001 surface impoundment; 2) visit the site to observe Cell 001; 3) evaluate whether the design, construction, operation, and maintenance of Cell 001 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our evaluation, including recommendations.

2. Description and Operation of Cell 001

2.1 DESCRIPTION OF CELL 001

Cell 001 is a CCR surface impoundment used for settling and temporary wet storage of bottom ash and boiler slag sluiced from Thomas Hill Units 1 and 2. CCR slurry is pumped from the power plant and discharges into the southwest corner of Cell 001 through two approximate 14-in. diameter pipes. After initial settling, water and suspended CCR enter a rectangular concrete decant structure equipped with 60-inch wide concrete stop logs, and flow via a 30-in. diameter concrete outlet pipe to a drainage channel which discharges into Cell 003.

It is understood that Cell 001 was originally designed by Burns & McDonnell in 1978-1979 and constructed shortly thereafter. The embankments were constructed from clayey fill obtained from an on-site borrow source. Underlying the embankment fill is naturally deposited stiff clay, which in turn is underlain by stiff shaley clay.

Historically, CCR that settled in Cell 001 were excavated from the impoundment and placed in the high and dry northern portion of Cell 002. The ash was then loaded onto trucks by a contractor who sold it for beneficial re-use. Excess CCR has been placed as mine reclamation.

In 2015, AECI constructed a CCR Processing and Containment Pad to allow continued removal and dewatering of CCR from Cell 001 in compliance with Federal CCR Regulation 40 CFR Part 257 Subpart D. The processing and containment pad was designed to allow removal and dewatering of CCR from Cell 001, with free liquids from the dredged CCR draining back into Cell 001. The construction included a 5-ft high containment berm to prevent CCR and free liquids from migrating outside the pad. Fill for the processing pad and containment berm consisted of clayey fill obtained from on-site borrow sources. The clay fill was keyed into the underlying natural clays, and a 2-ft thick compacted clay liner was placed below the processing and containment pad.

The Cell 001 impoundment has an area of approximately 2.3 acres. The Cell 001 embankments are generally 10 ft or less in height, with a crest width generally ranging from 15 to 20 ft. The containment berm defines the southern edge of the processing and containment pad. Beyond the containment berm, ground surface slopes downward to Cell 002 with a slope height of up to 30 ft.

2.2 OPERATION, MAINTENANCE AND INSPECTION

Cell 001 and the other cells within Pond 001 system are operated and managed by AECI personnel in accordance with AECI's "Operating and Management Plan" dated December 14, 2012 (Reference 1).

AECI personnel are conducting 7-day and annual inspections of the Cell 001 impoundment in accordance with EPA's Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257.83. In addition, the impoundment is inspected following heavy rain events. No instrumentation exists in the dike for the 30-day inspection.

Maintenance of the impoundment includes regular mowing of grass, seeding of thinly vegetated areas, control of woody growth, repair of erosion as needed, and inspection of the drain mechanisms.

Operation includes regular removal and processing of accumulated bottom ash and boiler slag from the impoundment, regulating and monitoring wastewater discharge from the plant to Cell 001, regulating water levels in the cell, and monitoring flow in the drainage channel from Cell 001 to Cell 003.

3. Structural Stability Assessment

3.1 REVIEW OF EXISTING INFORMATION

For this assessment, Haley & Aldrich reviewed multiple sources of information including:

- Report on the Initial Annual Inspection performed by AECI in accordance with 40 CFR §257.83, dated January 19, 2016
- Previous impoundment inspection reports by GEI (on behalf of EPA) and Geotechnology, Inc.
- Operating and Management Plan
- Topographic plans and aerial photos
- Construction drawings
- Subsurface information
- Geotechnical laboratory test results
- Slope stability evaluations
- Correspondence
- Variety of other information in addition to verbal information provided by AECI during our assessment.

Our review included, but was not limited to the references listed in Appendix A.

3.2 SITE VISIT AND FIELD OBSERVATIONS

On 29 August 2016, Haley & Aldrich visited Thomas Hill Energy Center to observe conditions at Cell 001, and to meet with AECI personnel to discuss operations and maintenance of the impoundment. Prior to the site visit, we reviewed previous inspection reports including the above-referenced Initial Annual Inspection Report by AECI, and previous inspection reports referenced above and listed in Appendix A. At the time of our site visit, Cell 001 was in operation with water levels at the normal operating level.

3.3 STRUCTURAL STABILITY ASSESSMENT

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

Haley & Aldrich reviewed the information provided to us and visited the site to observe Cell 001. Based on our review of available information and observations during our 29 August 2016 site visit, we have concluded the following in accordance with 40 CFR §257.73(d):

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

   Based on our review of available subsurface information, design/construction records, investigation reports, impoundment inspection reports, geotechnical laboratory test results, slope stability analyses, and observations during our 29 August 2016 site visit, Cell 001 was judged to have stable foundations. The Cell 001 embankments have not exhibited signs of excessive settlement, instability or other signs of inadequate foundation support.

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

   The Cell 001 interior slopes are covered with vegetation for the full height of the slopes. Based on observations during our 29 August 2016 site visit, the slope protection on the interior slopes was in good condition and was judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown.

   The exterior slopes are well vegetated with grass and were judged to have adequate slope protection.

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

   Records of the original construction of Cell 001 are not available. However, in 2001, Geotechnology, Inc. drilled three test borings through the Cell 001 embankments and into the underlying natural soils. The test borings indicate that the embankments consist of medium stiff clay fill with varying amounts of sand, gravel and slag.

   During our 29 August 2016 site visit, we observed no evidence of slope instability or other signs of inadequate compaction of the embankment fill. In addition, based on the information reviewed for this Structural Stability Assessment, there has been no historic evidence of slope instability or other signs of inadequate embankment compaction.

   Based on our review of the test boring logs and other available information on the Cell 001 embankments, as well as our observations during the 29 August 2016 site visit, we have concluded the fill soils used to construct the Cell 001 embankments were likely mechanically compacted during construction.

4. §257.73(d)(1)(iv): *Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection.*

   At the time of our 29 August 2016 site visit, the grass on the Cell 001 exterior slopes was typically 6 to 12 inches in height. During our site visit, AECI was mowing the interior slopes of Cell 001 using a recently purchased specialized mower that attaches to the boom of a Cat 330 long-reach excavator. The excavator has a 60-ft reach, enabling the equipment to mow areas that were previously inaccessible. After mowing, vegetation on the interior slopes was approximately 6 inches in length.

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

   The spillway in Cell 001 consists of the concrete decant structure located in the northwest corner of the impoundment. The concrete construction is non-erodible and designed to carry sustained flows.

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

   The spillway capacity for the impoundment is required to be modeled and analyzed in accordance with §257.82 Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundments. AECI will complete that capacity analysis requirement under separate cover, consistent with the CCR Rule Preamble reference to the same section.

7. §257.73(d)(1)(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.*

   Cell 001 hydraulic structures include the decant structure and outlet pipe. The rectangular concrete decant structure is located in the northwest corner of the impoundment. Flow entering the decant structure is conveyed through the Cell 001 west embankment via a 30-in. diameter reinforced concrete pipe which discharges to a drainage ditch that flows to Cell 003.

   The decant structure has some surface pitting on the concrete and surface rust on some of the metal components but was judged to be in good condition overall.

   The 30-inch discharge pipe is buried and is only visible for a few feet at each end of the pipe. There are no signs of ground settlement above or around the pipe. No sediment or debris were observed at either end of the outlet pipe.

8. §257.73(d)(1)(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.*

   There are no natural water bodies in the vicinity of Cell 001. Cell 002 exists immediately to the south of Cell 001 with normal operating levels below the elevation of the Cell 001 slope. The drainage channel west and southwest of Cell 001 that conveys flow from Cell 001 to Cell 003 also conveys other plant process water and coal pile runoff. Flow to this channel is controlled by the power plant, and their elevations and flow capacities prevent them from inundating the downstream slopes of Cell 001. As a result, inundation of the Cell 001 downstream slopes is not likely and no rapid drawdown potential exists.

9. *§257.73(d)(2): Identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures.*

   Our Structural Stability Assessment identified no structural stability deficiencies at Cell 001. However, we recommend the following maintenance actions:

   a. Maintain height of vegetation in accordance with §257.73(d)(1)(iv).

   b. Update Operating and Management Plan to reflect recent modifications to Cell 001 including the new processing and containment pad.

4. Conclusions/Certification

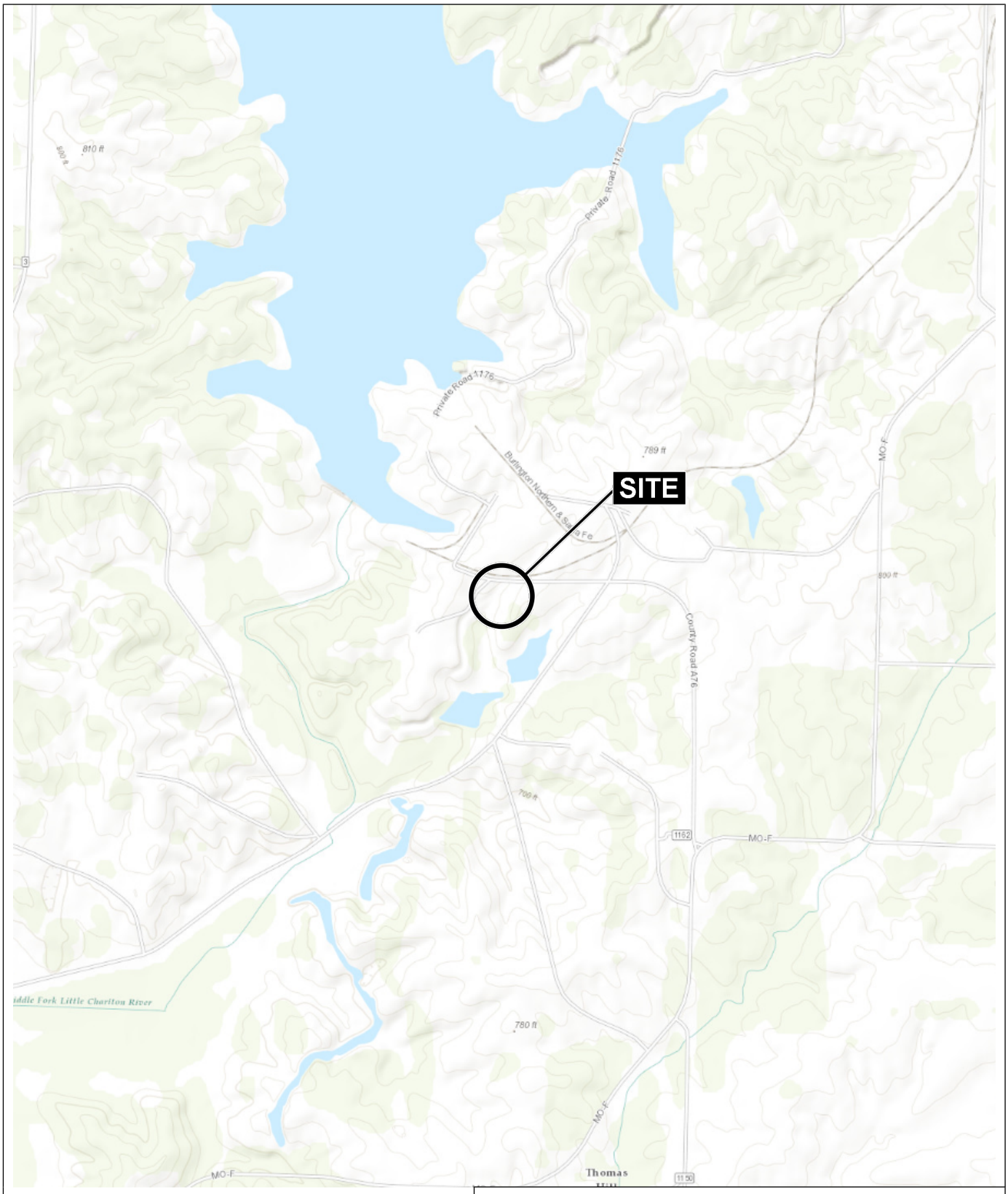
Based on our review of the information provided to us and observations during our 29 August 2016 site visit, it is our opinion that the design, construction, operation, and maintenance of Pond 001 – Cell 001 at Thomas Hill Energy Center is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded in Cell 001.

I certify that the Periodic Structural Stability Assessment for AECI's Pond 001 – Cell 001 at the Thomas Hill Energy Center was conducted in accordance with the requirements of §257.73(d) of the USEPA's CCR Rule.

Signed:_____
Certifying Engineer

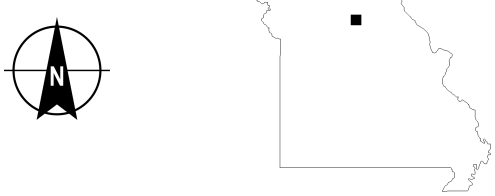
Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:



MAP SOURCE: ESRI

SITE COORDINATES: 39°32'51"N, 92°38'10"W



HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

POND 001 - CELL 001
PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
OCTOBER 2016

FIGURE 1

128064_1_LOCUS.PDF

LEGEND

- APPROXIMATE IMPOUNDMENT BOUNDARY
- WATER
- PIPE
- DITCH
- ROAD

NOTES

1. AERIAL IMAGERY PROVIDED BY GOOGLE EARTH PRO. PHOTO TAKEN ON 11 MAY 2015.

N

0 50 100
SCALE IN FEET

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CLIFTON HILL, MISSOURI

POND 001 - CELL 001
SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

APPENDIX A

References

References

1. AECI, “Pond #001, the Ash Pond Series Operating and Management Plan,” revised December 14, 2012.

2. AECI, “Report: Initial Annual CCR Surface Impoundment PE Inspection, Ash Pond 001 – Cell 001, Cell 002, Cell 003, Cell 004,” dated January 19, 2016.

3. Burns & McDonnell, Various Construction Drawings, dated 1979 and 1984.

4. GEI Consultants, “Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center,” dated June 2011.

5. Gredell Engineering Resources, Inc., “Project #3 – CCR Processing Pad & Containerization, Pond 001 Cell 1 – 2015, Project Description and Specifications,” dated September 9, 2015.

6. Gredell Engineering Resources, Inc., “Pond 001 Cell 1 CCR Processing Pad” Design and Construction Summary Report, dated December 2015.

7. Geotechnology, Inc., “Slope Stability and Seepage Analysis, Slag Dewatering Basin, Thomas Hill Energy Center,” dated February 3, 2012.