HALEY ALDRICH

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REPORT ON

INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 001 – CELL 004
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.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
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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 004
Thomas Hill Energy Center
Clifton Hill, Missouri

Ms. Dickerson:

Enclosed please find our report on the Initial Periodic Structural Stability Assessment (Assessment) for the Associated Electric Cooperative, Inc. (AECI) Pond 001 - Cell 004 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 Pond 001 – Cell 004 surface impoundment; 2) visit the site to observe Cell 004; 3) evaluate whether the design, construction, operation, and maintenance of Cell 004 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

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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 004 (Cell 004) 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 004 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 004 surface impoundment; 2) visit the site to observe Cell 004; 3) evaluate whether the design, construction, operation, and maintenance of Cell 004 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 004

2.1 DESCRIPTION OF CELL 004

Cell 004 is a CCR surface impoundment located to the south of the Thomas Hill power plant. Cell 004 was originally designed by Burns & McDonnell in 1978-1979 and constructed shortly thereafter. It is understood that Cell 004 was modified in the 1980's.

Cell 004 is the final settling pond and stores decant water from Cell 003 and a limited quantity of CCR material. The impoundment is surrounded mostly by earthen berms on all sides except for some portion that is natural ground in the northwest corner and other dike abutment areas. Maximum embankment height is approximately 15 ft. Exterior slopes range from approximately 4H:1V to 5H:1V with some flatter areas. Interior slopes are typically 3H:1V. Crest width varies from approximately 14 to 16 ft.

The embankments are constructed from clay fill obtained from an on-site borrow source. The embankments are underlain by naturally deposited soft to stiff clay with trace sand and/or gravel, which is in turn underlain by weathered limestone, siltstone or shale.

Cell 004 has a surface area of approximately 12 acres and total storage capacity of approximately 125 acre-feet as stated in the Initial Annual Inspection.

The outlet structure from Cell 004 consists of a rectangular concrete drop inlet tower equipped with 60-in. wide concrete stop logs. Decant water enters the structure and flows through a 48-in. diameter steel pipe that penetrates the Cell 004 south embankment and discharges from the NPDES-permitted Outfall #001 into a concrete open channel before flowing to the Middle Fork of the Little Chariton River.

The Cell 004 emergency spillway consists of an 18-ft wide riprap-lined channel which is approximately 2 ft in depth located across the crest of the south embankment. To provide vehicle access across the riprapped channel, the riprap has been topped off with a layer of crushed stone within the limits of access road.

2.2 OPERATION, MAINTENANCE AND INSPECTION

Cell 004 and the other cells within the 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 004 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 Cell 004 includes regular mowing of grass, seeding of thinly vegetated areas, control of woody growth, repair of erosion as needed, repair of riprap as needed, maintenance of the outfall to the Middle Fork of the Little Chariton River, and inspection of the drain mechanisms.

Operation includes regulating water levels in the impoundment, regulating and monitoring wastewater discharge from Cell 003 into Cell 004, and regulating and monitoring flow from Cell 004 to the outfall to the Middle Fork of the Little Chariton Rover.

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 004, 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 004 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 004. 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, impoundment inspection reports, geotechnical laboratory test results, slope stability analyses, and observations during our 29 August 2016 site visit, Cell 004 was judged to have stable foundations. The Cell 004 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.*

   Along the west embankment and northern half of the east embankment, the Cell 004 interior slopes are covered with vegetation for the full height of the slope. On all other interior slopes, riprap protection is provided on the lower 8 to 15 ft of the slope.

   Based on observations during our 29 August 2016 site visit, the slope protection on the interior slopes was judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown. The exterior slopes of Cell 004 are vegetated for the full height of the slopes 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.*

   Construction records are not available for the Cell 004 embankments.

   However, in 2010, Geotechnology, Inc. performed one test boring and one cone penetrometer sounding through the north embankment. In 2011, Geotechnology drilled one test boring through the south embankment and one boring at the exterior toe of the embankment. The borings and cone penetrometer were drilled through the embankment fill and into the underlying natural soils.

   The subsurface explorations indicate the embankment fill in the north embankment consists of medium stiff to stiff clay with varying amounts of silt, sand and gravel. In the south embankment, the borings encountered embankment fill generally consisting of medium stiff clay with varying amounts of gravel.

   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 subsurface exploration logs and other available information on the Cell 004 embankments, as well as our observations during the 29 August 2016 site visit, we have concluded the fill used to construct the Cell 004 embankments was mechanically compacted.

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.*

   The vegetation on the interior and exterior slopes of Cell 004 was generally 6 to 12 inches in height at the time of our 29 August 2016 site visit. AECI has recently purchased a 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 to conventional mowing equipment.

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 primary spillway in Cell 004 consists of the concrete decant structure located in the southwest corner of the impoundment. The concrete construction is non-erodible and designed to carry sustained flows.

   The emergency spillway in Cell 004 consists of an 18-ft wide riprap-lined channel which is approximately 2 ft in depth located across the crest of the west dike. The emergency spillway channel was judged to have adequate erosion protection to withstand short-term, infrequent 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 004 hydraulic structures include the rectangular concrete decant structure and outlet pipe. The decant structure was judged to be in good condition.

   Flow entering the decant structure is conveyed through the Cell 004 embankment and discharges from the NPDES-permitted Outfall #001 into a concrete open channel before flowing to the Middle Fork of the Little Chariton River. The discharge pipe is buried within the embankment and is not visible. There are no signs of ground settlement above or around the pipe. No sediment or debris was 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.

The only natural water body in the vicinity of Cell 004 is the Middle Fork of the Little Chariton River. Due to the limited size of the channel and the local topography, inundation of the Cell 004 downstream slopes by the Middle Fork of the Little Chariton River is not possible nor is a sudden drawdown condition.

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 004. However, we recommend the following maintenance actions:

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

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 004 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 004.

I certify that the Periodic Structural Stability Assessment for AECI's Pond 001 – Cell 004 at the Thomas Hill Energy Center was conducted in accordance with the requirements of §257.73(d) of the USEPA's Final CCR Rule.

Signed:_____
Certifying Engineer

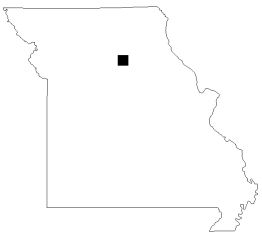
Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

HALEY ALDRICH

MAP SOURCE: ESRI

SITE COORDINATES: 39°32'28"N, 92°38'26"W



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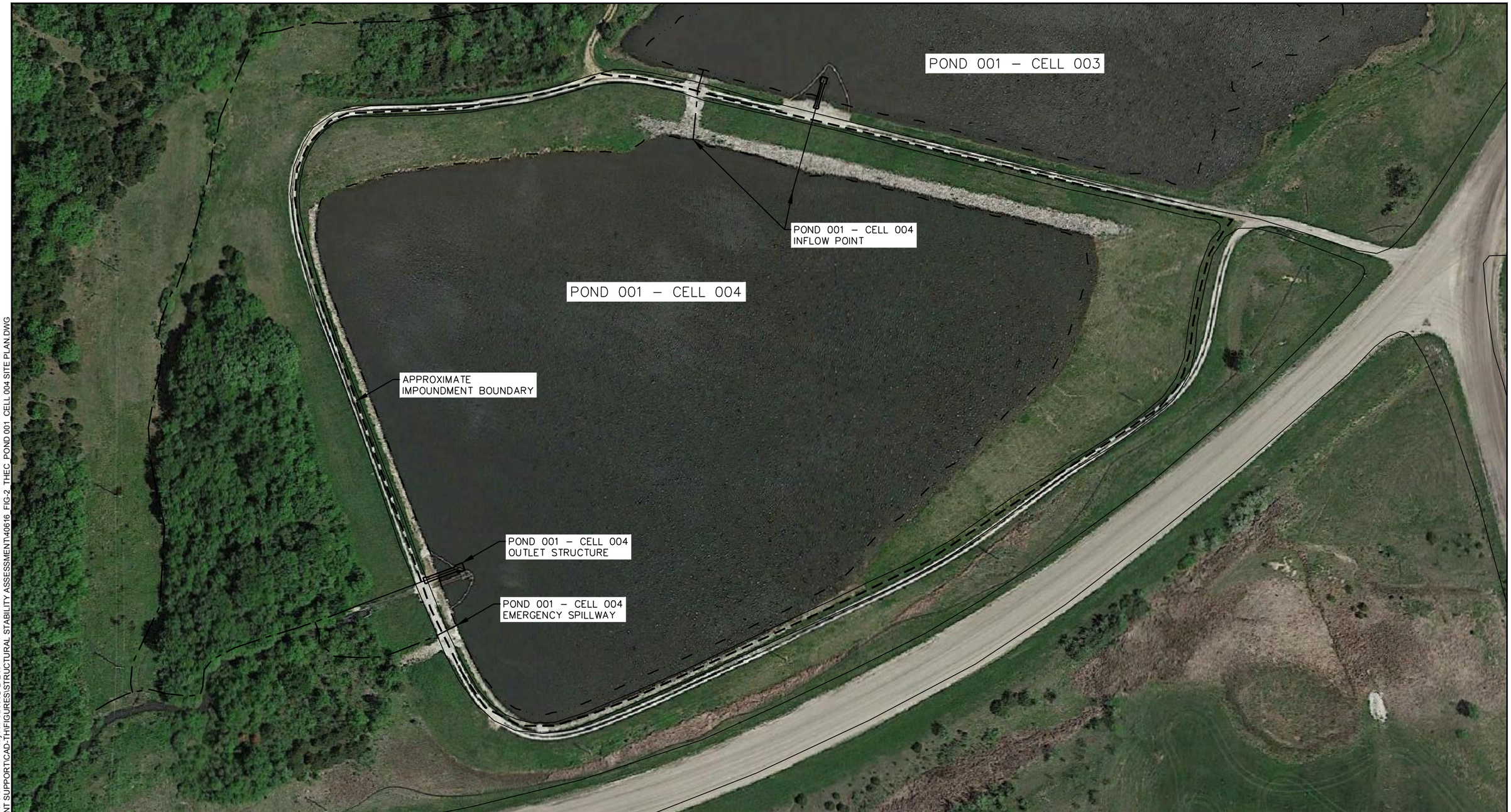
ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

POND 001 - CELL 004
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.

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0 120 240

SCALE IN FEET

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

POND 001 - CELL 004 SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

LUCAS, ANDY Printed: 10/3/2016 8:11 AM Layout: HA-FIG-B-L-H
G:\40616 AECI-CCR ELG MANAGEMENT SUPPORT\CAD-TH\FIGURES\STRUCTURAL STABILITY ASSESSMENT\40616_FIG-2_THEC_POND 001_CELL 004 SITE PLAN.DWG

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. Geotechnology, Inc., “Global Stability Evaluation, Mine Waste and Ash Pond Embankments, AECI Facilities, Bee Veer and Thomas Hill, Missouri,” dated April 22, 2010.

6. Geotechnology, Inc., “Slope Stability and Seepage Analysis, Ash Pond No. 3, Thomas Hill Energy Center,” dated February 3, 2012.