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REPORT ON

INITIAL PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 001 – CELL 003
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 003
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 003 (Cell 003) 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 003 surface impoundment; 2) visit the site to observe Cell 003; 3) evaluate whether the design, construction, operation, and maintenance of Cell 003 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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POND 001 – CELL 003
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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 003 (Cell 003) 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 003 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 003 surface impoundment; 2) visit the site to observe Cell 003; 3) evaluate whether the design, construction, operation, and maintenance of Cell 003 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 003

2.1 DESCRIPTION OF CELL 003

Cell 003 is a CCR surface impoundment located to the south of the Thomas Hill power plant. Cell 003 was originally designed by Burns & McDonnell in 1978-1979 and constructed shortly thereafter. It is understood that Cell 003 was modified in 1984.

Cell 003 is used for wet storage of fly ash, bottom ash, boiler slag and sediments from the coal pile runoff. Cell 003 is incised on the east and west sides. On the north side, an embankment with 18-ft crest width separates Cell 003 and Cell 002. The embankment is constructed from clay fill obtained from an on-site borrow source. The embankment is underlain by naturally deposited medium stiff to very stiff clay and silty clay. The north interior slope of Cell 003 varies from about 3H:1V to 2H:1V, while the north exterior slope is typically 3H:1V.

On the south side, an embankment with 16-ft crest width separates Cell 003 and Cell 004. The embankment is constructed from clay fill obtained from an on-site borrow source. The embankment is underlain by naturally deposited stiff clay with trace sand, which is in turn underlain by weathered limestone. The south interior and exterior slopes are typically 3H:1V. In 1984, the current south embankment was constructed and the original embankment was abandoned and left in place. The abandoned embankment is submerged at normal pool level.

Cell 003 has a surface area of approximately 13 acres and total storage capacity of approximately 160 acre-feet as stated in the Initial Annual Inspection.

Cell 003 receives decant water and suspended CCR from Cell 001 via an earthen bypass channel which flows from Cell 001 and around Cell 002, discharging into the northwest corner of Cell 003. In addition, stormwater and non-CCR process water from Cell 002 East flows to Cell 003, discharging from an underwater pipe in the northeast corner of the impoundment. During the 2015 modifications to Cell 002 West, a 15-in. corrugated metal pipe was installed through the Cell 002/003 embankment to convey water from Cell 002 to Cell 003. This pipe remains inactive as Cell 002 is maintained in a dry condition to facilitate the ongoing CCR removal from the impoundment.

The outlet structure from Cell 003 consists of a rectangular concrete drop inlet tower equipped with 60-in. wide concrete stop logs. Decant water entering the structure flows through a pipe that penetrates the common Cell 003/004 embankment and discharges underwater into Cell 004. The Cell 003 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 dike. 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.

Accumulated CCR is periodically dredged from Cell 003, generally in odd years, one half of the cell at a time at an approximate 4-year cycle for the full unit.

2.2 OPERATION, MAINTENANCE AND INSPECTION

Cell 003 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 003 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 regulating water levels in the impoundment, regulating and monitoring process water discharge from Cell 001 and Cell 002, and periodic dredging of accumulated CCR from the impoundment.

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 003, 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 003 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 003. 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 003 was judged to have stable foundations. The Cell 003 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 003 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 judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown. The exterior slopes of Cell 003 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.*

   Cell 003 is incised on the east and west sides. Constructed dikes around Cell 003 include the north and south embankments. The north embankment separates Cell 003 and Cell 002, while the south embankment separates Cell 003 and Cell 004.

   Construction records are not available for the north and south embankments. However, in 2010, Geotechnology, Inc. performed one test boring and one cone penetrometer sounding through the north embankment, and one test boring and one cone penetrometer sounding through the south embankment. The borings and cone penetrometers 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 stiff clay with trace silt and sand, while the fill in the south embankment consists of medium stiff to stiff clay with varying amounts of silt, sand and 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 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 003 embankments, as well as our observations during the 29 August 2016 site visit, we have concluded the fill used to construct the Cell 003 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 003 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. During our site visit, AECI was in the process of mowing such areas. After mowing, vegetation was approximately 6 inches in height.

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 003 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 003 consists of an 18-ft wide riprap-lined channel which is approximately 2 ft in depth located across the crest of the south 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 003 hydraulic structures include the rectangular concrete decant structure and outlet pipe. Flow entering the decant structure is conveyed through the Cell 003 south embankment and discharges underwater into Cell 004. The decant structure was judged to be in good condition.

   The discharge pipe is buried within the south 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.*

   There are no natural water bodies in the vicinity of Cell 003. Cell 002 exists immediately to the north (upstream) of Cell 003 and shares the northern edge of Cell 003, while Cell 004 exists immediately to the south (downstream) of Cell 003 and shares the south dike of Cell 003.

   The water level in Cell 004 is controlled by AECI using stop logs in the impoundment's outlet structure, thus a rapid drawdown condition is not a realistic possibility without a failure of its own berm. In addition, in 2010, Geotechnology, Inc. performed slope stability analyses on both the north

and south embankments of Cell 003 (Reference 5) and confirmed the stability of these embankments. Additional analyses for a Cell 004 sudden drawdown are recommended to confirm the stability of the Cell 003 berm under that unlikely scenario.

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 003. However, we recommend the following maintenance actions:

   a. Repair ruts on crest of the north embankment.

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

   c. Confirmation of Cell 003 structural stability following a sudden drawdown of Cell 004.

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 003 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 003.

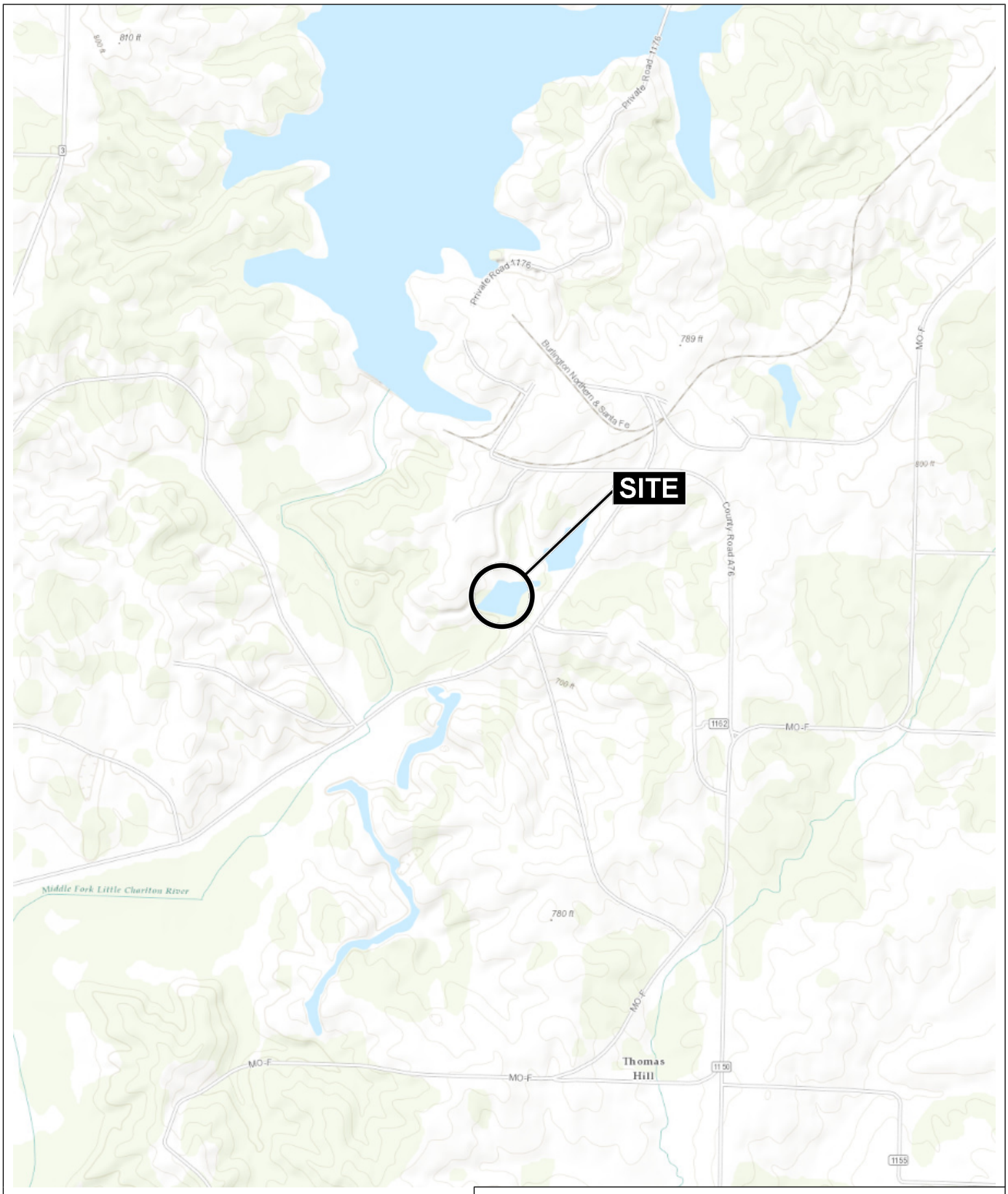
I certify that the Periodic Structural Stability Assessment for AECI's Pond 001 – Cell 003 at the Thomas Hill Energy Center was conducted in accordance with the requirements of §257.73(d) of the USEPA's Final CCR Rule.

Signed:_____
Certifying Engineer

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

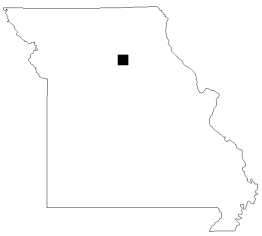
Professional Engineer's Seal:

HALEY ALDRICH



MAP SOURCE: ESRI

SITE COORDINATES: 39°32'34"N, 92°38'17"W



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

POND 001 - CELL 003
PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
OCTOBER 2016

FIGURE 1

128064_1_LOCUS.PDF

POND 001 – CELL 003
INFLOW POINT

POND 001 –
CELL 002 WEST

POND 001 –
CELL 002 EAST

POND 001 – CELL 003
INFLOW POINT

POND 001 – CELL 003
INFLOW POINT

APPROXIMATE
IMPOUNDMENT BOUNDARY

POND 001 – CELL 003

POND 001 – CELL 003
EMERGENCY SPILLWAY

POND 001 – CELL 003
OUTLET STRUCTURE

POND 001 – CELL 004

LEGEND

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

NOTES

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

N

0 120 240
SCALE IN FEET

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CLIFTON HILL, MISSOURI

POND 001 - CELL 003
SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

LUCAS, ANDY Printed: 10/15/2016 12:21 PM 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 003 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. Gredell Engineering Resources, Inc., “CCR Separation Berm - Pond 001 Cell 2 – 2015, Project Description and Specifications,” dated October 1, 2015.

7. Gredell Engineering Resources, Inc., “Pond 001 Cell 2 Separation Berm” Design and Construction Summary Report, dated November 2015.

8. Gredell Engineering Resources, Inc., “Ash Pond 001 Cell 2 Separation Berm” Construction Drawings, dated October 2015.