Stantec Consulting Services Inc.
10509 Timberwood Circle, Suite 100, Louisville, Kentucky 40223-5308

October 12, 2021
File: rpt_009_let_175568465
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Periodic Static Safety Factor Assessment
East Ash Disposal Area
EPA CCR Rule
TVA Allen Fossil Plant
Memphis, Tennessee

1.0 PURPOSE

This letter documents certification that the East Ash Disposal Area at the Tennessee Valley Authority (TVA) Allen Fossil Plant is in compliance with the static safety factor requirements set forth in 40 CFR 257.73(e)(1)(i)&(ii) of the EPA CCR Rule. The EPA CCR Rule requires periodic safety factor assessments, certified by a professional engineer, every five years. The initial certification of static safety factor was placed in the operating record on October 12, 2016.

2.0 INITIAL STATIC SAFETY FACTOR ASSESSMENT

The initial static safety factor assessment (Stantec 2016) is attached. The assessment calculated the static factors of safety for the following loading conditions:

- Long-term, maximum storage pool; and
- Maximum surcharge pool.

Stantec compiled and reviewed available historical site, topographic, and geotechnical data for the East Ash Disposal Area as part of the initial assessment and identified Section E-E' as the most critical cross section. The critical section was analyzed for the loading conditions specified in 40 CFR 257.73(e)(1)(i) and (ii). The result of the initial assessment was that East Ash Disposal Area complied with 40 CFR 257.73(e)(1)(i) and (ii).

3.0 CURRENT STATIC SAFETY FACTOR ASSESSMENT

Stantec reviewed the result of the initial static safety factor assessment and the changes in site conditions that have occurred in the past five years. The following items summarize changes that have occurred:

1. East Ash Disposal Area ceased receiving CCR and non-CCR waste streams. The main spillway has been temporarily plugged, and a drawdown/dewatering pump system has been installed that discharges to the Mississippi River.

2. East Ash Disposal Area operating pool level has decreased from El. 225.7 ft to El. 219.6 ft which improves the stability by reducing pore water pressure.

3. Cross-sectional geometry of the perimeter dike system has not changed.

4. Additional geotechnical data was obtained during October 2016 for a supplemental seismic stability assessment for Cross Section E-E' at East Ash Disposal Area (Geocomp 2016). This additional data was reviewed, and it was determined that changes in the static safety factor analyses are not warranted.

5. Annual and weekly inspections conducted since 2015 were reviewed as part of this assessment. No areas of interest were identified that would warrant remediation of static stability conditions.

6. Monthly instrumentation (i.e., piezometer) monitoring conducted since 2015 has been reviewed and the phreatic condition at the critical cross section has reduced or remained consistent.

Based on our review, there are no conditions that have changed in the past five years that would cause the result of the initial static stability assessment to have changed.

4.0 SUMMARY OF ASSESSMENT

Based on review of the initial static safety factor assessment and the items listed in Section 3.0, the result of this periodic static safety factor assessment is that the East Ash Disposal Area at the Allen Fossil Plant meets the requirements of §257.73(e)(1)(i)&(ii) of the EPA CCR Rule.

Re: **Periodic Static Safety Factor Assessment**
East Ash Disposal Area
EPA CCR Rule
TVA Allen Fossil Plant
Memphis, Tennessee

5.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stephen H. Bickel, being a Professional Engineer in good standing in the State of Tennessee, do hereby certify, to the best of my knowledge, information, and belief:

1. That the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. That the information contained herein is accurate as of the date of my signature below; and
3. That this periodic static safety factor assessment for the TVA Allen Fossil Plant's East Ash Disposal Area meets the requirements of 40 CFR 257.73(e)(1)(i) and (ii).

SIGNATURE ______________________ DATE 10/12/2021

ADDRESS: Stantec Consulting Services Inc.
10509 Timberwood Circle, Suite 100
Louisville, Kentucky 40223-5308

TELEPHONE: (502) 212-5075

ATTACHMENTS: Initial Static Safety Factor Assessment Report

References:

Stantec Consulting Services Inc. (2016). Initial Safety Factor Assessment, Allen Fossil Plant, East Ash Disposal Area, Memphis, Tennessee. Prepared for Tennessee Valley Authority, October 6

Geocomp (2016). Initial Seismic Safety Factor Assessment, EPA Final CCR Rule, TVA Allen Fossil Plant East Ash Disposal Area, Memphis, Tennessee; October 14

INITIAL STATIC SAFETY FACTOR ASSESSMENT

Stantec Consulting Services Inc.
10509 Timberwood Circle, Suite 100, Louisville, Kentucky 405223-5308

October 6, 2016
File: rpt_001_let_172675014
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Initial Static Safety Factor Assessment
East Ash Disposal Area
EPA Final CCR Rule
TVA Allen Fossil Plant
Memphis, Tennessee

1.0 PURPOSE

This letter documents Stantec's certification of the initial static safety factor assessment for the TVA Allen Fossil Plant's (ALF) East Ash Disposal Area. Based on this assessment, the East Ash Disposal Area is in compliance with the static factors of safety specified in the EPA Final CCR Rule at 40 CFR 257.73(e)(1)(i) and (ii).

2.0 INITIAL STATIC SAFETY FACTOR ASSESSMENT

The initial static safety factor assessment conducted pursuant to 40 CFR 257.73(e) addresses the following static factors of safety:

- Long-term, maximum storage pool loading condition; and
- Maximum surcharge pool loading condition.

Stantec compiled and reviewed available historical site, topographic, and geotechnical data for the TVA Allen Fossil Plant's East Ash Disposal Area as of December 11, 2015. A complete listing of documents reviewed is included in the attached references.

Based upon its review of these available documents, Stantec identified one cross section that had been previously analyzed as part of a prior stability assessment associated with the TVA Allen Fossil Plant's East Ash Disposal Area and was identified in that assessment as the most critical cross section. This cross section is designated Section E-E', and it was analyzed for the loading conditions specified in 40 CFR 257.73(e)(1)(i) and (ii).

Re: **Initial Static Safety Factor Assessment**
East Ash Disposal Area
EPA Final CCR Rule
TVA Allen Fossil Plant
Memphis, Tennessee

3.0 SUMMARY OF FINDINGS

The attached calculation package presents the new static safety factor assessment for Section E-E' for the loading conditions specified in 40 CFR 257.73(e)(1)(i) and (ii). The calculated static factors of safety are shown in the following table. The results show that the calculated static factors of safety for Section E-E' exceed the minimum safety factors required under 40 CFR 257.73(e)(1)(i) and (ii).

Plant	Facility	Critical Cross Section	EPA Criteria	EPA Required Factor of Safety (FOS)	Calculated FOS
ALF	East Ash Disposal Area	E-E'	Long-term maximum storage pool loading condition	1.50	1.66
			Maximum surcharge pool loading condition	1.40	1.65

4.0 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

I, Stephen H. Bickel, being a Professional Engineer in good standing in the State of Tennessee, do hereby certify, to the best of my knowledge, information, and belief:

1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and

Re: **Initial Static Safety Factor Assessment**
East Ash Disposal Area
EPA Final CCR Rule
TVA Allen Fossil Plant
Memphis, Tennessee

3. that the initial static safety factor assessment for the TVA Allen Fossil Plant's East Ash Disposal Area presented in the table above meets the requirements of the static factors of safety specified in 40 CFR 257.73(e)(1)(i) and (ii).

SIGNATURE ____________ DATE 10/6/2016

ADDRESS: Stantec Consulting Services Inc.
10509 Timberwood Circle, Suite 100
Louisville, Kentucky 40223-5308

TELEPHONE: (502) 212-5075

ATTACHMENTS: Safety Factor Assessment Calculation Package

STEPHEN H. BICKEL
REGISTERED ENGINEER
AGRICULTURE
COMMERCE
No. 113134
STATE OF TENNESSEE

Safety Factor Assessment

Allen Fossil Plant –
East Ash Disposal Area
Shelby County, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

Prepared by:
Stantec Consulting Services Inc.
Louisville, Kentucky

October 6, 2016
Revision 0

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1.0 INTRODUCTION

1.1 OBJECTIVE

On April 17, 2015 the "Final Rule: Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (Environmental Protection Agency, 2015) was published in the Federal Register. Stantec Consulting Services, Inc. (Stantec) was contracted by the Tennessee Valley Authority (TVA) to analyze the Structural Integrity Criteria for the Allen Fossil Plant (ALF) CCR surface impoundment and to evaluate compliance with §257.73 of the EPA Final CCR Rule.

1.2 OUTLINE OF RULE REQUIREMENTS

As required by §257.73 of the EPA Final CCR Rule, an initial structural integrity evaluation is required by October 17, 2016 and must include an initial safety factor assessment for each existing CCR surface impoundment that meets the conditions of paragraph (b) as follows:

1. Has a height of five feet or more and a storage volume of 20 acre-feet or more or
2. Has a height of 20 feet or more.

The safety factor assessment must document whether the calculated factors of safety for each existing CCR surface impoundment perimeter dike demonstrate the minimum static safety factors specified in paragraphs (e)(1)(i) and (e)(1)(ii) of the EPA Final CCR Rule for the critical cross section of the embankment.

Table 1 Factor of Safety Criteria

EPA Final CCR Rule Criteria	EPA Final CCR Rule Required Factor of Safety	EPA Final CCR Rule Reference
Long-term, maximum storage pool loading condition	1.50	§257.73(e)(1)(i)
Maximum surcharge pool loading condition	1.40	§257.73(e)(1)(ii)

In addition, in accordance with paragraph (f)(2), the owner or operator of the existing CCR surface impoundment may elect to use a previously completed assessment to serve as the initial assessment required by paragraph (e) of the EPA Final CCR Rule provided that the previous assessment(s) was completed no earlier than 42 months prior to October of 2016 and meets the applicable requirements of paragraph (e) of the EPA Final CCR Rule. Note that only the static slope stability analyses load cases are covered in this assessment.

1.3 DESCRIPTION OF STRUCTURE

Allen Fossil Plant (ALF) is a coal-fired, electric-generating plant. The plant is located in Shelby County, Tennessee near McKellar Lake adjacent to the Mississippi River. TVA has determined that the East Ash Disposal Area, encompassing the East Dredge Cell, East Ash Pond, and East Ash Stilling Pond, is a CCR surface impoundment and, therefore, is subject to the EPA Final CCR Rule. Figure 1 shows the location of the East Ash Disposal Area.

Figure 1 Allen Fossil Plant – East Ash Disposal Area

2.0 PROJECT RECONNAISSANCE

2.1 REVIEW OF EXISTING DATA

The existing data review included the following documents:

- Stantec Consulting Services Inc. (2015). *Inflow Design Flood Control System Plan, Allen Fossil Plant – East Ash Disposal Area, Shelby County, Tennessee.* Prepared for Tennessee Valley Authority, October 19 (DRAFT).
- Stantec Consulting Services Inc. (2011). *Geotechnical Report for the Evaluation of Dike Stability. Remedial Measures for the Eastern Perimeter Dike, East Stilling Pond. Allen Fossil Plant. Memphis, Tennessee*. Prepared for Tennessee Valley Authority, May 11.
- Stantec Consulting Services Inc. (2010a). *Report of Geotechnical Exploration and Evaluation of Slope Stability. Northern Perimeter Dike, East Active Ash Pond. Allen Fossil Plant. Shelby County, Tennessee*. Prepared for Tennessee Valley Authority, March 25.
- Stantec Consulting Services Inc. (2010b). *Report of Geotechnical Exploration and Evaluation of Slope Stability. Eastern Perimeter Dike, East Stilling Pond. Allen Fossil Plant. Shelby County, Tennessee*. Prepared for Tennessee Valley Authority, February 4.
- Stantec Consulting Services Inc. and URS Corporation (2014). *Instrumentation and Monitoring Plan (Rev. 2), Instrumentation Monitoring Program, Coal Combustion Product Storage Facilities, Various Plants, Alabama, Kentucky and Tennessee.* Prepared for Tennessee Valley Authority, September 30.
- Tennessee Valley Authority (2015). ALF151411_CAD.dwg. *ALF Hydrographic Data*. February 2. Supplemented by alf_eastactive_20150202.txt, alf_stilling_20150202.txt.
- Tuck Mapping Solutions, Inc. (2014). V-ET.dwg. *ALF Topographic Data.* March 11. Big Stone Gap, VA. Prepared for Tennessee Valley Authority.
- United States Army Corps of Engineers (USACE) (2009). Letter from Melissa Flanigan Mullen, P.E., Levee Safety Program Manager, Memphis District to Stuart Harris, P.E., Program Manager\Bi-Products Disposal, Tennessee Valley Authority. Subject: Slope Stability Failure, Memphis Port Authority Mississippi River Levee, Tennessee Valley Authority – Allen Steam Plant, Memphis, TN. May 6.

2.2 DATA GAPS

During the existing data review Stantec did not identify data gaps that would require additional geotechnical drilling/sampling, instrumentation, laboratory testing, or field surveying.

3.0 SUMMARY OF FIELD INVESTIGATIONS AND LABORATORY TESTING

Three geotechnical explorations were performed to characterize the northern and eastern perimeter dikes and the divider dike (between the East Ash Pond and East Stilling Pond) of the East Ash Disposal Area. Stantec (2010a) performed drilling and sampling eight soil test borings along the crest and near the exterior toe of the northern perimeter dike between July 14 and July 19, 2009. Stantec (2010b) also performed drilling and sampling five soil test borings along the crest and exterior toe of the eastern perimeter dike between July 15 and July 19, 2009. Stantec (2011) performed three soil test borings and two offset borings along the crest of the divider dike between February 2 and February 8, 2011. The geotechnical explorations, laboratory testing, and conclusions were used as the basis for this analysis and are found in the reports referenced in Section 2.1.

Recent topographic and bathymetric data was provided for the East Ash Disposal Area (Tennessee Valley Authority, 2015; Tuck Mapping Solutions, Inc., 2014).

Note that a supplemental geotechnical exploration and seismic stability analyses are being performed by Geocomp as part of the EPA Final CCR Rule compliance effort for §257.73(e)(1)(iii) and (iv). The seismic work is being performed concurrently with this stability analysis, and its data is not available for use in this report.

4.0 DETAILED TASK ANALYSIS CRITERIA

4.1 MATERIAL PROPERTIES

An overview of the subsurface conditions at the East Ash Disposal Area's eastern dike is summarized in Table 2. A more in-depth review is found in Stantec (2010b).

Table 2 Generalized Subsurface Conditions

Materials	Approximate Elevation	General Consistency/Density
Dike fill – consists of sandy silt, silty sand, silty clay, sandy clay, and lean clay	El. 237 to El. 210	Stiff to very stiff / medium dense
Alluvium – Irregularly bedded sandy silt, silty sand, silt, lean clay, sand, and fat clay	El. 210 to El. 175 (termination depth)	Very soft to stiff / very loose to medium dense

During the 2009 geotechnical explorations, Stantec performed a laboratory testing program consisting of natural moisture content determinations, sieve and hydrometer analyses, Atterberg limits, specific gravity determinations, consolidated-undrained triaxial compression tests, and permeability tests. The strength parameters derived using the laboratory data and used in this static safety factor evaluation are presented in Table 3. The results of the laboratory testing and derivation of the strength parameters can be found in Stantec (2010a, 2010b, and 2011).

Table 3 Strength Parameters for Stability Analysis for the Eastern Perimeter Dike

Soil Horizon	Saturated Unit Weight (pcf)	Wet Unit Weight (pcf)	Effective Stress Strength Parameters		Total Stress Strength Parameters	
			c' (psf)	ϕ' (degrees)	c' (psf)	ϕ' (degrees)
Dike Fill – Sandy Silt, Silty Sand Shell	124	120	0	31	200	22
Hydraulically Placed Ash	105	95	0	25	0	10
Compacted Bottom Ash	123	110	0	34	0	34
Riprap	120	120	0	38	0	38
Foundation – Sandy Silt	125	125	0	30	200	22
Foundation – Silt and Sandy Silt	115	110	0	28	200	12
Foundation - Lean and Fat Clay	115	110	0	26	400	12
Divider Dike Fill – Coarse Sand	120	115	0	34	0	34
Dike Fill – Sandy Silt Core	125	125	0	31	200	22

4.2 CRITICAL CROSS SECTION SELECTION

Historic steady-state slope stability analyses were available from Stantec (2010a and 2010b) and Stantec and URS (2014). Five primary cross sections were previously analyzed, labeled A-A' through E-E'. Figure 2 shows a plan view of the East Ash Disposal Area and the cross sections previously analyzed.

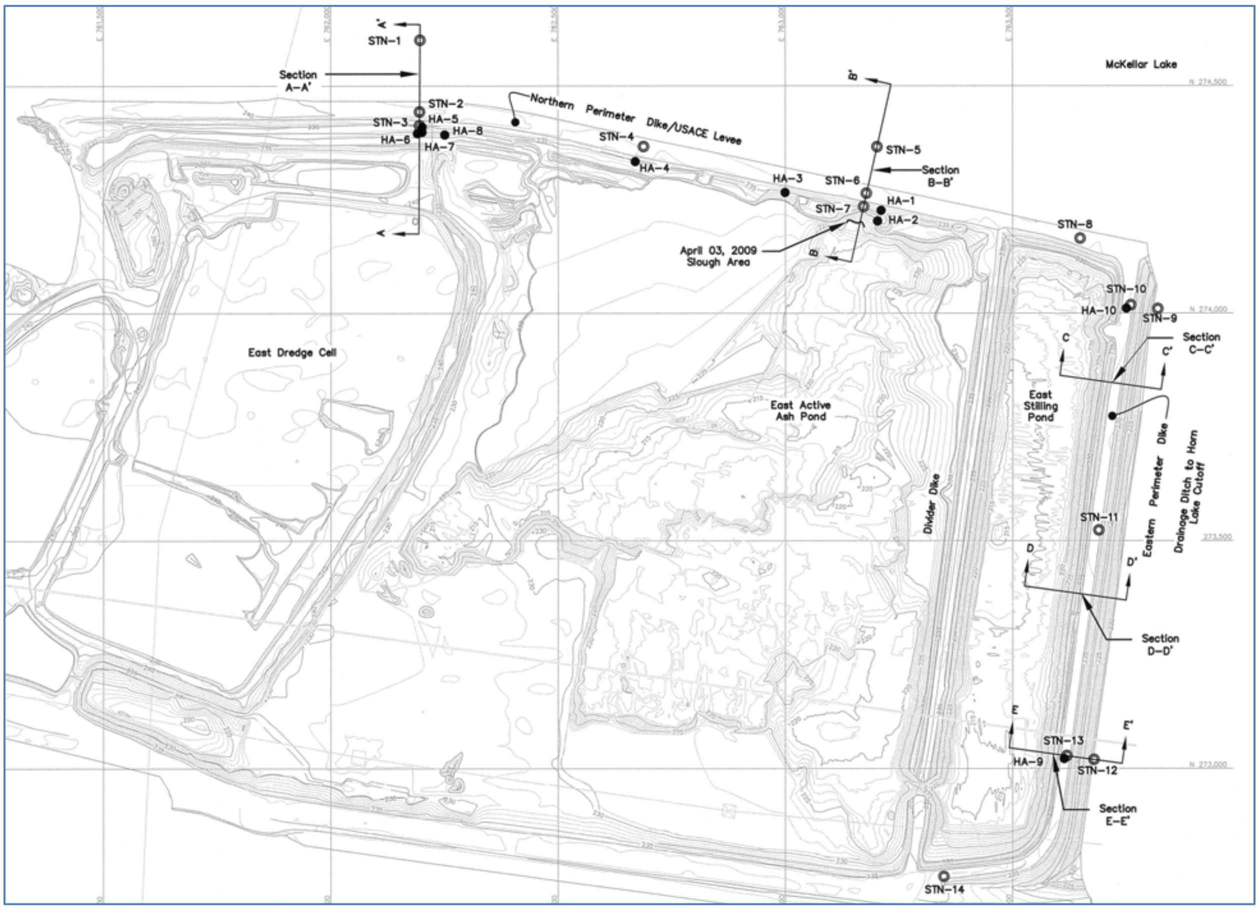


Figure 2 ALF East Ash Disposal Area – Plan View of Cross Sections
(Stantec, 2010a)

Sections A-A' and B-B' reflect the geometry along the northern perimeter dike of the East Ash Pond, constructed by the U.S. Army Corps of Engineers along McKellar Lake. Sections C-C', D-D', and E-E' reflect the geometry along the eastern perimeter dike, separating the East Ash Stilling Pond and the drainage channel to the Horn Lake Cutoff.

To determine if the five previous cross sections were still representative of field conditions, a review of recent construction activities, topographic, and bathymetric information was performed. The follow modifications were made to the East Ash Disposal Area since 2009:

- The water level was lowered in the East Stilling Pond.
- A riprap buttress was constructed on the east slope of the divider dike between the East Ash Pond and the East Stilling Pond.
- A sanitary sewer bypass line was constructed on the East Dredge Cell, and the sluice channel has been rerouted.

These structural modifications do not affect the exterior slope topography and the static slope stability analyses. Recent topographic data (Tennessee Valley Authority, 2015) indicated no change to the exterior slope of the East Ash Disposal Area. Minor geometry modifications were made to the models based on recent bathymetric data (Tuck Mapping Solutions, Inc., 2014). The model surface geometry and material properties provided in the historical reports were used in this static safety factor assessment.

The summary of the historic static slope stability results are listed in Table 4.

Table 4 Historic Static Slope Stability Results

Cross Section	Exterior Slope Global Failure	Pool Elevation	Reference
A-A'	2.0	Normal Pool	Stantec (2010a)
	1.8	Max. Storage Pool	
	1.6	Max. Surcharge Pool	
B-B'	2.2	Normal Pool	Stantec (2010a)
	1.9	Max. Storage Pool	
	1.6	Max. Surcharge Pool	
C-C'	1.7	Stilling Pond Pool 226 feet	Stantec (2010b)
D-D'	1.7	Stilling Pond Pool 226 feet	Stantec (2010b)
E-E'	1.5	Stilling Pond Pool 226 feet	Stantec (2010b)
A-A'	1.9	Dredge Cell 227.1, McKellar Lake 212.9	Stantec and URS (2014)
B-B'	2.4	Dredge Cell 226.2, McKellar Lake 212.9	Stantec and URS (2014)
C-C'	1.8	Stilling Pond 225.3, Horn Lake Cutoff 213	Stantec and URS (2014)
D-D'	1.7	Stilling Pond 223.6, Horn Lake Cutoff 213	Stantec and URS (2014)
E-E'	1.6	Stilling Pond 221.9, Horn Lake Cutoff 213	Stantec and URS (2014)

The eastern dike cross sections (C-C', D-D', and E-E') resulted in lower factors of safety than the northern cross sections in Stantec and URS (2014). The geometry within Sections C-C', D-D', and E-E' is similar with factor of safety differences based on the surface topography at the toe of slope. Section E-E' has a mild depression at the toe of slope and resulted in the lowest factor of safety for Stantec and URS (2014). For static slope stability, Section E-E' was selected as the critical cross section based on previous stability analyses results and current field conditions.

4.3 WATER LEVELS

Referring to Stantec (2015), the water elevations for East Ash Pond and Stilling Pond were redefined to meet the requirements of the EPA CCR Rule inflow design flood cases [§257.82(a)]. The long-term maximum storage pool elevation is the operating pool levels obtained from hydrographic survey dated February 2 and 3, 2015 (Tennessee Valley Authority, 2015). The maximum surcharge pool elevation is the pool level determined for the "Late Storm Peak with Valves Closed" 1,000-year, 6-hour storm.

The pond elevations proposed for the static slope analyses are summarized in Table 5.

Table 5 Water Elevations for Stability Modeling

CCR Rule Criteria	East Ash Pond Elevation (feet, NGVD29)	Stilling Pond Elevation (feet, NGVD29)
Long-term maximum storage pool loading condition	229.9	225.7
Maximum surcharge pool loading condition	231.8	230.9

The Horn Lake Cutoff is a wetland east of the East Ash Disposal Area. Tailwater information for this area is unavailable. Water was modeled at the ground surface for the long-term maximum storage pool analysis. Stantec (2015) assumed tailwater for the Horn Lake Cutoff to be equal to the 100-year lake elevation (225 feet). During the maximum surcharge analysis, the tailwater elevation was conservatively maintained at the ground surface, neglecting potential surcharge loading from the short-term pool conditions at the toe of the dike.

4.4 ANALYSIS METHODOLOGY

Stantec performed the static slope stability analyses using the GeoStudio 2007, Version 7.23 software package developed by GEO-SLOPE International, Ltd. of Calgary, Alberta, Canada (GEO-SLOPE International, Ltd, 2007). This package includes the SLOPE/W module for slope stability analysis. The analyses were performed in accordance with the guidelines in USACE Design Manuals EM 1110-2-1902 "Slope Stability" (United States Army Corps of Engineers, 2003).

4.4.1 Long-Term Maximum Storage Pool

A drained, effective stress analysis was performed for this load case to evaluate slope stability in the downstream direction. The headwater level is the "long-term maximum Storage pool" level provided in Table 5. The tailwater level is the top of the ground surface.

The phreatic surface and steady-state pore pressures are based on the static piezometric line of the dam at this pool level. The piezometric line is a straight-line assumption within the embankment. The required minimum factor of safety corresponds to the entry for "long-term maximum storage pool" in Table 6.

4.4.2 Maximum Surcharge Pool

The maximum surcharge pool load condition is created by a rapid pool level rise during a flood. It is a temporary water level, higher than the normal pool, which does not last long enough to develop steady-state seepage within the dam embankment and foundation (USACE, 2003). The pool is assumed to rise faster than water can flow in or out of fine-grained soils, and the surcharge pressure may cause shear-induced, excess pore pressures in the saturated zones. This assumption is based on the significance of the surcharge pressure with respect to the size of the dike.

Performed as an undrained analysis, materials below the phreatic surface are considered saturated and modeled using undrained material properties. The partially saturated zones above the phreatic surface are modeled using drained material properties.

The headwater level is the "long-term maximum storage pool" level provided in Table 5. Tailwater level is defined in Section 4.3. The phreatic surface and steady-state pore pressures are based on the static piezometric line of the dike at this pool level. The piezometric line is a straight-line assumption within the embankment. A surcharge pressure is applied to the ground surface reflecting the additional pressure load from the maximum surcharge pool loading condition. Surcharge pressures are discussed further in Section 5.0.

The slope stability in the downstream direction is evaluated. The required minimum factor of safety corresponds to the entry for "long-term maximum surcharge pool" in Table 5.

4.5 ACCEPTANCE CRITERIA

The following summary is taken from the EPA's CCR Rule §257.73(e). The factor of safety assessment criteria are explicitly outlined in Table 1.

5.0 ANALYSIS ASSUMPTIONS

The following assumptions apply to this analysis.

- Historical strength parameters were assumed to be appropriate for the analysis (Section 4.1).
- Section E-E' is the critical cross section for static slope stability (Section 4.2).
- The tailwater corresponds to the Horn Lake Cutoff, which is controlled by the McKellar Lake elevation (Section 4.3). Tailwater elevation for modeled at the ground surface for both analyses.
- The piezometric line for the long-term maximum storage case is defined by a straight-line assumption within the embankment between the pool level and the tailwater (Section 4.4.1).
- The surcharge pool is assumed to not last long enough to develop steady-state seepage within the dam embankment and foundation.
    - The piezometric line is a straight-line assumption within the embankment between the headwater (maximum storage) and tailwater pool elevations.
    - A surcharge pressure is applied to the slow-draining soils along ground surface, reflecting the difference in the elevation between the surcharge pool and the maximum storage pool.
    - The surcharge pressure is assumed not to apply to fully drained surficial soils. The pore pressures will be computed using a second piezometric line that corresponds to the maximum surcharge pool condition.
    - Materials below the phreatic surface are assumed to be saturated and modeled using undrained material properties. The partially saturated zones above the phreatic surface are modeled using drained material properties.

6.0 ANALYSIS RESULTS

The slope stability assessments presented in this report are focused on the potential for slope failures of significant mass, which could directly impact potential release of water and CCR materials from the ALF's East Ash Disposal Area. The search for a critical slip surface in the slope stability assessments is thus restricted to consider only potential surfaces where the depth (measured at the base of at least one slice) is more than 10 feet vertically below the ground surface. A summary of the static safety factor evaluation results at the East Ash Disposal Area Section E-E' is summarized in Table 6. Appendix A includes the results of the slope stability analyses referenced below.

Table 6 Factor of Safety Assessment Results

Plant	Facility	Critical Cross Section	EPA Criteria	EPA Final CCR Rule Required Factor of Safety	Calculated Factor of Safety
ALF	East Ash Disposal Area	E-E'	Long-term maximum storage pool loading condition	1.50	1.66
			Maximum surcharge pool loading condition	1.40	1.65

7.0 CONCLUSIONS

This report documents the static safety factor evaluation of Allen Fossil Plant's East Ash Disposal Area. The evaluation was performed in accordance with section §257.73(e) of the EPA Final CCR Rule.

The static safety factor evaluation resulted in static safety factors of 1.66 for the long-term maximum storage pool [§257.73(e)(1)(i)] and 1.65 for the maximum surcharge pool [§257.73(e)(1)(ii)] loading conditions. These results are greater than the required static safety factors of 1.50 and 1.40 for the long-term maximum storage pool and maximum surcharge pool loading conditions, respectively.

8.0 REFERENCES

Environmental Protection Agency (2015). "Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities", Federal Register, April 17.

GEO-SLOPE International, Ltd (2007). GeoStudio 2007, Version 7.23, Build 5099. Calgary, Alberta, Canada. www.geo-slope.com.

Stantec Consulting Services Inc. (2015). *Inflow Design Flood Control System Plan, Allen Fossil Plant – East Ash Disposal Area, Tennessee*. Prepared for Tennessee Valley Authority, October 19 (DRAFT).

Stantec Consulting Services Inc. (2011). *Geotechnical Report for the Evaluation of Dike Stability. Remedial Measures for the Eastern Perimeter Dike. East Stilling Pond. Allen Fossil Plant. Memphis, Tennessee.* Prepared for Tennessee Valley Authority, May 11.

Stantec Consulting Services Inc. (2010a). *Report of Geotechnical Exploration and Evaluation of Slope Stability. Northern Perimeter Dike, East Active Ash Pond. Allen Fossil Plant. Shelby County, Tennessee.* Prepared for Tennessee Valley Authority, March 25.

Stantec Consulting Services Inc. (2010b). *Report of Geotechnical Exploration and Evaluation of Slope Stability. Eastern Perimeter Dike, East Stilling Pond. Allen Fossil Plant. Shelby County, Tennessee.* Prepared for Tennessee Valley Authority, February 4.

Stantec Consulting Services Inc. and URS Corporation (2014). *Instrumentation and Monitoring Plan (Rev. 2), Instrumentation Monitoring Program, Coal Combustion Product Storage Facilities, Various Plants, Alabama, Kentucky and Tennessee.* Prepared for Tennessee Valley Authority, September 30.

Tennessee Valley Authority (2015). ALF151411_CAD.dwg. *ALF Hydrographic Data*. February 2. Supplemented by alf_eastactive_20150202.txt, alf_stilling_20150202.txt.

Tuck Mapping Solutions, Inc. (2014). V-ET.dwg. *ALF Topographic Data*. March 11. Big Stone Gap, VA. Prepared for Tennessee Valley Authority.

United States Army Corps of Engineers (USACE) (2009). Letter from Melissa Flanigan Mullen, P.E., Levee Safety Program Manager, Memphis District to Stuart Harris, P.E., Program Manager\Bi-Products Disposal, Tennessee Valley Authority. Subject: Slope Stability Failure, Memphis Port Authority Mississippi River Levee, Tennessee Valley Authority – Allen Steam Plant, Memphis, TN. 6 May.

United States Army Corps of Engineers (USACE) (2003). Engineering and Design. *Slope Stability. Engineering Manual EM 1110-2-1902, Department of the Army*. October 31.

APPENDIX
SLOPE STABILITY ANALYSIS

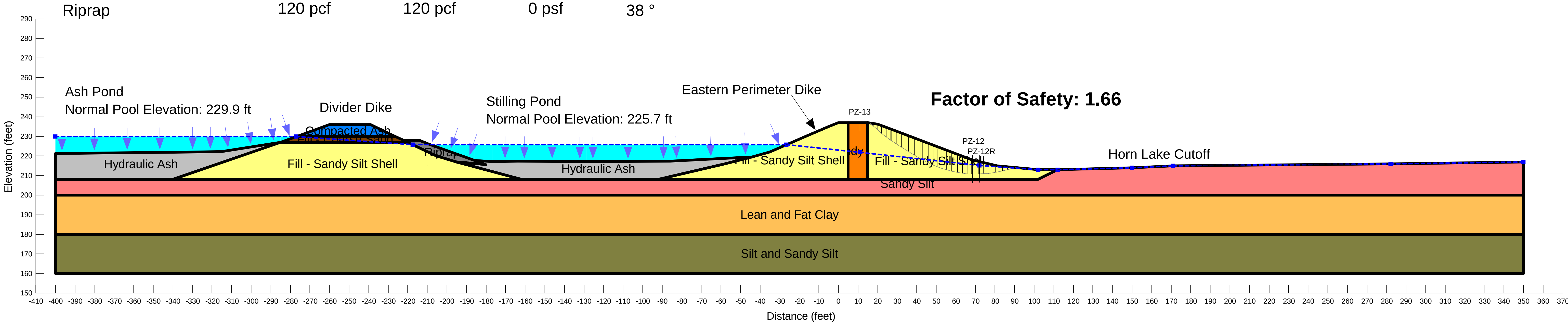
Static Slope Stability Analysis

Tennessee Valley Authority
Allen Fossil Plant East Ash Disposal Area
Memphis, Tennessee
Section E-E'

Existing Geometry;
Long-Term, Maximum Storage Pool Loading;
Effective Stress Analysis;
Drained Strengths

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Cohesion	Friction Angle
Fill - Sandy Silt Shell	124 pcf	120 pcf	0 psf	31 °
Fill - Sandy Silt Core	125 pcf	125 pcf	0 psf	31 °
Sandy Silt	125 pcf	125 pcf	0 psf	30 °
Lean and Fat Clay	115 pcf	110 pcf	0 psf	26 °
Silt and Sandy Silt	115 pcf	110 pcf	0 psf	28 °
Hydraulic Ash	105 pcf	95 pcf	0 psf	25 °
Compacted Ash	123 pcf	110 pcf	0 psf	34 °
Fill - Coarse Sand	120 pcf	115 pcf	0 psf	34 °
Riprap	120 pcf	120 pcf	0 psf	38 °



Project No. 172675014

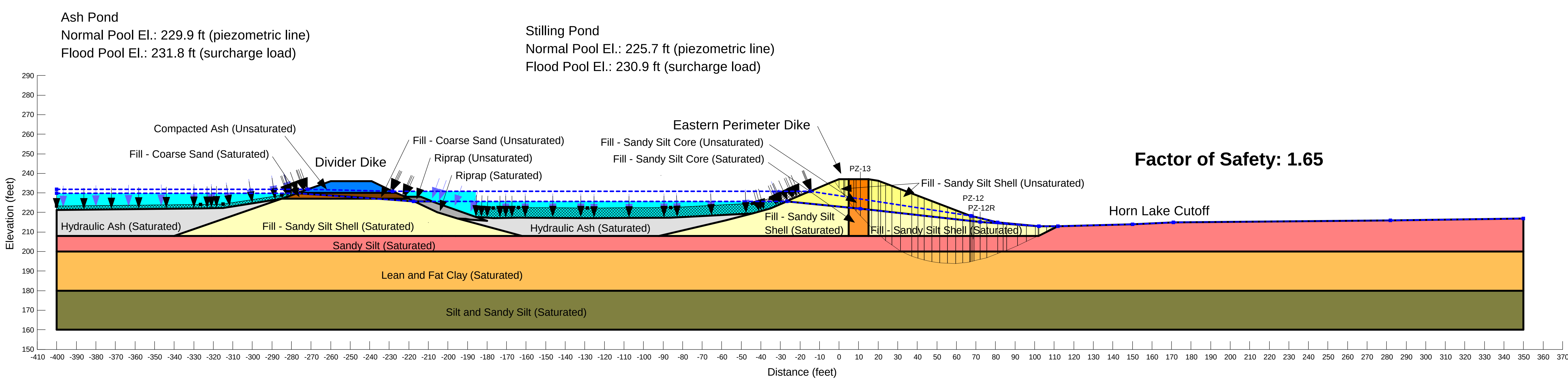
Static Slope Stability Analysis

Tennessee Valley Authority
Allen Fossil Plant East Ash Disposal Area
Memphis, Tennessee
Section E-E'

Existing Geometry
Maximum Surcharge Pool Loading
Total Stress Analysis;
Drained Strengths - above phreatic surface
Undrained Strengths - below phreatic surface

Material Type	Sat. Unit Wt.	Wet Unit Wt.	Effective Cohesion	Effective Friction Angle	Total Cohesion	Total Friction Angle
Fill - Sandy Silt Shell (Unsaturated)	124 pcf	120 pcf	0 psf	31 °	-	-
Fill - Sandy Silt Core (Unsaturated)	125 pcf	125 pcf	0 psf	31 °	-	-
Compacted Ash (Unsaturated)	123 pcf	110 pcf	0 psf	34 °	-	-
Fill - Coarse Sand (Unsaturated)	120 pcf	115 pcf	0 psf	34 °	-	-
Riprap (Unsaturated)	120 pcf	120 pcf	0 psf	38 °	-	-
Fill - Sandy Silt Shell (Saturated)	124 pcf	120 pcf	-	-	200 psf	22 °
Fill - Sandy Silt Core (Saturated)	125 pcf	125 pcf	-	-	200 psf	22 °
Sandy Silt (Saturated)	125 pcf	125 pcf	-	-	200 psf	22 °
Lean and Fat Clay (Saturated)	115 pcf	110 pcf	-	-	400 psf	12 °
Silt and Sandy Silt (Saturated)	115 pcf	110 pcf	-	-	200 psf	12 °
Hydraulic Ash (Saturated)	105 pcf	95 pcf	-	-	0 psf	10 °
Fill - Coarse Sand (Saturated)	120 pcf	115 pcf	-	-	0 psf	34 °
Riprap (Saturated)	120 pcf	120 pcf	-	-	0 psf	38 °

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.



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