McElroy's Run Impoundment
Periodic Safety Factor Assessment Report

Allegheny Energy Supply Company, LLC
A FirstEnergy Company
Pleasants Power Station
Pleasants County, West Virginia

November 2021

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Certification/Statement of Professional Opinion

The Periodic Safety Factor Assessment (Assessment) Report for the McElroy's Run Impoundment was prepared by GAI Consultants, Inc. (GAI). The Assessment Report was based on certain information that, other than for information GAI originally prepared, GAI has relied on, but not independently verified. Therefore, this Certification/Statement of Professional Opinion is limited to the information available to GAI at the time the Assessment Report was written. On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the State of West Virginia (WV), that the Assessment has been prepared in accordance with good and accepted engineering practices, as exercised by other engineers practicing in the same discipline(s), under similar circumstances, and at the time and in the same locale. It is my professional opinion that this Periodic Safety Factor Assessment was prepared consistent with the requirements of the United States Environmental Protection Agency's Federal Coal Combustion Residuals (CCR) Rule 40 CFR § 257.73(e), published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015. In accordance with 40 CFR §257.53(f)(3), the assessment is completed every five years.

The use of the words "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion and is not and shall not to be interpreted or construed as a guarantee, warranty or legal opinion.

Arica L. DiTullio, P.E.

Senior Engineering Manager

1.0 Purpose

Pursuant to the Federal Coal Combustion Residuals (CCR) Rule 40 CFR § 257.73(e)(1)(i-iv), each CCR impoundment is required to conduct an initial and periodic safety factor assessment to determine whether the CCR unit achieves the minimum safety factors at the critical cross section of the embankment. The critical cross section shown in Figure A-1 in Appendix A is the cross section determined to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations including loading conditions from the initial assessment conducted by GAI Consultants, Inc. (GAI) in 2016.

After the initial assessment, periodic assessments are required at an interval not exceeding 5 years. GAI performed the periodic assessment for 2021. For the 2021 periodic assessment, the 2016 initial assessment was reviewed and determined to be acceptable. The review of the GAI 2016 analyses is discussed throughout this document, along with the details of any additional analyses performed by GAI as part of this 2021 assessment.

2.0 Introduction

The Station is a coal-fired electric generating station located near the community of Willow Island in Pleasants County, West Virginia (WV). The Station is owned by Energy Harbor and consists of two generating units, which are capable of producing 1,300 megawatts of electricity.

CCRs generated at the Station are placed in the Impoundment, which is located approximately one-half mile east-southeast of the Station. The Impoundment is a captive facility that receives flue gas desulfurization scrubber by-product generated at the Station, effluent from the recirculation system through Sedimentation Ponds 1 and 2 of the adjacent landfill and their underdrains, and waste materials collected primarily because of general house-cleaning maintenance and/or repair at the Pleasants Station.

The dam of the Impoundment is approximately 243 feet (ft) high with a maximum storage of approximately 20,000 acre-ft. The crest of the dam is at elevation (El.) 900 ft, with El. 887.00 ft as the permitted final level of CCR and recommended normal operating pool level. The Impoundment area is approximately 253 acres.

3.0 Factor of Safety Assessment

GAI reviewed all the documents listed under the References (Section 5.0) in its assessment to determine if the impoundment meets the following safety factors:

i. (3.1) The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.

ii. (3.2) The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.

iii. (3.3) The calculated seismic factor of safety must equal or exceed 1.00.

iv. (3.4) For dikes constructed of soils that are susceptible to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20.

The stability assessments were previously evaluated using the Slope/W software package (GeoStudio 2007, version 7.15 by GeoSlope International). All analyses were previously conducted using the Bishop Method. The critical section is shown on Drawing APSC 506-190 (see Appendix A). The material strength parameters used in the analyses were obtained from a response to EPA comments letter prepared by GAI in 2010. These parameters were developed based on previous subsurface

explorations, laboratory testing, and engineering judgment. The phreatic surface used in the analyses were based on water level readings taken from embankment piezometers.

Sections indicating the critical calculated failure surfaces and the corresponding factors of safety are provided as Figures A-2, A-3, A-4, and B-1 in Appendices A and B.

3.1 Long-Term Maximum Storage Pool Loading Condition

Pursuant to the CCR Rule, the maximum storage pool loading is, "the maximum water level that can be maintained that will result in full development of a steady-state seepage condition." Additionally, "the maximum storage pool loading needed to consider a pool elevation in the CCR unit that is equivalent to the lowest elevation of the invert of the spillway, i.e., the lowest overflow point of the perimeter of the embankment." (emergency spillway)

The principal spillway riser structure has a two-foot-by-two-foot opening at El. 890 ft. The spillway maintains an operational sluice gate at El. 885 ft, which is kept closed. Therefore, the long-term maximum storage pool loading condition will have a water elevation of 890 ft (GAI Inflow Design Plan). The CCR material in the Impoundment was permitted to an elevation of 887 ft. The calculated factor of safety was 1.89, which is greater than the requirement for the long-term maximum storage pool condition (1.50). GAI reviewed the 2016 stability analysis, and determined it to be acceptable, and therefore did not perform additional analyses for this case.

3.2 Maximum Surcharge Pool Loading Condition

The maximum surcharge pool loading condition was based on the inflow design flood, which is the probable maximum flood (PMF). The maximum water surface elevation during the PMF is 894.8 ft. This water elevation corresponds to a water depth in the emergency spillway of 1.3 ft. The CCR material in the Impoundment was set at elevation 887 ft, which corresponds to the maximum permitted level. The calculated factor of safety was 1.89, which is greater than the requirement for the maximum surcharge pool condition (1.40). GAI reviewed the 2016 stability analysis, and determined it to be acceptable, and therefore did not perform additional analyses for this case.

3.3 Seismic Factor of Safety

The seismic factor of safety was analyzed with a seismic loading event with a 2 percent probability of exceedance in 50 years, based on the United States Geological Survey (USGS) seismic hazard maps. A peak ground acceleration (PGA) of 0.1g (acceleration of gravity) was used in the 2016 analysis. This value was obtained from a response to an EPA comments letter prepared by GAI in 2010. Using the more recent ASCE 7-16 code, GAI determined the modified PGA value as 0.083g for the 2021 periodic assessment. However, GAI concluded that calculations did not need to be revised since the recent PGA value is less than the design PGA value previously used in the 2016 analyses.

The seismic condition was conducted using the long-term maximum storage pool loading condition. This represents a conservative analysis, as there is a reasonable chance this situation could occur, and it results in full development of the steady-state seepage condition. The calculated factor of safety was 1.36, which exceeds the requirement for a seismic event (1.00). In 2016, GAI performed the stability analyses for seismic loading using effective strength parameters. GAI reviewed the 2016 analyses and performed additional analyses using undrained shear strength parameters obtained from the original 1977 analyses performed by D'appolonia as outlined in Reference 3. The calculated factor of safety for this additional analysis is 1.33, which is greater than the requirement for the seismic condition (1.00).

3.4 Liquefaction Factor of Safety

In 2010, GAI conducted a liquefaction analysis of the foundation soils. The soils underneath the Impoundment were found not to be susceptible to liquefaction. A corresponding analysis in 2010 was

conducted on the compacted fly ash in the embankment. The three boring locations analyzed were CP-9, CP-11, and CP-13. CP-9 and CP-13 did not have a groundwater table and the blow counts (i.e., N-value) in the fly ash exceeded 30. According to "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, 2001," soils with blow counts exceeding 30 are not susceptible to liquefaction. Based on this report, the downstream portion of the embankment is not susceptible to liquefaction.

In 2016, a modification to the 2010 liquefaction analysis on CP-9 was conducted in order to analyze the embankment with a water level. First Energy collects data for the piezometers located in and around the embankment. Boring log data is unavailable for the piezometers located in the centerline of the embankment. Therefore, to complete the liquefaction analysis, CP-9 boring data was used based on proximity to the centerline of the embankment. The liquefaction analysis was performed using the "Simplified Procedure" outlined in Reference 5. The highest water level recorded at that time in CP-1A, CP-4, and CP-6 was applied to the analysis for CP-9 to determine the susceptibility to liquefaction. The previous 2016 analyses determined that the embankment liquefaction minimum factor of safety is 8.50, which exceeded the minimum requirement for liquefaction. As a part of 2021 assessment, GAI reviewed the liquefaction susceptibility using the water levels from the most recent piezometer readings, and updated the equations based on Reference 6 for liquefaction assessments. The revised analysis indicated that the embankment liquefaction minimum factor of safety of 3.80 is greater than the minimum requirement of 1.20 for liquefaction.

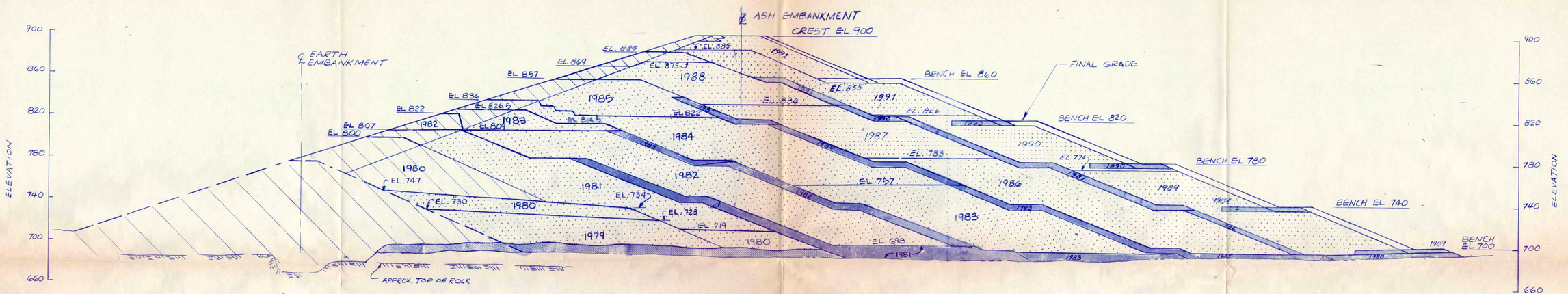
4.0 Conclusion

GAI reviewed previous 2016 stability analyses for this Periodic Safety Factor Assessment. GAI also performed additional stability analysis to check the seismic factor of safety using undrained parameters as a part of this 2021 assessment. In addition, GAI revised the liquefaction analysis to account for most recent piezometer readings, and updated the equations based on Reference 6 for liquefaction assessments. Based on the reviewed information and any additional analyses performed, GAI concludes that the McElroy's Run impoundment meets or exceeds the minimum FOS criteria outlined in the CCR rule. No further analyses are required, and no remedial stability measures are necessary at this time.

5.0 References

1. GAI Consultants. *IPeriodic Inflow Design Flood Control System Plan*. November 2021.
2. GAI Consultants. *Liquefaction Evaluation & Analysis*. June 2016.
3. GAI Consultants. *Responses to Address the Recommendations of the EPA Concerning Pleasants Power Station (McElroy's Run CCB Disposal Site).* Rep. N.p.: n.p., 2010.
4. GAI Consultants. *Sludge Stabilization Facility: McElroy's Run Disposal Site As-Built Construction Sequence*. Drawing APSC 506-190.
5. *Liquefaction Resistance of Soils: Summary Report,* from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, 2001.
6. *Idriss, I.M. and R.W. Boulanger. 2008. Soil Liquefaction During Earthquakes, EERI Special Publication, Monograph No. 12.*

APPENDIX A
2016 Initial Assessment



TYPICAL TRANSVERSE SECTION

SCALE 1" = 40'

40' 0 40' 80'

REFERENCE DRAWINGS:

1. APS DWG.NO.101-6514-104 REV.4 McELROY'S RUN DISPOSAL SITE-TRANSVERSE AND LONGITUDINAL SECTIONS OF EMBANKMENT
2. UNNUMBERED DRAWING TITLED McELROY'S RUN EMBANKMENT, PLEASANTS POWER STATION, BY H. DESKINS, DATED 1-31-83.

LEGEND

- APPROXIMATE TOP OF ROCK
- EXISTING GROUND SURFACE
- EARTH EMBANKMENT (PHASE I)
- PROPOSED GRADE
- SAND FILTER
- BOTTOM ASH
- CLAY
- FLY ASH

△5

Figure A-1

OCT 31 1996

ISSUE No	DATE	DWN	CHKD	APP	APP	ISSUED FOR
7	2-89	G.Y.	TRG	TDD		AS-BUILT THRU DEC. 1992
6	MAR	G.Y.	TDD	TDD		AS-BUILT THRU DEC. 1991
5	2-91	REM	TMG	TRG		AS BUILT THRU DEC. 1990
4	2-90	NER	TRG	TDD		AS-BUILT THRU FEB. 1990
3	2-89	G.Y.	TRG	TDD		AS-BUILT THRU FEB. 1989
2	2-88	FP	TRG	TDD		As Built Thru JAN. 1988
1	11-86	FP	TRG	TDD		As Built Thru DEC. 1986
0	2-86	AIC	JAB	TDD		AS-BUILT THRU DECEMBER 1985

SCALE: AS SHOWN

ENGINEER STATE REG No.

OCT 31 1996

PROJ. NO. 81-237

DWG. NO. 81-237-F13

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PLEASANTS POWER STATION-UNITS NO. 1 & NO. 2

MONONGAHELA POWER COMPANY | THE POTOMAC EDISON COMPANY | WEST PENN POWER COMPANY

SLUDGE STABILIZATION FACILITY
McELROYS RUN DISPOSAL SITE
AS-BUILT CONSTRUCTION SEQUENCE

APSC 506-190

DRAWING NUMBER 101-6514-196

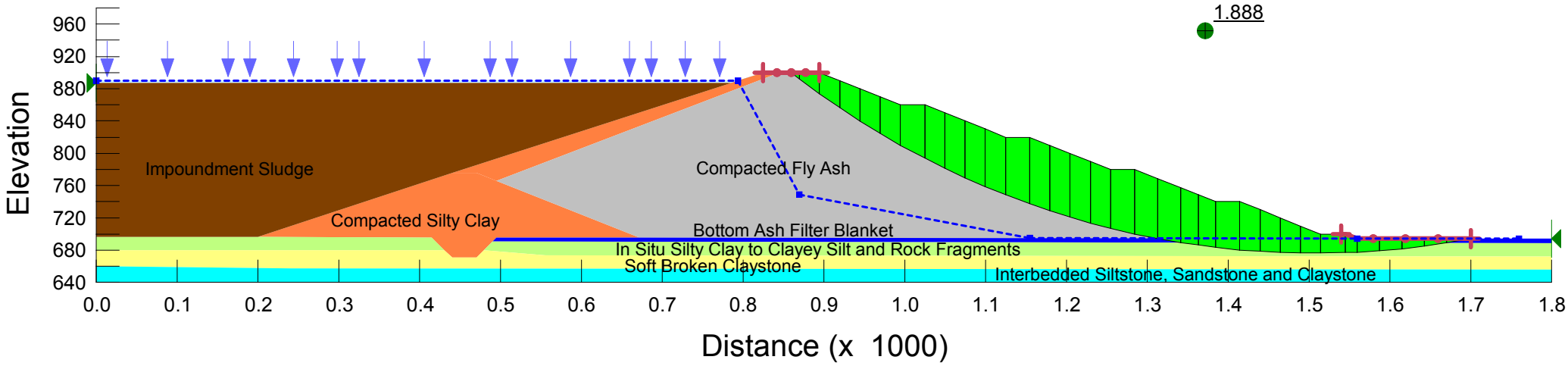
REVISION △5

IRVING 44-142-42457-2

BY: TIM DATE:03/08/2016

PLEASANTS POWER STATION
McELROY'S RUN CCB DISPOSAL FACILITY
LONG TERM MAXIMUM STORAGE POOL LOADING CONDITION

EMERGENCY SPILLWAY ELEVATION: 893.5-FT
WATER ELEVATION 890-FT
CCR ELEVATION 887-FT



Name: Compacted Silty Clay Unit Weight: 132.9 pcf Cohesion: 228 psf Phi: 26.8 °
Name: In Situ Silty Clay to Clayey Silt and Rock Fragments Unit Weight: 127.8 pcf Cohesion: 49 psf Phi: 24.8 °
Name: Soft Broken Claystone Unit Weight: 135 pcf Cohesion: 1238 psf Phi: 32 °
Name: Interbedded Siltstone, Sandstone and Claystone
Name: Compacted Fly Ash Unit Weight: 113.1 pcf Cohesion: 0 psf Phi: 29.7 °
Name: Bottom Ash Filter Blanket Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Impoundment Sludge Unit Weight: 70 pcf Cohesion: 0 psf Phi: 0.1 °

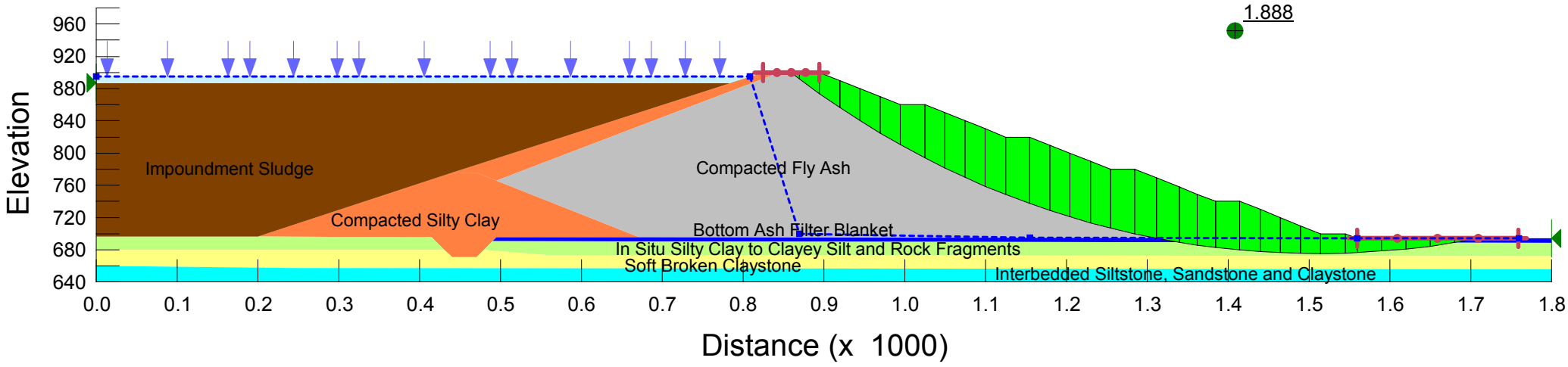
Horizontal Scale: 2400
Vertical Scale: 2400

Figure A-2

BY: TIM DATE:03/08/2016

PLEASANTS POWER STATION
McELROY'S RUN CCB DISPOSAL FACILITY
MAXIMUM SURCHARGE POOL LOADING CONDITION

SPILLWAY ELEVATION 893.5-FT
WATER ELEVATION 894.8-FT
CCR ELEVATION 887-FT



Name: Compacted Silty Clay Unit Weight: 132.9 pcf Cohesion: 228 psf Phi: 26.8 °
Name: In Situ Silty Clay to Clayey Silt and Rock Fragments Unit Weight: 127.8 pcf Cohesion: 49 psf Phi: 24.8 °
Name: Soft Broken Claystone Unit Weight: 135 pcf Cohesion: 1238 psf Phi: 32 °
Name: Interbedded Siltstone, Sandstone and Claystone
Name: Compacted Fly Ash Unit Weight: 113.1 pcf Cohesion: 0 psf Phi: 29.7 °
Name: Bottom Ash Filter Blanket Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Impoundment Sludge Unit Weight: 70 pcf Cohesion: 0 psf Phi: 0.1 °

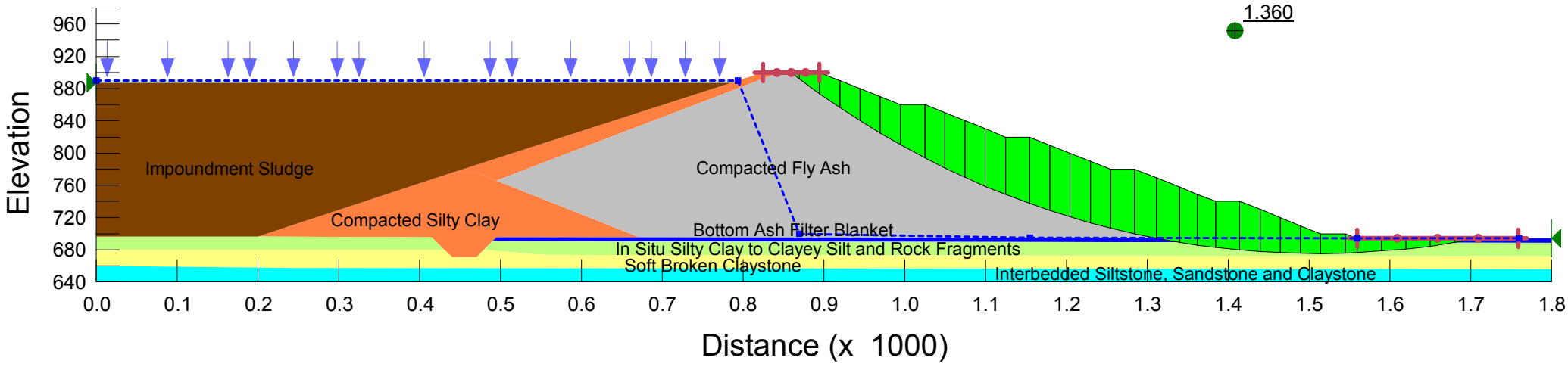
Horizontal Scale: 2400
Vertical Scale: 2400

Figure A-3

BY: TIM DATE:03/08/2016

PLEASANTS POWER STATION
McELROY'S RUN CCB DISPOSAL FACILITY
SEISMIC LONG TERM MAXIMUM STORAGE POOL LOADING CONDITION

SPILLWAY ELEVATION 893.5-FT
WATER ELEVATION 890-FT
CCR ELEVATION 887-FT
Seismic Value: 0.1



Name: Compacted Silty Clay Unit Weight: 132.9 pcf Cohesion: 228 psf Phi: 26.8 °
Name: In Situ Silty Clay to Clayey Silt and Rock Fragments Unit Weight: 127.8 pcf Cohesion: 49 psf Phi: 24.8 °
Name: Soft Broken Claystone Unit Weight: 135 pcf Cohesion: 1238 psf Phi: 32 °
Name: Interbedded Siltstone, Sandstone and Claystone
Name: Compacted Fly Ash Unit Weight: 113.1 pcf Cohesion: 0 psf Phi: 29.7 °
Name: Bottom Ash Filter Blanket Unit Weight: 110 pcf Cohesion: 0 psf Phi: 35 °
Name: Impoundment Sludge Unit Weight: 70 pcf Cohesion: 0 psf Phi: 0.1 °

Horizontal Scale: 2400
Vertical Scale: 2400

Figure A-4

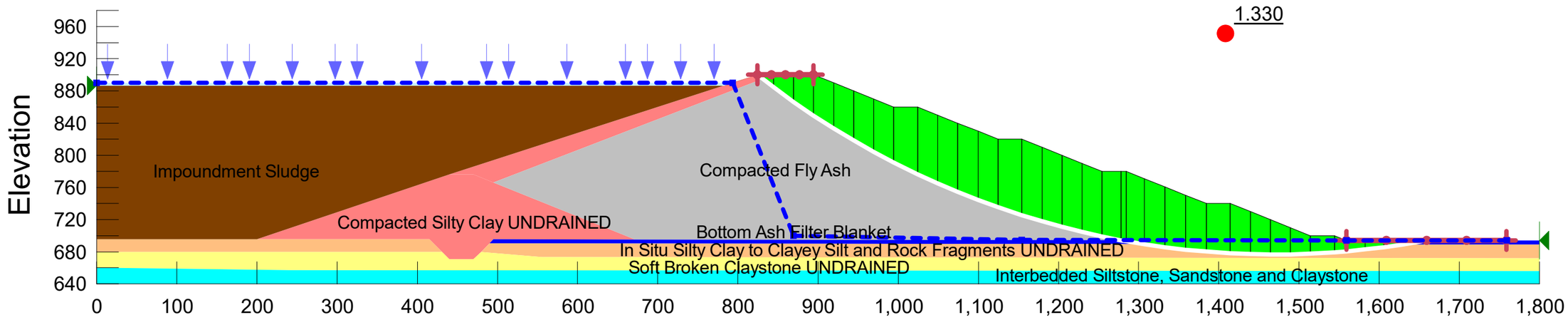
APPENDIX B
Additional Stability Analysis for 2021 Assessment

BY: RRJ DATE:10/12/2021

PLEASANTS POWER STATION
McELROY'S RUN CCB DISPOSAL FACILITY
SEISMIC LONG TERM MAXIMUM STORAGE POOL LOADING CONDITION

SPILLWAY ELEVATION 893.5-FT
WATER ELEVATION 890-FT
CCR ELEVATION 887-FT

Seismic Value: 0.1



Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Piezometric Line
	Bottom Ash Filter Blanket	Mohr-Coulomb	110	0	35	0	1
	Compacted Fly Ash	Mohr-Coulomb	113.1	0	29.7	0	1
	Compacted Silty Clay UNDRAINED	Mohr-Coulomb	132.9	2,000	0	0	1
	Impoundment Sludge	Mohr-Coulomb	70	0	0.1	0	1
	In Situ Silty Clay to Clayey Silt and Rock Fragments UNDRAINED	Mohr-Coulomb	127.8	1,500	0	0	1
	Interbedded Siltstone, Sandstone and Claystone	Bedrock (Impenetrable)					1
	Soft Broken Claystone UNDRAINED	Mohr-Coulomb	135	3,000	28	0	1

Horizontal Scale: 2,400
Vertical Scale: 2,400

Figure B-1