MWG

Midwest Generation, LLC
Joliet 29 Generating Station

2021 Safety Factor Assessment for Ash Pond 2

Revision 0

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Issue Purpose: Use

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1.0 PURPOSE & SCOPE

1.1 PURPOSE

Ash Pond 2 at Midwest Generation, LLC's (MWG) Joliet 29 Station ("Joliet" or the "Station") is an existing coal combustion residual (CCR) surface impoundment that is regulated by the Illinois Pollution Control Board's "Standards for the Disposal of Coal Combustion Residuals in CCR Surface Impoundments." These regulations are codified in Part 845 to Title 35 of the Illinois Administrative Code (35 Ill. Adm. Code 845, Ref. 1) and are also referred to herein as the "Illinois CCR Rule." Pursuant to 35 Ill. Adm. Code 845.460(a), MWG must conduct and complete a safety factor assessment that documents whether the critical cross section at Ash Pond 2 achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a).

Ash Pond 2 at Joliet is also regulated by the U.S. Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," 40 CFR Part 257 Subpart D (Ref. 2), also referred to herein as the "Federal CCR Rule." Pursuant to 40 CFR 257.73(f)(3), the Federal CCR Rule requires MWG to conduct and complete a safety factor assessment in accordance with 40 CFR 257.73(e) for the Ash Pond 2 every five years.

This report documents the 2021 safety factor assessment conducted and completed in accordance with the Illinois and Federal CCR Rules by Sargent & Lundy (S&L) on behalf of MWG for Ash Pond 2 at the Joliet 29 Station. This report:

- Lists the inputs and assumptions used in the 2021 safety factor assessment,
- Discusses the methodology used to conduct the 2021 safety factor assessment,
- Lists and compares the safety factor acceptance criteria for CCR surface impoundments promulgated by the Illinois and Federal CCR Rules,
- Summarizes the results from the initial safety factor assessment completed for Ash Pond 2 that was conducted in accordance with the Federal CCR Rule,
- Evaluates potential changes to the inputs used in the initial safety factor assessment to determine whether new or updated liquefaction and/or structural stability analyses are warranted, and
- Provides the 2021 factors of safety for Ash Pond 2 in accordance with 35 Ill. Adm. Code 845.460(a) and 40 CFR 257.73(e).

1.2 SCOPE

Per the 2016 Water Infrastructure Improvements for the Nation (WIIN) Act, Ash Pond 2 will continue to be subject to both the Illinois and Federal CCR Rules until the U.S. EPA approves the Illinois EPA's CCR permit program. The Illinois EPA has yet to publish a timeline for submitting its proposed CCR permit program to

the U.S. EPA for approval, and so MWG must conduct safety factor assessments pursuant to both sets of regulations at this time.

2.0 INPUTS

Safety Factor Acceptance Criteria for CCR Surface Impoundments

The Illinois CCR Rule (Ref. 1, § 845.460) requires all existing CCR surface impoundments to achieve four minimum safety factors at the impoundment's critical cross section, which is defined by the Illinois CCR Rule as "the cross section anticipated to be the most susceptible of all cross-sections to structural failure based on appropriate engineering considerations, including loading conditions." The Federal CCR Rule (Ref. 2, § 257.73(e)) has the same safety factor acceptance criteria as the Illinois CCR Rule. Table 2-1 presents the safety factor acceptance criteria promulgated by both sets of regulations for existing CCR surface impoundments.

Table 2-1 – Safety Factor Acceptance Criteria for Existing CCR Surface Impoundments

Loading Condition	Minimum Allowable Factor of Safety	Illinois CCR Rule Reference	Federal CCR Rule Reference
Long-Term, Maximum Storage Pool	1.50	§ 845.460(a)(2)	§ 257.73(e)(1)(i)
Maximum Surcharge Pool	1.40	§ 845.460(a)(3)	§ 257.73(e)(1)(ii)
Seismic	1.00	§ 845.460(a)(4)	§ 257.73(e)(1)(iii)
Liquefaction	1.20	§ 845.460(a)(5)	§ 257.73(e)(1)(iv)

Initial Safety Factor Assessment

Appendix A provides the initial safety factor assessment conducted by Geosyntec Consultants in 2016 for Ash Pond 2 (Ref. 3). The inputs, assumptions, and methodology utilized in this initial safety factor assessment were evaluated to determine whether any updates to this analysis are warranted.

Site Topography & Aerial Images

Topographic data for Ash Pond 2 and the adjacent areas was obtained from an aerial survey flown at the site in June 2008 (Ref. 4). Historical and recent aerial images of Ash Pond 2 and adjacent areas were obtained from Google Earth Pro (Ref. 5).

Groundwater

Groundwater data for Ash Pond 2 and the surrounding areas was obtained from annual groundwater monitoring reports prepared by KPRG and Associates, Inc. for the CCR surface impoundment in accordance with 40 CFR 257.90(e) (Refs. 11 through 14).

Ash Pond Conditions

The operating and physical conditions for Ash Pond 2 were based on discussions with MWG personnel and on the annual inspection reports prepared for the CCR surface impoundment in accordance with 40 CFR 257.83(b) (Refs. 6 through 10).

Horizontal Seismic Coefficient

Pursuant to 35 Ill. Adm. Code 845.460(a)(4) and 40 CFR 257.73(e)(1)(iii), Ash Pond 2 must have a minimum factor of safety of 1.00 when analyzed under a seismic loading condition. This loading condition is represented by a horizontal seismic coefficient that is based on a peak ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years in accordance with the definition of "[m]aximum horizontal acceleration in lithified earth material" promulgated by 35 Ill. Adm. Code 845.120 and 40 CFR 257.53. The design horizontal seismic coefficient is also based on the mapped spectral response acceleration at a period of 1 second (S_1) and on a site correction factor (F_v) that accounts for the impacts of site-specific soil conditions on the mapped PGA and spectral response acceleration. Table 2-2 presents the seismic response parameters obtained from ASCE 7-16 (Ref. 15) on which Ash Pond 2's seismic loading condition was based.

Table 2-2 – Horizontal Seismic Coefficient Inputs

Parameter	Symbol	Value
Peak Ground Acceleration	PGA	0.113
Mapped Spectral Response, 1-Second Period	S_1	0.069
Site Correction Factor for 1-Second Period	F_v	2.4

3.0 ASSUMPTIONS

There are no assumptions in this document that require verification.

4.0 METHODOLOGY

The inputs for Ash Pond 2's initial safety factor assessment were reviewed to determine if any changes have occurred since the initial assessment was completed. Identified changes were then evaluated to determine if updates to the pond's previous structural stability and/or liquefaction analyses were warranted. Where no

changes were noted for a given input, or where identified changes were determined to have no impact on the results and conclusions of the initial safety factor assessment, the previous evaluation of that input was considered to still be valid.

5.0 ASSESSMENT

5.1 SUMMARY OF INITIAL SAFETY FACTOR ASSESSMENT

The initial safety factor assessment for Ash Pond 2 was completed in October 2016 and is included in its entirety in Appendix A. The results of this assessment indicated that the pond's critical cross-section is stable and meets the factor of safety requirements presented in 40 CFR 257.73(e)(1)(i) through 257.73(e)(1)(iv). Because the Illinois and Federal CCR Rules have the same safety factor acceptance criteria, it is noted that the factors of safety calculated in the initial safety factor assessment also comply with the factor of safety requirements promulgated under 35 Ill. Adm. Code 845.460(a)(2) through 845.460(a)(5).

In addition to evaluating the pond's earthen dikes, the initial safety factor assessment also evaluated a reinforced concrete cantilever retaining wall located along the southwest portion of Ash Pond 2's southern dike. This wall section was analyzed to confirm it meets or exceeds the minimum factors of safety for bearing capacity, overturning, and sliding that are generally accepted industry standards.

5.2 CHANGES IN BASES FOR INITIAL FACTORS OF SAFETY

The following subsections summarize the evaluation conducted to determine if changes to the design inputs used in Ash Pond 2's initial safety factor assessment have occurred since the assessment was completed, and to determine whether the initial structural stability and liquefaction analyses can be accepted as-is for this 2021 assessment or if further analysis is required.

5.2.1 CHANGES IN GEOTECHNICAL DATA

Based on reviews of the annual inspection reports (Refs. 6 through 10) and Google Earth aerial images (Ref. 5), there have been no significant changes to the embankments or underlying soils that would require updating the geotechnical parameters used in the 2016 analysis (Ref. 3).

5.2.2 CHANGES IN TOPOGRAPHY ADJACENT TO ASH POND 2

Based on reviews of the annual inspection reports (Refs. 6 through 10) and Google Earth aerial images (Ref. 5), there have been no significant modifications to the ground surfaces adjacent to Ash Pond 2 (mass excavations, mass fill placement, *etc*.) since the initial safety factor assessment was completed. Therefore, the topographic data collected for the site in 2008 (Ref. 4) remains valid for use in this 2021 assessment.

5.2.3 CHANGES IN GROUNDWATER TABLE

Based on reviews of the annual groundwater monitoring and corrective action reports for Ash Pond 2 (Refs. 11 through 14), no significant variations in the groundwater were noted. Because Ash Pond 2 is lined with a geomembrane, the embankments are not hydraulically connected to the water levels within the pond, and a typical phreatic surface normally associated with seepage through an earthen embankment is not applicable. The reported static groundwater elevation is valid for this analysis, and there have been no significant changes in the surface water conditions near the site that would impact the site's groundwater levels.

5.2.4 CHANGES IN EMBANKMENT GEOMETRY

Based on reviews of the annual inspection reports (Refs. 6 through 10), Google Earth aerial images (Ref. 5), and visual observations made in September 2021, there have been no significant modifications to the embankments for the pond since the initial safety factor assessment was completed. Therefore, there is no basis to reevaluate Ash Pond 2's embankment geometry for this 2021 assessment.

5.2.5 CHANGES IN EARTHQUAKE DESIGN BASIS

The design horizontal seismic coefficient utilized in the existing technical analysis (Ref. 3) was based on published data in ASCE 7-10 (Ref. 16). Since the existing technical analysis was developed, an updated publication of the reference material has been produced (ASCE 7-16 (Ref. 15)), which provides updated values for the parameters used to determine the design horizontal seismic coefficient (see Tables 2-2 and 5-1). Based on the reduction in the site seismic loading parameters from ASCE 7-10 to ASCE 7-16, the horizontal seismic coefficient for Ash Pond 2's seismic loading condition will be less than the value used in the initial safety factor assessment. Therefore, the horizontal seismic coefficient used for the 2016 analysis is conservative. Thus, it is not necessary to change the earthquake design basis used to conduct the initial safety factor assessment for Ash Pond 2.

Table 5-1 – Seismic Loading Parameters Comparison

Parameter	Symbol	2016 Values per ASCE 7-10	2021 Values per ASCE 7-16
Peak Ground Acceleration	PGA	0.132	0.113
Mapped Spectral Response, 1-Second Period	S_1	0.069	0.069
Site Correction Factor for 1-Second Period	F_v	2.4	2.4

5.2.6 CHANGES IN ASH POND OPERATIONS

Ash Pond 2 was originally designed to manage CCR and miscellaneous non-CCR wastestreams from the Station. Following the conversion of Joliet 29's coal-fired units to natural gas, the pond was no longer used to manage CCR wastestreams and was eventually taken out of service. In accordance with the Station's ash pond maintenance practices, the Station then began dewatering and removing CCR from the pond. As documented in the pond's annual inspection reports since 2019 (Refs. 9 and 10), minimal CCR remains in Ash Pond 2. During a site visit in September 2021, it was noted that no CCR and only a few feet of stormwater were visually observed in Ash Pond 2. In April 2021, MWG filed a notice of intent to close Ash Pond 2 in accordance with the Federal CCR Rule's closure criteria (Ref. 2, § 257.102). Closure construction activities will commence upon receipt of a closure construction permit from the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule.

The decrease in surface water elevation in Ash Pond 2 decreases the driving forces in the embankment; therefore, the surface water elevation used for the 2016 analysis is conservative for the pond's current operating condition. Therefore, there is no basis to reevaluate the surface water elevations used to conduct the initial safety factor assessment for Ash Pond 2.

6.0 2021 SAFETY FACTOR ASSESSMENT CONCLUSIONS

The initial safety factor analysis for Ash Pond 2 (Ref. 3) was reviewed and validated for compliance with the Illinois and Federal CCR Rules' safety factor acceptance criteria for existing CCR surface impoundments. No changes that would invalidate the conclusions of the initial safety factor assessment were identified in reviews of available information and reports completed for the CCR surface impoundment since the initial assessment was completed in 2016. Therefore, the results reported in the initial safety factor assessment for Ash Pond 2's earthen dikes and retaining wall remain valid for this 2021 assessment.

Table 6-1 presents the 2021 factors of safety for Ash Pond 2's earthen dikes as determined in accordance with 35 Ill. Adm. Code 845.460(a) and 40 CFR 257.73(e).

Table 6-1 – 2021 Illinois & Federal CCR Rule Factors of Safety for Ash Pond 2 at the Joliet 29 Station

Loading Condition	Ash Pond 2	Min. Allowable Factor of Safety
Long-Term, Maximum Storage Pool	≥ 1.50	**1.50**
Maximum Surcharge Pool	≥ 1.40	**1.40**
Seismic	≥ 1.00	**1.00**
Liquefaction	Note 1	**1.20**

Notes: 1) The embankment soils for Ash Pond 2 are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system and depth to groundwater. Thus, liquefaction safety factors are not reported.

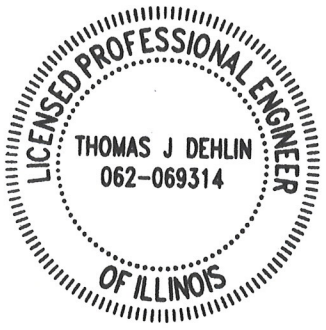
7.0 CERTIFICATION

I certify that:

- This safety factor assessment was prepared by me or under my direct supervision.
- The work was conducted in accordance with the requirements of 35 Ill. Adm. Code 845.460 and with the requirements of 40 CFR 257.73(e).
- I am a registered professional engineer under the laws of the State of Illinois.

Certified By: Thomas J. Dehlin Date: October 15, 2021

Seal:



Th. Dehlin
10/15/2021
Exp. 11/30/2021

8.0 REFERENCES

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APPENDIX A: 2016 ASH POND 2 SAFETY FACTOR ASSESSMENT