

MWG

Midwest Generation, LLC
Powerton Generating Station

2021 Safety Factor Assessment for Ash Surge Basin, Bypass Basin, & Former Ash Basin



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1.0 PURPOSE & SCOPE

1.1 PURPOSE

The Ash Surge Basin, Bypass Basin, and Former Ash Basin (the Basins) at Midwest Generation, LLC's (MWG) Powerton Generating Station ("Powerton" or the "Station") are existing coal combustion residual (CCR) surface impoundments that are 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 each of the Basins achieves the minimum safety factors specified in 35 Ill. Adm. Code 845.460(a).

The Ash Surge, Bypass, and Former Ash Basins at Powerton are 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." It should be noted that the Former Ash Basin is regulated under the Federal CCR Rule as an "inactive CCR surface impoundment," while it is regulated as an "existing CCR surface impoundment" under the Illinois 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 Basins 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 the Ash Surge, Bypass, and Former Ash Basins at Powerton. 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 assessments completed for the Basins that were conducted in accordance with the Federal CCR Rule,
- Evaluates potential changes to the inputs used in the initial safety factor assessments to determine whether new or updated liquefaction and/or structural stability analyses are warranted, and
- Provides the 2021 factors of safety for the Ash Surge, Bypass, and Former Ash Basins 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, the Ash Surge, Bypass, and Former Ash Basins 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 each existing CCR surface impoundment 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 Assessments

Appendix A provides the initial safety factor assessment conducted by Geosyntec Consultants in 2016 for the Ash Surge Basin and the Bypass Basin (Ref. 3). The inputs, assumptions, and methodology utilized in the Ash Surge and Bypass Basins’ initial safety factor assessment were evaluated to determine whether any updates to the analysis was warranted.

Appendix B provides the initial safety factor assessment conducted by Geosyntec Consultants in 2018 for the Former Ash Basin (Ref. 4). The 2018 assessment for the Former Ash Basin concluded that an

engineering analysis to calculate the safety factors for the basin could not be performed given the lack of necessary information due to the construction age of the basin. Since the minimum safety factors of the Former Ash Basin could not be demonstrated, MWG is closing the Former Ash Basin in accordance with 40 CFR 257.102. Consequently, the inputs, assumptions, and methodology utilized in the Former Ash Basin's initial safety factor assessment were not evaluated.

Site Topography

Topographic data for the Ash Surge Basin, Bypass Basin, and surrounding areas was obtained from an aerial survey performed by Aero-Metric, Inc. in 2008 (Ref. 5).

Groundwater

Groundwater data for the Ash Surge Basin, Bypass Basin, and surrounding areas was obtained from annual groundwater monitoring reports prepared by KPRG and Associates, Inc. for the CCR surface impoundments in accordance with 40 CFR 257.90(e) (Refs. 18 through 21).

Aerial Images

Historical and recent aerial images of the Basins and adjacent areas were obtained from Google Earth Pro (Ref. 6).

Ash Pond Conditions

The operating and physical conditions for the Ash Surge and Bypass Basins were based on discussions with MWG personnel and on the annual inspection reports prepared for the two CCR surface impoundments in accordance with 40 CFR 257.83(b) (Refs. 8 through 11).

Horizontal Seismic Coefficient

Pursuant to 35 Ill. Adm. Code 845.460(a)(4) and 40 CFR 257.73(e)(1)(iii), the Basins 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. 16) on which the Basins' seismic loading condition was based.

Table 2-2 – Horizontal Seismic Coefficient Inputs

Parameter	Symbol	Value
Peak Ground Acceleration	PGA	0.104
Mapped Spectral Response, 1-Second Period	S_1	0.079
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 the Ash Surge and Bypass Basins' 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 basins' 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 to 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 ASSESSMENTS

The initial safety factor assessment for the Ash Surge and Bypass Basins was completed in October 2016 and is included in its entirety in Appendix A. The results of this assessment indicated that the critical cross-sections for these basins are stable and meet 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).

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 the Ash Surge and Bypass Basins' 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. 7 through 11) and Google Earth aerial images (Ref. 6), there have been no 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 PONDS

Based on reviews of the annual inspection reports (Refs. 7 through 11) and Google Earth aerial images (Ref. 6), there have been no significant modifications to the ground surfaces adjacent to the Ash Surge and Bypass Basins (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. 5) 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 the Ash Surge and Bypass Basins (Refs. 18 through 21), no significant variations in the groundwater were noted. Because these two CCR surface impoundments are lined with a geomembrane, the embankments are not hydraulically connected to the water levels within the Basins, 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. 8 through 11), Google Earth aerial images (Ref. 6), and visual observations made in September 2021, there have been no significant modifications to the embankments for the Ash Surge Basin and Bypass Basin since the initial safety factor assessments were completed. Therefore, there is no basis to reevaluate the embankment geometry of the Basins 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) is based on published data in ASCE 7-10 (Ref. 18). Since developing the technical analysis, an updated publication of the reference material has been produced (ASCE 7-16 (Ref. 17)), 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 the Basins' 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 the Basins.

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	0.11	0.104
Mapped Spectral Response, 1-Second Period	S_1	0.083	0.079
Site Correction Factor for 1-Second Period	F_v	2.4	2.4

5.2.6 CHANGES IN ASH POND OPERATIONS

In early October 2020, Powerton took the Bypass Basin out of service for routine cleaning. During a site visit in September 2021 conducted by S&L, it was noted that most of the CCR previously stored in the Bypass Basin had been removed and minimal surface water remained. MWG currently plans to retrofit the Bypass Basin with a new composite liner system and a new leachate collection and removal system (LCRS). Retrofit construction activities will commence at the basin upon receipt of a retrofit construction permit from the Illinois EPA in accordance with Subpart B of the Illinois CCR Rule. Meanwhile, Powerton continues to operate the Ash Surge Basin to manage the Station's ash dewatering bin effluent and various non-CCR wastestreams in accordance with 40 CFR 257.103(f)(1). Operating conditions at this basin have not changed since the basin's initial safety factor assessment was conducted in 2016.

Of the two CCR surface impoundments, only the operating conditions at the Bypass Basin have changed since the initial safety factor assessment was completed for the Ash Surge and Bypass Basins. The decrease in surface water elevation in the Bypass Basin decreases the driving forces in the embankment; therefore, the surface water elevation used for the 2016 analysis is conservative for the basin's current operating condition. Because the operating conditions at the Ash Surge Basin have not changed since the initial hazard potential classification assessment was completed, the 2016 structural stability analysis for the basin remains valid. Therefore, there is no basis to reevaluate the surface water elevations used to conduct the initial safety factor assessment for the Ash Surge and Bypass Basins.

6.0 2021 SAFETY FACTOR ASSESSMENT CONCLUSIONS

6.1.1 ASH SURGE & BYPASS BASINS

The initial safety factor analyses for the Ash Surge and Bypass Basins (Ref. 3) were reviewed and validated for compliance with 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 for the Ash Surge Basin and Bypass Basin or its supporting calculations were identified in reviews of available information and reports completed for the CCR surface impoundments since the initial assessment was completed in 2016. Therefore, the results reported in the initial safety factor assessment for the Ash Surge and Bypass Basins remain valid for this 2021 assessment.

Table 6-1 presents the 2021 factors of safety for the Ash Surge Basin and Bypass Basin 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 the Ash Surge Basin and Bypass Basin at the Powerton Generating Station

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

Notes: 1) The embankment soils for the Basins are not considered susceptible to liquefaction because saturation of the embankment soils is unlikely based on the installed geomembrane liner system. A limited portion of the bottom of the embankments may become saturated with groundwater based on the design phreatic surface. Liquefaction triggering analyses of these saturated soils show that liquefaction and associated post-liquefaction shear strength loss is unlikely for the design seismic event (Ref. 3). Thus, liquefaction safety factors are not reported.

6.1.2 FORMER ASH SURGE BASIN

The initial safety factor assessment completed for the Former Ash Basin in 2018 (Ref. 4) concluded that an engineering analysis to calculate the safety factors for the basin could not be performed given the lack of necessary information due to the construction age of the Former Ash Basin. Since the minimum safety factors of the Former Ash Basin could not be demonstrated, MWG is closing the Former Ash Basin in

accordance with 40 CFR 257.102. Closure of the Former Ash Basin will also comply with the requirements promulgated under 35 Ill. Adm. Code Part 845 Subpart G.

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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2. U.S. Environmental Protection Agency. "Standards for Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments." 40 CFR Part 257 Subpart D. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-I/part-257/subpart-D>. Accessed October 15, 2021.
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**APPENDIX A: 2016 ASH SURGE BASIN &
BYPASS BASIN SAFETY FACTOR ASSESSMENT**



**APPENDIX B: 2018 FORMER ASH BASIN SAFETY FACTOR
ASSESSMENT**

