Hazard Potential Classification Assessment Report

J.C. WEADOCK GENERATING FACILITY

BOTTOM ASH POND HAZARD POTENTIAL CLASSIFICATION ASSESSMENT REPORT

Essexville, Michigan

Pursuant to 40 CFR 257.73

Submitted To: Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Prepared By: Golder Associates Inc.
15851 South US 27, Suite 50
Lansing, Michigan 48906

October 2016 **1655164**

Golder Associates

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.73(a)(2)(ii)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.73 (40 CFR Part 257.73), I attest that this Hazard Potential Classification Assessment Report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.73.

Golder Associates Inc.

Signature

October 14, 2016

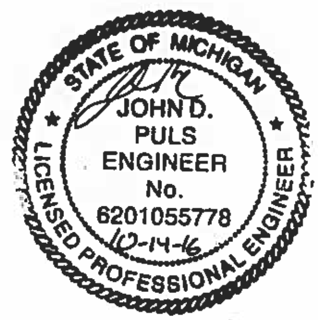
Date of Report Certification

John D Puls, PE

Name

6201055787

Professional Engineer Certification Number



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1.0 INTRODUCTION

On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the Coal Combustion Residual (CCR) Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) ("CCR RCRA Rule") to regulate the solid waste management of CCR generated at electric utilities. Section 257.73(a)(2) of the CCR RCRA Rule requires the owner or operator of an existing CCR surface impoundment to document the hazard potential classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. Consequently, the owner or operator must document the basis for each hazard potential classification.

Hazard potential classification means the possible adverse incremental consequences that result from the release of water or stored contents due to failure of the diked CCR surface impoundment or mis-operation of the diked CCR surface impoundment or its appurtenances. The hazard potential classifications include high hazard potential CCR surface impoundment, significant hazard potential CCR surface impoundment, and low hazard potential CCR surface impoundment, which terms mean:

- High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.
- Significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life; but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.
- Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.

According to 257.73(a)(2)(ii), the hazard classification potential assessment must be certified by a qualified professional engineer (QPE) stating that an initial hazard potential classification and each subsequent periodic classification was conducted in accordance with the requirements of 40 CFR 257.73. Golder Associates Inc. (Golder) is submitting this Hazard Potential Classification Assessment Report (Report) to certify a low hazard potential classification for the Bottom Ash Pond CCR surface impoundment (Bottom Ash Pond) at the Consumers Energy Company (CEC) J.C. Weadock Generating Facility (JC Weadock) in Essexville, Michigan per 40 CFR Part 257.73(a)(2).

2.0 HAZARD POTENTIAL CLASSIFICATION ASSESSMENT DETERMINATION

The Bottom Ash Pond is an existing CCR surface impoundment at JC Weadock (Figure 1) and is centrally located within JC Weadock, directly east of the generating facility. Saginaw Bay of Lake Huron is located to the north and east of the Bottom Ash Pond, approximately 5,000 feet in each direction. The Saginaw River is approximately 2,000 feet to the west of the Bottom Ash Pond. The nearest commercial facilities and/or inhabitants outside JC Weadock are approximately one mile to the south. This includes the Saginaw River Coast Guard Station, Saginaw Bay Yacht Club, and residential homes.

The Bottom Ash Pond is divided into two areas (Area 1 and Area 2), and the footprint area is approximately 1,600-feet-by-400-feet. An elevated trestle and pipe system hydraulically conveys bottom ash and discharges to the north into Bottom Ash Pond Area 1 and to the south to Bottom Ash Pond Area 2. The crest elevations of Area 1 and Area 2 are approximately 600.1 feet and 596.6 feet (NAVD88), respectively. The bottom elevations are approximately 594.5 feet and 590.0 feet (NAVD88), respectively. The Bottom Ash Pond is located along the southern bank of the JC Weadock Discharge Channel with a broad (250-foot-wide) embankment separating the Bottom Ash Pond from the Discharge Channel. The Discharge Channel is hydraulically connected to Lake Huron but not regulated as Waters of the State (WOS) since each of these channels serve as Plant Section 402 internal conveyances regulated under the National Pollutant Discharge Elimination System (NPDES) Permit as wastewater collection, treatment, and discharge conveyances.

The Bottom Ash Pond is no longer receiving CCR from an active power generating plant. The Bottom Ash Pond is anticipated to accept negligible amounts of CCR contact wash water and other low-volume miscellaneous wastewaters. It is anticipated that the Bottom Ash Pond’s final receipt of waste will occur on or before October 1, 2018; and resulting subsequent closure activities will commence within regulated timeframes.

During the inflow design flood (100-year storm event), the water levels will be temporarily elevated. The water levels have been estimated in the J.C. Weadock Generating Facility Bottom Ash Pond, Inflow Design Flood Control System Plan (Golder 2016). The peak 100-year water level is 596.9 feet and 592.5 feet (NAVD88) for Area 1 and Area 2, respectively; which is associated with storage volumes of 0.6 and 2.3 acre-feet for each of the areas. Table 2.0.1 provides a summary of the Bottom Ash Pond parameters.

Table 2.0.1 - Bottom Ash Pond Dimension and Water Level Summary

Cell Area	Perimeter Berm Crest Elevation (ft)	Pond Bottom Elevation (ft)	100-year Water Elevation (ft)	Storage Volume during 100-year Storm Event (acre-ft)
Area 1	600.1	594.1	596.86	0.6
Area 2	596.6	590.0	592.53	2.3

Note: Dimensions are from topographic survey by Engineering and Environmental Solutions, LLC (E&ES) (June 2016), elevations are in NAVD88

2.1 Dam Break Analysis

Two dam break analyses scenarios were conducted for the identification of potential hazards. These included: 1) assuming breach occurs on southern perimeter dike and 2) at culvert outlet on east end of Bottom Ash Pond into outlet channel. Both scenarios assume the volume of water from Area 2 contribute to the dam break volume since the two areas are disconnected and Area 2 has the larger volume. The dam break analysis followed a two-step process. First, the dam breach hydrograph was estimated using empirical methods. Then, the breach hydrograph was routed using a 2D hydraulic model.

2.1.1 Dam Breach Hydrograph

Dam breach parameters, including the volume of material eroded and failure time (from inception to completion of breach), were estimated based on the MacDonald and Langridge-Monopolis (1984) empirical equations as presented in Prediction of Embankment Dam Breach Parameters (Wahl 1998). These parameters are both a function of the storage volume and height of the Bottom Ash Pond. From these parameters, the final breach dimensions were estimated based on the geometry of the Bottom Ash Pond and assumed side slope of breach.

Breach hydrographs were developed using level-pool routing techniques in a spreadsheet based on the above estimated breach parameters, a linear breach growth, and stage-storage relationships.

2.1.2 2D Hydraulic Model

Dam break flood routing was conducted using TUFLOW, a hydraulic model that solves the full 2D shallow water equations. The following are components of the hydraulic model:

- <u>Digital Elevation Model (DEM)</u> – A DEM for the hydraulic model was created by mosaicking three data sources using ArcGIS with NAVD88 as the vertical datum. The three data sources included:
  - Site topo – An AutoCAD file of the Bottom Ash Pond and adjacent area based on a topographic survey by Engineering and Environmental Solutions, LLC (E&ES) in June 2016.
  - 2013 US Army Corps of Engineers (USACE) National Coastal Mapping Program (NCMP) Topobathy LiDAR Lake Huron. Downloaded from National Oceanic and Atmospheric Administration (NOAA) Digital Coast Data Access Viewer, August 2016.

- 2004 NOAA LiDAR – Saginaw Bay, Lake Huron. Downloaded from NOAA Digital Coast Data Access Viewer, August 2016.

- 2D Grid Extents – The hydraulic model's 2D grid extends from the Bottom Ash Pond south extending both to the Intake Channel to the west and Discharge Channel to the east.
- Cell Size and Time Step – The model was run with a cell size of eight-feet-by-eight-feet and a 3 second time step.
- Manning's n-values – All other areas were set to n = 0.040.
- Culverts – Five culverts were included in the model as 1D elements for Scenario 2 where the breach is routed to the east through a series of channels and culverts. The culverts were estimated as 24 inches.
- Outlet Boundary Condition – The outlet boundary condition was set as a constant head of 580 feet (NAVD88) at the Discharge Channel for Scenario 2. The recent long-term (1918-2013) mean lake level based measurements taken by the NOAA is 579.4 feet (NAVD88). To be conservative, the boundary condition was set at 580.0 (NAVD88). The boundary condition is located on the edge of the 2D grid at both the Intake Channel and Discharge Channel.
- Inflow Boundary Condition – The inflow boundary condition is the dam breach hydrograph. It was positioned on the edge of the 2D grid at the southern edge of the impoundment embankment for Scenario 1 and on the east edge of the impoundment for Scenario 2.

2.2 Dam Break Analysis Results

The resulting dam break inundation maps are presented in Figure 2 – Dam Break Inundation Map Scenario 1 and Figure 3 – Dam Break Inundation Map Scenario 2.

Flooding caused by a potential dam break of the Bottom Ash Pond on the southern perimeter dike (Scenario 1) enters a ditch directly south of the Bottom Ash Pond. The majority of the flood wave runs along the ditch to the east and then south, ending in a low area approximately 1,000 feet southeast of the Bottom Ash Pond.

Flooding caused by a potential dam break at the Bottom Ash Pond at the outlet culvert on the east end of the pond (Scenario 2) enters the channel directly to the east. The flood wave continues through the outlet channel and culvert system out the Discharge Channel. The flood wave attenuates from approximately 25 cfs at the dam break to 1.6 cfs through the NPDES Outfall into the Discharge Channel. Approximately 0.6 acre-feet of stored water reaches the Discharge Channel within 10 hours of the dam break.

2.3 Hazard Classification

If a release of stored water due to failure or mis-operation were to occur, the dam break analysis predicts that a small amount of water and/or stored content would discharge across part of the JC Weadock site and; in the case of Scenario 2, into the Discharge Channel through the NPDES Outfall. No probable loss of human life and low economic and/or environmental losses are expected. Any losses are principally limited to the surface impoundment owner's property. As a result, the Bottom Ash Pond surface impoundment at JC Weadock has been rated a low hazard potential classification.

3.0 CONCLUSIONS AND SUMMARY

The Bottom Ash Pond at JC Weadock has been rated a low hazard potential classification, as a dike failure would result in no probable loss of human life and low economic and/or environmental losses. Any losses are principally limited to the surface impoundment owner's property.

Low hazard potential classification assessments for existing CCR surface impoundments provide the design inflow criterion of the 100-year flood event in the inflow design flood control system and the factor of safety assessment required in 40 CFR 257.82 and 40 CFR 257.73, respectively.

This initial hazard potential classification certification must be placed in the facility's operating record in accordance with 257.105(f) and must be made available on the facility's publicly accessible internet site in accordance with 257.107(f).

Sincerely,

GOLDER ASSOCIATES INC.

Scott Stoneman, P.E.
Senior Water/Civil Engineer

John Puls, P.E.
Senior Engineer

4.0 REFERENCES

Golder Associates. 2016. JC Weadock Generating Facility Bottom Ash Pond, Inflow Design Flood Control System Plan.

MacDonald, Thomas C., and Jennifer Langridge-Monopolis. 1984. Breaching Characteristics of Dam Failures. Journal of Hydraulic Engineering, vol. 110, no. 5, p. 567-586.

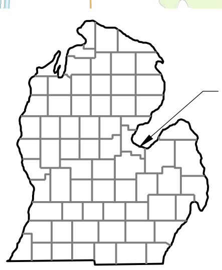
NOAA (National Oceanic and Atmospheric Administration). 2004. LiDAR – Saginaw Bay, Lake Huron. Downloaded from NOAA Digital Coast Data Access Viewer 8/2016.

USACE (Army Corps of Engineers). 2013. NCMP Topobathy LiDAR Lake Huron. Downloaded from NOAA Digital Coast Data Access Viewer 8/2016.

USEPA (Environmental Protection Agency). 2015. Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 40 CFR Part 257. Effective Date October 19, 2015.

Wahl, Tony L. 1998. Prediction of Embankment Dam Breach Parameters – A Literature Review and Needs Assessment. DSO-98-004. US Department of Interior. Bureau of Reclamation, Dam Safety Office.

FIGURES



REFERENCE(S)
BASE MAP TAKEN FROM USGS 7.5 MINUTE QUADRANGLE
BAY CITY NE, MICHIGAN
DATED 2014

0 1000 2000 3000
SCALE FEET

CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI. 48732

PROJECT
J.C. WEADOCK
BOTTOM ASH POND

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-08-22
DESIGNED	MAL
PREPARED	MAL
REVIEWED	JRP
APPROVED	MAB

TITLE
SITE LOCATION MAP

PROJECT NO.	REV.	FIGURE
1655164	0	1

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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A
0 1 in

LEGEND

- 2D Grid Extents
- Inflow and Outlet Boundaries
- Waterbody (El. 580)

Maximum Inundation Depth (ft)

High : 3

Low : 0

0 100 200 400

Feet

NOTE(S)

1. RESULTS FROM TUFLOW 2D HYDRAULIC MODEL.

REFERENCE(S)

1. SITE TOPO KARN BOTTOM ASH POND BY ENGINEERING AND ENVIRONMENTAL SOLUTIONS (MAY 2016).
2. 2013 USACE NCMP TOPOBATHY LIDAR LAKE HURON.
3. 2004 NOAA LIDAR - SAGINAW BAY, LAKE HURON.
4. BATHYMETRY IN LAKE HURON AND INTAKE AND DISCHARGE CHANNELS ESTIMATED.

HORIZONTAL DATUM: NAD 1983 STATE PLANE MICHIGAN SOUTH FIPS 2113, FEET
VERTICAL DATUM: NAVD 88

CLIENT

CONSUMERS ENERGY

PROJECT

J.C. WEADOCK GENERATING FACILITY
BOTTOM ASH POND
HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

TITLE

DAM BREAK INUNDATION MAP
SCENARIO 1

CONSULTANT

Golder Associates

YYYY-MM-DD	2016-09-02
DESIGNED	SS
PREPARED	SS
REVIEWED	JP
APPROVED	MW

PROJECT NO.	REV.	FIGURE
1652598	A	2

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0 1 in IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

LEGEND

- 2D Grid Extents
- Inflow and Outlet Boundaries
- Culvert
- Waterbody (El. 580)

Maximum Inundation Depth (ft)

High : 3

Low : 0

0 100 200 400
Feet

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HORIZONTAL DATUM: NAD 1983 STATE PLANE MICHIGAN SOUTH FIPS 2113, FEET
VERTICAL DATUM: NAVD 88

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PROJECT
J.C. WEADOCK GENERATING FACILITY
BOTTOM ASH POND
HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

TITLE
DAM BREAK INUNDATION MAP
SCENARIO 2

CONSULTANT
Golder Associates

YYYY-MM-DD	2016-09-02
DESIGNED	SS
PREPARED	SS
REVIEWED	JP
APPROVED	MW

PROJECT NO. 1652598 | REV. A | FIGURE **3**

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity