Stantec Consulting Services Inc.
9200 Shelbyville Road, Suite 800, Louisville, Kentucky 40222-5112

April 13, 2023
File: let_011_175578372
Revision 0

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

RE: Periodic Inflow Design Flood Control System Plan
Fly Ash Stilling Pond 2C and Sluice Channel
EPA CCR Rule
TVA Bull Run Fossil Plant
Clinton, Tennessee

1.0 PURPOSE

This letter documents certification that the Fly Ash Stilling Pond 2C and Sluice Channel at the Tennessee Valley Authority (TVA) Bull Run Fossil Plant complies with the inflow design flood control system requirements set forth in 40 CFR 257.82(a)&(b) of the EPA CCR Rule. The EPA CCR Rule requires periodic inflow design flood control system plan assessments, certified by a qualified professional engineer, every five years. The initial certification of the inflow design flood control system plan was placed in the operating record on April 17, 2018.

2.0 INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN ASSESSMENT

The initial inflow design flood control system plan (prepared in accordance with 40 CFR 257.82(c)(1)) is attached. The 1,000-year flood event was selected for the design storm based upon a hazard potential classification of "significant". The initial assessment found that the Fly Ash Stilling Pond 2C and Sluice Channel met the requirements of 40 CFR 257.82(a)&(b).

3.0 CURRENT INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN ASSESSMENT

Stantec reviewed the result of the initial inflow design flood control system plan assessment and the changes in site conditions that have occurred in the past five years at the site. The following operational changes and other factors were considered in this periodic assessment:

1. Fly Ash Stilling Pond 2C is adjacent to the Main Ash Pond within the southwest portion of the BRF Plant property. The unit was closed in June 2020, CCR was removed, and the area was repurposed to serve as a stormwater and non-CCR process water pond (Process Water Basin). Repurposing operations included, in part, removal of CCR, regrading the interior slopes of the perimeter dikes and installing a crushed stone drainage layer, geosynthetic liner, and riprap.

2. The Sluice Channel was closed and capped with a geomembrane liner system and a vegetative cover in 2017.

Re: **Periodic Inflow Design Flood Control System Plan**
Fly Ash Stilling Pond 2C and Sluice Channel
EPA CCR Rule
TVA Bull Run Fossil Plant
Clinton, Tennessee

3. Non-CCR process water from the plant is conveyed to the non-CCR Process Water Basin. The lined Process Water Basin was constructed within the repurposed footprint of the closed Fly Ash Stilling Pond 2C.

4. The risers of the historic outlet structure at Outfall 001 have been removed and the connecting 36-inch diameter reinforced concrete pipes were grouted and abandoned. The historic outlet structure was replaced with a 3-bay concrete stop log structure at Outfall 001.

5. A concrete emergency overflow spillway was constructed.

Because of these changes, a revised Hydrologic and Hydraulic (H&H) analysis was performed as part of the closure design to document the closed conditions. Closure was completed per the general design. Based on our review, there are no conditions that have changed since the Fly Ash Stilling Pond 2C was closed that would cause the result of the design calculations to have changed. The updated analysis shows that the unit can safely pass the 1,000-year, 6-hour storm without overtopping the crest of the surrounding dike.

4.0 SUMMARY OF ASSESSMENT

The revised H&H analysis resulted in the water surface elevation shown in the following table. Based on a review of the initial inflow design flood control system plan, the items listed in Section 3.0, and the revised H&H analysis, this periodic inflow design flood control system plan assessment for the Fly Ash Stilling Pond 2C and Sluice Channel at the Bull Run Fossil Plant meets the requirements of §257.82(a)&(b) of the EPA CCR Rule.

Plant	Facility	Inflow Design Storm	Water Surface Elevation (feet)	Minimum Embankment Elevation (feet)
BRF	Fly Ash Stilling Pond 2C and Sluice Channel	1000-year storm	802.9	805.0

Re: **Periodic Inflow Design Flood Control System Plan**
Fly Ash Stilling Pond 2C and Sluice Channel
EPA CCR Rule
TVA Bull Run Fossil Plant
Clinton, 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 the inflow design flood control system plan for the TVA Bull Run Fossil Plant's Fly Ash Stilling Pond 2C and Sluice Channel meets the requirements specified in 40 CFR 257.82(a), (b), and (c)(1).

SIGNATURE Stephen H. Bickel DATE 04/13/2023

ADDRESS: Stantec Consulting Services Inc.
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Louisville, Kentucky 40222-5112

TELEPHONE: (502) 212-5075

ATTACHMENTS: Fly Ash Stilling Pond Closure Design Calculations
Initial Inflow Design Flood Control System Plan

FLY ASH STILLING POND CLOSURE
DESIGN CALCULATIONS
NOVEMBER 2019

1. Introduction

1.1 Project Location

The Tennessee Valley Authority (TVA) owns and operates the Bull Run Fossil Plant (BRF) in Clinton, Tennessee. The plant is located along the banks of the Clinch River and Bull Run Creek. The Main Ash Pond is an inactive Coal Combustion Residual (CCR) impoundment that currently manages storm water and plant wastewater flows. Process Water Basin 1 is located in the southwestern corner of BRF, bordered by the Clinch River to the west, Bull Run Creek to the South, and the Main Ash Pond to the east (see **Figure 1**).

Figure 1. Site Overview

1.2 Existing Conditions

Process Water Basin 1 (PWB1) and the Main Ash Pond and are utilized as settling ponds for process and stormwater flows from the site. The ponds also provide storage and detention for stormwater flow. Under existing conditions, the drainage area for the PWB1 is approximately 115.3 acres. The following areas are included in the PWB1 watershed:

- A portion of the Bottom Ash Disposal Area
- A portion of the Gypsum Disposal Area
- The Conveyance Ditch and surrounding areas
- The Main Ash Pond and surrounding areas
- Process Water Basin 1 and surrounding areas

The existing conditions at the pond complex consist of several elements that carry process flows and stormwater to the ponds and ultimately to the Clinch River via Outfall 001. At the far upstream end, a process water ditch (Conveyance Ditch) begins at a concrete process water outlet which discharges non-CCR process water from the plant. The Conveyance Ditch runs approximately 6,200-feet to the Main Ash Pond. Along the way, the Conveyance Ditch receives stormwater flows from the Bottom Ash Disposal Area, the Gypsum Disposal Area, and rainfall that falls directly on the Conveyance Ditch. The Conveyance Ditch is the main channel for

carrying process water and stormwater along the southeast side of the BRF CCR facility. The Conveyance Ditch discharges into the Main Ash Pond.

The Main Ash Pond and the Conveyance Ditch receive stormwater from the south slope of the Gypsum Disposal Area and rainfall that falls directly on the Main Ash Pond. The Main Ash Pond also receives stormwater flows from the top of the Gypsum Disposal Area via two riser pipes with 24-inch HDPE outlets into the north side of the pond. Water from the Main Ash Pond is discharged to PWB1 through a concrete stop log structure. A divider dike separates the Main Ash Pond from PWB1, with a minimum crest elevation of 805.0 ft.

The discharge is authorized by National Pollutant Discharge Elimination System (NPDES) permit number TN0005410 at Outfall 001. The historic discharge structures at Outfall 001 consisted of (3) riser-type structures, each fitted with a 54-inch diameter weir ring set at approximate elevation 800.0 ft. The risers discharged into (3) separate 36-inch diameter reinforced concrete pipes that conveyed water to the Clinch River. Due to stability issues, the historic outlet structures were removed and the outlet pipes were grouted and abandoned in May 2019. Storm and process water is currently managed in the Main Ash Pond and PWB1 by pumps. The minimum dike crest elevation of PWB1 is 809.9 ft. Historically, PWB1 has not had an emergency spillway. However, an emergency overflow spillway is included as a part of the plans for PWB1. The emergency spillway consists of a concrete overflow along the dike, approximately three feet below the dike crest.

The proposed primary outlet structure to be constructed at Outfall 001 will consist of a 3-bay concrete stop log structure, with the stop logs set at an approximate elevation of 799.4 ft. Each bay within the structure shall outlet into a 24-inch diameter SDR17 HDPE conduit. Each of the three conduits will discharge into the Clinch River at Outfall 001.

1.3 Proposed Conditions

Proposed construction at PWB1 includes the removal of CCR material from the pond bottom, re-grading the pond floor to slope to the east to a drainage collection system, the installation of a drainage layer, and the lining of the pond floor and interior pond slopes, incorporating a geomembrane liner system with a protective cover. Additionally, proposed primary and emergency spillways will be constructed. **Figure 2** depicts the proposed conditions hydraulic routing diagram. It must be noted that the Main Ash Pond will also be modified to incorporate a new process and stormwater pond just upstream of PWB1. The new process water pond that will be constructed within the footprint of the Main Ash Pond will be known as Process Water Basin 2 (PWB2), and will flow into PWB1 via a three-bay concrete stoplog structure. The entire footprint of the Main Ash Pond will be lined and closed in place. The proposed up-to-date design drawings are provided in **Appendix A**.

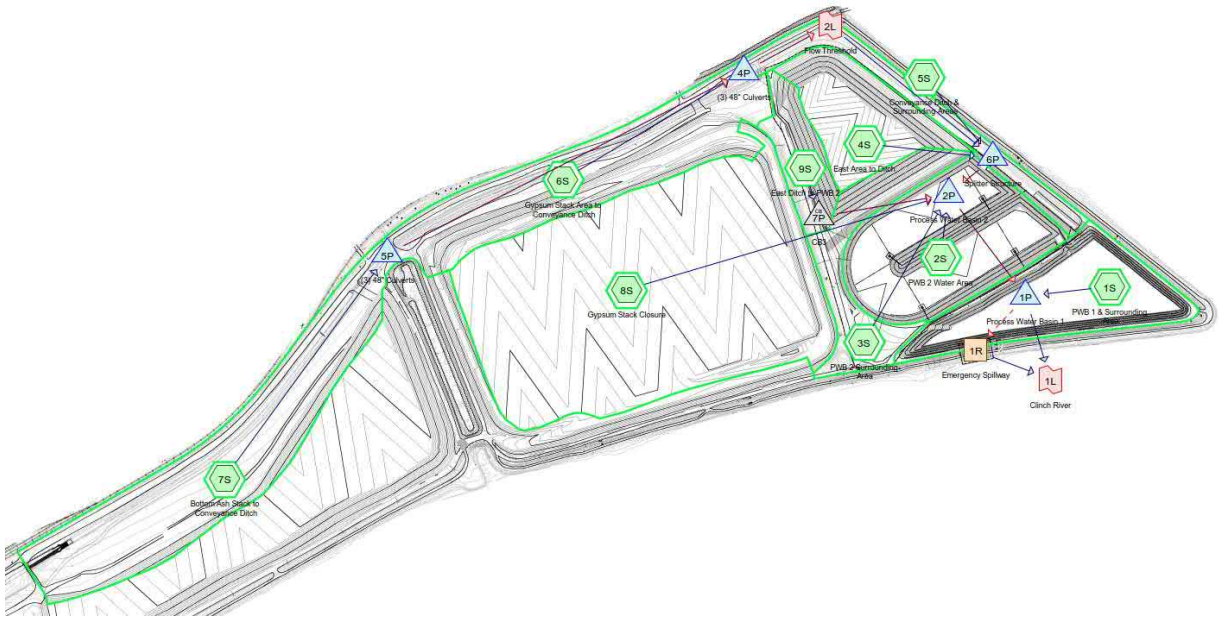

Figure 2. Proposed Conditions Hydraulic Routing Diagram

2. Hydrologic Analysis

2.1 Design Criteria

AECOM was contracted by TVA to conduct a hydrologic and hydraulic modeling analysis of the proposed PWB1 for compliance with the Federal Register Coal Combustion Residual (CCR) regulations (40 CFR Part §257.82). Stantec Consulting Services, Inc. completed a Hazard Potential Classification Assessment for the Main Ash Pond and Stilling Pond 2C (now PWB1) in 2017. Both impoundments were determined to be “significant” hazards. Based on this classification, the regulations require that the ponds safely store and convey the 1,000-year 6-hour storm event, in addition to normal process flow conditions (40 CFR Part §257.82(a)(3)(ii)). The inflow design flood (IDF) for PWB1 and the Main Ash Pond is the 1,000-year, 6-hour storm.

In addition to the Federal Register CCR regulations, PWB1 must also comply with the Tennessee Department of Environment and Conservation (TDEC) Design Criteria for Review of Sewage Works Construction Plans and Documents, Chapter 9.

The TDEC Water Resources Division Rules Chapter 0400-45-07, “Rules and Regulations Applied to the Safe Dams Act of 1973” was also referenced during design. Based on the TDEC Water Resources Division Rules Chapter 0400-45-07, the minimum freeboard design storm for a “significant” hazard dam with small size is the flow generated by the 1/3 PMP (0400-45.07-.05 (1) & 0400-45.07-.06 (3) (b)).

2.2 Rainfall Depth

Rainfall data were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3. Rainfall depths were determined using the NOAA Precipitation Frequency Data Server (PFDS) with the location set to Clinton, Tennessee. The NOAA PFDS data is included in **Appendix B**.

The most recent PMP analysis was searched for, and found to be a 2015 study performed by the firm Applied Weather Associates. AECOM contacted Applied Weather Associates to obtain

the PMP study entitled “TVA Overall Basin Probable Maximum Precipitation and Local Intense Precipitation Analysis”, TVA Calculation Identifier CDQ0000002016000041. Applied Weather Associates personnel used the TVA PMP tool to analyze the 1 mi^2 tile that BRF is located within, and reported the results to AECOM. A PMP depth of 21.05 inches was determined based on the PMP tool. Correspondence between AECOM and Applied Weather Associates is included in **Appendix B**. **Table 1** summarizes the rainfall depths obtained through the NOAA PFDS and the TVA PMP analysis.

Table 1: Rainfall Depths from the NOAA PFDS and TVA PMP Analysis

Storm Event	Storm Duration	Rainfall Depth (in)
2-Year	24-Hour	3.27
25-Year	24-Hour	5.43
100-Year	24-Hour	6.86
100-Year	6-Hour	4.65
1,000-Year	6-Hour	6.74
1/3 PMP	6-Hour	7.02

3. Hydraulic Analysis

3.1 Methodology

To assess the capacity of the pond complex to store and convey the design storm, a hydraulic model was created using HydroCAD v10.00-22. The model was developed based upon Aerial LiDAR data, field survey, site reconnaissance, historic construction plans provided by TVA, and proposed construction plans by AECOM. The Soil Conservation Service (SCS) TR-20 Runoff method was used with the dynamic-storage-indication routing method. The dynamic-storage-indication routing method considers downstream elevations at each calculation time step, allowing the program to account for ongoing tailwater changes. The NOAA Type B storm distribution was selected at BRF. The SCS Curve Number method was used for estimating infiltration losses, and the SCS Unit Hydrograph was used to transform precipitation into runoff for each sub-basin. Hydrologic soil group C was assumed based on future site soil conditions.

3.2 Boundary Conditions

The expected maximum daily flow rate of 17 MGD, or approximately 26.3 cfs, was used in the analysis based on information provided by TVA. The normal operating water surface elevation (WSE) of PWB1 is expected to be 800.0 ft. assuming a base flow of 26.3 cfs. The 100-Year WSE of the Clinch River was used as a downstream boundary condition for the model. A 100-Year WSE of 796.0 ft. was used based on FEMA National Flood Hazard Layer (NFHL) Maps.

3.3 HydroCAD Model Inputs

All structure dimensions and invert elevations are modeled in accordance with the proposed operating conditions at BRF. Existing topographic and survey information for BRF was provided by TVA. Drainage areas, volumes, and other site geometry were determined using AutoCAD Civil 3D in conjunction with survey data provided by TVA. **Table 2** provides the HydroCAD model inputs for each subcatchment. CN was assumed based on final proposed site conditions.

Table 2: HydroCAD Model Inputs

ID	Description	Area (ac.)	CN	Time of Concentration (min.)
1S	PWB1 & surrounding area	10.2	98	0.8
2S	Main Ash Pond (Wet)	14.5	98	2.5
3S	Main Ash Pond (Dry)	12.1	92	3.0
4S	Main Ash Pond to Conveyance Ditch	5.7	92	3.3
5S	Gypsum Stack Area to Conveyance Ditch	11.8	80	19.1
6S	Bottom Ash Stack to Conveyance Ditch	18.0	78	9.7
8S	Gypsum Stack	43.0	92	31.2

3.4 Pond Hydraulics & Routing

A detailed H&H modeling summary of PWB1, the Main Ash Pond, and the Conveyance Ditch is provided in **Appendix C**. The HydroCAD model outputs demonstrate the performance of the surface impoundments during the 1,000-year 6-hour storm event as required by the hazard potential classification, and the 1/3 PMP, 6-hour storm as required by the TDEC Water Resources Division.

3.5 PWB1 Primary Outlet Structure

Part of the PWB1 project includes the construction of a new primary outlet structure to convey flows from PWB1 to the Clinch River through NPDES Outfall 001. The structure will also be designed to safely pass the IDF.

The proposed stop log outlet structure will consist of three stop log bays that are each 6 feet wide. Each stoplog bay will flow into a box with a 24” nominal diameter (21” inside diameter) HDPE SDR17 discharge pipe. The stoplogs will allow maintenance of each individual pipe. The minimum stoplog elevation will be 796.9 ft. (one stoplog installed in the frame) and a maximum elevation of 803.4 ft. The normal stop log elevation will be set at 799.4 ft. to maintain a normal water surface elevation of approximately 800.0 ft. in PWB1. Each bay will be topped with a grate at elevation 803.4 ft. The grates allow additional flow into the structure through the top of the box and provide an access point for water sampling. The (3) 24” HDPE pipes will have an upstream invert of 796.15 ft., a downstream invert of 795.50 ft., a length of 80 ft., and a slope of approximately 0.8%.

Structural calculations for the PWB1 Primary Outlet Structure can be found in **Appendix E**.

3.6 PWB1 Emergency Spillway

An emergency spillway is included in the plans for PWB1 and was designed to pass the 1/3 PMP based on TDEC Water Resource Division Chapter 0400-45-07. The spillway will be located in close proximity to the existing NPDES permitted outfall to eliminate the need to develop an additional NPDES outfall. The existing outer dike has a minimum elevation of 809.9 ft. The spillway was designed to have a minimum of 1 foot of freeboard at the dike crest. The proposed emergency spillway will have an invert elevation of 807.0 ft., a bottom width of 75-feet, and 10:1 side slopes until the existing dike is met. There are two access road crossings over the spillway, so access must be maintained; therefore, the maximum side slope will be 10% to allow vehicular traffic.

TVA personnel requested that AECOM design a riprap-lined emergency spillway. The Hydraulic Engineering Circular No. 15, Third Edition was used to determine the required riprap size and design a filter blanket. The Tennessee DOT Design Division Drainage Manual, 2011 Edition, was used to select appropriately sized riprap that is available locally. The TDOT Drainage Manual was also used to determine the required minimum thickness of riprap lining. Emergency Spillway design calculations are included in **Appendix E**.

4. Results and Conclusions

4.1 Pond Hydraulics & Routing

The following results summarized in **Table 3** represent the design storm events run through the proposed site. The following results are based on normal operating conditions. Inflow and Outflow hydrographs can be found in **Appendix C**.

Table 3: Main Ash Pond & PWB1 Estimated Peak Flows and Peak Pool Elevation

Location	Storm Event	Storm Duration	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Pool Elevation (ft.)	* Remaining Freeboard (ft.)
Main Ash Pond	Normal	-	0.0	0.0	801.5	3.5 (8.4)
	25-Yr	24-Hr	242.6	75.5	802.5	2.5 (7.4)
	100-Yr	24-Hr	311.8	105.6	802.8	2.2 (7.1)
	1,000-Yr	6-Hr	691.9	144.0	803.1	1.9 (6.8)
	1/3 PMP	6-Hr	722.4	150.3	803.1	1.9 (6.8)
PWB1	Normal	-	26.3	26.3	800.0	5.0 (9.9)
	25-Yr	24-Hr	178.9	75.4	801.7	3.3 (8.2)
	100-Yr	24-Hr	242.1	80.7	802.4	2.6 (7.5)
	1,000-Yr	6-Hr	401.1	84.3	802.9	2.1 (7.0)
	1/3 PMP	6-Hr	419.0	85.1	803.0	2.0 (6.9)

** Remaining freeboard as reported in **Table 3** is in comparison to the minimum divider dike elevation of 805.0 ft. Actual freeboard at the site is based on the outer dike which has a minimum elevation of (809.9) ft.*

The modeling results indicate that the existing PWB1 and the Main Ash Pond would not overtop during a 1,000-year, 6-hour storm as required by the Federal CCR Rule Regulations. The Main Ash Pond maintains 1.9 feet of freeboard below the divider dike, or 6.8 feet of freeboard below the outer dike. PWB1 maintains 2.1 feet of freeboard below the divider dike, or 7.0 feet of freeboard below the outer dike.

4.2 PWB1 Emergency Spillway

The HydroCAD model created by AECOM estimated the peak pool elevation of PWB1 during the 1/3 PMP rainfall as 803.0 ft., providing a freeboard of 6.9 feet below the outer dike minimum elevation. Although the proposed BRF conveyance system will safely pass the 1/3 PMP without use of an emergency spillway, an emergency spillway was designed that would pass the estimated peak inflow to PWB1 during the IDF.

The emergency spillway was designed to maintain a minimum of 1 foot of freeboard during the 1/3 PMP, 6-hour storm. The peak inflow to PWB1 for the 1/3 PMP was estimated to be 419.0 cfs based on the HydroCAD results. A design flow of 420 cfs was conservatively used for the emergency spillway. A separate HydroCAD model was created which isolates PWB1 and the emergency spillway. A base flow of 420 cfs was used to size the emergency overflow weir and spillway. The result is a 75-foot bottom width spillway with an invert elevation of 807.0 ft. and 10:1 side slopes. The top width of the emergency overflow will be approximately 125-feet.

The spillway was modeled using a manning's 'n' value of 0.013 for concrete, an 'n' value of 0.10 for riprap, and a maximum slope of 33%. Based on the above inputs, a peak velocity of 10.0 ft/s was calculated with a steady flow of 420 cfs, which is within the limits of Class B riprap in the TDOT Drainage Design Manual.

4.3 Conclusions

The hydraulic modeling results indicate that PWB1 and the Main Ash Pond would be able to safely pass the IDF with acceptable freeboard. The pond outlet control system manages flow into the CCR unit during and the following the peak outflow of the design storm. Discharge is handled in accordance with the surface water requirements under Final CCR Rule 40 CFR §257.82. Additionally, the emergency spillway is able to safely pass the flow generated by the 1/3 PMP with acceptable freeboard.

INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM ASSESSMENT

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April 13, 2018

Tennessee Valley Authority
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Initial Inflow Design Flood Control System Plan
Fly Ash Stilling Pond 2C and Sluice Channel
EPA Final CCR Rule
TVA Bull Run Fossil Plant
Clinton, Tennessee

1.0 PURPOSE

This letter documents AECOM's certification of the initial inflow design flood control system plan for the TVA Bull Run Fossil Plant's Fly Ash Stilling Pond 2C and Sluice Channel. Based on the assessment, the Fly Ash Stilling Pond 2C and Sluice Channel comply with the inflow design flood control requirements in the Final CCR Rule 40 CFR § 257.82.

2.0 INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

As described in 40 CFR § 257.82(c), an inflow design flood control system plan must be prepared to document how the inflow design flood control system has been designed and constructed to manage the design storm required by the hazard classification. Based on the Hazard Potential Classification, the Fly Ash Stilling Pond 2C and Sluice Channel have been assigned a significant hazard potential classification rating. The Sluice Channel was closed in place after the lined process water Conveyance Ditch was constructed and put into service. Thus, the 1,000 year storm event was selected from 40 CFR § 257.82(a)(3) as the inflow design storm flood event analyzed for Fly Ash Stilling Pond 2C based upon the selected hazard potential classification.

3.0 SUMMARY OF FINDINGS

The attached plan presents the analysis of the inflow design flood control system for the Fly Ash Stilling Pond 2C and Sluice Channel. The plan and results show that the impoundment meets the requirements set forth in 40 CFR § 257.82(a) and (b).

4.0 Limitations

The signature of AECOM's authorized representative on this document represents that to the best of AECOM's knowledge, information and belief in the exercise of its professional judgment, it is AECOM's professional opinion that the aforementioned information is accurate as of the date of such signature. Any recommendation, opinion, or decisions by AECOM are made on the basis of AECOM's experience, qualifications and professional judgment and are not to be construed as warranties or guaranties. In addition, opinions relating to environmental, geologic, and geotechnical conditions or other estimates are based on available data and actual conditions may vary from those encountered at the times and locations where data are obtained, despite the use of due care.

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5.0 Qualified Professional Engineer Certification

I, Thomas Kovacic PE, being a Professional Engineer in good standing in the State of Tennessee do hereby certify, to the best of my knowledge, information, and belief:

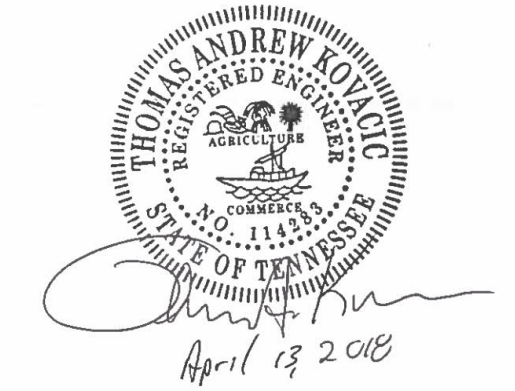
1. that the information contained in this certification is prepared in accordance with the accepted practice of engineering;
2. that the information contained herein is accurate as of the date of my signature below; and
3. that the inflow design flood control system plan for the TVA Bull Run Fossil Plant's Fly Ash Stilling Pond 2C and Sluice Channel meet the requirements specified in 40 CFR § 257.82(a), (b), and (c)(1).

SIGNATURE _____ DATE 4-13-2018

ADDRESS: AECOM
1300 E. 9th Street, Suite 500
Cleveland, OH 44114

TELEPHONE: (216) 622-2300

ATTACHMENTS: Initial Inflow Design Flood Control System Plan for Coal Combustion Residuals (CCR) Existing Surface Impoundment



COAL COMBUSTION PRODUCT DISPOSAL PROGRAM

TENNESSEE VALLEY AUTHORITY – FLY ASH STILLING POND 2C AND SLUICE CHANNEL
BULL RUN FOSSIL PLANT
ANDERSON COUNTY, TENNESSEE

INITIAL INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN (40 CFR §257.82) FOR COAL COMBUSTION RESIDUALS (CCR)

FLY ASH STILLING POND 2C AND SLUICE CHANNEL

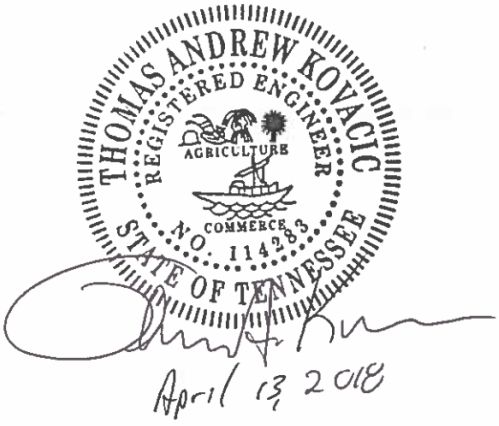
Prepared for

Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402-2801

April 13, 2018

Prepared by

AECOM



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APPENDICES

1.0 BACKGROUND

This plan outlines compliance to **Rule § 257.82** of the EPA Final CCR Rule.

The owner or operator of an existing CCR surface impoundment must design, construct, operate, and maintain an inflow design flood (IDF) control system as specified in **Rule §257.82 (a),** which is directly stated below for clarity.

Rule §257.82(a)(1): The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood.

Rule §257.82(a)(2): The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

Rule §257.82(a)(3): The inflow design flood is:

(i): For a high hazard potential CCR surface impoundment, the probable maximum flood;

(ii): For a significant hazard potential CCR surface impoundment, the 1,000-year flood;

(iii): For a low hazard potential CCR surface impoundment, the 100-year flood; or

(iv): For an incised CCR surface impoundment, the 25-year flood.

According to **Rule §257.82(b)**, discharge from the CCR unit must be handled in accordance with the surface water requirements under **§257.3-3.**

Section **§257.82(c)(1)** states that the owner or operator must prepare initial and periodic inflow design flood control system plans for the CCR unit according to the timeframes specified in paragraphs **(c)(3)** and **(4)**. The plans must document how the inflow design flood control system has been designed and constructed to meet the requirements of the section. Each plan must be supported by appropriate engineering calculations. The owner or operator of the CCR unit has completed the inflow design flood control system plan when the plan has been placed in the facility's operating record.

Section **§257.82(c)(2)** allows amendments to the written inflow design flood control system plan at any time and requires amendments to the written inflow design flood control system plan whenever there is a change in conditions that would substantially affect the written plan in effect. The revised plan must be placed in the facility's operating record.

Section **§257.82(c)(3)** requires that the initial inflow design flood control system plan be completed no later than October 17, 2016, except that inactive CCR surface impoundments that meet the criteria under Section 257.100(e) have until April 18, 2017 to prepare the initial inflow design flood control system plan.

Section **§257.82(c)(4)** states that the owner or operator must prepare periodic inflow design flood control system plans every five years.

Section **§257.82(c)(5)** requires a certification from a qualified professional engineer stating that the initial and periodic inflow design flood control system plans meet the requirements of **Rule §257.82**.

According to **Rule §257.82(d)**, the owner or operator must comply with recordkeeping, notification, and internet requirements specified elsewhere in the Rule.

1.1 SITE LOCATION

Tennessee Valley Authority (TVA) owns and operates the Bull Run Fossil Plant (BRF) in Clinton, Tennessee. The plant is located along the banks of the Clinch River (Melton Hill Reservoir) and Bull Run Creek. The Fly Ash Stilling Pond 2C (Stilling Pond 2C) is located in the southwestern corner of BRF. Stilling Pond 2C is bordered by the Main Ash Pond to the north and east, the Clinch River to the west, and Bull Run Creek to the south (See **Figure 1**). The Sluice Channel spans approximately 5 acres and was closed in place after the lined process water Conveyance Ditch was constructed and put into service.

Figure 1: Site Overview

1.2 SITE HISTORY

The original embankments of the Ash Disposal Area #2, currently known as the Main Ash Pond, were constructed in the 1960s, building embankments in the floodplains adjacent to the Clinch River and Bull Run Creek. The embankments of the Main Ash Pond were constructed approximately 15-feet tall to a crest elevation of 800.0 ft. The original embankments were constructed of light brown to dark brown, sometimes sandy, lean clay.

In 1976, an internal dike was constructed to form Fly Ash Stilling Pond 2C in the western portion of the Main Ash Pond. Following the construction of the earthen dike, the pond embankments were raised to an elevation of 810.0 ft. (NAVD88 Vertical Datum). In 2006, a drainage channel, also known as the Sluice Channel, was built during the construction of the Gypsum Disposal Area. The Sluice Channel began approximately 300 feet southeast of the northernmost point of the Bottom Ash Stack and terminated at the Main Ash Pond. Process water flow from the Sluice Channel ultimately flowed to Stilling Pond 2C and discharged through Outfall 001. In 2016 a geomembrane-lined Conveyance Ditch was constructed to convey storm water and plant wastewater flows ultimately terminating in Stilling Pond 2C and discharging through Outfall 001. The Sluice Channel was closed in 2017 after the completion of the Conveyance Ditch.

2.0 EXISTING CONDITIONS - §257.82(a)(1)

The hydrologic and hydraulic modeling analyzed for the Inflow Design Flood Control Plan examined the existing conditions of Stilling Pond 2C. Under the existing conditions, the drainage area for Stilling Pond 2C is approximately 116 acres. The following areas are included in the Stilling Pond 2C drainage area:

- A portion of the Bottom Ash Stack
- A portion of the Gypsum Stack
- The Conveyance Ditch and surrounding areas
- The Main Ash Pond
- The Stilling Pond 2C footprint
- The closed Sluice Channel footprint

The existing conditions at the pond complex consist of several elements that carry water to the ponds and ultimately to the Clinch River via Outfall 001. At the far upstream end, a process water ditch (Conveyance Ditch) begins at a concrete process water outlet, and receives non-CCR process water from the plant. The process water includes pumped stormwater from the plant, which is accounted for in the modeling. The Conveyance Ditch runs approximately 6,200-feet to the Main Ash Pond. Along the way, the Conveyance Ditch receives storm water flows from the Bottom Ash Stack, the Gypsum Stack, and rainfall directly falling on the Conveyance Ditch. The Conveyance Ditch is the main conduit for carrying process water and storm water along the southeast side of the BRF CCR facility. The Conveyance Ditch discharges into the Main Ash Pond.

The Main Ash Pond and the Conveyance Ditch receive stormwater from the south slope of the Gypsum Stack and rainfall that falls directly on the Main Ash Pond. The Main Ash Pond also receives stormwater flows from the top of the Gypsum Stack via two riser pipes with 24-inch HDPE outlets into the north side of the pond. Water from the Main Ash Pond is discharged to Stilling Pond 2C through a rock-lined outlet channel with a concrete weir. A divider dike separates the Main Ash Pond from Stilling Pond 2C, with a minimum crest elevation of 805.0 ft.

Outfall 001 consists of three riser-type structures, each equipped with a 54-inch diameter weir ring set at an approximate elevation of 800.0 ft. The risers outlet into three separate 36-inch diameter reinforced concrete pipes that discharge into the Clinch River. The minimum dike crest elevation of Stilling Pond 2C is 809.9 ft. At its current state, Stilling Pond 2C is not equipped with an emergency spillway. The discharge is authorized by National Pollutant Discharge Elimination System (NPDES) permit no. TN0005410 at Outfall No. 001.

The Sluice Channel was closed in 2017, and therefore no longer receives water.

3.0 METHODS / DESIGN CRITERIA

AECOM was contracted by the Tennessee Valley Authority (TVA) to conduct a hydrologic and hydraulic modeling analysis of Stilling Pond 2C for compliance with the new Federal Register Coal Combustion Residual regulations (40 CFR Part 257.82). Stantec Consulting Services, Inc. completed a Hazard Potential Classification Assessment for Stilling Pond 2C in 2017. The

impoundment was determined to be a "significant" hazard.[1] Based on this classification, the regulations require that the ponds safely store and convey the 1,000-yr storm event in addition to normal process flow conditions (40 CFR Part 257.82(a)(3)(ii)).

To assess the capacity of the pond to store and convey the IDF, a hydraulic model was created in HEC-HMS. HEC-HMS is a deterministic model and as such, assumes boundary conditions, initial conditions, and parameters of the model elements are known. The model incorporates model element characteristics and meteorological data to calculate infiltration losses, runoff, and reservoir storage and flow conditions. The model was developed based upon Aerial LiDAR data, field survey, site reconnaissance, and plans provided by TVA.

The following **Table 1** provides the IDF rainfall depth. The 6-hour, 1,000-year precipitation depth was obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3.

Table 1. IDF Rainfall Depth

Recurrence Interval	Storm Duration	Rainfall Depth	Storm Distribution
1,000-Year	6 Hour	6.74 inches	SCS Type II

The Soil Conservation Service (SCS) Type II distribution for average conditions was selected for BRF. The SCS Curve Number method was used for estimating infiltration losses, and the SCS Unit hydrograph was used to transform precipitation into runoff for each subbasin. The pond routing method used was an outflow curve. The outflow curve was generated using the computer program HydroCAD v10.0. The outlet geometry was entered into the HydroCAD model and an outflow curve was created. **Figure 2** below shows the outflow curve applied in the HEC-HMS analysis.

[1] Hazard potential classification ratings define the consequences in the event of a failure - the ratings have nothing to do with the likelihood of failure or the structural stability of the impoundment.

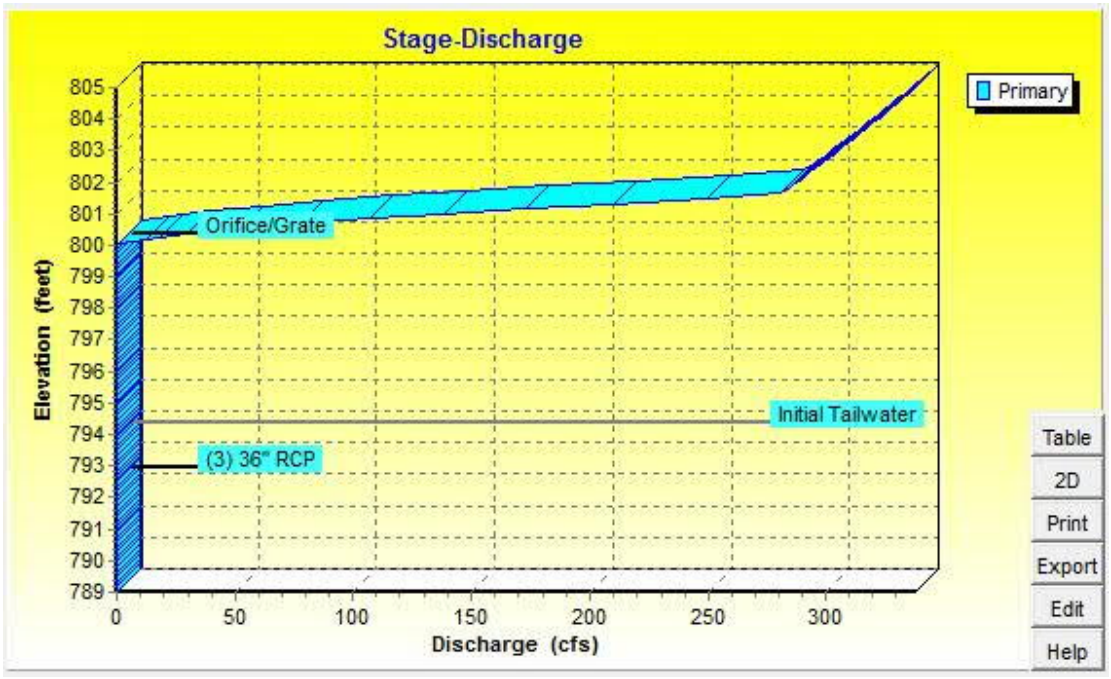


Figure 2: Stilling Pond 2C Outflow Curve

A base flow of 12 MGD or 18.6 cfs is considered for normal operating conditions, based on information provided by TVA. The normal operating water surface elevation of Stilling Pond 2C is 800.3 ft. The 100-Year water surface elevation (WSE) of the Clinch River was used as a downstream boundary condition for the model. A 100-Year WSE of 794.0 ft. was used based on FEMA National Flood Hazard Layer (NFHL) maps.

All structure dimensions and invert elevations are modeled using the available information under current operating conditions of BRF. Existing topographic and survey information for BRF was provided by TVA. Drainage areas, volumes, and other site geometry were determined using the AutoCAD Civil 3D software package in conjunction with survey data provided by TVA. **Table 2** provides the HEC-HMS model inputs for each subcatchment.

Table 2. HEC-HMS Model Inputs

ID	Description	Area (ac.)	CN	Time of Concentration (min.)
1S	Stilling Pond 2C	10.2	98	0.8
2S	Main Ash Pond (Wet)	9.6	98	2.5
3S	Main Ash Pond (Dry)	16.4	92	3.0
4S	Main Ash Pond to Conveyance Ditch	8.3	92	3.3
5S	Gypsum Stack Area to	13.8	79	19.1

ID	Description	Area (ac.)	CN	Time of Concentration (min.)
	Conveyance Ditch			
6S	Bottom Ash Stack to Conveyance Ditch	18.0	78	9.7
7S	Gypsum Stack to Main Ash Pond	39.3	74	31.2

A detailed H&H modeling summary of Stilling Pond 2C is provided in **Appendix A**. Computer model outputs provided demonstrate performance of Stilling Pond 2C during the IDF.

The Sluice Channel was discontinued operation in 2016, and was closed in 2017.

4.0 CALCULATION RESULTS - §257.82(a)(2)

The followings results represent the 1000-year, 6-hour storm routed through Stilling Pond 2C with the existing outlet structure. The risers and outlet pipes of Outfall 001 will be lined and the skimmers galvanized. Inflow and outflow hydrographs can be found in **Appendix A**.

There are no calculations for the Sluice Channel, as it was closed in 2017 and no longer receives water.

Table 3. Stilling Pond 2C Estimated Peak Inflow and Estimated Peak Pool Elevation

Recurrence Interval	Storm Duration	Peak Inflow	Peak Pool Elevation	Remaining Freeboard
1,000-Year	6 Hour	179.1 cfs	801.0 ft.	8.9 ft.

5.0 CONCLUSIONS

The modeling results indicate the ponds would not overtop during a 1000-year, 6-hour design storm, and the freeboard for Stilling Pond 2C during this storm event is acceptable. The inflow design flood control system adequately manages flow into the CCR unit during and following the peak discharge of the inflow design flood. Discharge is handled in accordance with the surface water requirements under Final CCR Rule 40 CFR 257.82.

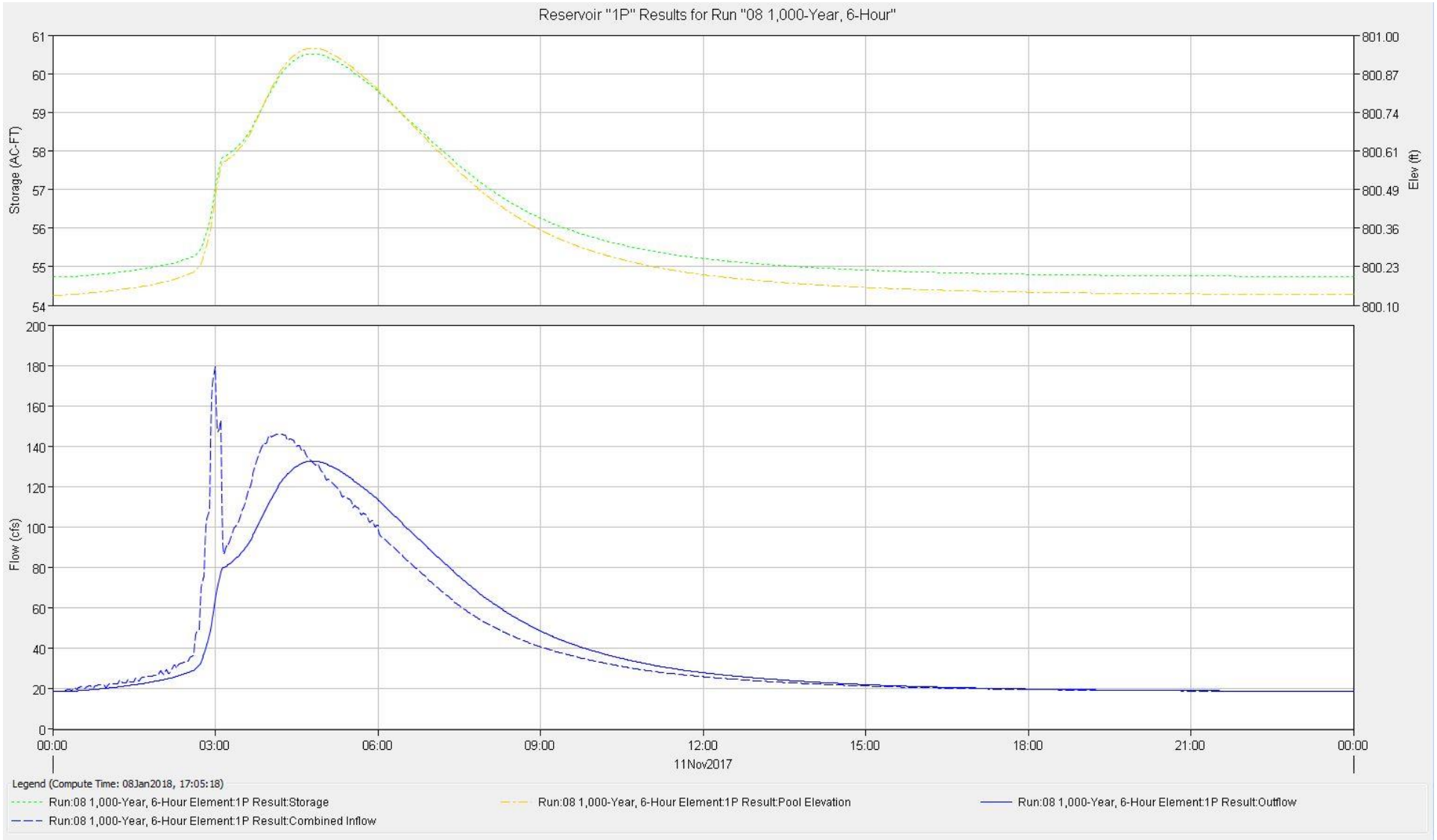
6.0 REFERENCES

The modeling results suggest the ponds would not overtop during a 1000-year, 6-hour design storm, and the freeboard for Stilling Pond 2C during this storm event is acceptable.

1. Environmental Protection Agency, “Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities”, Federal Register, April 17, 2015.
2. AECOM, Stilling Pond 2C, History of Construction 257.73(c)(1) prepared for CCR Certification, 2017
3. Stantec Consulting Services Inc., Hazard Potential Classification Assessment, Stilling Pond 2C, 2017
4. National Oceanic and Atmospheric Administration, Atlas 14, Volume 2, Version 3; 2017
5. United States Army Corps of Engineers, Hydrologic Modeling System (HEC-HMS), Version 4.2.1, 2017.

APPENDIX A
HEC-HMS OUTPUT

BRF Stilling Pond 2C
1,000-Year, 6-Hour, SCS Type II Storm



BRF Stilling Pond 2C
1,000-Year, 6-Hour, SCS Type II Storm

Project: BRF Stilling Pond Simulation Run: 08 1,000-Year, 6-Hour

Reservoir: 1P

Start of Run:	11Nov2017, 00:00	Basin Model:	BRF Stilling Pond Closure
End of Run:	12Nov2017, 00:00	Meteorologic Model:	08 1,000-Year, 6-Hour
Compute Time:	08Jan2018, 17:05:18	Control Specifications:	6-Hour Storm

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	179.14 (CFS)	Date/Time of Peak Inflow:	11Nov2017, 03:00
Peak Discharge:	132.52 (CFS)	Date/Time of Peak Discharge:	11Nov2017, 04:47
Inflow Volume:	8.64 (IN)	Peak Storage:	60.51 (AC-FT)
Discharge Volume:	8.63 (IN)	Peak Elevation:	800.96 (FT)