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April 13, 2018

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

Initial Inflow Design Flood Control System Plan
Main Ash Pond
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 Main Ash Pond. Based on the assessment, the Main Ash Pond complies 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 Main Ash Pond has been assigned a significant hazard potential classification rating. Thus, the 1,000 year storm event was selected from 40 CFR § 257.82(a)(3) as the inflow design storm flood event based upon a hazard potential classification.

3.0 SUMMARY OF FINDINGS

The attached plan presents the analysis of the inflow design flood control system for the Main Ash Pond. 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 Main Ash Pond meets the requirements specified in 40 CFR §257.82(a), (b), and (c)(1).

SIGNATURE ______________________ DATE 4-13-2018

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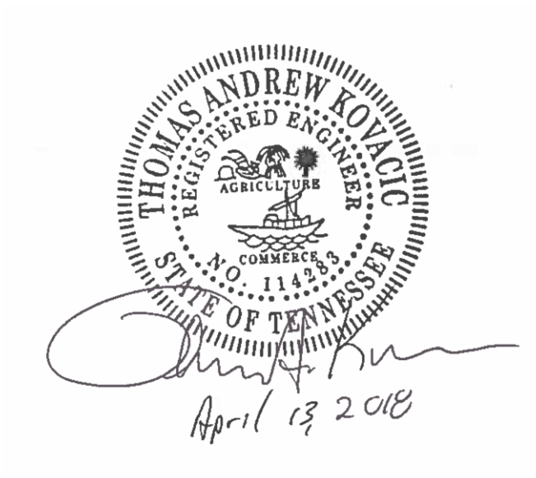
ATTACHMENTS: Initial Inflow Design Flood Control System Plan for Coal Combustion Residuals (CCR) Existing Surface Impoundment



COAL COMBUSTION PRODUCT DISPOSAL PROGRAM

TENNESSEE VALLEY AUTHORITY – MAIN ASH POND
BULL RUN FOSSIL PLANT
ANDERSON COUNTY, TENNESSEE

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

INACTIVE SURFACE IMPOUNDMENT

Prepared for

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

April 13, 2018

Prepared by

AECOM

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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 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 (IDF) 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 Main Ash Pond is an inactive Coal Combustion Residual (CCR) impoundment that currently manages storm water and plant wastewater flows. The Main Ash Pond is located in the southeastern corner of BRF, bordered by the Gypsum Stack to the north, Stilling Pond 2C to the west, and Bull Run Creek to the south and east (See **Figure 1**).

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 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. BRF is closing CCR facilities at the site, and will incorporate the closure and re-purposing of the Main

Ash Pond as a combined storm water and process water pond. The closure design of the proposed work is currently in progress.

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 the Main Ash Pond. Under the existing conditions, the drainage area for the Main Ash Pond is approximately 105 acres. The following areas are included in the Main Ash Pond 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 and surrounding areas
- The footprint of the closed Sluice Ditch

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 stormwater 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.

3.0 METHODS / DESIGN CRITERIA

AECOM was contracted by the Tennessee Valley Authority (TVA) to conduct a hydrologic and hydraulic modeling analysis of the Main Ash Pond 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 the Main Ash Pond 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.

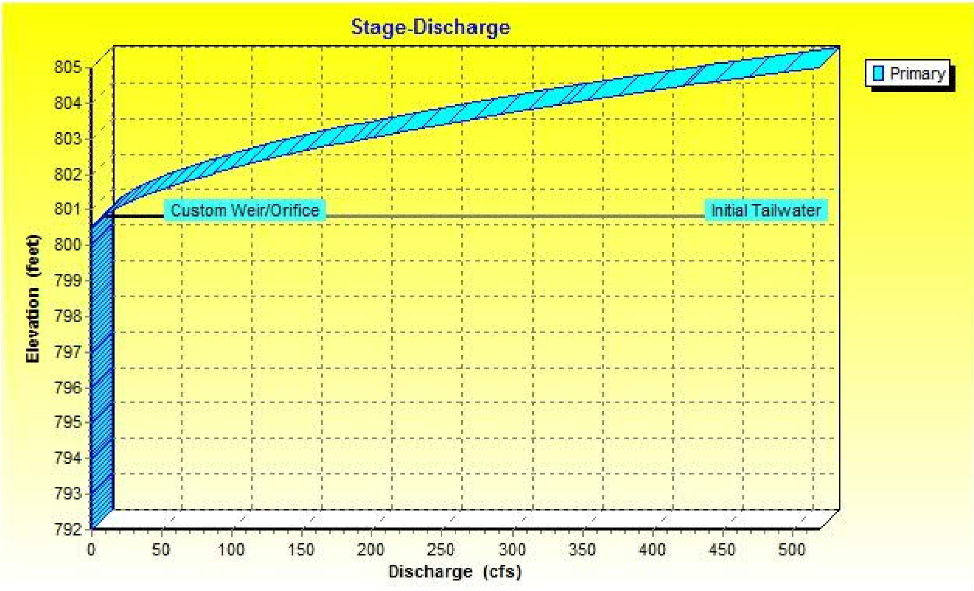


Figure 2: Main Ash Pond Outflow Curve

A base flow of 12 MGD or 18.6 cfs is considered for normal operating conditions, based on direction from TVA. The normal operating water surface elevation of the Main Ash Pond is approximately 801.1 ft.

All structure dimensions and invert elevations are modeled using the best 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 Conveyance Ditch	13.8	79	19.1
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 the Main Ash Pond is provided in **Appendix A**. Computer model outputs provided demonstrate performance of the Main Ash Pond during the IDF.

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

The following results represent the 1000-year 6-hour storm routed through the Main Ash Pond with existing outlet structures in use. Inflow and outflow hydrographs can be found in **Appendix A**.

Table 3. Main Ash Pond Estimated Peak Inflow and Estimated Peak Pool Elevation

Recurrence Interval	Storm Duration	Peak Inflow	Peak Pool Elevation	Remaining Freeboard
1,000-Year	6 Hour	394.1 cfs	802.5 ft.	2.5 ft.

5.0 CONCLUSIONS

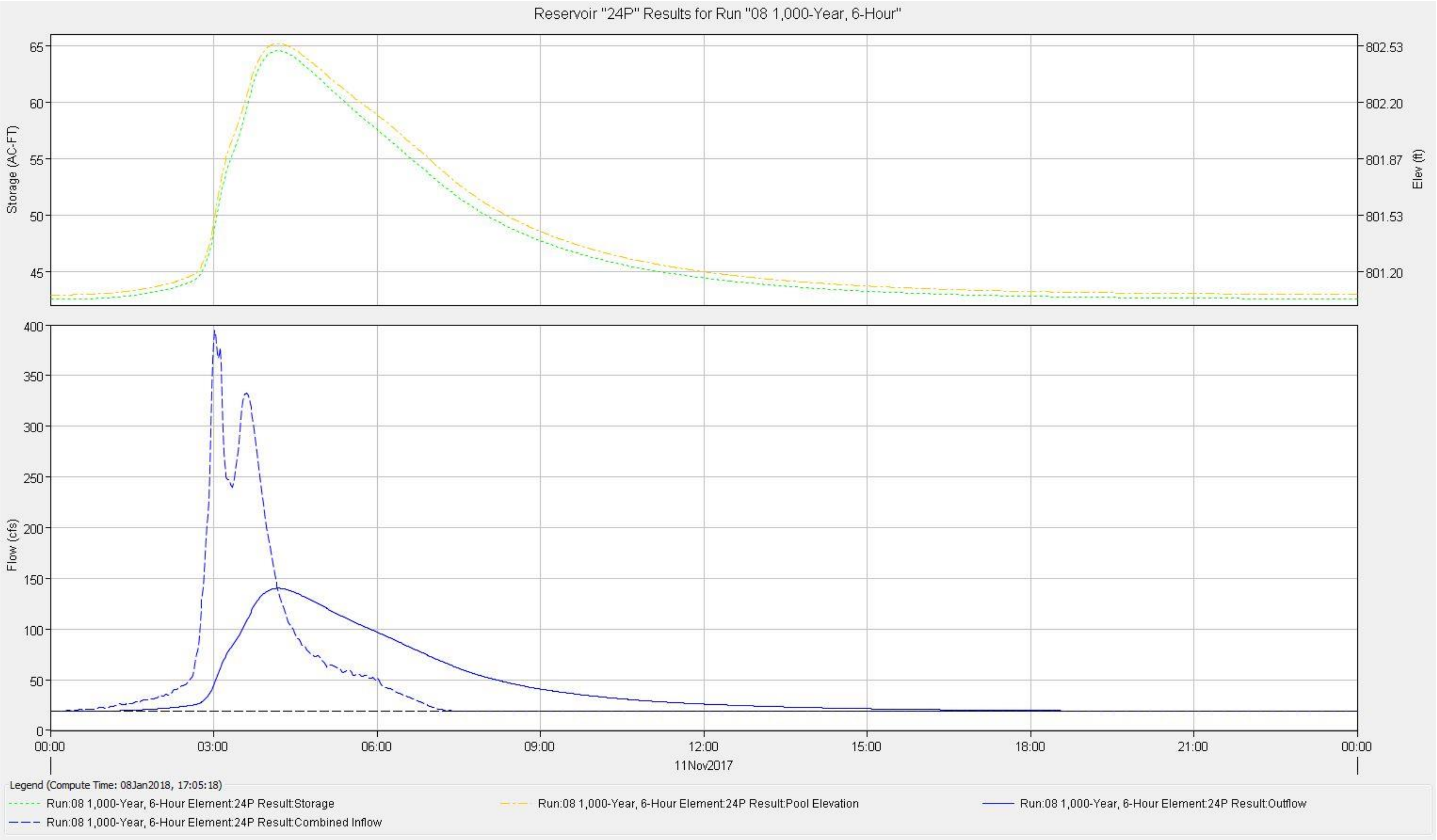
The modeling results indicate the Main Ash Pond would not overtop during a 1000-year, 6-hour design storm, and the freeboard for the Main Ash Pond during this storm event is acceptable. The inflow design flood control system adequately manages flow into the CCR unit during and following the peak discharge 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

1. Environmental Protection Agency, "Final Rule: Disposal of Coal Combustion Residuals from Electric Utilities", Federal Register, April 17, 2015.
2. AECOM, Main Ash Pond, History of Construction 257.73(c)(1) prepared for CCR Certification, 2017
3. Stantec Consulting Services Inc., Hazard Potential Classification Assessment, Main Ash Pond, 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 Main Ash Pond
1,000-Year, 6-Hour, SCS Type II Storm



BRF Main Ash Pond
1,000-Year, 6-Hour, SCS Type II Storm

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

Reservoir: 24P

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:	394.10 (CFS)	Date/Time of Peak Inflow:	11Nov2017, 03:01
Peak Discharge:	140.24 (CFS)	Date/Time of Peak Discharge:	11Nov2017, 04:11
Inflow Volume:	8.85 (IN)	Peak Storage:	64.53 (AC-FT)
Discharge Volume:	8.85 (IN)	Peak Elevation:	802.54 (FT)