**UPDATED INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN**
**PLANT GORGAS ASH POND**
**ALABAMA POWER COMPANY**

Section 257.82 of EPA's regulations requires the owner or operator of an existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to design, construct, operate and maintain an inflow design flood control system capable of safely managing flow during and following the peak discharge of the specified inflow design flood. The owner or operator also has to prepare a written plan documenting how the inflow flood control system has been designed and constructed to meet the requirements of this section of the rule.

The existing CCR surface impoundment referred to as the Plant Gorgas Ash Pond is located at Alabama Power Company's Plant Gorgas. The facility consists of a 420 acre CCR storage area. The inflow design flood consists of the rainfall that falls within the limits of the surface impoundment, runoff from approximately 882 acres of adjoining watershed, and a nominal amount (relative to the rainfall) of process flows. Stormwater is temporarily stored within the limits of the surface impoundment and discharged through a principal and auxiliary spillway. The primary spillway (constructed in 2007) is constructed of a concrete overflow weir structure discharging to a 48-in diameter corrugated metal pipe. A two-bay concrete spillway structure serves as an auxiliary spillway.

The inflow design flood has been calculated using the Natural Resources Conservation Service method (also known as the Soil Conservation Service (SCS) method) using the Probable Maximum Flood (PMF) storm event required for a High hazard potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). The U.S. Department of Commerce's Hydro Meteorological Report 51 was used to determine the storm depth for a 6-hr PMF storm event, taken as 30.1 inches. A USGS SITES program storm distribution was used to model the 6-hr PMF storm.

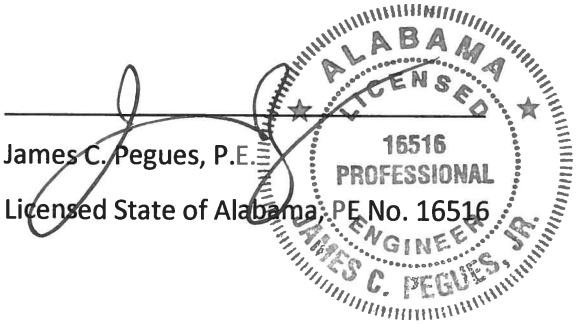
The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological groups A, B, and D should be used to best reflect the characteristics of the soils on site. Curve number values for each land use (determined from aerial photography) and soil combination were taken from the National Engineering Handbook

Part 630, Chapter 9. Rating curves were generated from the dynamic wave in PCSWMM and imported into Hydrologic Engineering Center - Hydrologic Modeling System and used to generate appropriate precipitation curves and storm basin routing information to evaluate surface impoundment capacity.

Calculations indicate the unit can safely store and pass the inflow design storm.

The facility is operated subject to and in accordance with § 257.3-3 of EPA's regulations.

I hereby certify that the inflow design flood control system plan meets the requirements of 40 C.F.R. Part 257.82.

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**Updated Inflow Design Control System Plan:**
**Hydrologic and Hydraulic Calculation Summary**

for

***Plant Gorgas Ash Pond***

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## 1.0 Purpose of Calculation

The purpose of this report is to demonstrate the hydraulic capacity of the subject CCR impoundment in order to prepare an inflow design flood control plan as required by the United States Environmental Protection Agency's (EPA) final rule for Disposal of CCR from Electric Utilities (EPA 40 CFR 257).

## 2.0 Summary of Conclusions

A hydrologic and hydraulic model was developed for the Plant Gorgas Ash Pond to determine the hydraulic capacity of the impoundment. The design storm for the Plant Gorgas Ash Pond is a Probable Maximum Flood (PMF) rainfall event. Southern Company has selected a storm length of 6-hours for the inflow design flood control plan. The results of routing a PMF, 6-hour rainfall event through the impoundment are presented in Table 1 below:

Table 1-Flood Routing Results for Plant Gorgas Ash Pond

| Plant Gorgas | Normal Pool El (ft) | Top of embankment El (ft) | Emergency Spillway Crest El (ft) | Peak Water Surface Elevation (ft | Freeboard* (ft) | Peak Inflow (cfs) | Peak Outflow (cfs) |
|---|---|---|---|---|---|---|---|
| Ash Pond | 382.0 | 395.0 | 385.0 | 389.7 | 5.3 | 21876 | 1040 |

*Freeboard is measured from the top of embankment to the peak water surface elevation

## 3.0 Methodology

### 3.1 HYDROLOGIC ANALYSES

The Plant Gorgas Ash Pond is classified as a High hazard structure. The design storm for a High hazard structure is a PMF rainfall event. A summary of the design storm parameters and rainfall distribution methodology for these calculations is summarized below in Table 2.

Table 2. Plant Gorgas Ash Pond Storm Distribution

| Hazard Classification | Return Frequency (years) | Storm Duration (hours) | Rainfall Total (Inches) | Rainfall Source | Storm Distribution |
|---|---|---|---|---|---|
| High | PMF | 6 | 31.0 | U.S. Department of Commerce's Hydro Meteorological Report 51 | USGS SITES |

The drainage area for the Plant Gorgas Ash Pond was delineated based on LiDAR data acquired for the Plant in 2016. Runoff characteristics were developed based on the Soil

Conservation Service (SCS) methodologies as outlined in TR-55. An overall SCS curve number for the drainage area was developed based on the National Engineering Handbook Part 630, Chapter 9 which provides a breakdown of curve numbers for each soil type and land use combination. Soil types were obtained from the USGS online soils database. Land use areas were delineated based on aerial photography. Time of Concentration and Lag Time calculations were developed based on the overland flow method as described in the National Engineering Handbook Part 630, Chapter 15.Pertinent basin characteristics of the Ash Pond is provided below in Table 3.

Table 3—Ash Pond Hydrologic Information

| | |
|---|---|
| Drainage Basin Area (acres) | 1,302 |
| Hydrologic Curve Number, CN | 80 |
| Hydrologic Methodology | SCS Method |
| Time of Concentration (minutes) | 46.8 |
| Lag Time (minutes) | 28.1 |
| Hydrologic Software | USACE HEC-HMS |

Runoff values were determined by importing the characteristics developed above into a hydrologic model with the US Army Corps of Engineers HEC-HMS program.

Process flows from Plant Gorgas were considered in this analysis. Based on normal plant operations, the Ash Pond receives an additional 21.9 MGD (33.9 cfs) of inflow from the Plant.

## 3.2 HYDRAULIC ANALYSES

Storage values for the Ash Pond were determined by developing a stage-storage relationship utilizing contour data. The spillway system at the Plant Gorgas Ash Pond consists of a primary spillway and an auxiliary spillway. The primary spillway consists of a sharp crested riser weir of 12-foot length which conveys flow to a corrugated metal conduit. The top of the weir box coincides with the normal pool elevation of 382.0 feet. The conduit is 48-inches in diameter and has a length of approximately 190 feet divided into three segments. The auxiliary spillway consists of two 7' x 5' box culverts with a 1% slope. The receiving spillway is a 15' x 5' rectangular flume on a 55% slope. A summary of spillway information is presented below in Table 4.

Table 4—Spillway Attribute Table

| Spillway Component | US Invert El (feet) | DS Invert El (feet) | Dimension (ft) | Slope (ft/ft) | Length (ft) | Spillway Capacity (cfs) |
|---|---|---|---|---|---|---|
| Primary segment 1 | 371.0 | 362.7 | 4 | 7.1% | 116.8 | 380 |
| Primary segment 2 | 362.2 | 349.2 | 4 | 23.5% | 55.3 | 380 |
| Primary segment 3 | 348.7 | 348.6 | 4 | 0.5% | 16.6 | 380 |
| Auxiliary | 385.0 | 384.5 | 7-foot span 5-foot rise | 0.10 | 49.6 | 1,100 |

Based on the spillway attributes listed above, a rating curve was developed using PCSWMM and inserted into HEC-HMS to determine the pond performance during the design storm. Results are shown in Table 1.

## 4.0 SUPPORTING INFORMATION

### 4.1 CURVE NUMBER

| | Soil | Area (acres) | Curve Number |
|---|---|---|---|
| Forest | A | 76.3 | 45 |
| | B | 285.5 | 66 |
| | D | 530.0 | 83 |
| Field | A | 4.5 | 30 |
| | B | 21.6 | 58 |
| | D | 31.0 | 78 |
| 2 Acre Residential | B | 10.3 | 65 |
| | D | 0.9 | 82 |
| Graded Area | D | 3.4 | 94 |
| Surface Water | N/A | 338.6 | 98 |
| | **Total** | **1302.0** | **80** |

### 4.2 STAGE-STORAGE TABLE

| Elevation | Area (acres) | Volume (acre-ft.) |
|---|---|---|
| 320 | 1.6 | 0 |
| 325 | 5.3 | 17.4 |
| 330 | 10.6 | 57.3 |
| 335 | 14.3 | 119.6 |
| 340 | 20.0 | 205.3 |
| 345 | 32.5 | 336.5 |
| 350 | 45.5 | 531.6 |
| 355 | 62.7 | 802.0 |
| 360 | 85.5 | 1172.3 |
| 365 | 197.0 | 1878.4 |
| 370 | 261.9 | 3025.7 |
| 375 | 286.7 | 4397.3 |
| 380 | 308.3 | 5885.0 |
| 385 | 361.2 | 7558.9 |
| 390 | 394.6 | 9448.6 |
| 395 | 427.8 | 11504.7 |

TIME OF CONCENTRATION

***Sheet Flow***

| | | | |
|---|---|---|---|
| **Manning's coefficient* | *n* | *0.4* | |
| *Sheet Flow Length* | *l* | *55* | *ft* |
| *2-yr, 24-hr Rainfall* | $P_2$ | *4.13* | *in* |
| ***Slope of Land Surface* | *S* | *0.127273* | *ft/ft* |
| *Travel Time* | $T_{t1}$ | *0.09* | *hr* |

***Shallow Concentrated Flow***

| | | | |
|---|---|---|---|
| *Segment Length* | *l* | *1417* | *ft* |
| *Slope of Land Surface* | *S* | *0.02* | *ft/ft* |
| *Woodland Landuse* | | | |
| **Flow Velocity* | *V* | *0.7* | *ft/s* |
| *Travel Time* | $T_{t2}$ | *0.56* | *hr* |

***Channel Flow 1***

| | | | |
|---|---|---|---|
| *Up Invert* | | *148.00* | *ft-msl* |
| *Down Invert* | | *112.00* | *ft-msl* |
| *Length* | *l* | *1142.00* | *ft* |
| *Slope* | *s* | *0.03* | *ft/ft* |
| *Bottom Width* | *a* | *2.00* | *ft* |
| *Side Slope 1* | | *3.00* | *:1* |
| *Side Slope 2* | | *3.00* | *:1* |
| *Channel Height* | *h* | *2.00* | *ft* |
| *Wetted Perimeter* | $P_w$ | *12.65* | *ft* |
| *Channel Area* | *A* | *12.00* | $ft^2$ |
| *Hydraulic Radius* | *r* | *0.95* | *ft* |
| *Manning's Coefficient* | *n* | *0.03* | |
| *Velocity* | *V* | *8.51* | *ft/s* |
| *Travel Time* | $T_{t3}$ | *0.04* | *hr* |

| *Lake Flow 1* | | | |
|---|---|---|---|
| *Mean Lake Depth* | *Dm* | *20* | *ft* |
| *Flow Length* | *L* | *8044* | *ft* |
| *Wave Velocity* | *V* | *25.38* | *ft/s* |
| *Travel Time* | $T_{t3}$ | *0.09* | *hr* |
| *Total TOC* | | *0.78* | *hr* |
| *Lag Time* | | *28.1* | *min* |

## 4.3 RATING CURVE

| Elevation (ft-msl) | Head (feet) | Weir | Conduit | Primary Spillway | Auxiliary Spillway | Total |
|---|---|---|---|---|---|---|
| | | Flow (cfs) | | | | |
| 382.0 | 0.0 | 0.0 | 293.2 | 0.0 | 0.0 | 0.0 |
| 382.5 | 0.5 | 13.2 | 297.9 | 13.2 | 0.0 | 13.2 |
| 383.0 | 1.0 | 37.2 | 302.6 | 37.2 | 0.0 | 37.2 |
| 383.5 | 1.5 | 68.3 | 307.2 | 68.3 | 0.0 | 68.3 |
| 384.0 | 2.0 | 105.2 | 311.8 | 105.2 | 0.0 | 105.2 |
| 384.5 | 2.5 | 147.0 | 316.3 | 147.0 | 0.0 | 147.0 |
| 385.0 | 3.0 | 193.3 | 320.7 | 193.3 | 0.0 | 193.3 |
| 385.5 | 3.5 | 243.6 | 325.1 | 243.6 | 33.9 | 277.5 |
| 386.0 | 4.0 | 297.6 | 329.4 | 297.6 | 79.4 | 377.0 |
| 386.5 | 4.5 | 355.1 | 333.6 | 333.6 | 138.4 | 472.0 |
| 387.0 | 5.0 | 415.9 | 337.8 | 337.8 | 206.3 | 544.1 |
| 387.5 | 5.5 | 479.8 | 342.0 | 342.0 | 282.2 | 624.1 |
| 388.0 | 6.0 | 546.7 | 346.1 | 346.1 | 365.2 | 711.3 |
| 388.5 | 6.5 | 616.5 | 350.1 | 350.1 | 454.9 | 805.0 |
| 389.0 | 7.0 | 689.0 | 354.1 | 354.1 | 550.7 | 904.8 |
| 389.5 | 7.5 | 764.1 | 358.1 | 358.1 | 652.3 | 1,010.3 |
| 390.0 | 8.0 | 841.7 | 362.0 | 362.0 | 743.9 | 1,105.9 |
| 390.5 | 8.5 | 921.9 | 365.8 | 365.8 | 801.5 | 1,167.3 |
| 391.0 | 9.0 | 1,004.4 | 370.0 | 370.0 | 857.4 | 1,227.4 |
| 391.5 | 9.5 | 1,089.3 | 371.4 | 371.4 | 911.9 | 1,283.3 |
| 392.0 | 10.0 | 1,176.4 | 371.5 | 371.5 | 965.0 | 1,336.5 |
| 392.5 | 10.5 | 1,265.7 | 372.7 | 372.7 | 1,016.9 | 1,389.6 |
| 393.0 | 11.0 | 1,357.2 | 375.0 | 375.0 | 1,067.7 | 1,442.7 |
| 393.5 | 11.5 | 1,450.7 | 377.3 | 377.3 | 1,100.0 | 1,477.3 |
| 394.0 | 12.0 | 1,546.4 | 380.0 | 380.0 | 1,100.0 | 1,480.0 |
| 394.5 | 12.5 | 1,644.0 | 381.9 | 381.9 | 1,100.0 | 1,481.9 |
| 395.0 | 13.0 | 1,743.6 | 384.2 | 384.2 | 1,100.0 | 1,484.2 |

## 4.4 DRAINAGE BASIN