

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 1000-yr storm event required for a Significant hazard potential facility. Runoff curve number data was determined using Table 2-2A from the Urban Hydrology for Small Watersheds (TR-55). Appendix A and B from the TR-55 were used to determine the rainfall distribution methodology. Precipitation values were determined from NOAA's Precipitation Frequency Data Server (Atlas-14).

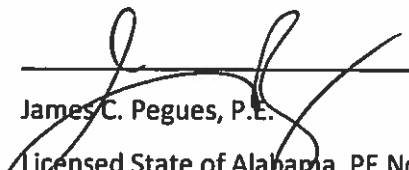
The NRCS provided information on the soil characteristics and hydrologic groups present at the site. It was determined that the hydrological groups A, B, and D should be used to best reflect the characteristics of the soils on site. Curve numbers values for each land use (determined from aerial photography)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


James C. Pegues, P.E.
Licensed State of Alabama, PE No. 16516



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

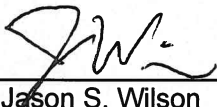
for


Plant Gorgas Ash Pond

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Reviewer:  10/11/16
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Approval:  10/12/16
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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 1000-year rainfall event. Southern Company has selected a storm length of 24-hours for all inflow design flood control plans. The results of routing a 1000-year, 24-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	385.2	9.8	8201	234

*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 significant hazard structure. The design storm for a significant hazard structure is a 1000-year 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
Significant	1000	24	14.3	NOAA Atlas 14	SCS Type III

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.

A table of the 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

4.3 TIME OF CONCENTRATION

Sheet Flow

*Mannings 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
Mannings Coefficient	n	0.03
Velocity	V	8.51 ft/s
Travel Time	T_{t3}	0.04 hr

Lake Flow 1

Mean Lake Depth *D_m* 20 ft

Flow Length *L* 8044 ft

Wave Velocity *V* 25.38 ft/s

Travel Time *T₁₃* 0.09 hr

Total TOC 0.78 hr

Lag Time 28.1 min

4.4 RATING CURVE

Elevation (ft-msl)	Head (feet)	Weir	Conduit	Primary Spillway	Auxiliary Spillway	Total
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

4.5 DRAINAGE BASIN

