OCTOBER 2016

CLECO POWER LLC
BRAME ENERGY CENTER

HAZARD POTENTIAL CLASSIFICATION ASSESSMENT:

FLY ASH POND

Prepared By:

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Project Number 002-186

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

Providence Engineering and Environmental Group LLC (Providence) was contracted by Cleco Power LLC (Cleco) to conduct a hazard potential classification assessment of the Fly Ash Pond at Cleco's Brame Energy Center located in Lena, Louisiana. Recent Coal Combustion Residual (CCR) regulations at 40 CFR 257.73(a)(2) established requirements for owners and operators to conduct a hazard potential classification assessment to assess the potential adverse incremental consequences that would occur if there was a failure of the CCR surface impoundment.

The Cleco Brame Energy Center is located near Lena in Rapides Parish, Louisiana. A site location map and site map showing the Brame Energy Center and the Fly Ash Pond is included as **Figure 1** and **Figure 2**, respectively. This hazard potential classification assessment pertains to the Fly Ash surface impoundment (Pond) utilized for the Unit 2 coal-fired generation unit.

2.0 HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

Per the CCR regulations, a hazard potential classification provides an indication for danger to life, development, or the environment in the event of a release of CCR from a surface impoundment. The new rule requires an owner or operator of any existing or new CCR surface impoundment or any lateral expansion of a CCR surface impoundment to determine which of the following hazard potential classifications characterizes apply to their particular CCR unit. These potential classifications include the following:

- High Hazard Potential CCR Surface Impoundment – means a diked surface impoundment where failure or misoperation will probably cause loss of life.
- Significant Hazard Potential CCR Surface Impoundment – means a diked surface impoundment where failure or misoperation 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 misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment's owner's property.

The Fly Ash Pond was analyzed to determine effects of a breach in the current levee system. Two scenarios were used in each model: Maximum and Most Probable Loss. In both scenarios, a shear break to the bottom of the levee was assumed. The Maximum scenario flow rate was calculated using a height of water measured from the bottom of pond to the top of levee. The Most Probable Loss scenario flow rate was calculated using a height of water measured from the bottom of pond to the normal operating elevation.

The flood elevations in the vicinity of the Fly Ash Pond are highly influenced by the existing water surface elevations of Bayou Jean de Jean and the Red River. The surface elevation data used in this analysis for adjacent property is from Light Detection and Ranging (LIDAR) data and shows the drainage feature between the Fly

Ash Pond and Interstate 49 at elevation 79 feet NAVD 88, Bayou Jean de Jean at elevation 74 feet NAVD 88, and the Red River at elevation 74 feet NAVD 88.

The results of the levee breach analysis for the Fly Ash Pond shows that the rise in water is mostly contained in the drainage feature between the ponds and Interstate 49. The outflow from the pond during this flood event has a very negligible volume to add to Bayou Jean de Jean and the Red River. The downstream flood area allows the floodwaters to spread into existing bodies of water over a large area, therefore adjacent property is not affected. Also not affected are the properties along Bayou Jean de Jean which are protected by levees. This is true for both the Maximum and the Most Probable Loss scenarios.

Approximately 90% of the fly ash in the Fly Ash Pond has setup in a cementious manner and therefore that portion would not be released in a breach of the levee. The model shows that any release from both the Fly Ash Pond would go into the channel beside the ponds and then enter Bayou Jean de Jean and thence the oxbow on the Red River.

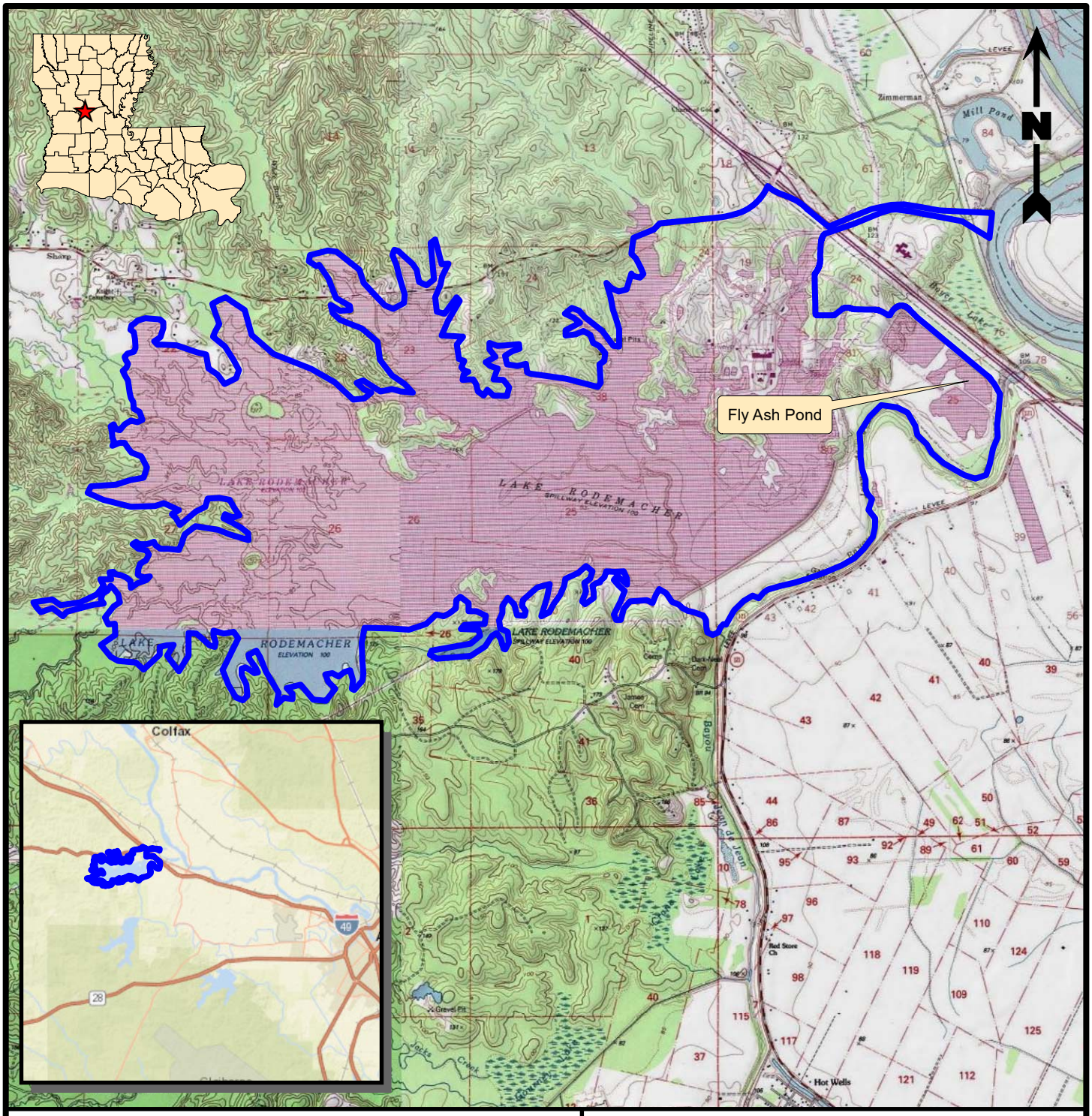
The complete Levee Breach Analysis can be found in **Appendix A.**

3.0 CONCLUSIONS

Based on the results of the Maximum and Most Probable Loss scenarios, the Fly Ash Pond at Cleco's Brame Energy Center is classified as a significant hazard potential CCR surface impoundment due to the potential effects on Bayou Jean de Jean and the oxbow of the Red River. **Attachment B** contains a P.E. Certification that attests to this assessment.

FIGURE 1

SITE LOCATION MAP



Legend

Property Boundary

Reference

Base map comprised of U.S.G.S. 7.5 minute topographic maps, "Lena, LA", "Boyce, LA", "Jericho, LA", and "Gardner, LA".

Site Location Map

Hazard Potential Classification Assessment - Fly Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

PROVIDENCE

Drawn By	LMM	10/04/16
Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

Project Number	002-186
Drawing Number	002-186-A005
1 Figure	

FIGURE 2

SITE MAP

N

Legend

Property Boundary

Reference

Base map comprised of Google Earth aerial imagery from 10/03/14.

1,000 500 0 1,000
Feet

Site Map

Hazard Potential Classification Assessment - Fly Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

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2
Figure

APPENDIX A

LEVEE BREACH ANALYSIS

JULY 2016

CLECO BRAME ENERGY CENTER
CLECO POWER LLC
RAPIDES PARISH, LENA, LOUISIANA

LEVEE BREACH ANALYSIS REPORT:

FLY ASH POND

Prepared By:

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Project Number: 002-186

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 PROJECT DESCRIPTION

Brame Energy Center is a 6,000-acre site located west of Interstate 49 (I-49) in Lena, Louisiana. The site has a Fly Ash Pond that accept the byproducts derived from burning coal for the generation of electricity. This report documents the effort undertaken to study the effects of a breach of the Fly Ash Pond levees.

2.0 DATA ACQUISITION

The proposed project is located on Federal Emergency Management Agency (FEMA) map panel 0125B in Rapides Parish and is bound by Interstate 49 and the Red River to the east, LA 28 to the south, and LA 8 to the west and north. The study area is presented in **Figure 1**.

The flood elevations are highly influenced by the existing water surface elevations of Bayou Jean de Jean and the Red River. The water surface elevation data used in this analysis is from Light Detection And Ranging (LIDAR) data and shows Bayou Jean de Jean at elevation 74' NAVD88 and the Red River at 74' NAVD88. The channel adjacent to this pond has a bottom elevation ranging from 84' NAVD88 at the most upstream point to 74' NAVD88 at the junction with Bayou Jean de Jean.

3.0 HYDRAULIC MODEL DEVELOPMENT

LIDAR information was obtained and used to develop a ground model of existing conditions for the project area. This information was imported into a hydraulic analysis program in order to model the effects of breaking the levee system. An elevation terrain was generated based on LIDAR data. Channel geometry for the outflows from this pond was created using raindrop analysis, and cross sections were created by referencing the elevation terrain. Cross sections were extended to cover any area of concern both within and surrounding the project area.

The Fly Ash Pond was analyzed as two separate events. Two scenarios were used in each model: Maximum and Most Probable Loss. In both scenarios, a shear break to the bottom of the levee was assumed. The Maximum scenario flow rate was calculated using a height of water measured from the bottom of pond to the top of levee. The Most Probable Loss scenario flow rate was calculated using a height of water measured from the bottom of pond to the normal operating elevation.

The outflow was modeled in GeoHEC-RAS by inputting the steady flow data for each scenario. The upstream boundary for the Most Probable Loss scenario was the normal operating elevation of each pond. The upstream boundary for the Maximum scenario was the top of levee elevation for each pond. The analysis was then computed on the steady flow data. The results for the flood maps and for the cross sections were then generated. It should be noted that these models were generated based on a continuous outflow from the pond as this was determined to be the most conservative way to model a levee breach. Real-world

scenarios should be less impactful as the flow rate will steadily decrease as the pond empties.

4.0 MODELING RESULTS

The results of the levee breach analysis for the Fly Ash Pond shows that the rise in water is mostly contained to the channel area adjacent to the pond. The outflow from the pond during this flood event has a very negligible volume to add to Bayou Jean de Jean and the Red River. The downstream flood area allows the floodwaters to spread into existing bodies of water, therefore adjacent property is not affected. Also not affected are the properties along Bayou Jean de Jean which are protected by levees. This is true for both the Maximum and the Most Probable Loss scenarios.

For the Fly Ash Pond, the Most Probable Loss condition results in no more than 1' increase which is localized to the channel adjacent to the pond and has no effects to surrounding properties or Interstate 49. The Maximum condition results in no more than a 7' increase which is localized to the channel adjacent to the pond and has no effects to surrounding properties or Interstate 49. The Fly Ash Pond results are presented in **Figures 2** and **3**.

Approximately 90% of the fly ash in the Fly Ash Pond has setup in a cementious manner and therefore that portion would not be released in a breach of the levee. The other 10% that may be loose material is applied at higher elevations in the operation of the pond and is not expected to be released. Therefore, only a de minimus amount of fly ash is expected to be released from the Fly Ash Pond should a major breach occur.

It should be noted that the average elevation shown in **Figure 2** and **Figure 3** represents the average elevation of the entire outflow path.

5.0 COST ANALYSIS

A cost analysis was completed based on the information obtained in the Flood Analysis and available historical cost data. A cost estimate was determined for both the Most Probable Loss and the Maximum Loss scenarios for the pond. The flood area was broken into categories of wooded land, existing channels, plant property, and structures. As noted in the Flood Analysis section, for all of the failures, the majority of the pond water would spread across wooded land.

It is assumed that the levee breach and resulting flood waters would negatively impact all surrounding timber to the point that the timber would be declared a total loss. This is very conservative, as the flood waters should dissipate in a relatively short amount of time depending on site conditions at the time of the event.

Cleanup costs associated with a levee breach are a substantial portion of the total cost for this analysis. Clearing & Grubbing of the impacted properties will be

necessary to clear the existing timber that is damaged and was estimated at $2,000 per acre of affected wooded land.

Since 90% of the fly ash in the Fly Ash Pond has setup in a cementitious manner, a minimal amount of fly ash would be released. The quantity of ash in the pond is constantly changing; therefore, it was assumed that the pond was half full of ash before the levee breach. Elevation data for the Fly Ash Pond is included in **Appendix A**. Multiple percentages of ash loss were analyzed, all of which were minimal (ranging from 5% to 10% for the Fly Ash Pond). For the purpose of this report, the costs of a 10% ash loss for the Fly Ash Pond have been included in the final cost for each scenario of each pond. The volume and cost for all assumed percentages can be found in **Appendix B**. The material would be returned to the pond, as there is no landfill for the fly ash. The cost for removal and hauling ash back to the pond was estimated at $25 per cubic yard of ash.

It is assumed that the length of exposure of pond water to ash would be minimal and would not cause contamination of drinking water, nor would it contaminate the topsoil. For this reason, removal of topsoil is not necessary and was not included in the cost estimate.

It is assumed that any vegetation impacted by a levee breach would need to be reestablished to original conditions. Site Preparation/Planting includes the reestablishment of pine/hardwood timber and the spraying of underbrush vegetation during re-establishment and was priced at $500 per acre of affected wooded land. The Loss of Timber Value assumes that valuable timber (pine/hardwood) was present and was priced at $750 per acre. Seeding and Fertilizing was also considered and includes the re-establishment of grass for erosion control of the cleared and grubbed acreage. This was priced at $2,500 per acre of land. Any value of the timber harvested was not included as a discount to the total cost.

It was also assumed that the affected levee of the pond would be rebuilt immediately, and no temporary measures for levee replacement would be necessary. The failure shape of the levee is assumed to be a shear type failure. In order to reconstruct the levee, an additional removal of material is anticipated to safely reconstruct the levee. The cost to reestablish the levee was estimated at $25 per cubic yard and $6.84 per square foot.

As mentioned in the Flood Analysis, the rise in water is mostly contained in the drainage feature between this pond and I-49. The downstream flood area allows the floodwaters to spread into existing bodies of water over a large area; therefore, no structures within or surrounding the plant are affected. This is true for both the Maximum and the Most Probable Loss scenarios for the pond.

Details of the Levee Risk Assessment Costs are included in **Appendix B**. The calculations show a total cost for each scenario of each pond. These costs are broken down into the different percentages of ash loss. The total clean-up cost is

then divided into the cost of on-site clean-up and the cost of off-site clean-up. These totals are also broken down into the different percentages of ash loss.

A cost for Mobilization/Demobilization was added to each total. For the on-site costs, mobilization/demobilization was estimated at $12,000. For the off-site costs, mobilization/demobilization was estimated at 8%.

The total costs, assuming a 10% ash loss for the Fly Ash Pond, are as follows:

- For the Fly Ash Pond, clean-up costs for the Most Probable Loss scenario total $1.0 million, and clean-up costs for the Maximum Loss scenario total $2.4 million.

The on-site scenario of the pond includes only the levee repair costs and assumes that any ash that falls on-site is in the levee repair area. The on-site costs for each scenario of the Fly Ash Pond are as follows:

- For the Fly Ash Pond, on-site clean-up costs for the Most Probable Loss scenario total $111,605, and on-site clean-up costs for the Maximum Loss scenario total $111,605.

The off-site costs for each scenario of the pond, assuming a 10% ash loss for the Fly Ash Pond, are as follows:

- For the Fly Ash Pond, off-site clean-up costs for the Most Probable Loss scenario total $928,000, and off-site clean-up costs for the Maximum Loss scenario total $2.3 million.

FIGURE 1

LEVEE BREACH STUDY AREA

Legend

Channel Alignment

Note:

Base map comprised of ESRI World Imagery

500 250 0 500 1000 1500

Fly Ash Pond
Levee Breach Study Area

Lena, Rapides Parish, Louisiana

Cleco Power, LLC
Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

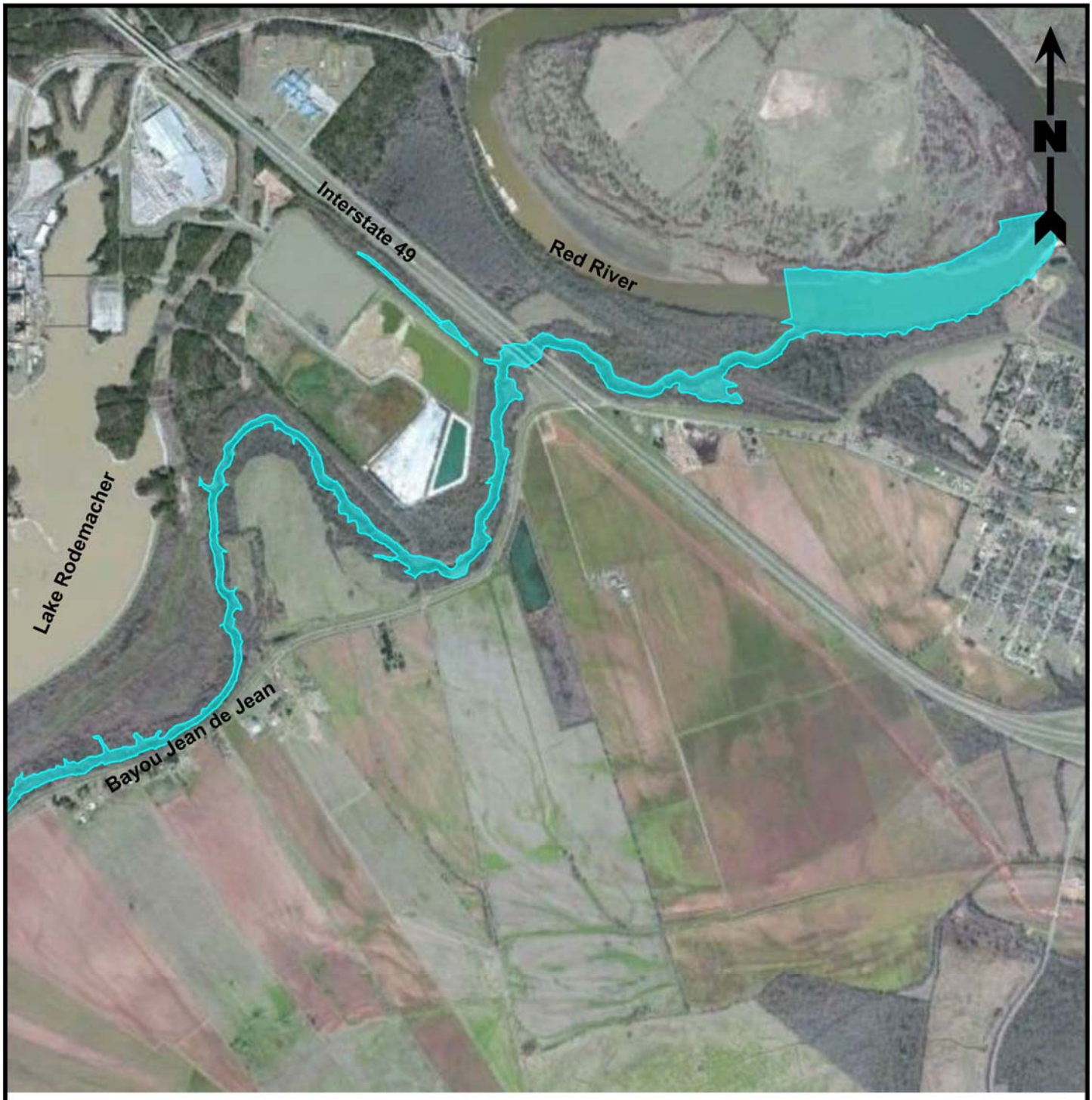
Project Number
002-186

Drawing Number
002-186-A008

1
Figure

FIGURE 2

FLY ASH POND MOST PROBABLE LOSS



Legend

Most Probable Loss (Avg. El. 75.61')

Note:

Base map comprised of ESRI World Imagery

1000 500 0 1000 2000 3000

Fly Ash Pond
Most Probable Loss

Lena, Rapides Parish, Louisiana

Cleco Power, LLC
Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

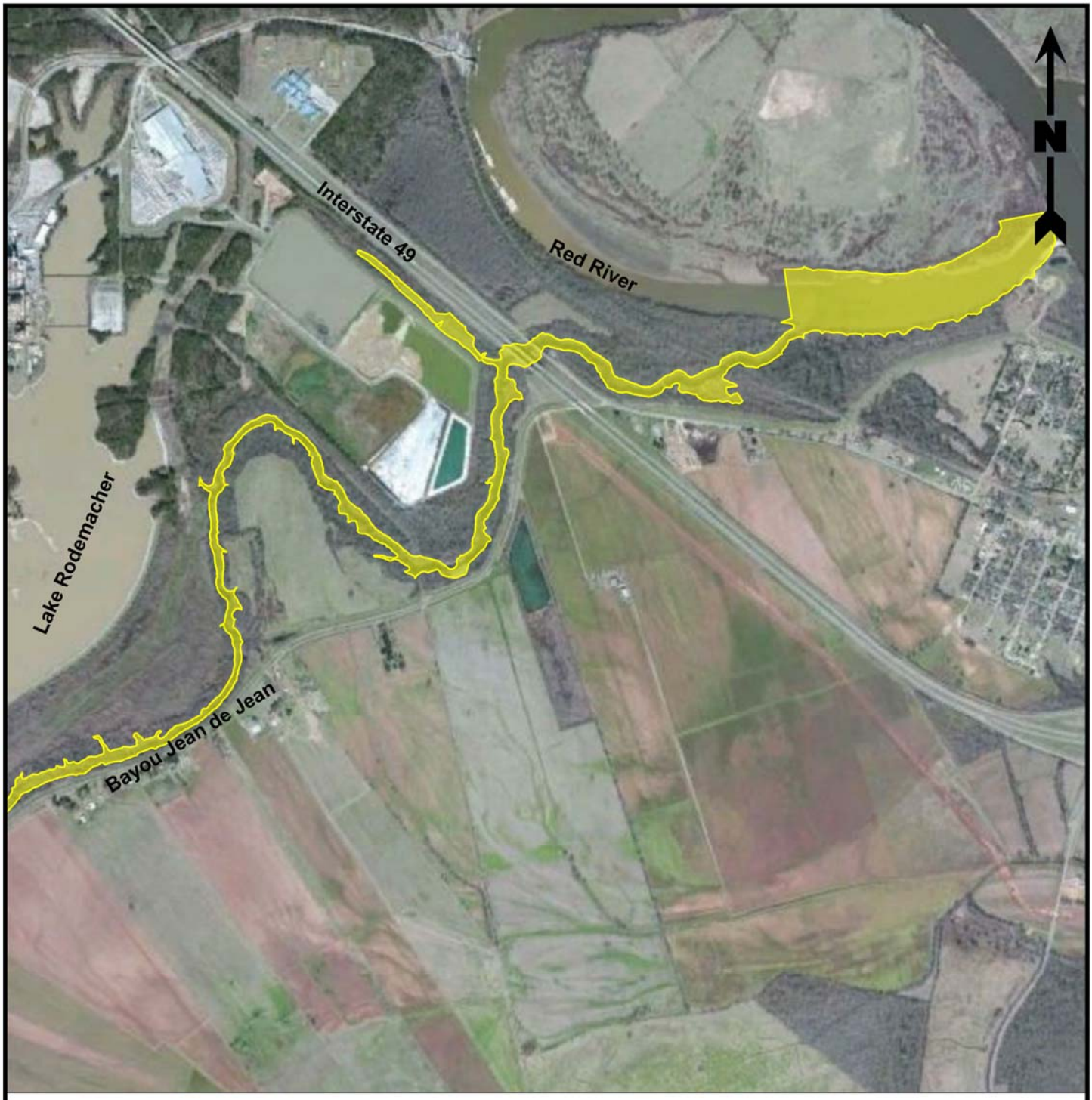
Project Number 002-186

Drawing Number 002-186-A011

2 Figure

FIGURE 3

FLY ASH POND MAXIMUM LOSS



Legend

Maximum Loss (Avg. El. 76.41')

Note:

Base map comprised of ESRI World Imagery

1000 500 0 1000 2000 3000

Fly Ash Pond
Maximum Loss

Lena, Rapides Parish, Louisiana

Cleco Power, LLC
Cleco Brame Energy Center

PROVIDENCE

Drawn By	AMV	07/26/16
Checked By	JDM	07/26/16
Approved By	JDM	07/26/16

Project Number
002-186

Drawing Number
002-186-A012

3
Figure

APPENDIX A

ACQUIRED DATA

Facility Name:		Cleco Brame Energy Center	
Address:		275 Rodemacher Rd. Lena, LA	
Surface Impoundment Name :	Fly Ash Pond	**Owner:**	Cleco Power LLC
Surface Impoundment ID:	P-0005	**Operator:**	Cleco Power LLC
Nearest City:	Boyce	**Parish:**	Rapides
GENERAL			
Dam Status:	Operational	**Year Built:**	1982
Latitude:	31° 23.67' N	**Longitude:**	92° 42.00' W
Dam Size:	653.4 acre-feet @ elevation 103.0 ft. NAVD 88		
Bottom of Pond Elevation Information:	85 ft. MSL	**Top of Dike Elevation:**	105 ft. NAVD 88
Low Operating Level Elevation:	86 ft. NAVD 88	**High Operating Level Elevation:**	102 ft. NAVD 88
High Operating Level Storage:	617.1 acre-feet @ elevation 102.0 ft. NAVD 88		
Maximum Storage:	653.4 acre-feet @ elevation 103.0 ft. NAVD 88		
Maximum Surface Area:	36.3 Acres		
Offsite Drainage Area:	Discharges to Bottom Ash Pond		
Spillway Type:	None, Pumped through discharge pipe to Bottom Ash Pond		

APPENDIX B

LEVEE BREACH COST ANALYSIS

APPENDIX B
LEVEE BREACH ANALYSIS
BRAME ENERGY CENTER
FLY ASH

Description	Unit	Most Probable Loss	Maximum Loss
Wooded land	acres	111.31	112.71
Existing channel/bayou/river	acres	37.15	37.15
Area of levee repair	sq ft	5200	5200
Volume of levee repair	cu yd	2561	2561
5% ash leaving pond	cu yd	11,384	11,384
10% ash leaving pond	cu yd	8,785	58,564
Plant property	acres	none	none
Structures other than levee wall	each	none	none

Fly Ash Pond Costs

Description	Unit	Unit price	Most Probable Loss	Maximum Loss
Site prep/planting[1]	acre	$500	$55,654	$56,354
Loss of timber value[2]	acre	$750	$83,481	$84,531
Clearing & grubbing	acre	$2,000	$222,616	$225,416
Seeding & fertilizing [3]	acre	$2,500	$278,270	$281,770

Levee Repair	Unit	Unit price	Most Probable Loss	Maximum Loss
Incorporation of lime, reprocessing, recompacting clay material on exterior of slope	cu yd	$25	$64,037	$64,037
Purchase and installation of structural geogrid material	sq ft	$0.50	$2,600	$2,600
Purchase and installation of HDPE membrane	sq ft	$0.42	$2,184	$2,184
Purchase and installation of fabric formed concrete revetment	sq ft	$5.50	$28,600	$28,600
Purchase and placement of erosion control matting	sq ft	$0.35	$1,820	$1,820
Seeding and fertilization	sq ft	$0.07	$364	$364
		Levee repair total	**$99,605**	**$99,605**

APPENDIX B
LEVEE BREACH ANALYSIS
BRAME ENERGY CENTER
FLY ASH

Ash Removal and Haul to Landfill[4]	Unit	Unit price	Most Probable Loss	Maximum Loss
5% ash leaving pond	cu yd	$25	$284,609	$284,609
10% ash leaving pond	cu yd	$25	$219,615	$1,464,100

Mobilization/Demobilization on-site	$12,000	$12,000
Mobilization/Demobilization off-site	8%	8%

On-site Costs[5]	**$111,605**	**$111,605**

Off-site Costs

5% ash loss	**$998,601**	**$1,007,295**
10% ash loss	**$928,408**	**$2,281,146**

Total Costs

5% ash loss	**$1,110,206**	**$1,118,900**
10% ash loss	**$1,040,013**	**$2,392,751**

NOTES:

1. Includes the re-establishment of pine/hardwood timber and the spraying of underbrush vegetation.

2. Assumes that valuable timber (pine/hardwood) is present. Also assumes that cost for haul/cut is included.

3. Includes the re-establishment of grass for erosion control.

4. Assumes that half of the pond is filled with ash, and minimal amounts would be released.

5. Includes levee repair costs and assumes that any ash that falls on-site is in the levee repair area.

6. Timber value once purchased and brought to mill is not included.

7. Assume no contamination of topsoil; therefore, no removal necessary.

8. Assume length of exposure of pond water to ash is minimal and will not cause contamination of drinking water.

9. Assume affected pond is being rebuilt immediately and no temporary measures for levee replacement are necessary.

APPENDIX B
LEVEE BREACH ANALYSIS
BRAME ENERGY CENTER
FLY ASH

Fly Ash Pond Ash

Pond area (acre) 36.3

	Most Probable Loss	Maximum Loss
High Operating Level (ft)	88	
Top of Levee (ft)		105
Levee Toe (ft)	85	85
Half Full of Ash (ft)	2	10.0
Volume of Existing Ash (yd^3)	87,846	585,640

Volume of Ash Leaving Pond (yd^3):	Most Probable Loss	Maximum Loss
5%	4,392	29,282
10%	8,785	58,564

Fly Ash Pond Levee

slope = 3:1

	Most Probable Loss	Maximum Loss
Width At Break (ft)	120	120
Length Across Top	40	40
Volume of Failure	2,561	2,561

APPENDIX B

P.E. CERTIFICATION

CLECO BRAME ENERGY CENTER
FLY ASH POND
CCR HAZARD POTENTIAL CLASSIFICATION ASSESSMENT

PROFESSIONAL ENGINEER CERTIFICATION

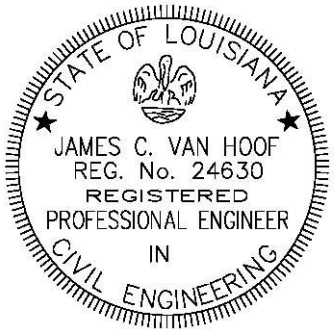
I hereby certify that I have performed a hazard potential classification assessment for Cleco's Brame Energy Center Fly Ash Pond in accordance with the CCR requirements at 40 CFR 257.73(a)(2). This hazard potential classification assessment has determined that the Fly Ash Pond is classified as a significant hazard potential surface impoundment.

James C. Van Hoof
Name

24630 **LA**
Registration No. State

James C. Van Hoof, P.E.
Signature

10/12/2016
Date



(Seal)