OCTOBER 2016

CLECO POWER LLC
Brame Energy Center

BOTTOM ASH POND CCR LINER VERIFICATION

Prepared By:

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Project Number 002-191

PROVIDENCE

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1.0 INTRODUCTION

Effective October 17, 2015, the U.S. Environmental Protection Agency (EPA) implemented final rule, 40 CFR 257, the Coal Combustion Residuals (CCR) regulations. Included in the final rule is 40 CFR 257.71, the liner requirements for CCR surface impoundments.

Cleco Power LLC (Cleco) has consulted with Providence Engineering and Environmental Group LLC (Providence) to determine if the bottom liner system in the Bottom Ash Pond CCR surface impoundment at the Brame Energy Center in Lena, Louisiana meets the liner requirements of the newly promulgated CCR regulations.

A Site Location Map and a Site Plan showing the location of the Bottom Ash surface impoundment within the facility is provided as **Figures 1** and **2**.

2.0 SUMMARY OF 40 CFR 257.71 LINER REQUIREMENTS

No later than October 17, 2016, the owner or operator of an existing CCR surface impoundment must document whether or not such unit was constructed with any one of the following:

a. A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec
b. A composite liner that meets the requirements of 257.70(b), or
c. An alternative composite liner that meets the requirements of 257.70(c)

The hydraulic conductivity of the compacted soil must be determined using recognized and generally accepted methods.

An existing CCR surface impoundment is considered to be an existing <u>unlined</u> CCR surface impoundment if either:

1. The owner or operator of the CCR unit is not constructed with a liner that meets the requirements of a, b, or c above, or
2. The owner or operator of the CCR unit fails to document whether the CCR unit was constructed with a liner that meets the requirements of a, b, or c above.

EPA defines a CCR surface impoundment in Part 257 as “a natural topographic depression, manmade excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores and disposes of CCR”.

The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer attesting that the documentation meets the requirements of 257.71.

3.0 BOTTOM ASH POND FACTS

As noted in the excerpts below from the 1981 solid waste permit application (**Attachment 1**) and the drawings within the application that were submitted to the Louisiana Department of Natural Resources, Solid Waste Management Division (LDNR), “the in situ clay in the upland terrace area that extended to about midway east/west of the Bottom Ash Pond met the permeability requirements”.

A three-foot thick clay liner was placed over the exposed granular soils beyond the upland terrace area. The clay was placed in lifts of 8 to 10 inches and compacted with a “sheeps foot” roller. Laboratory permeability results on the recompacted samples ranged from 1.1×10^{-7} to 2.1×10^{-8} cm/sec. The liner permeability requirements as contained in the CCR rule were not met in all cases as shown with the 1.1×10^{-7} cm/sec data. No additional permeability verification laboratory results are available.

6.4.3.B.4) Geological Characteristics

a) Exhibits BA6.4.3.B.2-2 and 3 present the generalized soil conditions beneath the Bottom Ash Pond. The depth to ground water varies from 6 to 10 feet below grade. There is a very soft to medium stiff clay which extends to 20 feet (terminal depth of borings) in all of the borings except Boring 244. In that boring, the clay extended to 12 feet with a silty sand to sandy silt beneath. The laboratory coefficient of permeability for

the in situ clay varies from 1.3 x 10^{-8} to 3.5 x 10^{-8} cm/sec. As was shown in Exhibit BA6.4.3.B.1-1, the approximate limit of the insitu clay barrier is about midway of the Bottom Ash Pond. A 3 foot thick compacted clay layer was placed over the exposed granular soils on the bottom of the Bottom Ash Pond. The extent of the clay blanket was determined in the field by ensuring that the in situ clay had a minimum thickness of 3 feet. Laboratory permeability tests on recompacted samples of the clay varied from 1.1 x 10^{-7} to 2.1 x 10^{-8} cm/sec. and the Plasticity Index averaged 41 with an average liquid limit of 62 which classifies the soil as CH according to the Unified Soil Classification System. The clay liner was placed in horizontal lifts of 8 to 10 inches and was compacted with "sheeps foot" compaction equipment. The 3 foot compacted clay liner coupled with the in situ clay layer should form an effective barrier to liquid waste migration to the ground water.

However, as shown below in the responses to the DNR, (**Attachment 2**), Cleco responded that “if it cannot be shown that these permeable soils are isolated by impermeable soils, they will be replaced with an impermeable liner.” Also, it should be noted that the boring locations D-19 and 231 are actually located in the Fly Ash Pond area and this was supposed to be corrected with the second phase of the construction of the Fly Ash Pond.

Bottom Ash Pond

Section 6.4.3.B.4

Q) Where is the bottom contour of the Bottom Ash Pond in relation to the subsurface diagram?

A) Revised diagrams showing the bottom contour were distributed.

Section 6.4.3.C.3.b.i

Q) What portions of the Bottom Ash Pond would the 3-foot clay liner be placed on?

A) The lining will be placed on the portion of the Bottom Ash Pond cut into what was the original upland terrace.

Q) There are localized areas of permeable soils at boring locations D-19 and 231. Can these be excavated and replaced with liner material?

A) If it cannot be shown that these permeable soils are isolated by impermeable soils, they will be replaced with an impermeable liner.

4.0 BOTTOM ASH POND LINER PERMEABILITIES

Cleco's 1981 Bottom Ash Pond solid waste permit application (**Attachment 1**) contains the following information:

Section 6.4.3.B.4.a of permit application:

- Soft to medium stiff clay is at least 12 feet thick below the Bottom Ash Pond
- Laboratory coefficient of permeability for the in situ clay varies from 1.3 x 10^{-8} to 3.5 x 10^{-8} cm/sec
- The approximate limit of the in situ clay barrier is about midway east/west of the Bottom Ash Pond
- 3 foot-thick clay layer was placed over the exposed granular soils on the bottom of the Bottom Ash Pond
- The extent of the clay blanket was determined in the field by ensuring that the in situ clay had a minimum thickness of 3 feet
- Laboratory permeability tests on recompacted samples of the clay varied from 1.1x 10^{-7} to 2.1 x 10^{-8} cm/sec
- Soils were classified as CH according to the Unified Soil Classification System
- Clay liner was placed in horizontal lifts of 8 to 10 inches and was compacted with "sheeps foot" compaction equipment

Work was certified by the engineering firm of Sargent & Lundy and the Professional Engineer "supervised preparation of the design, plans, and specifications for the Unit 2 Bottom Ash Pond and equipment associated with such ponds". And to the best of his knowledge, "the design, plans, and specifications of the above mentioned waste disposal facilities at Rodemacher Power Station, Unit 2, meet applicable requirements of the Louisiana Solid Waste Rules and Regulations".

5.0 CLAY LINER SAMPLING ACTIVITIES

In order to verify the clay liner thickness and permeabilities in those locations that Cleco did not have enough verifiable information, seven Shelby tubes were installed in the clay liner for the collection of clay liner samples in the Bottom Ash Pond as shown on **Figure 3**.

The specific methods that were followed for the collection of the clay liner samples are summarized in the following sections.

5.1 Clay Liner Sampling

Providence contracted a Louisiana licensed driller to provide personnel and equipment, including a drilling rig mounted on a track propelled marsh buggy, to collect undisturbed samples of the clay liner in the bottom of the Bottom Ash Pond. The marsh buggy was positioned at the sample locations based on survey data points.

A temporary surface casing was used to compliment sampling and retraction grouting procedures. The materials at the mud-line were hand probed. If soft unconsolidated material was present, a 4" nominal diameter temporary surface casing was lightly pressed into place. If harder materials were present, they were broken up in order to place the temporary surface casing. For mechanical breaking of the surface material, the driller utilized Geoprobe "pre-probing tools", followed by, or in combination with, a frost auger or other solid/hollow stem auger. The express intent of this action was to only break hardened sediments (and not significantly penetrate the clay liner) such that the surface casing could be installed.

As stated above, Cleco collected seven (7) samples of the clay liner in the Bottom Ash Pond. A temporary surface casing was used at each sampling location. Undisturbed Shelby tubes were pushed to collect unconsolidated and consolidated soil matrices from the bottom of the pond, not impoundment sediments. Shelby tube samples were collected in approximately two foot intervals.

All sample locations were plugged and abandoned using CETCO 3/8 diameter coated bentonite pellets. The coated pellets are designed to "drop" through water and hydrate once they "fall" in-place. The pellets were dropped through the temporary surface casing described above. The amount placed was calculated based on the diameter of the soil boring and depth of penetration below the sediment line. Once the pellets were in-place, the surface casing was removed.

5.2 Sample Collection and Handling

Sample Handling

The Shelby tubes containing the undisturbed soil samples were capped on the tops and bottoms, and retained in as vertical position as possible and the samples were handled with care in order to minimize disturbance. The Shelby tubes were not opened in the field but were brought to the contract geotechnical laboratory where they were opened and examined for overall sample quality. A representative sample of the material in the Shelby tube was collected for the permeability testing and Atterberg limit determination.

6.0 LABORATORY ANALYSES

Providence subcontracted to APS Engineering and Testing (APS) geotechnical testing laboratory to conduct Atterberg limit determinations for the clay liner material obtained from each sample from the bottom of the pond in accordance with ASTM D 4318 and to conduct hydraulic conductivity analysis (permeability) on the samples of the clay liner material obtained from the bottom of the pond in accordance with ASTM D 5084. The results of the Atterberg limit determinations and hydraulic conductivity analysis were compared to the liner requirements for CCR facilities contained in the recently promulgated regulations.

7.0 DATA EVALUATION AND REPORTING

The geotechnical data from the original application and follow-up information to LDNR is shown in **Table 1** below for the Bottom Ash Pond.

Table 1 Bottom Ash Pond Permeabilities (Historical)

Boring ID	Unified Soil Classification	Liquid Limit	Plastic Limit	Plasticity Index	Permeability cm/sec
246	CH	69	22	47	1.3×10^{-8}
247	CH	87	24	63	2.3×10^{-8}

APS completed the Atterberg limit determinations and the permeability analysis for the samples obtained from the Bottom Ash Pond which are shown in **Attachment 3**. Photos depicting samples of the clay liner material obtained from the bottom of the Bottom Ash pond are shown in **Attachment 4.** All of the samples tested met the permeability requirements as shown in **Table 2** below. Based on the sample specimens obtained, the liner met or exceeded the two feet of compacted clay required by the CCR regulations for the Bottom Ash Pond. This data reinforces the data from the original permit application and any follow-up information provided to LDNR.

Table 2 Bottom Ash Pond Permeabilities (Additional Data)

Boring ID	Clay Type	Liquid Limit	Plastic Limit	Plasticity Index	Permeability cm/sec
AB-1	Grayish Brown Clay	64	20	44	3.4×10^{-8}
AB-2	Grayish Brown Clay	69	24	45	8.1×10^{-8}
AB-3.1	Brown Clay	71	26	45	6.5×10^{-8}
AB-4.1	Yellowish Brown Clay	51	22	29	6.6×10^{-8}
AB-5	Dark Brown Clay	81	26	55	4.5×10^{-8}
AB-6	Yellowish Brown Clay	102	37	65	8.9×10^{-8}
AB-7	Dark Brown Clay	96	36	60	8.1×10^{-8}

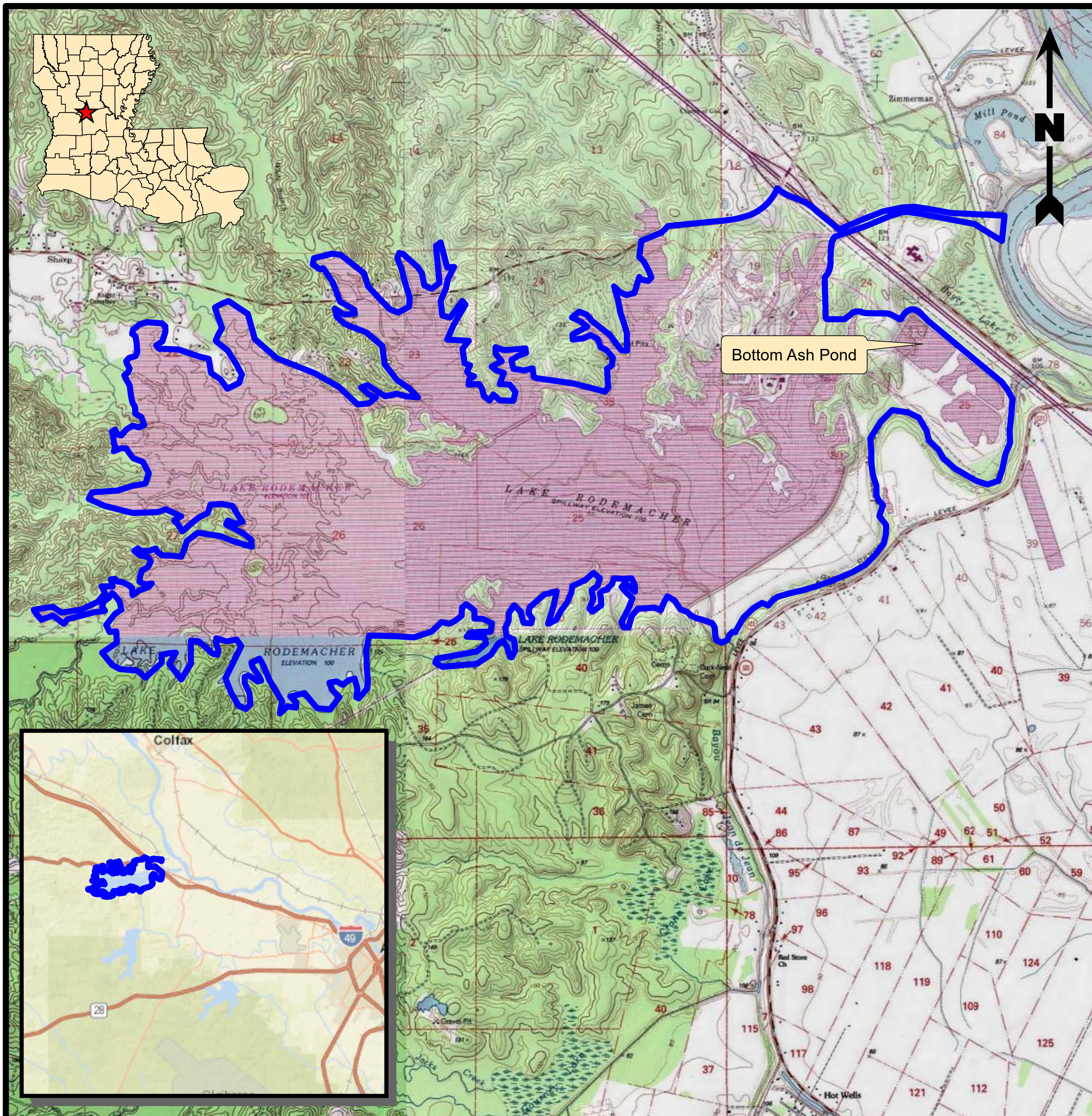
8.0 CONCLUSIONS

Providence reviewed the existing information that was completed when the Bottom Ash Pond was constructed and noted that Cleco intended to have a three-foot “compacted” clay liner in place for the Bottom Ash Pond that met the regulatory permeability requirements at the time of construction. Available information for the Bottom Ash Pond is noted in **Table 1**. Providence could not locate all of the laboratory permeability results for the liner in the Bottom Ash Pond, therefore, additional undisturbed samples of the clay liner were obtained to verify the thickness of the clay liner and to verify the permeability of the bottom liner system. Based on the information in **Table 1**, along with the additional data in **Table 2**, Providence confirms that a liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec is in-place for the Bottom Ash Pond at Brame Energy Center.

Based on the results for the liner verification, the existing clay liner for the Bottom Ash Pond meets the liner verification requirements of the CCR regulations at 40 CFR 257.71. **Attachment 5** contains a P.E. Certification that attests to this assessment.

FIGURE 1

SITE LOCATION MAP



4,000 2,000 0 4,000
Feet

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

Liner Verification - Bottom 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
002-191

Drawing Number
002-191-A006

1
Figure

Providence Engineering and Environmental Group LLC

FIGURE 2

SITE MAP

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

Liner Verification - Bottom Ash Pond
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

PROVIDENCE

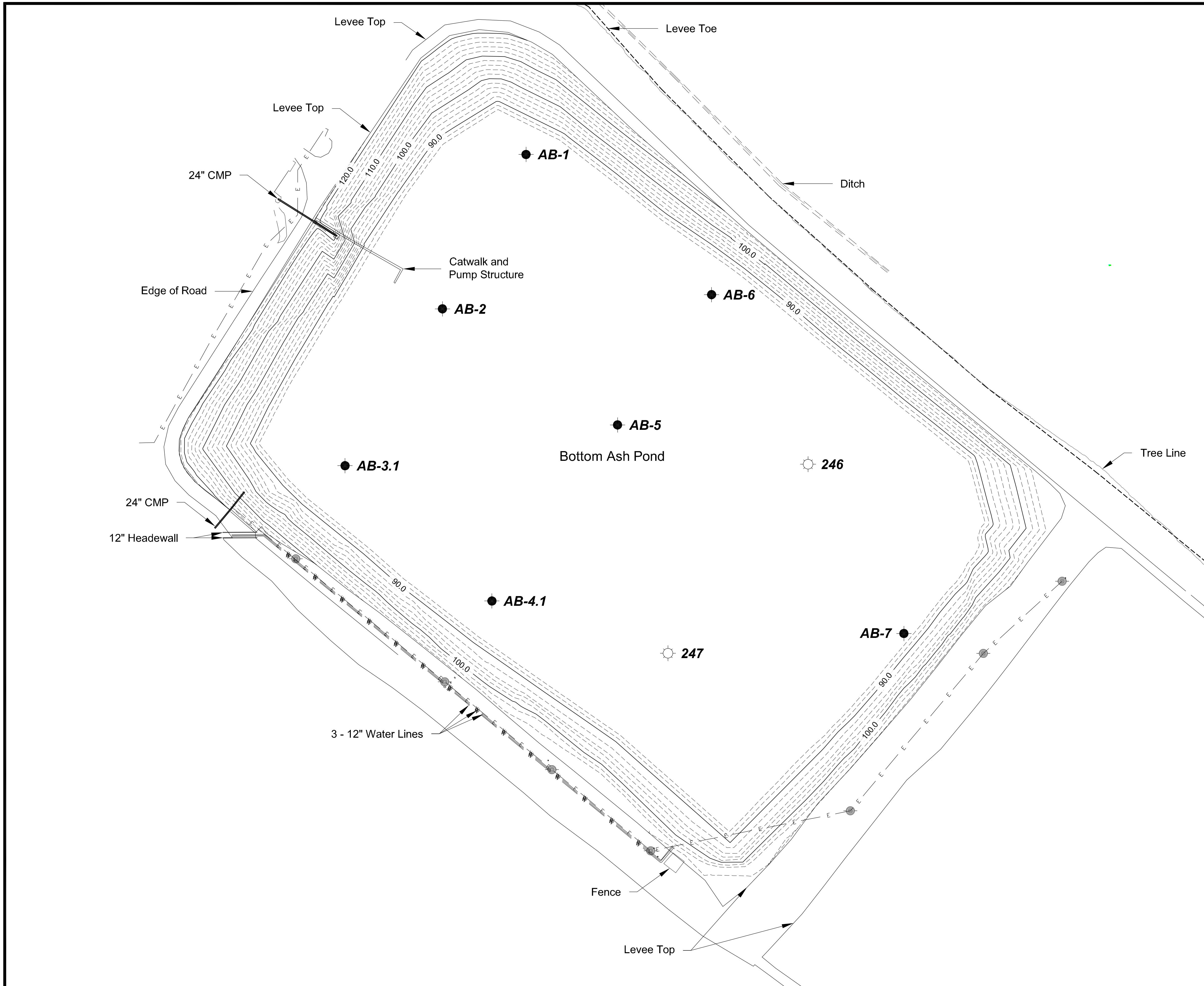
Drawn By	LMM	10/04/16
Checked By	LMH	10/04/16
Approved By	CVH	10/04/16

Project Number 002-191	2 Figure
Drawing Number 002-191-B007	

Providence Engineering and Environmental Group LLC

FIGURE 3

BOTTOM ASH POND LINER VERIFICATION



N

Legend

- Major Contour (10' Interval)
- Minor Contour (2' Interval)
- Overhead Electric Line
- Water Line
- Power Pole
- Boring Location
- Boring Location Taken at Time of Construction

Note

Above grade contours and features presented are comprised of survey data obtained in June of 2015. The survey contours for the ash material were removed to depict the bottom contours of the pond. The pond contours underneath the ash material and in the pond bottom are a combination of survey data collected in June of 2015 and elevation data obtained from historical figures.

200 0 200

Scale: 1" = 200'

Bottom Ash Pond Liner Verification

Clay Liner Verification
Boyce, Rapides Parish, Louisiana

Cleco Power LLC
Brame Energy Center

PROVIDENCE

Drawn By	LMM	09/14/16
Checked By	LMH	09/14/16
Approved By	CVH	09/14/16

Project Number
002-191

Drawing Number
002-191-B004

3
Figure

Providence Engineering and Environmental Group LLC

ATTACHMENT 1

1981 PERMIT APPLICATION BOTTOM ASH POND SECTION

6.4.3.B SITE MASTER PLAN FOR UNIT 2, BOTTOM ASH POND

6.4.3.B.1) Site Plan for Bottom Ash Pond

a) Exhibit BA6.4.3.B.1-1 shows the Bottom Ash Pond with original and final contours. The Bottom Ash Pond is located on both alluvial and terrace deposits. The surface area of the pond is 36 acres at elevation 106. The dikes built for the pond have a slope of 3 horizontal to 1 vertical. Four inches of seeded top soil are placed on the outward portions of the dikes for erosion control. The limits of execavation were controlled by the required design size. The ash pipe corridor is also shown in Exhibit BA6.4.3.B.1-1 along with the discharge channel to the NPDES discharge point. Cross sections of the bottom ash dikes and other details are shown in Exhibit BA6.4.3.B.1-2.

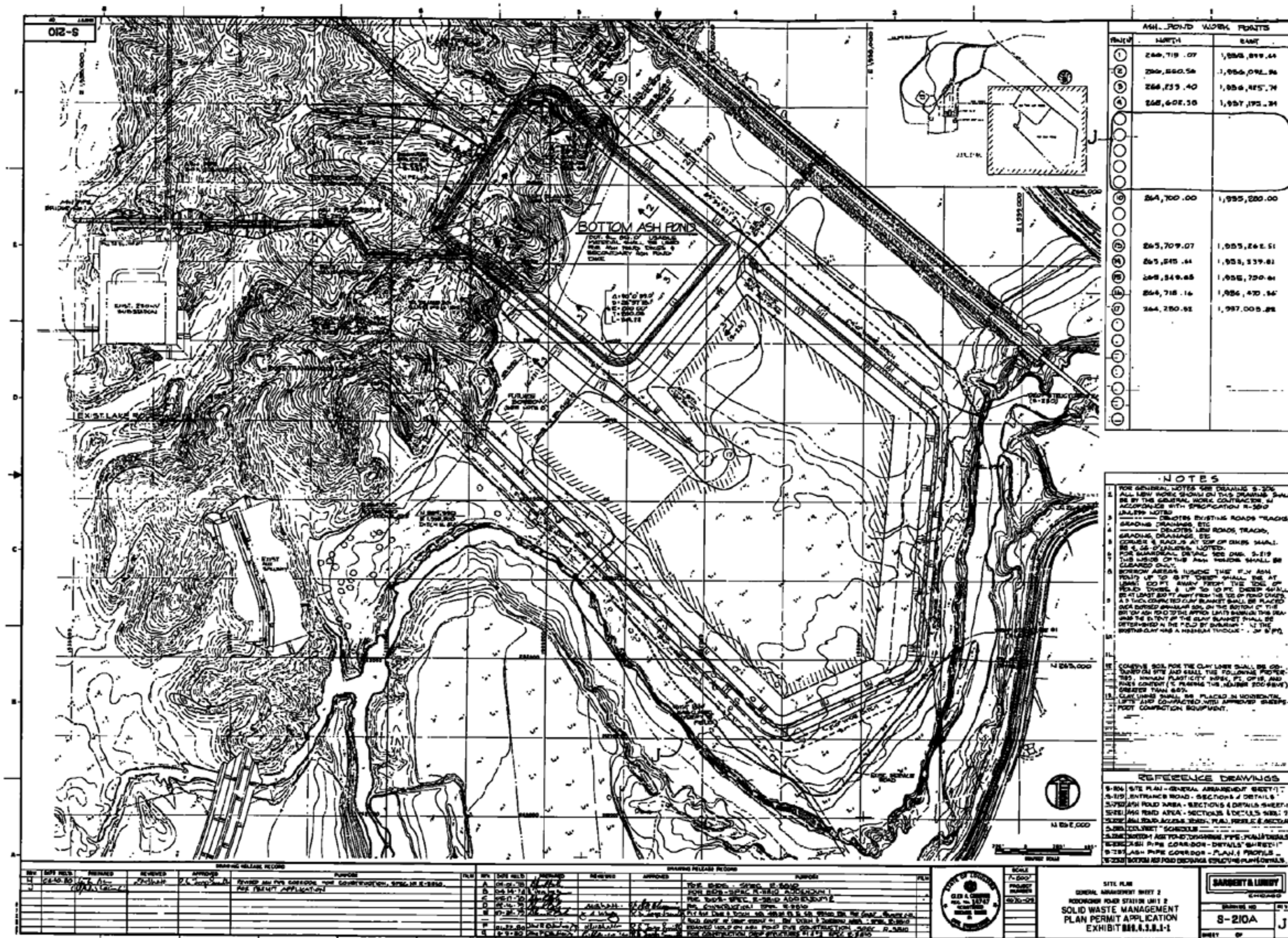
b) Peripheral fencing is not planned for the Bottom Ash Pond since the disposal facility is within the station proper and access is controlled.

c) The size of the pond was designed to accommodate the bottom ash ~~sludge~~ expected to be generated over the lifetime of Unit 2. It is not planned to monitor the daily quantities put into the Bottom Ash Pond beyond normal plant engineering practice of every few years recording an elevation of the top of the sludge and computing the remaining volume versus projected disposal volumes.

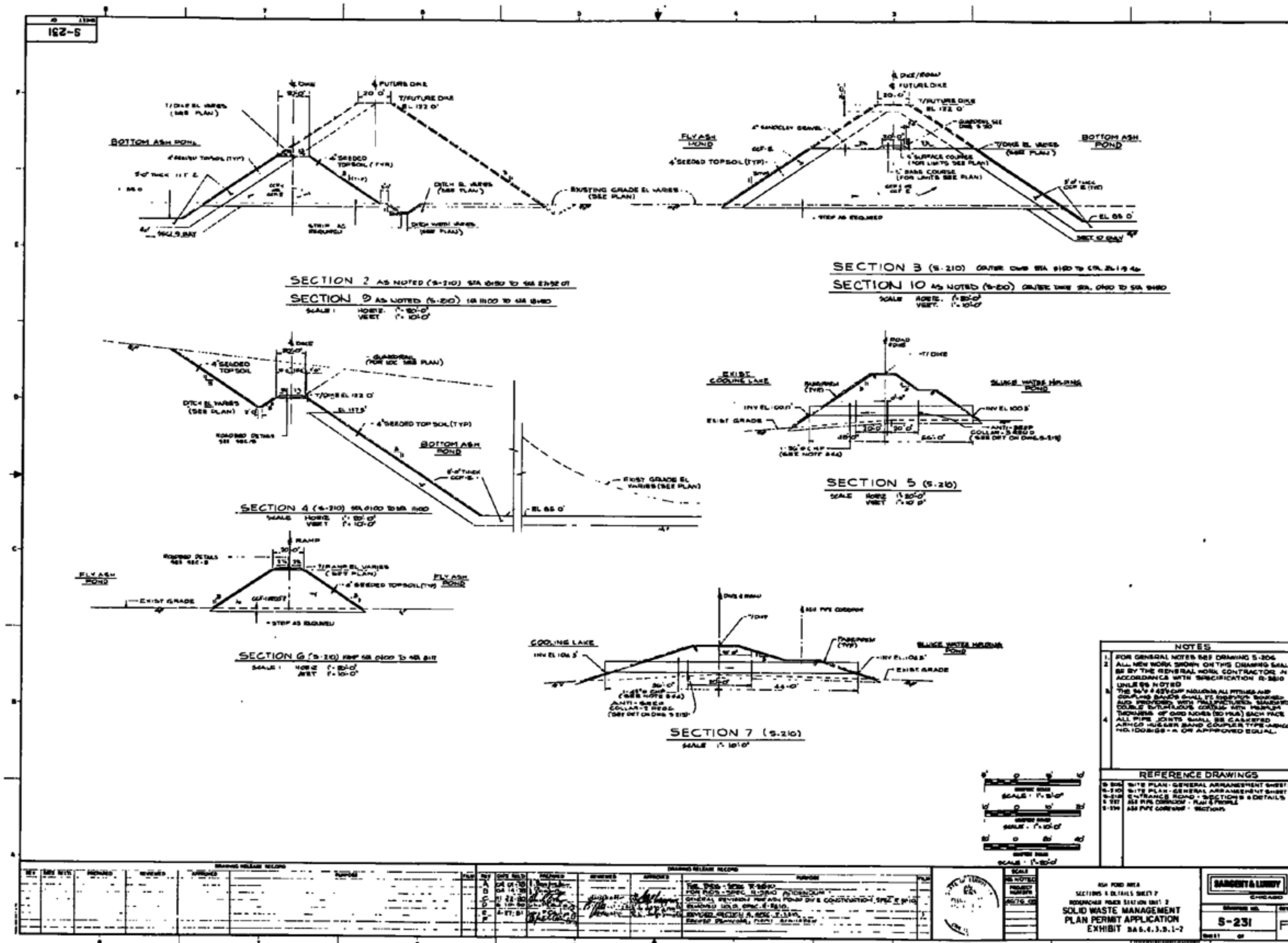
d) The waste in the Bottom Ash Pond is non-combustible, thus no special fire protection facilities are planned.

e) The surface area of the Bottom Ash Pond is 36 acres at elevation 106 with a storage volume of 740 acre feet. The bottom ash waste will be disposed of by sluicing versus sequential filling because the facility is a pond rather than a landfill.

f) No leachate collection or treatment facilities are needed for the liquid waste pumped to the Bottom Ash Pond. The design of the facility incorporates an impermeable silty clay liner



S-210
BOTTOM ASH POND
ASH POND WORK POINTS
NORTH
EAST
NOTES
REFERENCE DRAWINGS
SITE PLAN
GENERAL ARRANGEMENT SHEET 2
SOLID WASTE MANAGEMENT
PLAN PERMIT APPLICATION
SARGENT & LUNDY
CHICAGO
S-210A
J



S-231
SECTION 2 AS NOTED (S-210)
SECTION 9 AS NOTED (S-210)
SECTION 3 (S-210)
SECTION 10 AS NOTED (S-210)
SECTION 4 (S-210)
SECTION 5 (S-210)
SECTION 6 (S-210)
SECTION 7 (S-210)
BOTTOM ASH POND
FLY ASH POND
COOLING LAKE
SLUICE WATER HOLDING POND
EXISTING GRADE EL VARIES (SEE PLAN)
4" SEEDED TOPSOIL (TYP)
EL 85.0'
EXIST GRADE
NOTES
1. FOR GENERAL NOTES SEE DRAWING S-206
2. ALL NEW WORK SHOWN ON THIS DRAWING SHALL BE BY THE GENERAL WORK CONTRACTOR IN ACCORDANCE WITH SPECIFICATION R-3810 UNLESS NOTED
4. ALL PIPE JOINTS SHALL BE GASKETED
REFERENCE DRAWINGS
ENTRANCE ROAD - SECTIONS & DETAILS
ASH POND AREA
SECTIONS & DETAILS SHEET 2
SOLID WASTE MANAGEMENT
PLAN PERMIT APPLICATION
EXHIBIT
SARGENT & LUNDY
CHICAGO
S-231
F

within the dike and over the western portion (see Exhibit BA6.4.3.B.1-1 for limits) with a natural silty clay liner along the remaining bottom portion of the pond.

g) A wind rose applicable to the entire setting of the station is shown on Exhibit 6.4.3.A.1-1.

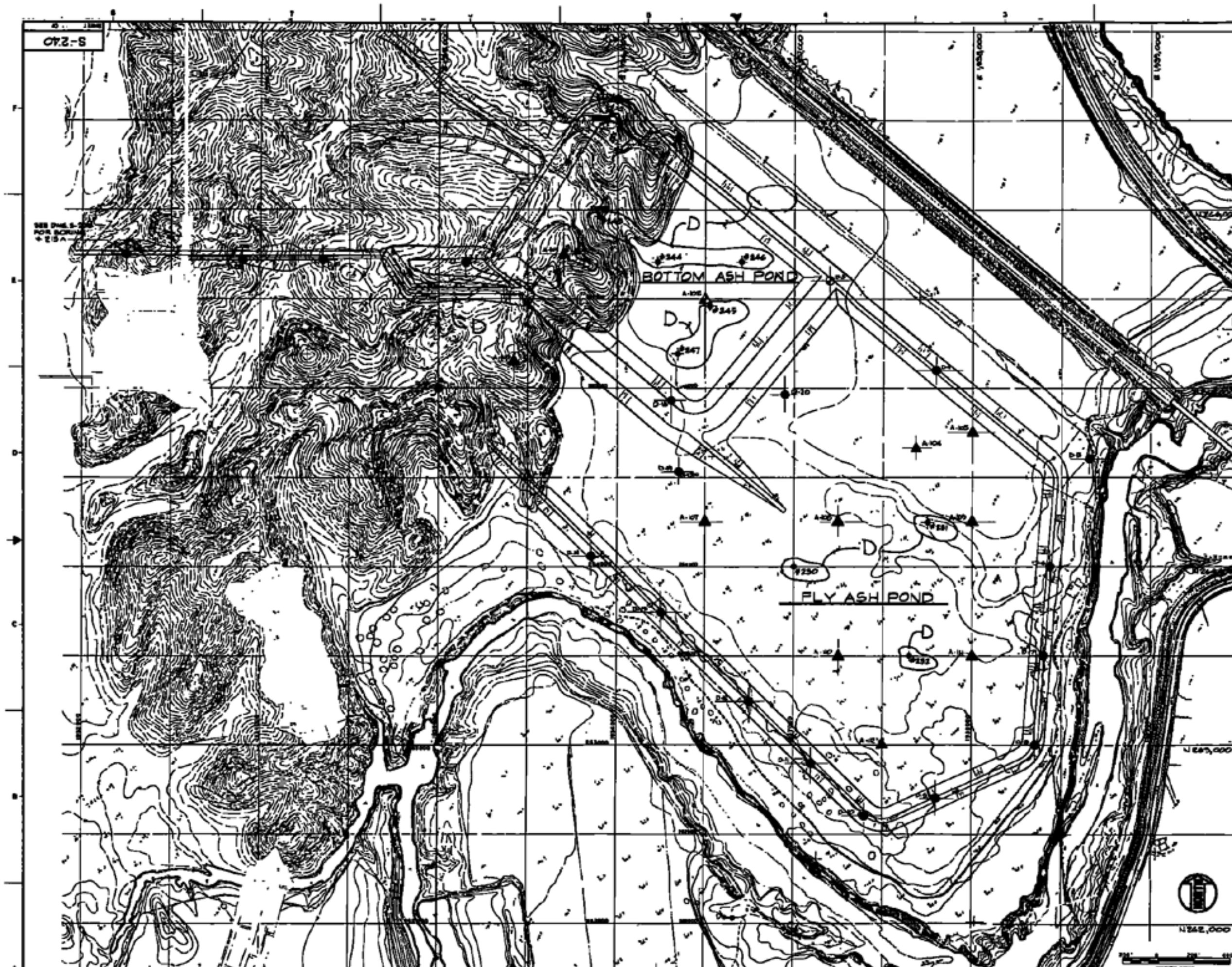
h) The waste to the Bottom Ash Pond will be a slurry so no provisions are necessary for litter control.

i) The design of the facilty is such that all trees surrounding the pond have been left not only for erosion control but also as a landscape consideration. The exterior embankments of the impoundment have been seeded. Users of LA Highways #1 and #8 and boaters on Lake Rodemacher cannot see the Bottom Ash Pond.

6.4.3.B.2) Hydrological Characteristics for Bottom Ash Pond:

a) The locations of the five borings in the Bottom Ash Pond are shown on Exhibit BA6.4.3.B.2-1. The borings, spaced between 150 and 200 feet apart, extended to 20 feet below construction grade. A northwest to southeast cross section is shown as section A-A on Exhibit BA6.4.3.B.2-2 and a southwest to northeast soil profile is shown on Exhibit BA6.4.3.B.2-3. The regional direction of ground water flow is generally to the east-southeast which is the direction of ground water flow under the Bottom Ash Pond. The borings, which were drilled to confirm the thickness of available clay liner, are within the Red River alluvial deposits and the ground water at this facility is probably hydrologically connected to the bayou. There is no evidence, however, to hydraulically connect this upper aquifer to the much deeper aquifer in the Miocene deposits which are used as a source of drinking water in the vicinity.

b) Section 6.4.3.A.2 presents further details on the ground water withdrawal rates as well as major users in the vicinity. There are irrigation wells within the vicinity of the Bottom Ash Pond but no drinking water wells.



PROPOSED BORINGS

BORING NO.	LOCATION		DEPTH
A-101	N 258,750.00	E 1,915,700.00	20.0 FT.
A-102	N 255,900.00	E 1,916,500.00	30.0 FT.
A-103	N 255,150.00	E 1,915,427.00	20.0 FT.
A-104	N 254,671.50	E 1,917,480.24	15.0 FT.
A-105	N 254,750.00	E 1,918,000.00	15.0 FT.
A-106	N 254,700.00	E 1,915,500.00	20.0 FT.
A-107	N 264,250.00	E 1,916,700.00	15.0 FT.
A-108	N 254,750.00	E 1,917,250.00	20.0 FT.
A-109	N 264,250.00	E 1,918,500.00	15.0 FT.
A-110	N 260,750.00	E 1,917,250.00	15.0 FT.
A-111	N 263,500.00	E 1,918,000.00	15.0 FT.
A-112	N 260,000.00	E 1,917,500.00	15.0 FT.
D-1	N 256,480.00	E 1,916,000.00	75.0 FT.
D-2	N 256,100.00	E 1,914,930.00	50.0 FT.
D-3	N 251,600.00	E 1,917,200.00	50.0 FT.
D-4	N 255,100.00	E 1,917,807.00	50.0 FT.
D-5	N 254,400.00	E 1,918,690.00	50.0 FT.
D-6	N 254,000.00	E 1,918,431.00	50.0 FT.
D-7	N 252,900.00	E 1,918,395.00	50.0 FT.
D-8	N 253,000.00	E 1,918,250.00	50.0 FT.
D-9	N 252,300.00	E 1,917,800.00	50.0 FT.
D-10	N 252,800.00	E 1,917,400.00	50.0 FT.
D-11	N 252,900.00	E 1,917,100.00	50.0 FT.
D-12	N 255,250.00	E 1,916,750.00	50.0 FT.
D-13	N 250,750.00	E 1,915,250.00	50.0 FT.
D-14	N 254,060.00	E 1,915,850.00	50.0 FT.
D-15	- - - - - - DELETED - - - - - -		
D-16	N 259,000.00	E 1,955,000.00	75.0 FT.
D-17	N 257,720.00	E 1,955,150.00	75.0 FT.
D-18	N 254,950.15	E 1,916,909.58	50.0 FT.
D-19	N 258,370.00	E 1,916,350.00	50.0 FT.
D-20	N 254,941.88	E 1,916,946.15	50.0 FT.
D-21	N 255,700.00	E 1,914,730.00	50.0 FT.
D-22	N 261,720.00	E 1,915,900.00	50.0 FT.

LEGEND

- PROPOSED DESIGN BORINGS
- DRILLED DESIGN BORINGS
- PROPOSED AUGER BORINGS
- DRILLED AUGER BORINGS

NOTES

1. BORINGS D-3, D-4, D-8, D-9, D-12, D-13, D-17, AND D-18 SHALL HAVE SHELBY TUBE SAMPLES TAKEN ONLY AT DEPTHS OF 2.5, 5.0, 10.0, 15.0, 25.0, AND 35.0 FEET UNLESS OTHERWISE SPECIFIED BY THE CONSULTING ENGINEERS.
2. THE REMAINING DESIGN (D SERIES) BORINGS SHALL HAVE SPLIT-BARREL SAMPLING UNLESS OTHERWISE SPECIFIED BY THE CONSULTING ENGINEERS.
3. SOIL BORING WORK SHALL BE IN ACCORDANCE WITH THE TECHNICAL REQUIREMENTS FOR SOIL BORING WORK TO WHICH THIS DRAWING HAS BEEN ATTACHED.

REFERENCE DRAWINGS

S-206	SITE PLAN-GENERAL ARRANGEMENT SHEET-1
S-210	SITE PLAN-GENERAL ARRANGEMENT SHEET-2

DRAWING RELEASE RECORD

REV	DATE REL'D	PREPARED	REVIEWED	APPROVED	PURPOSE
A	11-15-[illegible]	[illegible]	[illegible]	[illegible]	FOR REFERENCE
B	10-25-[illegible]	[illegible]	[illegible]	[illegible]	RECORD REVISION FOR BORINGS [illegible]
C	[illegible]	[illegible]	[illegible]	[illegible]	REVISED DRAWING NUMBER
D		[illegible]			RECORD DRAWING PERMIT APPLICATION

BORING LOCATION PLAN

ROCKPORT POWER STATION UNIT 2

SOLID WASTE MANAGEMENT PLAN PERMIT APPLICATION

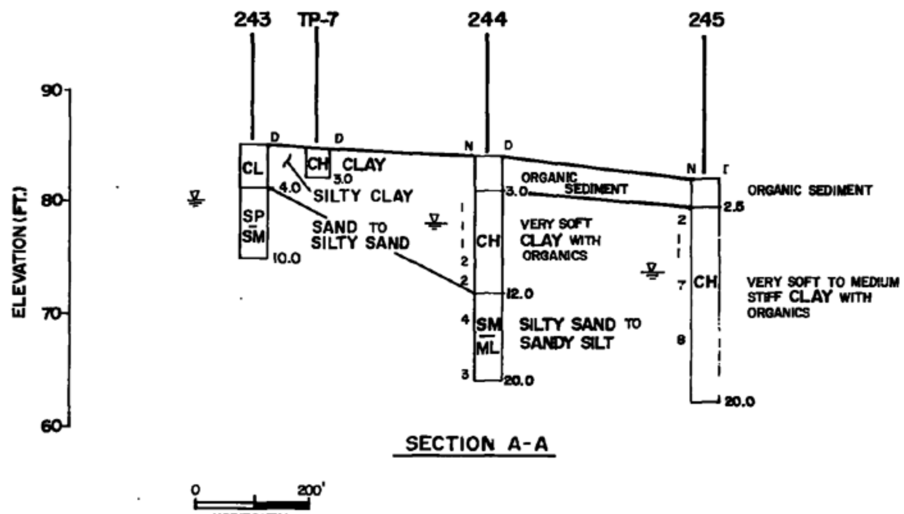
EXHIBIT [illegible]

SARGENT & LUNDY

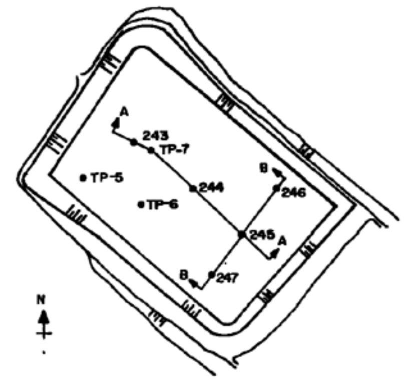
CHICAGO

DRAWING NO. S-240 REV D

FORMERLY S-235



SECTION A-A



PLAN
N.T.S.

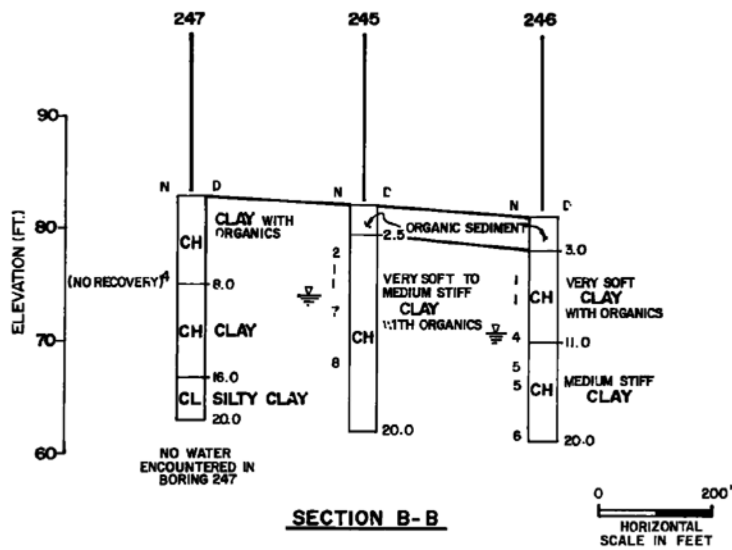
LEGEND

TP = TEST PIT
D = DEPT IN FEET
N = STANDARD PENETRATION TEST, BLOWS PER FOOT
▽ = GROUND WATER LEVEL

GENERALIZED SUBSURFACE DIAGRAM - SECTION A-A
BOTTOM ASH POND

RODEMACHER POWER STATION UNIT 2
SOLID WASTE MANAGEMENT PLAN
PERMIT APPLICATION

EXHIBIT BA 6.4.3.B.2-2



SECTION B-B

LEGEND

D = DEPTH IN FEET
N = STANDARD PENETRATION TEST, BLOWS PER FOOT
▽ = GROUND WATER LEVEL

NOTE

1. FOR BORING LOCATION PLAN, SEE SECTION A-A.

GENERALIZED SUBSURFACE DIAGRAM - SECTION B-B BOTTOM ASH POND
RODEMACHER POWER STATION UNIT 2 SOLID WASTE MANAGEMENT PLAN PERMIT APPLICATION EXHIBIT BA 6.4.3.B.2-3

c) The uppermost freshwater aquifer beneath the Bottom Ash Pond, as recorded in the boring logs, is between 6 feet and 9 feet below grade. The depth to the nearest aquifer used for drinking water should be between 50 and 200 feet below grade.

6.4.3.B.3) Surface Drainage Information

a) There will be no surface streams directed through the Bottom Ash Pond. The pond is a completely diked facility except on the northwestern portion where excavation into a hillside was necessary. There is a perimeter interceptor ditch on the northwestern portion of the pond which should divert surface water run on.

b) Above-ground pipes carry the bottom ash sluice to the Bottom Ash Pond. The decanted water will overflow via the discharge channel to the NPDES permitted discharge point number 004. (For further details on NPDES permit conditions and discharge points, see the attachment to Part I of this application.)

c) The 25-year, 24-hour maximum rainfall for the Bottom Ash Pond is 9 inches according to U.S. Weather Bureau data. Any rainfall event up to or exceeding the 25-year, 24-hour maximum will flow out of the pond at its outfall.

d) Discharge water from the Bottom Ash Pond will be handled by a weir box pipe structure and channel located on the northwest side. There is no need for a dewatering plan beyond the normal operating procedures.

6.4.3.B.4) Geological Characteristics

a) Exhibits BA6.4.3.B.2-2 and 3 present the generalized soil conditions beneath the Bottom Ash Pond. The depth to ground water varies from 6 to 10 feet below grade. There is a very soft to medium stiff clay which extends to 20 feet (terminal depth of borings) in all of the borings except Boring 244. In that boring, the clay extended to 12 feet with a silty sand to sandy silt beneath. The laboratory coefficient of permeability for the in situ clay varies from 1.3×10^{-8} to 3.5×10^{-8} cm/sec. As was shown in Exhibit BA6.4.3.B.1-1, the approximate limit of the insitu clay barrier is about midway of the Bottom Ash Pond. A 3 foot thick compacted clay layer was placed over the exposed granular soils on the bottom of the Bottom Ash Pond. The extent of the clay blanket was determined in the field by ensuring that the in situ clay had a minimum thickness of 3 feet. Laboratory permeability tests on recompacted samples of the clay varied from 1.1×10^{-7} to 2.1×10^{-8} cm/sec. and the Plasticity Index averaged 41 with an average liquid limit of 62 which classifies the soil as CH according to the Unified Soil Classification System. The clay liner was placed in horizontal lifts of 8 to 10 inches and was compacted with "sheeps foot" compaction equipment. The 3 foot compacted clay liner coupled with the in situ clay layer should form an effective barrier to liquid waste migration to the ground water.

A summary of the laboratory test results is presented in Table BA6.4.3.B.4-1.

6.4.3.B.5) Environmental Characteristics for Bottom Ash Pond:

a) There are no known historical or archaeological sites within 1000 feet of the Bottom Ash Pond. No habitats for endangered species or other sensitive ecological species are within 1000 feet of the Bottom Ash Pond.

   The basis for the statements is the 1972-1973 ecological studies of the environment at the Rodemacher Station. The survey addressed in detail the terrestrial wildlife, the aquatic life, and vegetation in the area. Since that time the station and lake have been constructed and the immediate area of the station, including the Bottom Ash Pond, is one of an industrial setting.

TABLE BA 6.4.3.B.4-1

SUMMARY OF LABORATORY TESTS
BOTTOM ASH POND

Feature	Boring No. Sample No.	Bottom of Sample Depth, Ft.	Particle Size Analysis (% Passing) (2): No. 4 Sieve	No. 10 Sieve	No. 40 Sieve	No. 200 Sieve	Atterberg Limits (3): Liquid Limit (°/o)	Plastic Limit (°/o)	Plasticity Index	Unified Soil Classification Symbol	Natural Water Content (°/o) (4)	Dry Density lbs/ft³	Laboratory Permeability (5) cm/sec
Bottom Ash Pond	243	1.5				91	47	20	27	CL	21.8		
		3.0				89	47	19	28	CL	21.7		
		7.5				9	21	N.P.	N.P.	SP-SM	24.6		
	244, 2	4.5				96	69	22	47	CH	97.8 ?		
	3	6.0				97	81	23	58	CH	78.1		
	4	7.5				94	77	23	54	CH	79.2		
	5	9.0				98	69	22	47	CH	63.5		
	6	10.5				97	71	23	48	CH	65.6		
	8	15.0				50	20	17	3	SM-ML	18.2		
	9	20.0				50	19	N.P.(6)	N.P.	SM-ML	18.0		
	245, 2	4.0				93	81	22	59	CH			
	3	5.5				94	74	22	52	CH			
	4	7.0				100	65	21	44	CH			
	6	10.0				98	82	23	59	CH	63.3		
	7	15.0				98	-	-	-				
	246, 2	6.5				95	70	23	47	CH	82.3		
	3	8.0				97	60	21	39	CH	98.2		
	4	9.5				95	85	23	62	CH	40.9		
	5	11.0				?	69	22	47	CH	37.6	78.0	1.3×10^{-8}
	7	15.0				99	64	22	42	CH	32.5		
	8	20.0				100	69	22	47	CH	35.6		
	247, 2	4.0				100	78	21	57	CH	45.0		2.3×10^{-8}
	3	6.0				100	87	24	63	CH	66.0		3.5×10^{-8}
	5	10.0				98	54	20	34	CH	60.8		
	6	15.0				87	70	23	47	CH	30.6		
	7	20.0				98	40	20	20	CH	61.8		

TABLE BA 6.4.3.B.4-1 (Continued)

SUMMARY OF LABORATORY TESTS
BOTTOM ASH POND

Feature	Boring No. Sample No.	Bottom of Sample Depth, Ft.	Particle Size Analysis (% Passing) (2) No. 4 Sieve	No. 10 Sieve	No. 40 Sieve	No. 200 Sieve	Atterberg Limits (3) Liquid Limit (%)	Plastic Limit (%)	Plasticity Index	Unified Soil Classification Symbol	Natural Water Content (%) (4)	Dry Density lbs/ft³	Laboratory Permeability (5) cm/sec
Bottom Ash Pond (CONTD.)	TP-5, 1	1.0	-	-	-	96	60	20	40	CH	28.4		
	2	2.0	-	-	-	96	64	21	43	CH	28.0		
	3	3.0	-	-	-	99	60	21	39	CH	27.6		
	TP-6, 1	1.0	-	-	-	99	65	20	45	CH	24.8		
	2	2.0	-	-	-	99	61	22	39	CH	25.1		
	3	3.0	-	-	-	99	60	21	39	CH	22.4		
	TP-7, 1	1.0	-	-	-	93	58	21	37	CH	26.1		
	2	2.0	-	-	-	99	70	24	46	CH	33.4		
	3	3.0	-	-	-	93	65	22	43	CH	32.8		
													2.1×10^{-8} (A)
													1.1×10^{-7} (A)
	230, 1	3.0	100	100	100	100	58	20	38	CH	25.6		
	4	6.0											
	6	9.0											
	8	15.0	-	-	100	66	27	19	8	CL	27.4		
	231, 2	3.0	-	-	-	37	N.P.(6)	N.P.	N.P.	SM	17.7	-	
	4	6.0	-	-	-	15	N.P.	N.P.	N.P.	SC	25.1		
	9	20.0	-	-	-	99	61	20	41	CH	38.9	-	
	232, 1	1.5	-	-	-	100	62	20	42	CH	35.3	-	
	3	4.5	100	100	100	98	58	19	39	CH	36	83	1.1×10^{-8}
	5	7.5	-	-	-	89	29	18	11	CL	24.1	-	

NOTE: A) Two Permeability Tests performed on composite material of all samples from TP-5, TP-6, and TP-7.

GENERAL NOTES:

(1) Laboratory testing performed by Southwestern Laboratories, Inc., Shreveport, Louisiana
(2) Laboratory Particle Size Analysis Tests performed in accordance with ASTM D422 and ASTM D1140
(3) Laboratory Atterberg Limit Tests performed in accordance with ASTM D423 and ASTM D424.
(4) Laboratory Water Content Tests of Soils performed in accordance with ASTM D2216. Most of Water Content Tests performed on split-spoon samples.
(5) Laboratory Vertical Permeability Test performed on undisturbed Shelby tube samples unless otherwise noted. Samples tested using Falling Head Test procedure in accordance with EM 1110-2-1906.
(6) N.P.= Non Plastic

b) The operation of the Bottom Ash Pond will have no adverse impact upon the use of the lake the quality of the lake environment.

6.4.3.C <u>FACILITY PLANS AND SPECIFICATIONS - BOTTOM ASH POND</u>

1) <u>Design, Plans, and Specifications</u>: The plans submitted herein for the Bottom Ash Pond were prepared and sealed by Professional Engineers with the required expertise in processing or disposing of solid waste as defined by the Solid Waste Management Plan.

2) <u>Certification</u>: Exhibit BA 6.4.3.C.2-1 is a certification that the facility meets the requirements outlined in the state regulations.

3) <u>Special Requirements</u>:

a) <u>Incineration</u>. Incineration is not planned as a disposal option in the operation of the Bottom Ash Pond.

b) <u>Sanitary Landfills</u>.

b.i) Typical cross sections of the above ground structures for the Bottom Ash Pond are shown in Exhibits BA 6.4.3.B.1-1, 2 and 3. No daily fill or cover is necessary for the liquid waste to be placed in the pond. The ground water table is at least 6 feet below construction grade and the 6 feet of soil between the ground water and the bottom of the pond is a CH material. In the northwestern part of the Bottom Ash Pond and in the surrounding dikes, the minimum thickness of compacted clay is 3 feet. The natural impermeability of the in situ soils and the compacted clay liner form a suitable protective barrier to the ground water.

b.ii) The soil types underlying the Bottom Ash Pond comprised a minimum of 3 feet of compacted clay over silty to clayey sands or very plastic in situ clay (CH). Cross sections of the subsurface conditions are shown in Exhibits BA 6.4.3.B.2-2 and 3.

CERTIFICATE OF SARGENT & LUNDY ENGINEERS

I, Richard I. Gavin, make this certification as a registered Professional Engineer on behalf of Sargent & Lundy Engineers for the benefit of all persons interested in the application of Central Louisiana Electric Company, Inc. for a Solid Waste Disposal Permit from the Louisiana Department of Natural Resources, Office of Environmental Affairs.

I do hereby certify as follows:

1. I am a registered Professional Engineer in the State of Louisiana.

2. I have supervised preparation of the design, plans, and specifications for the Unit 2 Boiler Cleaning Waste Pond, Bottom Ash Pond, Fly Ash Pond, Clarifier Sludge Pond, and equipment associated with such waste ponds.

3. To the best of my knowledge, the design, plans, and specifications for the above mentioned waste disposal facilities at Rodemacher Power Station, Unit 2, meet applicable requirements of the Louisiana Solid Waste Rules and Regulations.

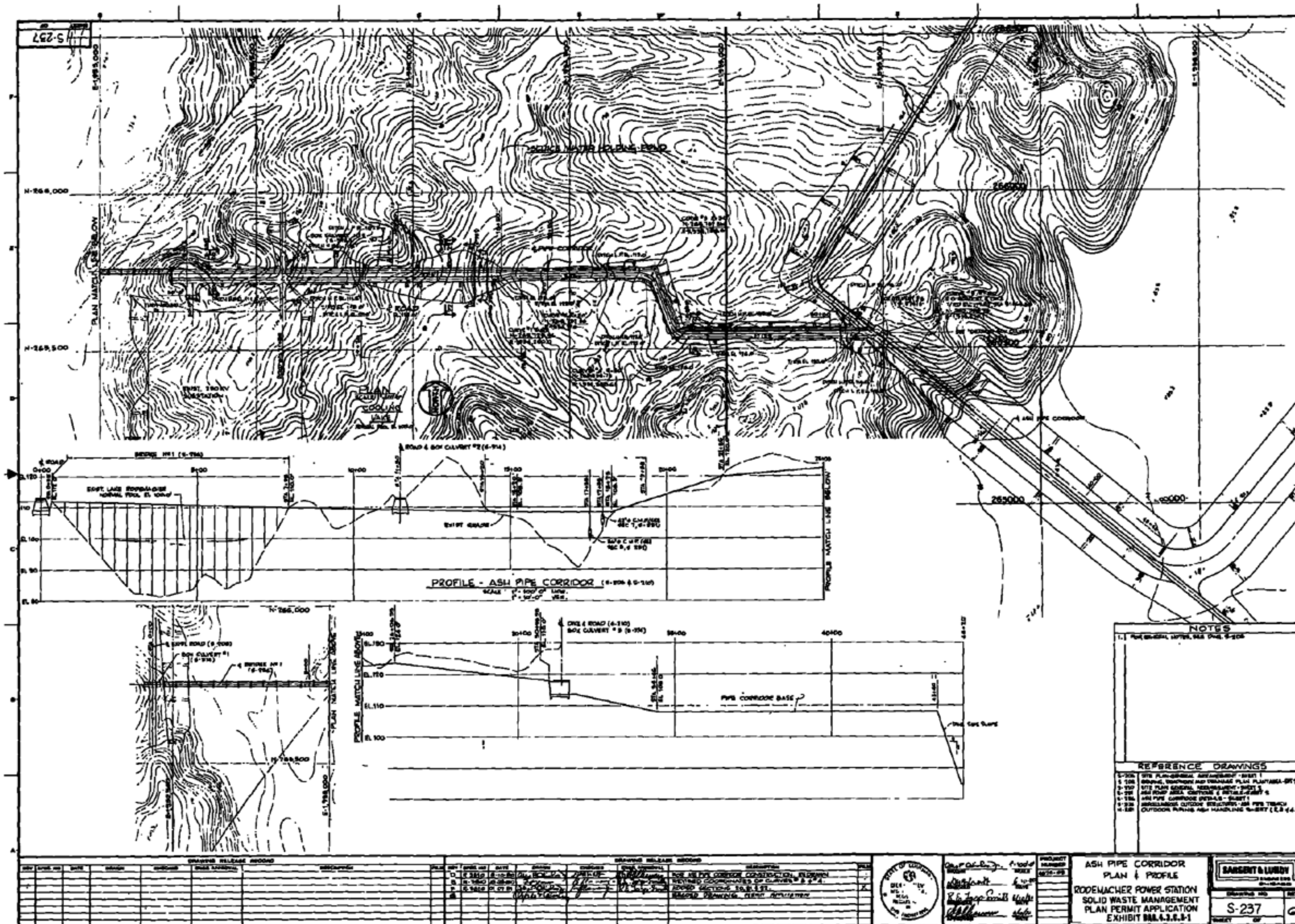
4. To the extent that this certification is based upon information and data prepared and analyzed by Sargent & Lundy personnel other than myself, I have reviewed this certification with such personnel to confirm its completeness and accuracy.

IN WITNESS WHEREOF, I have hereunto set my hand this 2 day of October, 1981.

Richard I. Gavin, Partner
Sargent & Lundy Engineers

STATE OF LOUISIANA
R. I. GAVIN
REG. No. 11283
REGISTERED PROFESSIONAL ENGINEER
IN
MECHANICAL ENGINEERING

EXHIBIT BA 6.4.3.C.2-1



PROFILE - ASH PIPE CORRIDOR
NOTES
REFERENCE DRAWINGS
PIPE CORRIDOR BASE
PLAN MATCH LINE BELOW
PROFILE MATCH LINE BELOW
ASH PIPE CORRIDOR
PLAN & PROFILE
RODEMACHER POWER STATION
SOLID WASTE MANAGEMENT
PLAN PERMIT APPLICATION
SARGENT & LUNDY
S-237
G

b.iii) Section 6.4.3.D.2 discusses the characteristics of the wastes to be placed in the Bottom Ash Pond. Given the relatively harmless nature of the waste and the clay barrier in the pond, ground water quality should not be affected by operation of the Bottom Ash Pond.

b.iv) No cover material will be needed in the daily operation of the Bottom Ash Pond since the waste is in a liquid form.

b.v) A detailed description of the equipment to be used in the overall operation of the Bottom Ash Pond is presented in Section 6.4.3.D.2.

b.vi) No leachate collection and/or treatment system is planned for the Bottom Ash Pond since it is designed to contain liquids.

b.vii) The ground water monitoring strategy for the Bottom Ash Pond is tied to the down gradient monitoring wells for the Fly Ash Pond. The proximity of these two ponds as shown on Exhibit BA 6.4.3.B.2-1 is such that the two monitoring wells shown on Exhibit 6.4.3.A.2-2 should serve as indicators if contamination should occur. This decision also considers the relatively clean characteristics of the bottom ash waste and its relatively harmless influence on the environment. The two wells shown for the Bottom Ash and Fly Ash ponds are keyed to the network of monitoring wells for the Rodemacher Station. There are two background wells proposed in the northern portion of the station and at least two downgradient from each of waste disposal facilities. facilities. A typical cross section of a monitoring well is shown in Exhibit BA 6.4.3.C.3-1. The two monitoring wells for the Bottom Ash and Fly Ash ponds would extend below the protective clay liner into the more sandy soils or at least 10 to 15 feet into the CH soils of the area.

As a contingency plan to the above minimum monitoring program, if a significant increase (or pH decrease) shows up in the chemical parameters being monitored (see Section 7.3.3.G.3) then additional ground water samples from the affected wells would be immediately obtained following the same sampling procedure outlined in Section 7.3.3.G.3. The samples would be split and tested to first determine if the change was the result of laboratory error. If no laboratory error was found then at least two additional borings would be drilled and soil samples obtained on continuous intervals to a depth corresponding to the level where contamination was recorded. Depths to the ground water surface would be recorded.

Field permeability tests (packer tests) would be performed, at least one per boring, at a depth determined by the geologist/geohydrologist responsible for the field program. The locations would depend upon the log of boring and depth from which the contaminated samples had been obtained. At least three laboratory permeability tests would be performed upon samples from the new borings.

Leachate tests on at least three soil samples, at different depths, should be conducted and laboratory tests (parameters to be determined based on parameters that increased) performed. As a part of the laboratory testing, moisture and density tests on undisturbed samples, Atterburg Limits and grain size analysis would be conducted (the number to be determined).

Statistical evaluation of the new laboratory data would be made and compared to previously reported data for trends. Detailed cross sections with all data would be prepared showing both physical and chemical parameters.

A simple "first estimate" model of the subsurface conditions would be evaluated using EPA or state approved modeling programs. The data would be evaluated and

ATTACHMENT 2

BA RESPONSE TO DNR 1981

copy to Laf.

CENTRAL LOUISIANA ELECTRIC COMPANY INC.

RECEIVED NOV 9 1981 DNR - OEA ACADIAN REGION LAFAYETTE, LOUISIANA

RODEMACHER POWER STATION
(Near Boyce, Louisiana)
CONSTRUCTION DEPARTMENT

Area Code: 318
Telephone: 793-2126

Please Reply to:
Rt. 1, Lena, La. 71447

November 2, 1981

RECEIVED NOV 3 1981 DEPARTMENT OF NATURAL RESOURCES SOLID WASTE MANAGEMENT

Mr. John Koury, Administrator
Solid Waste Management Division
Department of Natural Resources
P. O. Box 44066
Baton Rouge, LA 70804

Re: Responses to DNR Questions on Solid Waste Disposal Permit Application for Rodemacher Power Station Surface Impoundments

Dear Mr. Koury:

In accordance with instructions from Ms. Barbara Delatte, Solid Waste Specialist, we are hereby submitting responses to comments and questions presented by your staff during the October 29, 1981, review meeting for the Solid Waste Disposal Permit Application for the Rodemacher Power Station. We understand that this letter will be appended to our application filing in lieu of actually changing the application in response to DNR comments and questions.

The responses are organized below according to their respective subsection of the Louisiana Solid Waste Management Program Rules and Regulations.

Boiler Cleaning Waste Pond

Section 6.4.3.B.4

Q) The Plasticity Index is low for the materials on the slopes of the Unit 2 Boiler Cleaning Waste Pond. Will it be adequate for a liner?

A) The specification for the liner requires a Plasticity Index of 15 or more. The specification will be adhered to.

Q) Where is the bottom contour of the Unit 2 Boiler Cleaning Waste Pond in relation to the subsurface diagram?

A) Revised diagrams showing the bottom contour were distributed.

Q) Is there a need for an additional liner on the upper slopes of the Unit 2 Boiler Cleaning Waste Pond in the areas lacking natural clay?

A) S&L indicated that an adequate liner was being provided on the upper slopes as shown in the plans.

Bottom Ash Pond

Section 6.4.3.B.4

Q) Where is the bottom contour of the Bottom Ash Pond in relation to the subsurface diagram?

A) Revised diagrams showing the bottom contour were distributed.

Section 6.4.3.C.3.b.i

Q) What portions of the Bottom Ash Pond would the 3-foot clay liner be placed on?

A) The lining will be placed on the portion of the Bottom Ash Pond cut into what was the original upland terrace.

Q) There are localized areas of permeable soils at boring locations D-19 and 231. Can these be excavated and replaced with liner material?

A) If it cannot be shown that these permeable soils are isolated by impermeable soils, they will be replaced with an impermeable liner.

Fly Ash Pond

Section 6.4.3.C.3.b.i

Q) Exhibit FA6.4.3.B.1-2 is missing.

A) The reference should be to Exhibit BA6.4.3.B.1-2 presented in the Bottom Ash Pond subsection.

Section 6.4.3.C.3.b.vii

Q) Due to groundwater flow, a monitoring well should be placed on the eastern dike between the Fly Ash Pond and Bayou Jean de Jean.

A) A monitoring well will be placed as requested.

Clarifier Sludge Pond

Section 6.4.3.B.4

Q) Will the 1.5-foot bentonite/soil mixture be equivalent to a 3-foot natural clay liner?

A) The permeability tests on the bentonite/soil mixtures have indicated that the permeability of a 7% bentonite mixture is low enough to assure that 1.5 feet of the mixture is more than equivalent to 3 feet of natural clay. A set of calculations demonstrating the adequacy of the bentonite/soil mixture was distributed.

Clarifier Sludge Pond (Cont'd)

Section 6.4.3.B.4 (Cont'd)

Q) Can it be shown that the bentonite/soil mixture will be adequate after placement?

A) Tests will be taken after liner placement and compaction to demonstrate compliance with the permeability and thickness requirements.

We trust that the above responses will adequately address any concerns expressed by your staff during their review of the Solid Waste Disposal Permit Application. We look forward to your written confirmation of the adequacy of these responses and the eventual issuance of a permit to operate the new surface impoundments at Rodemacher Power Station.

Very truly yours,

J. T. Simms

J. T. Simms, Jr.
Manager Power Plant Engineering
& Construction

RECEIVED

JTSJR:kej
cc: Mr. W. Buchanan
Mr. R. E. Torp-Smith
Mr. P. J. Turregano
Mr. M. Hess

ATTACHMENT 3

BOTTOM ASH POND PERMEABILITY TESTS

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Dark Grayish Brown Clay
Boring No.:	-----
Sample:	AB-1
Sample Length (inches):	30.0"
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	6/7
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =27.4 %
Assumed Specific Gravity:	2.65
Atterbergs:	LL: 64 PL:20 PI: 44

Parameter	Initial	Final
Height, in	2.85	2.80
Diameter, in	3.00	2.97
Area, in^2	7.07	6.93
Volume, in^3	20.1	19.4
Mass, g	618	618
Bulk Density, pcf	117	121
Moisture Content, %	25.7	25.7
Dry Density, pcf	92.8	96.4
Degree of Saturation, %	87.0	95.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 97.04 **Cell Pressure Increment, psi : 4.95** **Increased Cell Pressure, psi : 101.99**

Sample Pressure, psi: 87.03 **Corresponding Sample Pressure, psi: 91.56** **B Coefficient: 0.91**

Sample Pressure Increment, psi: 4.53 **(β value did not increase with increase in pressure. Final degree of saturation > 95%)**

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/30	1	97.0	87.0	16.5	16.3	0.2	132	29.2	3.7E-08	20.2	0.995	3.6E-08
8/30	2	97.0	87.0	16.5	16.3	0.2	139	29.2	3.5E-08	20.2	0.995	3.5E-08
8/30	3	97.0	87.0	16.3	16.3	0.2	144	29.2	3.4E-08	20.2	0.995	3.3E-08
8/30	4	97.0	87.0	16.3	16.3	0.2	149	29.2	3.2E-08	20.2	0.995	3.2E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 3.4 x10^{-8} cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Very Dark Grayish Brown Clay
Boring No.:	-----
Sample:	AB-2
Sample Length (inches):	24.0''
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	12/2
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =36.4 %
Assumed Specific Gravity:	2.65
Atterbergs:	LL: 69 PL:24 PI:45

Parameter	Initial	Final
Height, in	3.16	3.07
Diameter, in	2.90	2.86
Area, in^2	6.61	6.42
Volume, in^3	20.9	19.7
Mass, g	598	596
Bulk Density, pcf	109	115
Moisture Content, %	33.5	33.0
Dry Density, pcf	81.6	86.4
Degree of Saturation, %	86.0	96.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 94.96 **Cell Pressure Increment, psi : 5.18** **Increased Cell Pressure, psi : 100.14**

Sample Pressure, psi: 85.02 **Corresponding Sample Pressure, psi: 90.03** **B Coefficient: 0.97**

Sample Pressure Increment, psi: 5.01

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/30	1	95.0	85.0	18.0	17.8	0.2	60	29.1	8.7E-08	20.2	0.995	8.7E-08
8/30	2	95.0	85.0	18.0	17.8	0.2	62	29.1	8.5E-08	20.2	0.995	8.4E-08
8/30	3	95.0	85.0	18.0	17.8	0.2	67	29.1	7.8E-08	20.2	0.995	7.8E-08
8/30	4	95.0	85.0	18.0	17.8	0.2	70	29.1	7.5E-08	20.2	0.995	7.5E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 8.1 x10^{-8} cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Brown Clay
Boring No.:	-----
Sample:	AB-3.1
Sample Length (inches):	33.0"
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	11/1
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =34.9 %
Assumed Specific Gravity:	2.65
Atterbergs:	LL:71 PL:26 PI: 45

Parameter	Initial	Final
Height, in	3.00	2.94
Diameter, in	2.88	2.87
Area, in^2	6.51	6.47
Volume, in^3	19.5	19.0
Mass, g	579	580
Bulk Density, pcf	113	116
Moisture Content, %	31.9	32.1
Dry Density, pcf	85.4	87.7
Degree of Saturation, %	90.0	96.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 97.03 Cell Pressure Increment, psi : 4.91 Increased Cell Pressure, psi : 101.94

Sample Pressure, psi: 87.03 Corresponding Sample Pressure, psi: 91.51 B Coefficient: 0.91

Sample Pressure Increment, psi: 4.48 (β value did not increase with increase in pressure. Final degree of saturation > 95%)

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/30	1	97.0	87.0	17.0	16.8	0.2	71	28.7	7.4E-08	20.2	0.995	7.4E-08
8/30	2	97.0	87.0	17.0	16.8	0.2	80	28.7	6.6E-08	20.2	0.995	6.6E-08
8/30	3	97.0	87.0	17.0	16.8	0.2	86	28.7	6.1E-08	20.2	0.995	6.1E-08
8/30	4	97.0	87.0	17.0	16.8	0.2	92	28.7	5.7E-08	20.2	0.995	5.7E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 6.5 x10^{-8} cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Light Yellowish Brown Clay
Boring No.:	-----
Sample:	AB-4.1
Sample Length (inches):	37.0''
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	1/6
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =21.4%
Assumed Specific Gravity:	2.65
Atterbergs:	LL: 51 PL: 22 PI: 29

Parameter	Initial	Final
Height, in	3.01	3.22
Diameter, in	2.86	2.91
Area, in^2	6.42	6.65
Volume, in^3	19.3	21.4
Mass, g	600	699
Bulk Density, pcf	118	124
Moisture Content, %	6.2	23.9
Dry Density, pcf	111.0	100.2
Degree of Saturation, %	33.0	97.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 94.98 **Cell Pressure Increment, psi : 4.96** **Increased Cell Pressure, psi : 99.94**

Sample Pressure, psi: 84.98 **Corresponding Sample Pressure, psi: 89.76** **B Coefficient: 0.96**

Sample Pressure Increment, psi: 4.78

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/22	1	95.0	85.0	17.5	17.3	0.2	73	27.0	7.5E-08	20.1	0.998	7.5E-08
8/22	2	95.0	85.0	17.5	17.3	0.2	81	27.0	6.7E-08	20.1	0.998	6.7E-08
8/22	3	95.0	85.0	17.5	17.3	0.2	88	27.0	6.2E-08	20.1	0.998	6.2E-08
8/22	4	95.0	85.0	17.5	17.3	0.2	94	27.0	5.8E-08	20.1	0.998	5.8E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 6.6 x10^{-8} cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Dark Brown Clay
Boring No.:	-----
Sample:	AB-5
Sample Length (inches):	33.0''
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	7/3
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =47.2%
Assumed Specific Gravity:	2.70
Atterbergs:	LL:81 PL: 26 PI: 55

Parameter	Initial	Final
Height, in	2.75	2.73
Diameter, in	2.97	2.89
Area, in^2	6.93	6.56
Volume, in^3	19.1	17.9
Mass, g	533	533
Bulk Density, pcf	106	113
Moisture Content, %	36.2	36.1
Dry Density, pcf	78.1	83.1
Degree of Saturation, %	84.0	95.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 97.01 **Cell Pressure Increment, psi : 4.93** **Increased Cell Pressure, psi : 101.94**

Sample Pressure, psi: 87.01 **Corresponding Sample Pressure, psi: 91.54** **B Coefficient: 0.92**

Sample Pressure Increment, psi: 4.53 **(β value did not increase with increase in pressure. Final degree of saturation > 95%)**

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/22	1	97.0	87.0	16.0	15.8	0.2	103	29.1	5.0E-08	20.1	0.998	5.0E-08
8/22	2	97.0	87.0	16.0	15.8	0.2	111	29.1	4.6E-08	20.1	0.998	4.6E-08
8/22	3	97.0	87.0	16.0	15.8	0.2	117	29.1	4.4E-08	20.1	0.998	4.4E-08
8/22	4	97.0	87.0	16.0	15.8	0.2	124	29.1	4.1E-08	20.1	0.998	4.1E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 4.5 x10^{-8} cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Dark Yellowish Brown Clay
Boring No.:	-----
Sample:	AB-6
Depth:	30.0'
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	7/3
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =78.0%
Assumed Specific Gravity:	2.65
Atterbergs:	LL: 102 PL:37 PI: 65

Parameter	Initial	Final
Height, in	3.07	3.01
Diameter, in	2.83	2.80
Area, in^2	6.29	6.16
Volume, in^3	19.3	18.5
Mass, g	465	460
Bulk Density, pcf	91	94
Moisture Content, %	74.8	73.2
Dry Density, pcf	52.3	54.5
Degree of Saturation, %	92.0	95.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 95.01 **Cell Pressure Increment, psi : 5.11** **Increased Cell Pressure, psi : 100.12**

Sample Pressure, psi: 85.01 **Corresponding Sample Pressure, psi: 90.05** **B Coefficient: 0.99**

Sample Pressure Increment, psi: 5.04

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/31	1	95.0	85.0	14.0	13.8	0.2	71	23.1	9.7E-08	19.7	1.008	9.8E-08
8/31	2	95.0	85.0	14.0	13.8	0.2	77	23.1	9.0E-08	19.7	1.008	9.0E-08
8/31	3	95.0	85.0	14.0	13.8	0.2	80	23.1	8.6E-08	19.7	1.008	8.7E-08
8/31	4	95.0	85.0	14.0	13.8	0.2	85	23.1	8.1E-08	19.7	1.008	8.2E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 8.9 $\times 10^{-8}$ cm/sec (@ 10 psi effective stress)

APS Engineering and Testing

HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIAL USING A FLEXIBLE WALL PERMEAMETER BY ASTM D 5084

Client:	Providence
Project Name:	Bottom Ash Pond at Brame Energy Center
Visual Description:	Moist Dark Brown Clay
Boring No.:	-----
Sample:	AB-7
Sample Length (inches):	39.0'
Sample Type:	Intact
Permeant Fluid:	De-aired Distilled Water
Orientation:	Vertical
Cell:	19/2
Sample Preparation:	Cut, trimmed and placed into permeameter at as received density and moisture content .Trimming moisture content =56.2%
Assumed Specific Gravity:	2.65
Atterbergs:	LL:96 PL:36 PI: 60

Parameter	Initial	Final
Height, in	2.90	2.82
Diameter, in	2.90	2.87
Area, in^2	6.61	6.47
Volume, in^3	19.2	18.2
Mass, g	482	476
Bulk Density, pcf	96	99
Moisture Content, %	61.1	59.1
Dry Density, pcf	59.3	62.3
Degree of Saturation, %	91.0	95.0

B COEFFICIENT DETERMINATION

Cell Pressure, psi: 95.02 **Cell Pressure Increment, psi : 4.92** **Increased Cell Pressure, psi : 99.94**

Sample Pressure, psi: 85.01 **Corresponding Sample Pressure, psi: 89.35** **B Coefficient: 0.88**

Sample Pressure Increment, psi: 4.34 **(β value did not increase with increase in pressure. Final degree of saturation > 95%)**

FLOW DATA

Date	Trial	Pressure, psi		Manometer Readings			Elapsed Time, sec	Gradient	Permeability K, cm/sec	Temp., °C	R_t	Permeability K @ 20 °C cm/sec
		Cell	Sample	Z_1	Z_2	Z_1-Z_2						
8/31	1	95.0	85.0	14.0	13.8	0.2	72	24.6	8.6E-08	19.7	1.008	8.6E-08
8/31	2	95.0	85.0	14.0	13.8	0.2	74	24.6	8.3E-08	19.7	1.008	8.4E-08
8/31	3	95.0	85.0	14.0	13.8	0.2	78	24.6	7.9E-08	19.7	1.008	8.0E-08
8/31	4	95.0	85.0	14.0	13.8	0.2	82	24.6	7.5E-08	19.7	1.008	7.6E-08

TEST RESULTS: PERMEABILITY AT 20 °C: 8.1 x10^{-8} cm/sec (@ 10 psi effective stress)

ATTACHMENT 4

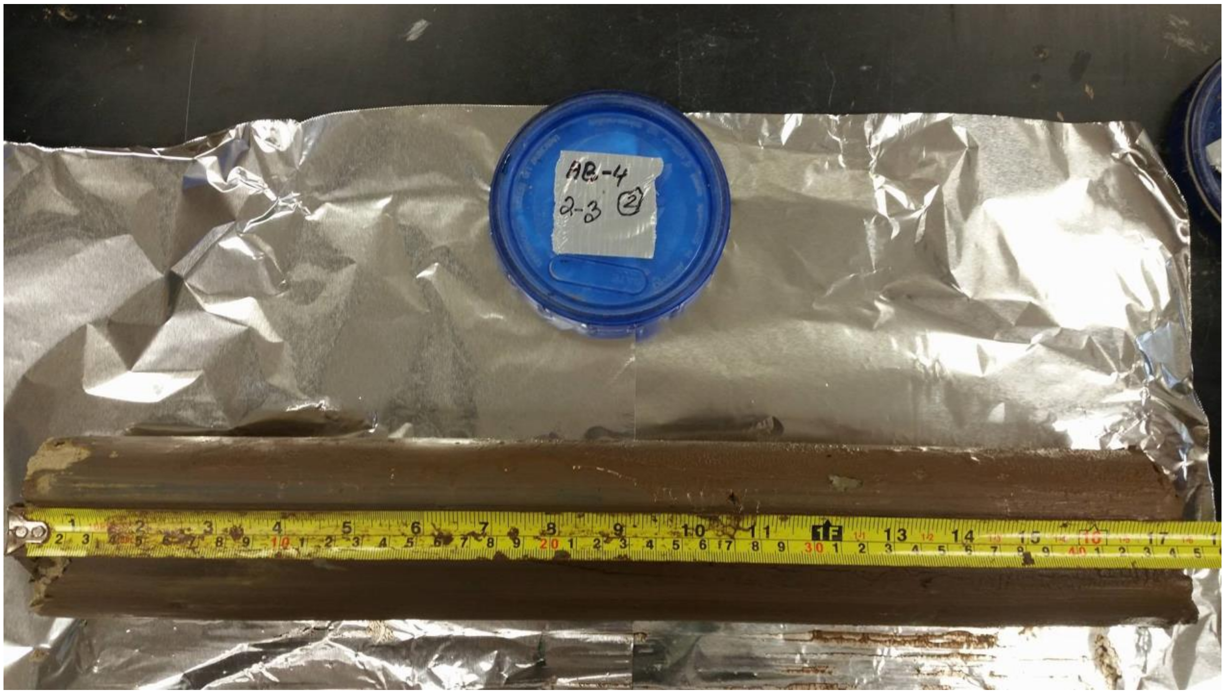
BOTTOM ASH POND BORING PHOTOS

PHOTOGRAPH 1
Bottom Ash Pond - Typical Geotechnical Drilling Rig Setup.

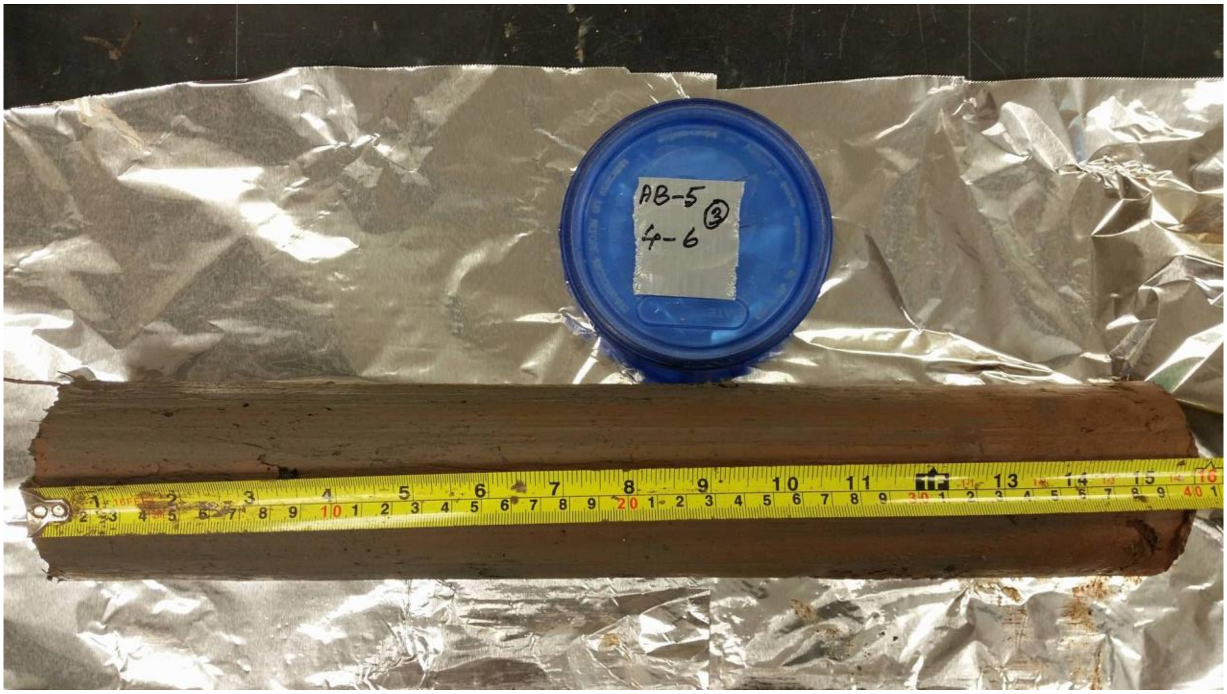
PHOTOGRAPH 2
Bottom Ash Pond Undisturbed Soil Sample AB-1.

PHOTOGRAPH 3
Bottom Ash Pond Undisturbed Soil Sample AB–2.

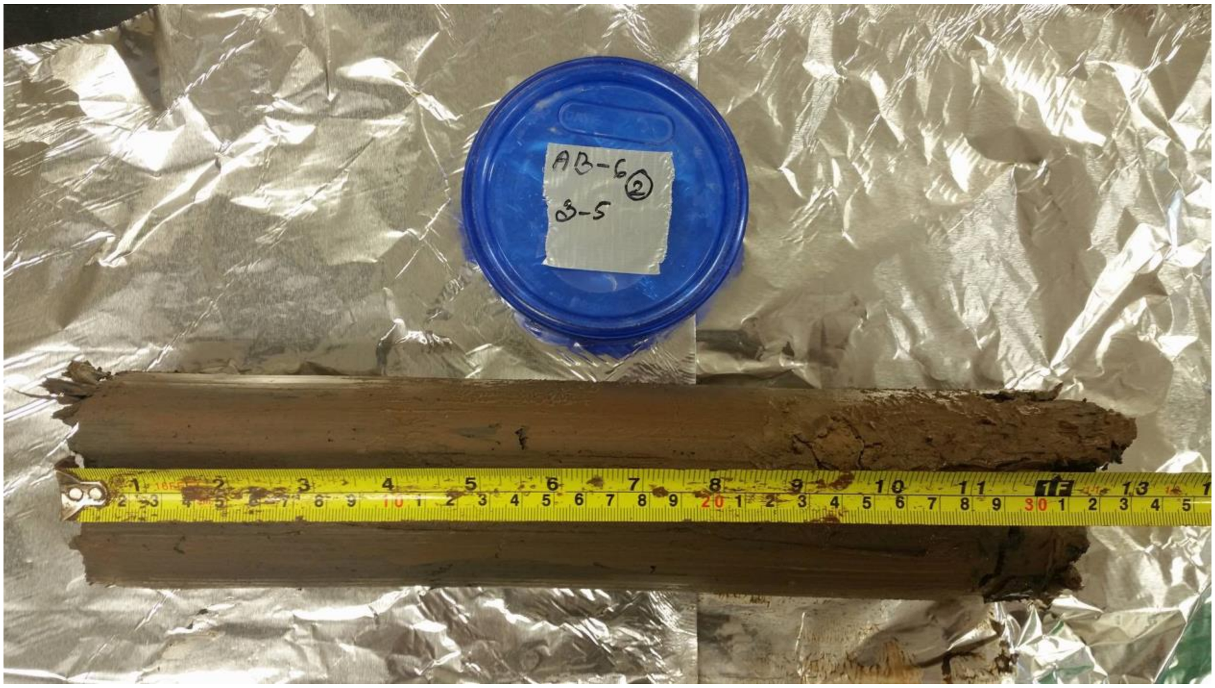
PHOTOGRAPH 4
Bottom Ash Pond Undisturbed Soil Sample AB–3.



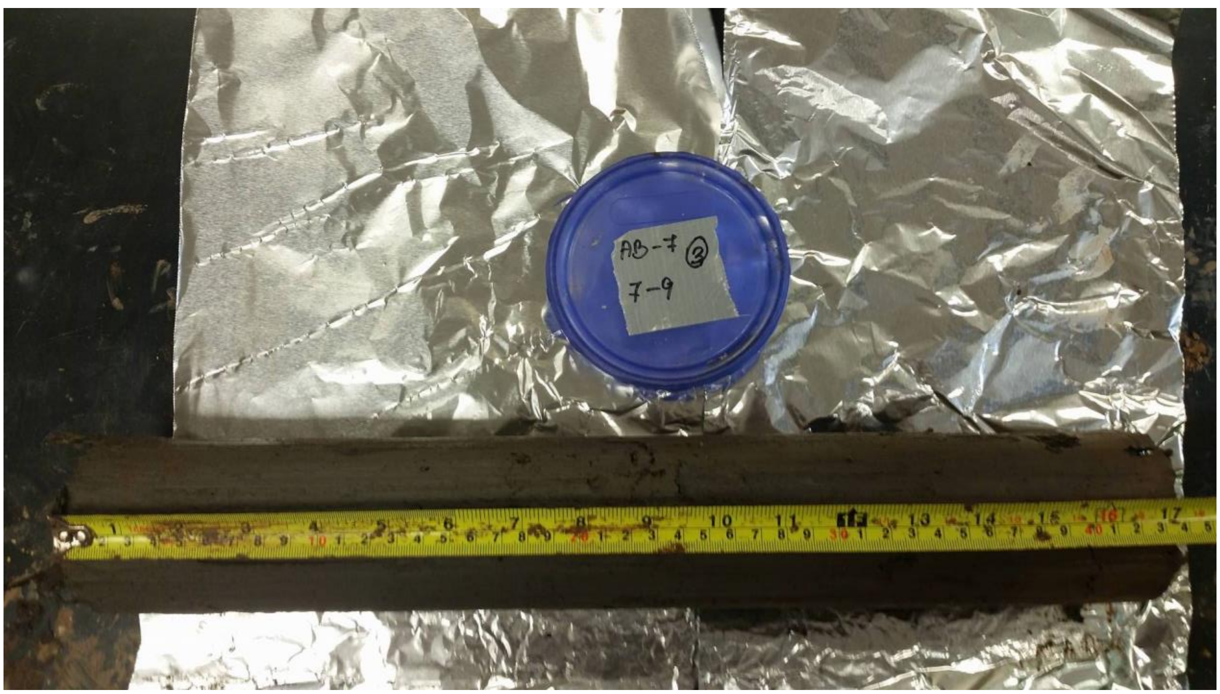
PHOTOGRAPH 5
Bottom Ash Pond Undisturbed Soil Sample AB–4.



PHOTOGRAPH 6
Bottom Ash Pond Undisturbed Soil Sample AB–5.



PHOTOGRAPH 7
Bottom Ash Pond Undisturbed Soil Sample AB–6.



PHOTOGRAPH 8
Bottom Ash Pond Undisturbed Soil Sample AB–7.

ATTACHMENT 5

BOTTOM ASH POND P.E. CERTIFICATION

CLECO BRAME ENERGY CENTER
BOTTOM ASH POND
CCR LINER VERIFICATION ASSESSMENT

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I have performed a liner verification assessment for Cleco's Brame Energy Center Bottom Ash Pond in accordance with the 40 CFR 257.71 CCR requirements. This liner verification assessment has determined that the Bottom Ash Pond has met the following requirement:

- A liner consisting of a minimum of two feet of compacted soil with a hydraulic conductivity of no more than 1 x 10^{-7} cm/sec

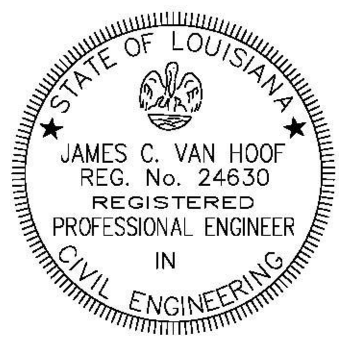
James C. Van Hoof
Name

24630 — Registration No.

LA — State

Signature

10/12/2016
Date



(Seal)