STRUCTURAL INTEGRITY CRITERIA & HYDROLOGIC/ HYDRAULIC CAPACITY ASSESSMENT LABADIE ENERGY CENTER

Labadie Energy Center
226 Labadie Power Plant Road
Labadie, MO 63055

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STRUCTURAL INEGRITY CRITERIA & HYDROLOGIC/ HYDRAULIC CAPACITY ASSESSMENT - LABADIE ENERGY CENTER

I. **Introduction**

Ameren Missouri has evaluated the Labadie Energy Center's ("Labadie") active surface impoundments in accordance with operating and design criteria requirements set forth below:

§257.71, Liner Design Criteria for Existing CCR Surface Impoundments;
§257.73(a)(2), Periodic Hazard Potential Classification;
§257.73(d)(1), Periodic Structural Stability Assessment;
§257.73(e)(1), Periodic Safety Factor Assessment;
§257.73(c)(1), History of Construction; and
§257.82, Initial Hydrologic and Hydraulic Capacity Requirements.

For this initial assessment, Ameren Missouri retained the engineering firm Reitz & Jens, Inc. to evaluate Labadie's active surface impoundments to determine whether such units conform to good engineering practices[1] with respect to the following criteria: liner design criteria; hazard potential classification; structural stability assessment; safety factor assessment; and initial hydrologic and hydraulic capacity requirements. Such criteria will be reassessed every five years until such time as the units are closed in accordance with regulatory requirements. Engineering calculations, diagrams, modeling, and work papers supporting this assessment have been placed in the facility's operating record.

II. **Background**

A. **Active Ponds**

Labadie is located adjacent to the Missouri River and is surrounded by agricultural fields. At the time of construction, fill material was used to raise ground surface below power plant buildings out of the floodplain and to a minimum elevation of about 490 feet. The facility utilizes two (2) active surface impoundments for the management of process waters along with fly and bottom ash. Such impoundments are identified as follows*:* *LCPA (Bottom Ash Pond)*; and LCPB *(Fly Ash Pond)*. Decant water from LCPB flows via submerged pumps into the LCPA before being discharged, through an MDNR NPDES Outfall, into a manmade channel located at the western edge of the property. This channel runs parallel to Labadie Creek before discharging into the Missouri River.

LCPA was built in the early 1970s south of the plant and as part of the original construction of the Labadie facility. LCPA occupies approximately 164 acres and for approximately twenty years managed both fly and bottom ash. Following the construction of LCPB in the early 1990s, LCPA manages only bottom ash. LCPA is surrounded by an earthen embankment which ties into plant fill on the north side of the impoundment.

[1] Based on engineering codes, widely accepted standards, or a practice widely recommended through the industry. See *40 CFR 257.53, Definitions*.

LCPB is located immediately east and adjacent to LCPA and occupies approximately 79 acres. A section of the earthen embankment that encircles LCPA, also forms the western side of LCPB. The LCPB is used to manage fly ash.

The location of the Labadie Energy Center is depicted on Figure 1, United States Geological Services ("USGS") 7.5 minute topographical quadrangle map. Various design and operational features of the CCR units, including water flow path, is set forth on Figure 2.

B. **Embankment Dam**

The north side of the LCPA impoundment is adjacent to plant fill, and the embankment height is generally less than 5 feet. In contrast, on the south and west side of LCPA the maximum levee height is 26.3 feet. The embankment on the east side of the impoundment is shared by both the LCPA and LCPB. The embankment dam encircling LCPA is approximately 10,500 feet long and was constructed of compacted fill with upstream slopes of 2 horizontal (H) to 1 vertical (V) and downstream slopes of 3H to 1V. The minimum crown width is approximately 20 feet but increases from 75 to 225 feet along the south and west sides of the impoundment where it accommodates a plant access road. In addition, in 2006 and 2008, additional fly and bottom ash fill material was added along a 2000 foot embankment segment on the south side of LCPA. The fill material was part of a beneficial use project which facilitated the construction of, and access to, a concrete packaging facility.

As part of the construction of LCPB, an embankment was built around three sides of the fly ash pond. Embankment height is greatest on the east and south sides of LCPB where the maximum dam height is 29.5 feet. The western embankment section separates the LCPB from LCPA. The embankment's upstream slopes are 2H to 1V and 3H to 1V with downstream slopes of 3H to 1V. Earth fill was obtained from the incised portion of the pond, and the lowest elevation at the bottom of the pond is at 460.0 feet. The typical crown width is 20 feet; however the crown width is 10 feet near the northwest corner of the pond where the embankment height is generally less than 10 feet. Excluding the length of the western embankment section originally constructed for the LCPA, the crest length of the dam is approximately 6,100 feet. The interior of LCPB is lined with 60 MIL HDPE on the interior slopes, and 40 MIL HDPE on the pond bottom.

Both LCPA and LCPB are offset at least 2,000 feet from the Missouri River. In 2012, emergency spillways were added to both impoundments and along the south side of the embankment. The Labadie site is surrounded by agricultural fields and no residential homes, businesses or lifeline facilities are located down gradient of the surface impoundments.

III. **Structural Integrity Assessment**

A. **Liner Design Criteria – *40 CFR §257.71***

For existing CCR surface impoundments constructed with liner systems, an owner/operator of such units must determine if such liner complies with the specified design and performance standards. At Labadie, only LCPB was constructed with a liner system: 60 MIL HDPE on the interior slopes and

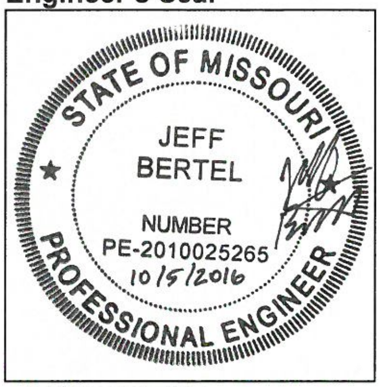
40 MIL HDPE on the bottom. The existing liner system does not satisfy the required design criteria set forth in *40 CFR 257.71* in that it does not have a 2-foot layer of compacted soil with hydraulic conductivity of no more than 1 x 10^{-7} cm/sec. LCPA and LCPB are therefore considered under the CCR Rule as unlined surface impoundments.

1. Engineering Certification – Liner Design Criteria for Existing CCR Surface Impoundments

The existing CCR surface impoundments LCPA and LCPB at the Labadie Energy Center were evaluated to determine if they were constructed with a liner which meets the requirements of §257.71, Liner Design Criteria for Existing CCR Surface Impoundments. The existing liner system does not have a 2-foot layer of compacted soil with hydraulic conductivity of no more than 1 x 10^{-7} cm/sec.

CCR Unit	Existing liner meets requirements of 40 CFR 257.71
LCPA (Bottom Ash Pond)	No
LCPB (Fly Ash Pond)	No

Engineer's Seal



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B. **Periodic Hazard Potential Classification –** ***40 CFR §257.73(a)(2)***

Periodically (every five (5) years), an owner or operator of a coal combustion residual ("CCR") unit must update the hazard potential of CCR units and certify the results by a qualified professional engineer. The classification categories are based upon criteria established by the Federal Emergency Management Agency (FEMA) and range as follows: *low hazard potential, significant hazard potential, and high hazard potential.* The FEMA classification system categorizes a dam based on the probability of loss of human life and the impacts on economic, environmental, and lifeline facilities should the dam fail. The specific categories are defined as follows:

> *(1)* *High hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation will probably cause loss of human life.*
>
> *(2)* *Significant hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns.*
>
> *(3)* *Low hazard potential CCR surface impoundment means a diked surface impoundment where failure or mis-operation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the surface impoundment owner's property.*

Both LCPA and LCPB at Labadie are classified as having a *low hazard potential* because any structural failure would not be expected to cause a loss of human life.

- **LCPA** – Failure of the LCPA would result in the release of water and CCR into a man-made channel or Labadie Creek to the west, LCPB to the east, and/or the surrounding terrain or plant facilities to the south and north that have not been filled to the level of the pond berms. Should such hypothetical failure occur, it would not be expected to cause loss of life, and economic, environmental, and lifeline losses of the impoundment would generally be limited to the owner.

- **LCPB** - Failure of the LCPB would result in the release of water and CCR into the surrounding terrain to the south or to the east, LCPA to the west, and/or plant facilities to the north. Should such hypothetical failure occur, it would not be expected to cause loss of life, and economic, environmental, and lifeline losses of the impoundment would generally be limited to the owner.

Since none of the active impoundments are classified as *high or significant potential hazards*, an emergency action plan does not need to be prepared. The hazard classification of these units must be re-evaluated every five (5) years.

1. Engineering Certification – Periodic Hazard Potential Classification

The 2015 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundments LCPA (Bottom Ash Pond), and LCPB (Fly Ash Pond) at the Labadie Energy Center in accordance with the requirements of 40 CFR 257.73(a). These CCR surface impoundments are low hazard potential because failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. The hazard potential classification was completed in general accordance with *Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams* by the Federal Emergency Management Agency (January 2004). The engineering support for this certification has been placed in the operating record.

CCR Unit	Hazard Potential Classification
LCPA (Bottom Ash Pond)	Low
LCPB (Fly Ash Pond)	Low

Engineer's Seal

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C. **Periodic Structure Stability Assessment – 40 CFR §257.73(d)**
The owner or operator of a CCR unit must inspect and certify that the design, construction, operation and maintenance of a CCR unit are in accordance with good engineering practices. Such engineering assessment includes the following: stable foundations and abutments; slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown; berm compaction is sufficient to withstand the range of loading conditions, including low pool of an adjacent water body or sudden drawdown; adequately vegetated slopes and surrounding areas; adequate spillway capacity, operation and maintenance; spillways constructed, operated, and maintained to adequately manage the design flow event; and structural integrity and functionality of hydraulic structures underlying the base of CCR unit or passing through the dike.

The downstream slopes for the LCPA are vegetated on the south and west sides of the pond. On the north side of the pond the downstream slope in this area is poorly defined given the thick section width, and low embankment height that tapers at a shallow slope angle into the adjacent plant fill. The downstream slope on the north side of the pond is vegetated or consists of bottom ash. The east embankment downstream slope is also the upstream slope of the fly ash pond and is covered with an HDPE liner. The upstream slopes primarily consist of bottom ash, but are intermittently vegetated and an approximately 400 foot section immediately west of the emergency spillway is armored with riprap. Except near the emergency spillway, the upstream slopes subjected to frequent wave loading are at locations with wide embankment sections. The downstream slopes of the LCPB are vegetated, and the upstream slopes are lined with 60-mil HDPE.

Vegetative management protocols are set forth in the Operations and Maintenance Procedures and have been implemented so as to minimize erosion while facilitating the visibility of slopes during inspections.

The engineering team visually inspected the interior and exterior embankment slopes of the active surface impoundments, and reviewed pertinent geotechnical data. Reitz & Jens visually inspected berm foundations for signs of instability. None were observed. In addition, hydraulic structures (i.e. spillways, overflow pipes and ditches) were inspected to confirm proper maintenance and operation. No significant deficiencies of the structures were observed. (Some of the piping was under water and not available for visible or video inspection.) Recommended and ongoing activities include general maintenance (i.e. vegetation maintenance, erosion and rut repair), monitoring (e.g. spillways, submerged piping, pond levels, wet areas near berms, and installation of staff gauge to maintain pool levels), and operational planning (flow isolation).

1. Engineering Certification – Periodic Structural Stability Assessment

The 2015 Initial Periodic Structural Stability Assessment was conducted for the active CCR surface impoundments LCPA (Bottom Ash Pond), and LCPB (Fly Ash Pond) at the Labadie Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of both CCR Units found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction are adequate, however some corrective measures were recommended. The engineering support for this certification has been placed in the operating record.

Requirement	LCPA (Bottom Ash Pond)	LCPB (Fly Ash Pond)
Initial periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes	Yes

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D. **Safety Factor Assessment – 40 CFR §257.73(e)**

All active CCR units must have calculated Factors of Safety (FOS) that meet or exceed the following designated values:

Table 1

Loading Conditions	Minimum FOS
Maximum Storage Pool	1.50
Maximum Surcharge Pool	1.40
Seismic	1.00
Liquefaction	1.20

Reitz & Jens performed stability analysis on the active CCR surface impoundments and calculated the following values:

Table 2

Ponds	Maximum Storage Pool (FOS)	Maximum Surcharge Pool (FOS)	Seismic (FOS)	Liquefaction (FOS)
LCPA	1.81	1.52	1.16	1.30
LCPB	1.64	1.64	1.08	1.27

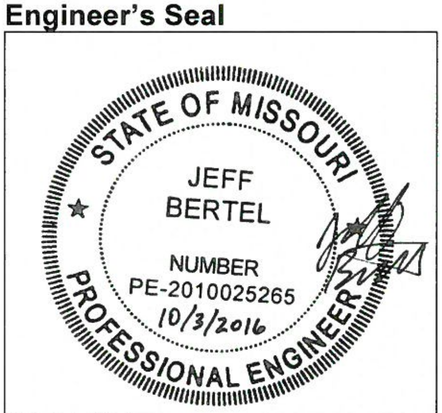
The calculated factors of safety for the critical cross-section at each CCR unit identified above ***meet or exceed*** the minimum factors of safety for each loading condition required by 40 CFR §257.73(e).

1. Engineering Certification – Safety Factor Assessment

The 2015 Periodic Safety Factor Assessment was conducted for the active CCR surface impoundments LCPA (Bottom Ash Pond), and LCPB (Fly Ash Pond) at the Labadie Energy Center. The Periodic Safety Factor Assessment for each active CCR Unit at the Labadie Energy Center shows that the critical cross section for these Units meet or exceed the minimum factors of safety specified in 40 CFR Part §257.73(e)(1) as summarized below. The engineering support for this certification has been placed in the operating record.

Requirement	LCPA (Bottom Ash Pond)	LCPB (Fly Ash Pond)
The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.	≥1.50	≥1.50
The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.	≥1.40	≥1.40
The calculated seismic factor of safety must equal or exceed 1.00.	≥1.00	≥1.00
The calculated liquefaction factor of safety must equal or exceed 1.20.	≥1.20	≥1.20

Engineer's Seal



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E. **Hydrologic and Hydraulic Capacity Requirements - 40 CFR §257.82**

Flood control system plans must be adequate to manage the inflow from a designated flood event. Such plans must be updated and verified every five (5) years. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge from the design flood event.

Pertinent data regarding the active surface impoundments is set forth below:

Table 3

CCR Unit	Maximum Surface Area (acres)	Levee Crest Elevation (feet)	Crest Length (feet)	Normal Pool Elevation (feet)	Maximum Surcharge Pool[2] (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
LCPA	164	492.7	10,500	486	489	2:1	3:1
LCPB	79	492.7	6,100	480	492	2:1 & 3:1	3:1

Reitz & Jens performed a modeling analysis using the 100-year flood event for low hazard potential surface impoundments as the design flood as required by 40 CFR §257.82(a)(3)(iii). The hydrologic and hydraulic modeling analysis assumed rainfall of 7.2 inches[3] as an estimated 24-hour, 100-year precipitation event. As depicted on Figure 2, water flows from LCPB to LCPA. Reitz & Jens modeling analysis assumed only the LCPA secondary spillway was functional. LCPA primary spillway discharges into a man-made channel approximately 0.5 miles upstream of its confluence with the Missouri River.

For the LCPA, peak pool (maximum surcharge) levels within the ponds are estimated to occur in 24 hours after the start of the storm event. Peak water levels during a 100-year flood event are projected to rise to elevation 488.91 feet, 1.09 feet *below* the crest of LCPA emergency spillway. No flow was assumed through the primary spillway for LCPA. For the LCPB, peak pool level occurs in 15.5 hours. The analyses assume the spillway pumps were turned on when the pool level reached el. 484 feet, and discharged 2 cfs into LCPA. The LCPB emergency spillway is at el. 491.7 feet, and peak flow into the LCPA during the storm event is 28.96 cfs. Based on the model, the peak water level during a 100-year flood event would rise to elevation 492.02 feet, 0.7 feet *below* the crest of LCPB, therefore, LCPB has adequate storage to contain such an event provided that the outlet works remain functional. Pool level was lowered to el. 484 feet approximately 300 hours after a 100-year flood event. Accordingly, the facility's inflow design control system adequately manages flow through the CCR units during and following a 100-year flood event as required by 40 CFR §257.82. Outlet works and spillways should be maintained in proper condition to ensure normal pool elevation and to lower pool levels if necessary. The CCR in the ponds will be managed so that the available storage is at least as great as that assumed in the hydrologic and hydraulic models.

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[2] Calculated based on 100- year flood event modeling demonstration.

[3] Huff, F.A. and J.R. Angel. (1992). "Rainfall Frequency Atlas of the Midwest." Bulletin 71, Midwestern Climate Center and Illinois State Water Survey.

F. **Inflow Design Flood Control System Capacity Plan**

The initial inflow design flood control system has been evaluated for both the LCPA and LCPB at the Labadie Energy Center. Based on the hydrologic and hydraulic capacity calculations, the inflow control system for these ponds can adequately handle and discharge the 100-Year design flood event. Specifically, 3.7 feet of freeboard exists in LCPA and 0.7 feet in LCPB. So as to properly maintain such inflow storage capacity, the following measures of the *Inflow Design Flood Control System Plan* have been incorporated into the Operations and Maintenance Manual and should be observed:

- **LCPA** - normal pool elevation should be maintained no higher than elevation 486 feet to maintain a maximum surcharge pool at elevation 489 feet.
- **LCPB** - normal pool elevation should be maintained no higher than elevation 480 feet to maintain a maximum surcharge pool at elevation 492 feet. If the pool level exceeds elevation 484 feet, daily monitoring of weather forecasts, pool level and pump functionality should begin.
- If the water levels exceed the maximum surcharge pool elevations, special inspections by the Dam Safety Group of the primary spillways should be completed, and temporary measures implemented to prevent the water from overtopping the Pond embankments until the primary spillways are functioning as designed. Such measures could include cessation of generation, the addition of fill, sandbags, pumps, siphons, etc.
- If the LCPB pool level exceeds elevation 484 feet and significant precipitation is forecast, mobilize additional pumps to lower pool levels and consider suspending or diverting sluice flow.
- Prior to the next scheduled evaluation of the Periodic Inflow Design Flood Control System Plan, topographic surveys should be completed on the interior of all active ponds to confirm the necessary water storage is available.
- Pool level readings should be recorded during weekly inspections to confirm the assumed normal pool elevations.

1. Engineer's Certification – Hydrologic and Hydraulic Capacity

The initial inflow design flood control system plan was completed for the active CCR surface impoundments LCPA (Bottom Ash Pond), and LCPB (Fly Ash Pond) at the Labadie Energy Center. The initial inflow design flood control system plan was completed in general accordance with 40 CFR Part §257.82(c) using the 100-year design flood for low hazard potential CCR surface impoundments. The engineering support for this certification has been placed in the operating record.

Requirement	LCPA (Bottom Ash Pond)	LCPB (Fly Ash Pond)
The initial inflow design flood control system plan meet the requirements of 40 CFR Part §257.82	Yes	Yes

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IV. **Construction Summary – *40 CFR 257.73(c)***

The Labadie Energy Center is located in Franklin County, Missouri along the Missouri River. The plant is approximately 3 miles north of the Town of Labadie on the right descending bank of the Missouri River at river mile 57.5. The Missouri River has a watershed area of approximately 520,000 square miles at the site. The Labadie Energy Center does not receive stormwater run-on from areas outside the facility.

A. **Owner and Operator**

The CCR Units at the Labadie Energy Center are owned and operated by Ameren Missouri. Labadie Energy Center plant personnel have the primary responsibility of CCR unit operation. The Labadie Energy Center is located at 226 Labadie Power Plant Road in Labadie, Missouri 63055. The Ameren Missouri Dam Safety Group performs CCR unit inspections, and reviews all updates to the Operations and Maintenance Manual.

B. **Bottom Ash Pond (LCPA)**

The design plans for the LCPA were issued in 1969 and construction completed shortly after. The LCPA currently receives process water used to sluice bottom ash, flow from the plant combined drain sump (CDS), and discharge from LCPB. The impoundment received both bottom and fly ash prior to completion of LCPB. Process water is discharged in the northeast corner of the impoundment where the bottom ash is deposited, and decant water generally flows east to west through ditches in the CCR. The eastern half of the impoundment is essentially filled to capacity with CCR. Nearly all of the bottom ash sluiced to the pond is removed and used for beneficial use projects. Discharge from the LCPB is near the southeast corner of the impoundment, and the water generally flows east to west through ditches in the CCR. Flow from the CDS is pumped at a maximum rate of 50 cfs and is discharged near the northeast corner of the impoundment. The CDS collects stormwater from an area of approximately 154 acres. The estimated average and maximum depth of CCR in the LCPA is approximately 63 and 85 feet, respectively.

The principal spillway for the LCPA consists of an 8-foot diameter galvanized corrugated metal pipe (CMP) skimmer and 36-inch diameter carbon steel pipe. Flow through this pipe and the pool elevation is regulated by two motor operated butterfly valves. The principal spillway discharges through a NPDES permitted outfall (#002) into a man-made channel. The LCPA also has a 75-foot long broad crested emergency spillway that is located on the southwest side of the pond.

1. Foundation and Abutment Geology

The typical soil profile for the LCPA foundation consists of an upper most stratum of stiff to very stiff clay that is 5 feet thick. The clay is intermittently silty, and low to high plastic. The clay is underlain by silt and silty sand with a thickness of 5 to 15 feet. Sand is encountered beneath the silt, and is fine to coarse, and with some silty layers and gravel. Typically at a depth of about 40 to 50 feet beneath the original ground surface the sands become gravelly sand or sandy gravel. Limestone bedrock exists beneath the alluvium at a depth of 100 to 120 feet.

2. Embankment Material

There are no construction documents or records for the original construction of the LCPA. In the early 1990s, the embankment was raised 8.5 feet using a mixture of bottom and fly ash. Fill placed to raise the embankments was blended and compacted to achieve permeability no greater than $1x10^{-6}$ cm/sec. Based on borings conducted in 2010, the top 9 to 10 feet of the embankment is medium dense to very dense and consists of bottom and fly ash. Beneath the ash fill are 1 to 3 foot thick layers of clay, silt and sand.

3. 1990s Embankment Raise

In the early 1990's, the LCPA embankment was raised 8.5 feet to increase its storage capacity. The new embankment fill consisted of a mixture of bottom and fly ash that was blended and compacted to achieve a hydraulic conductivity of $1x10^{-6}$ cm/sec. The compacted ash was covered with a minimum of 1 foot of earthen cover, except for the access road at the crest of the embankment which is paved with bottom ash. The original spillway was also replaced with the principal spillway in its current configuration. The original spillway consisted of two pumps and discharge piping which ran over the embankment dam and discharged just north of the current outlet works.

4. 2006 and 2008 Beneficial Fill

In 2006 and 2008, additional fill material consisting of bottom and fly ash was placed parallel to the southern embankment section for a new concrete packaging facility. Over a distance of approximately 2000 lineal feet, the fill increased the embankment section width 70 to 225 feet. The fill was constructed of compacted bottom and fly ash, consistent with engineering plans and drawings.

5. 2011 Slurry Wall and Anti Seepage Collar Construction

In 2011 Ameren constructed a 500 foot long slurry wall near the southwest corner of the pond. The wall was constructed to mitigate seepage. The wall was constructed with a minimum hydraulic conductivity of $1x10^{-6}$ cm/sec, through the crest of the embankment and has a width of 2.5 feet. The wall was terminated in fine grain foundation soil, or at a minimum depth of 30 feet. An anti-seepage collar was also installed around the spillway conduit. The seepage collar consisted of a compacted soil and bentonite mixture.

6. 2012 Emergency Spillway

In 2012 an emergency spillway was constructed near the southwest corner of the pond. The emergency spillway is a 75-foot long broad crested weir with an elevation of 490.0 feet. The spillway was constructed of MoDOT Type 4 riprap on the upstream and downstream slopes, and the crest is constructed of aggregate sufficient to withstand design flows.

7. 2013 Slurry Wall

Seepage was identified below the emergency spillway that was constructed in 2012. To cut-off the seepage, a soil-bentonite slurry wall was constructed through the crest of the embankment and extended from the 2011 slurry wall approximately 600 feet east.

8. 2015 Seepage Collar and Valve Replacement

In 2015 a concrete collar was constructed around the outfall pipe to help reduce seepage. At the same time, the area surrounding the downstream outlet works was graded to drain and armored with riprap. One butterfly valve was also replaced in 2015.

C. **Fly Ash Pond (LCPB)**
The LCPB was built in the 1990's. The LCPB receives process water used to sluice fly ash. The LCPB does not receive stormwater run-on from areas outside of the perimeter embankment. The northern half of the pond is essentially filled to capacity. Water is sluiced to ditches excavated in the ash. Fly ash settles in the ditches, and the decant water flows to the outlet works on the south side of the pond. The ditches are periodically excavated to remove the settled ash, and the excavated material is placed in large stockpiles built within the pond. The LCPB outlet works are located near the southwest corner of the pond. The principal spillway consists of two manually operated 6-inch diameter submersible pumps that discharge into 6-inch diameter PVC pipes. The LCPB also contains a 50-foot long broad crested weir emergency spillway which is also located near the southwest corner of the pond. The estimated average and maximum depth of CCR in the fly ash system is approximately 33 and 49 feet, respectively.

1. Foundation and Abutment Geology

The typical soil profile for the LCPB foundation consists of a thin upper most stratum of firm to stiff clay that is 2 to 5 feet thick. The foundation soil then becomes clayey or sandy silt and loose to medium-dense. The thickness of the silty soil is typically 4 to 10 feet. Underlying the silt is poorly graded, fine to coarse sand which is medium dense to dense. Typically at a depth of about 40 to 50 feet beneath the original ground surface the sands become gravelly sand or sandy gravel. Limestone bedrock exists beneath the alluvium at a depth of 100 to 120 feet.

2. Embankment Material

The embankment was constructed of earth fill borrowed from the interior of the pond. The design plans note that the top 6 feet of the foundation soil inside the perimeter berm should be used as embankment fill. Geotechnical investigations show the embankment fill is heterogeneous and consists of sand, silt and clay that were generally placed in 8 to 12 inch thick lifts.

3. 2012 Emergency Spillway

In 2012 an emergency spillway was constructed near the southwest corner of the pond. The emergency spillway is a 50-foot long broad crested weir with an elevation of 491.7 feet. The spillway was constructed of MoDOT Type 4 riprap on the upstream and downstream slopes, and the crest is constructed of aggregate sufficient to withstand design flows.

4. Planned Haul Road

Construction of a haul road on the crest of the north embankment is planned to begin in late 2016. The construction will lower the crest of the embankment to el. 491, and the HDPE liner to el. 490. The haul road will be paved with 12 inches of non-reinforced concrete that is underlain by 12 inches of compacted MoDOT Type 1 Aggregate Base Course. Upstream of the haul road, a swale is planned with a bottom elevation of 487 feet and minimum width of 9 feet. The ditch will be drained into the pond interior by a 12-inch diameter ductile iron pipe (DIP) with a check valve on the downstream end. Upstream of the swale an ash berm will be constructed so that the elevation of the crest is at 494.0 feet. The ash berm will have a minimum crown width of 10 feet and 2H to 1V side slopes.

D. **Surveillance, Maintenance and Repair of the CCR Units**

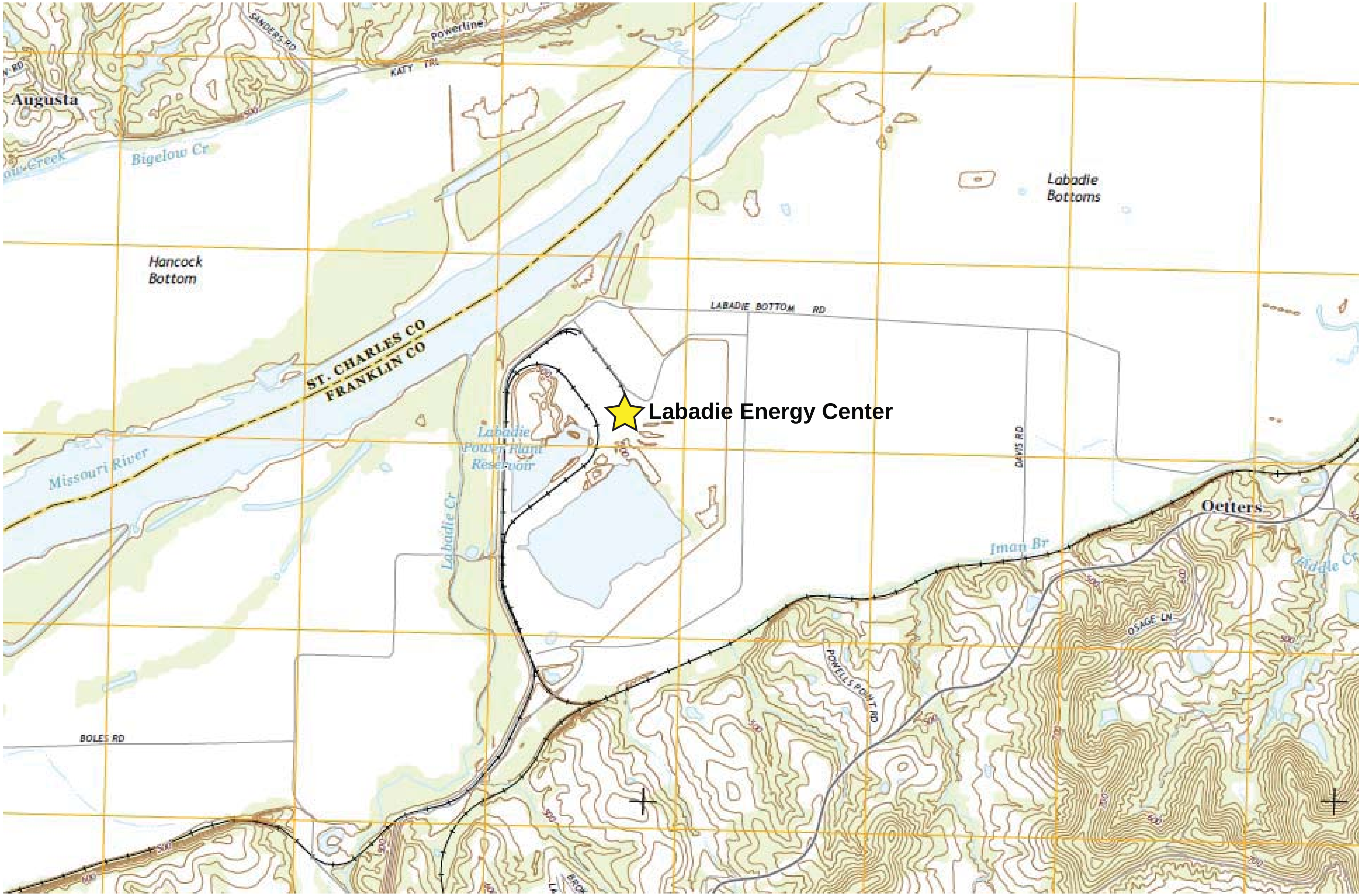
The Operations and Maintenance Manual outlines the objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the CCR units. The embankments of the CCR units are visually inspected weekly by Ameren plant operations staff. Ameren Missouri Dam Safety Group personnel perform annual inspections and periodic inspections[4] or assessments with plant operations staff. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections.

The Operations and Maintenance Manual requires that timely repairs must be made after problem areas are identified. The plant engineer is to specify the work to be completed using Ameren's Work Control Process and provide direction to correct items noted in the operation and maintenance, and engineering inspections. The work request by the plant engineer will be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the request. The Operations & Maintenance Manual specifies the minimum maintenance activities and requires that maintenance activities be documented. The Operations and Maintenance Manual further specifies that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer and the concurrence of the MDNR Water Resources Center.

E. **Instrumentation**

The pool level in the LCPA is monitored with an optical water level sensor. The pool level in LCPB is monitored by measuring the depth of the water relative to the steel bridge for the outlet works. Pool level readings are documented in weekly inspection reports.

[4] The annual and periodic inspection reports contain the following information: depth of impounded water; storage capacity; modifications from last inspection, if any, CCR depth; volume of impounded water and CCR; changes to the downstream watershed, if any.



Ameren Missouri
Labadie Energy Center
CCR Unit Evaluation
USGS 7.5 minute quadrangle map

REITZ & JENS, INC.

Figure 1

Legend:

- Pond Footprint
- Primary Flow Path
- Emergency Spillway Flow Path

CCR UNIT	MAXIMUM SURFACE ELEVATION (ACRES)	DAM CREST ELEVATION (FEET)	CREST LENGTH (FEET)	NORMAL POOL ELEVATION (FEET)	MAXIMUM SURCHARGE POOL (FEET)	UPSTREAM SLOPE STEEPNESS (H:V)	DOWNSTREAM SLOPE STEEPNESS (H:V)
LCPA	164.0	492.7	10500	486.0	489.0	2H:1V	3H:1V
LCPB	79.0	492.7	6100	480.0	492.0	2H:1V & 3H:1V	3H:1V

Ameren Missouri

Labadie Energy Center

CCR Unit Evaluation

Figure 2 - Operational Data