STRUCTURAL INTEGRITY CRITERIA & HYDROLOGIC/HYDRAULIC CAPACITY ASSESSMENT

SIOUX ENERGY CENTER

Sioux Energy Center
8501 North State Route 94
West Alton, MO 63386

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

I. Introduction

Ameren Missouri has evaluated the Sioux Energy Center's ("SEC" or "Sioux") coal combustion residual ("CCR") surface impoundments in accordance with the operating and design criteria set forth below:

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

For this periodic assessment, Ameren Missouri retained the engineering firm Reitz & Jens, Inc. to evaluate Sioux's active CCR 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 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**

Sioux currently utilizes one (1) surface impoundment, SCPC, for the management of process waters along with gypsum from the facility's flue gas desulfurization system (FGD). Two other surface impoundments, SCPA and SCPB, no longer receive process water or CCRs, have been dewatered and are currently being closed. The active surface impoundments occupy approximately 149 acres and are identified as follows*: SCPA (Bottom Ash Pond); SCPB (Fly Ash Pond)*; and S*CPC (Cell 1)*. The facility also uses a Recycle Pond to manage stormwater and discharge waters from SCPC, but such impoundment does not collect or manage CCR and is not subject to 40 CFR §257 requirements.

SCPA was built as part of the original design of the Sioux facility in 1967. Earthen material excavated from SCPA was used to construct the embankment dam and for plant fill. SCPA is bound to the east and northeast by plant fill. The pond historically received process water used to sluice bottom and fly ash, and flow from the plant combined drained sump (CDS). Currently the pond is

[1] Based on engineering codes, widely accepted standards, or a practice widely recommended through the industry. See *40 CFR 25.53, Definitions*.

being closed and no longer receives flow from either of these sources. Decant water from SCPA was ponded in the northwest portion of the pond before discharge via an NPDES outfall into an unclassified waterway, a backwater to the Mississippi River located west of SPCA. The outfall is being removed during closure.

SCPB was constructed in 1994. The pond historically received process water used to sluice fly ash and stormwater runoff from the coal pile. The pond no longer receives process water or stormwater runoff and is currently being closed. The pond is lined with HDPE and stores fly ash. Decant water ponds in the southern portion of SCPB before discharge to the Mississippi River via backwaters that are unclassified waterways. The outfall is being removed during closure. The perimeter embankment was constructed of compacted earth fill.

SCPC was placed into service in 2010 and receives process water used to sluice gypsum. The impoundment stores gypsum and discharges decant water into the Recycle Pond. Water collected in the Recycle Pond is returned to the plant for reuse. The impoundment is formed by a compacted earth fill ring dam that is capped by 2 feet of impervious clay and HDPE liner. SCPC is subject to Missouri Solid Waste regulations and requirements.

The location of the Sioux Energy Center is depicted on Figure 1, United States Geological Services (USGS) topographical quadrangle map. Various design and operational features of the CCR units, including water flow path, is set forth on Figures 2 and 3.

B. **Embankment Levee**

Embankment dams surround all of Sioux's CCR impoundments. The area impounded by SCPA is approximately 49 acres, and the length of the embankment dam is 6,700 feet. The embankment has a maximum height of 27 feet, a minimum crest width of 10 feet, 2 horizontal (H) to 1 vertical (V) upstream slopes, and 2H and 2.5H to 1V downstream slopes. Portions of the downstream and upstream slopes have been armored with riprap.

SCPB has an area of 62 acres, and the length of the embankment dam is 7,900 feet. The embankment has a maximum height of 22 feet, minimum crest width of 20 feet, 3H to 1V upstream slopes, and 2H and 3H to 1V downstream slopes. SCPB is bound to the north and east by plant fill. The embankment section is thickened to the south by a railroad embankment, and to the west by the plant access road.

SCPC has an area of 37.5 acres, and the length of the embankment dam is 5,200 feet. The embankment has a maximum height of 24 feet, minimum crest width of 12 feet, and 3H to 1V upstream and downstream slopes. Portions of the downstream slopes have been armored with riprap.

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 Sioux, both SCPB and SCPC were constructed with a liner system. SCPA is unlined. SCPB has 60 MIL HDPE liner on the slopes and 40 MIL HDPE liner 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. The existing liner for SCPC consists of two feet of compacted soil with a hydraulic conductivity of 1x10^{-7} cm/sec which is overlain by 80 MIL HDPE; the liner system satisfies the required design criteria set forth in 40 CFR 257.71.

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

The existing CCR surface impoundments SCPA, SCPB and SCPC at the Sioux 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 SCPA and SCPB 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. The SCPC existing liner consists of two feet of compacted soil with a hydraulic conductivity of 1×10^{-7} cm/sec which is overlain by an 80 MIL HDPE liner.

CCR Unit	Existing liner meets requirements of 40 CFR 257.71
SCPA	No
SCPB	No
SCPC	Yes

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

Every five (5) years, an owner or operator of a 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.*

All active ponds at Sioux are classified as having a *low hazard potential* because any structural failure would not be expected to cause a loss of human life.

- **SCPA** - Failure of the Bottom Ash Pond would result in the release of water and CCR into unclassified waterways. The 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.
- **SCPB -** Failure of the Fly Ash Pond would result in the release of water and CCR into the surrounding Ameren property and/or unclassified waterways. The 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.
- **SCPC -** Failure of SCPC would result in the release of water and CCR into the surrounding Ameren property and adjacent agricultural fields. The 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.

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 2020 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundments SCPA, SCPB and SCPC at the Sioux 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
SCPA	Low
SCPB	Low
SCPC	Low

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D. **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.

SCPA upstream slopes subjected to wave loading are armored with riprap and the downstream slopes have a vegetative cover or are armored with riprap. The upstream slopes for SCPB and SCPC are overlain with an HDPE liner and the downstream slopes are vegetated or armored with riprap. Vegetative management protocols are set forth in the Operations and Maintenance Procedures and have been implemented 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 inspection.) Recommended and ongoing activities include general maintenance (i.e. erosion repair, vegetation removal, animal control, seeding for vegetative cover) and monitoring (e.g. spillways and wet areas near berms).

1. Engineering Certification – Periodic Structural Stability Assessment

The 2020 Periodic Structural Stability Assessment was conducted for the active CCR surface impoundments SCPA, SCPB and SCPC at the Sioux Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of all three 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	SCPA	SCPB	SCPC
Periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes	Yes	Yes

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E. **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 impoundment SCPC and calculated the following values:

Table 2

Ponds	Maximum Storage Pool (FOS)	Maximum Surcharge Pool (FOS)	Seismic (FOS)	Liquefaction (FOS)
SCPC	2.14	2.14	1.27	1.33

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

Reitz & Jens performed the initial periodic safety factor assessments for SCPA and SCPB in October 2016. The initial assessment found that the calculated factors of safety for the critical cross-sections of each CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). SCPA and SCPB no longer receive CCRs, have been dewatered and are currently being closed. As a result, current conditions are no longer representative of those used in the 2016 assessment. A separate safety factor assessment for the closed condition has been performed by Golder Associates. Their assessment found that the static and seismic stability factors of safety meet or exceed the minimum requirements. The following tables list the factors of safety from the initial periodic safety factor assessment and for the closed condition.

Table 3 – Factors of Safety from the Initial Periodic Safety Factor Assessment

Ponds	Maximum Storage Pool (FOS)	Maximum Surcharge Pool (FOS)	Seismic (FOS)	Liquefaction (FOS)
SCPA	1.50	1.42	1.12	1.26
SCPB	2.78	2.78	2.11	3.45

Table 4 – Factors of Safety for the Closed Condition

Ponds	Maximum Storage Pool (FOS)	Maximum Surcharge Pool (FOS)	Seismic (FOS)	Liquefaction (FOS)
SCPA	1.72	1.67	1.12	1.47
SCPB	1.97	1.60	1.22	1.97

1. Engineering Certification – Safety Factor Assessment

The 2020 Periodic Safety Factor Assessment was conducted for the active CCR surface impoundment SCPC at the Sioux Energy Center. The Periodic Safety Factor Assessment for SCPC shows that the critical cross section for this Unit meets or exceeds the minimum factors of safety specified in 40 CFR Part §257.73(e)(1) as summarized below. SCPA and SCPC no longer receive CCRs, have been dewatered and are currently being closed. A safety factor assessment for the closed condition of SCPA and SCPC, completed by Golder Associates found that the minimum factors of safety meet or exceed the minimum requirements. The engineering support for this certification has been placed in the operating record.

Requirement	SCPA	SCPB	SCPC
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	≥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	≥1.40
The calculated seismic factor of safety must equal or exceed 1.00.	≥1.00	≥1.00	≥1.00
The calculated liquefaction factor of safety must equal or exceed 1.20.	≥1.20	≥1.20	≥1.20

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F. 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.

The initial periodic inflow design flood control system plan was developed in October 2016 for SCPA, SCPB and SCPC. SCPA and SCPB have been dewatered and are currently being closed. Closure of SCPA and SCPB was designed by Golder Associates so that water is not permanently impounded within the perimeter embankment. Operation of SCPC is generally unchanged, the impoundment continues to receive process water. The inflow design flood control system plan was updated only for the SCPC.

Pertinent data regarding the SCPC 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)
SCPC	37.5	446.0	5,200	441.1	441.9	3H:1V	3H:1V

Reitz & Jens performed a modeling analysis for SCPC 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 7.21 inches[3] as an estimated 24-hour, 100-year precipitation event. Flow paths and spillway discharge locations are depicted on Figure 2. SCPC discharges into the Recycle Pond, and water from the Recycle Pond is recirculated back to the plant for reuse.

The total volume of stormwater from the 24-hour, 100-year precipitation event and 24 hours of normal process water flow raise the level of SCPC to elevation 442.5 feet assuming there is no flow through the spillway. The peak pool level is 2.5 feet below the crest of the emergency spillway.

Provided that the outlet works remain functional, the SCPC's inflow design control system adequately manages flow through the CCR unit 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 SCPC will be managed so that the available storage is more than 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.

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

The inflow design flood control system has been evaluated for SCPC at the Sioux Energy Center. Based on the hydrologic and hydraulic capacity calculations, the inflow control system for this pond can adequately handle and discharge the 100-Year design flood event. *Specifically, 3.5 feet of freeboard exists in SCPC.* 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:

- **<u>SCPC</u>** - normal pool elevation should be maintained no higher than elevation 441.1 feet to maintain a maximum surcharge pool at elevation 442.5 feet.
- 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.
- 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 2020 periodic inflow design flood control system plan was completed for the active CCR surface impoundment SCPC at the Sioux Energy Center. The inflow design flood control system plan was completed in general accordance with 40 CFR Part §257(e)(1) using the 100-year design flood for low hazard potential CCR surface impoundments. SCPA and SCPB have been dewatered and are currently being closed. Closure of SCPA and SCPB was designed by Golder Associates so that water is not permanently impounded within the perimeter embankment.

Requirement	SCPA	SCPB	SCPC
The periodic inflow design flood control system plan meets the requirements of 40 CFR Part §257.82	Yes	Yes	Yes

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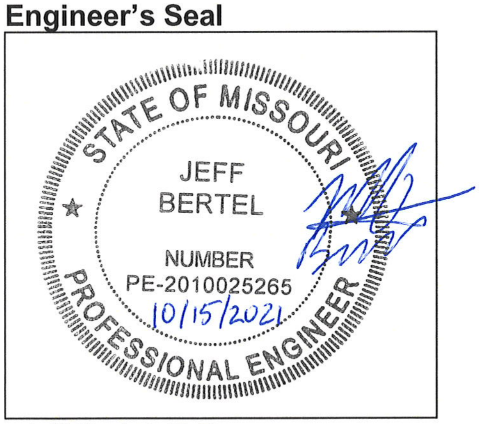

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IV. Construction Summary – *40 CFR 257.73(c)*

The Sioux Energy Center is located along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River. The Mississippi River is immediately to the north of the CCR units and the Missouri River is about 1 mile to the south of the Sioux Energy Center. Poeling Lake, which connects to the Mississippi River, is located immediately to the west of the SCPB and SCPA. The Mississippi River has a watershed area of approximately 170,000 square miles at the site and the Missouri River has a watershed area of approximately 500,000 square miles at their confluence. The Sioux Energy Center does not receive stormwater run-on from areas outside of the facility.

A. **Owner and Operator**

The CCR Units at the Sioux Energy Center are owned and operated by Ameren Missouri. The Sioux Energy Center plant personnel have the primary responsibility for CCR unit operation. The Sioux Energy Center is located at 8501 North State Route 94, West Alton, Missouri 63386. The Ameren Missouri Dam Safety Group performs CCR unit inspections and reviews all updates to the Operations and Maintenance Manual.

B. **SCPA (Bottom Ash Pond) (1967)**

SCPA is an unlined impoundment constructed in 1967 as part of the original design of the facility. The pond was excavated to raise the elevation of the power plant building and to construct a perimeter embankment around SCPA. Prior to the completion of closure, flow from the pond is routed through an outlet structure and discharged through a 30-inch diameter conduit. The outlet structure is reinforced concrete, with a reinforced concrete weir and steel bulkhead on the upstream side. The bulkhead has an orifice with a manually operated sluice gate. Flow to the structure is through an opening cut in a large diameter, galvanized, corrugated steel skimmer. The outlet channel discharges into unclassified waterways. The outfall is located approximately 0.4 miles upstream of the Mississippi River. The estimated maximum depth of CCR in the pond is 45 feet.

a. Foundation and Abutment Geology

The typical foundation profile consists of an uppermost stratum of clay to silty clay that is firm to stiff, and approximately 7 to 15 feet thick. In the southern portion of the pond the uppermost stratum is silty sand. The clay is generally underlain by 4 to 7 feet of loose to medium-dense silty sand. Poorly graded sand is encountered generally at a depth of about 20 feet below the natural ground surface beneath the silty sand. The sand is intermittently fine to coarse and medium-dense to dense. The sand extends to bedrock, and typically becomes coarser with depth, with gravel, cobbles and boulders encountered in the deeper sands near the interface with bedrock. In the vicinity of the SCPA, bedrock is encountered at a depth of about 105 to 110 feet below the original ground surface.

b. Embankment Material

Embankment fill generally consists of compacted layers with varying amounts of clay, silt and sand that were excavated from the incised portion of the pond. Fill material is generally soft to firm or loose to medium-dense. All or portions of the downstream slopes along the south, southwest, northwest and north embankments are armored with riprap to provide stability and erosion protection.

c. SCPA Modifications

1. 2009 Spillway Modification

The original spillway consisted of a reinforced concrete structure with a concrete weir and concrete or wooden stoplogs on the upstream side, and a corrugated steel skimmer. In 2009, the stoplogs were removed and replaced with a steel frame (bulkhead) and manually operated stainless steel sluice gate. The gate is used to restrict flow through an orifice in the steel frame that has a width of 2.5 feet and height of 2 feet. The invert of the orifice is at el. 429 and the top of the steel frame is at el. 440.

2. 2009 Riprap Armor Slopes

Riprap armor was installed on approximately 750 lineal feet of the southwest and approximately 630 feet of the north downstream slopes, and on approximately 570 lineal feet on the north upstream slope. On the downstream slope the riprap was installed from the toe to about half-way up the embankment. Riprap was large stone with a median size of approximately 18 inches.

3. 2012 Stability Berm, Rock Wedge and Inverted Filter

In 2012, Ameren Missouri constructed an approximately 620 lineal feet riprap stability berm along the toe of the north side of the pond. The berm has a minimum width of 17 feet and thickness of 4 feet. At the same time, a rock wedge was constructed on the adjacent drainage channel slope over approximately 160 lineal feet. The rock wedge was designed with a maximum steepness of 2H to 1V and a minimum thickness of 3 feet. An inverted filter was also installed along the downstream toe at the northeast corner of the perimeter berm. The inverted filter consists of two, 2 foot layers of filter media that is armored with 4 feet of riprap. The riprap armor is keyed in 2 feet at the downstream toe.

4. 2012 Combined Sump Discharge

In 2012, the CDS outlet was relocated and moved south approximately 400 feet on the east side of the SCPA.

5. 2015 Embankment Modifications and Slurry Wall Addition

The downstream slope along the southwest and south perimeter berms was flattened to a 2.5H to 1V slope and armored with riprap. Ten inches of riprap was placed from the shoulder to the downstream toe of the embankment. The riprap has a maximum size of 10 inches and a predominate size of 6 inches. A geotextile fabric was placed under the riprap along the length of the embankment slope. In addition, a ditch with 2H to 1V sideslopes was cut in the CCR on the upstream side of the embankment. A slurry cutoff wall was also constructed through the crest of the embankment in the northeast corner of the perimeter berm. The slurry wall extends to a minimum depth of 40 feet below the embankment crest. A 3-foot-thick clay cap was constructed above the slurry wall. The slurry wall extends approximately 300 lineal feet along the northeast perimeter embankment.

6. Closure Construction (2017 to 2021)

The SCPA is being closed in two phases. Phase 1 was completed in 2019 and consisted of closure of an approximate 16-acre area on the southwest and west sides of the pond. The area was graded and capped with two feet of soil as part of closure. Portions of the Phase 1 area were subsequently developed for a new parking lot and low volume wastewater treatment facility (LVW).

Phase 2 closure was initiated and is scheduled to be completed in 2021. Phase 2 closure will include grading the remaining exposed CCR to facilitate drainage and capping the CCR with a 60 mil HDPE geomembrane and 2 feet of soil. Ditches created during closure for stormwater runoff will be lined with closure turf underlain by a geomembrane, and the existing NPDES outlet works will be removed.

C. **SCPB (Fly Ash Pond) (1994)**

In 1994, Ameren Missouri constructed SCPB as a lined impoundment to manage fly ash and coal pile stormwater runoff. The pond was incised to a bottom elevation of approximately 422 feet and has 60-mil HDPE liner on the side slopes and 40-mil HDPE liner on the bottom. Prior to completion of closure the water level was controlled by an upturned 18” HDPE pipe inlet. The discharge pipe is regulated by two motor operated butterfly valves. The HDPE pipe penetrates the southern half of the west perimeter embankment and discharges decant water into unclassified waterways and into the Mississippi River. The estimated maximum depth of CCR in the pond is 32 feet.

a. Foundation and Abutment Geology

The uppermost stratum is firm to stiff clay with a thickness of about 8 to 10 feet. The clay is underlain by silty sand and then poorly graded sand. The consistency of the silty sand and sand is medium dense and medium dense to dense, respectively. The silty sand stratum is generally 11 to 13 feet thick. The sand is fine to coarse, and intermittently silty and gravely. The sand extends to limestone bedrock, which is encountered at a depth of about 120 feet beneath the original ground surface.

b. Embankment Material

Embankment fill generally consists of compacted layers of clays, silts and sands that were excavated from the incised portion of the pond. Fill material is generally firm to stiff or medium dense. The upstream and downstream slopes are 3H to 1V, except where the embankment section has been widened by adjacent improvements. In the locations where the embankment has been widened the downstream slopes can vary from 2H to 1V and 3H to 1V.

c. SCPB Modifications

1. 2010 Riprap Placement

In 2010, Ameren Missouri placed riprap on the downstream slopes in the northwest part of the pond. The segment armored has not been thickened by adjacent improvements. The riprap was placed to help prevent future erosion from occurring on the slopes.

2. Gypsum Slurry Piping Fill

In 2010, and in order to facilitate new piping used to transport gypsum slurry to SCPC, fill was placed adjacent to the embankment near the southeast corner of the pond. The fill is compacted fly ash with a soil cap and was placed adjacent to and on the downstream slope at a steepness of about 3H to 1V.

3. 2012 Planned Solar Panel Fill Area

As part of a beneficial use project, an area adjacent to the east perimeter berm was filled with compacted ash to an elevation near the top of the embankment. The area filled was approximately 17 acres and included a storm drainage system. The area was developed for potential solar power generation, but to date additional site development has not occurred.

4. Closure Construction (2020 to 2021)

Closure of SCPB was initiated in 2020 and is scheduled to be complete in 2021. Closure will include grading the exposed CCR to facilitate drainage and capping the CCR with a 60 mil HDPE geomembrane and 2 feet of soil. Ditches created during closure for stormwater runoff will be lined wth closure turf underlain by a geomembrane, and the existing NPDES outlet works will be removed.

D. **SCPC (Cell 1) (2010)**

SCPC was placed into service in 2010 to manage gypsum created as a byproduct from Sioux's FGD. The gypsum slurry is pumped to SCPC where it is managed for long-term or permanent storage. The pond does not receive any additional stormwater run-off outside its bounded area. The gypsum slurry discharges into the cell at the approximate midpoint of the east embankment. The gypsum settles out into the pond and the decant water flows into the Recycle Pond through a set of triple box culverts. SCPC and the Recycle Pond are separated by an embankment. Triple box culverts connect SCPC with the Recycle Pond, and the culverts control the maximum water level in SCPC to el. 441. SCPC also has an emergency spillway on the west side of the impoundment. The bottom and side slopes of SCPC are lined with 80-mil HDPE liner, which was constructed over 24 inches of compacted, impervious clay. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms in SCPC. The estimated maximum depth of CCR in the pond is 21 feet. There have been no significant modifications to SCPC since construction was completed in 2010.

a. Foundation and Abutment Geology

The uppermost stratum is generally clays and silty clays with scattered seams and layers of low plastic silt, underlain by silts. The thickness of these fine-grain deposits ranged from 0 to 24 feet, but generally between about 5 to 10 feet. Clay soils are almost all high plastic. The fine-grain soils are firm to stiff, with undrained cohesive shear strengths of 500 psf to over 2000 psf.

The upper fine-grain soils are underlain by sandy silts, silty fine sands, and fine sands, generally to a depth of 30 feet. These upper sandy soils are generally loose to medium-dense. The upper sandy soils are underlain by fine to coarse, poorly graded sands and well-graded sands, with some silty sands and gravelly sands at greater depths. Limestone bedrock is at a depth of about 115 feet. The lower sands generally ranged from medium dense to very dense, increasing in density with increasing depth.

b. Embankment Material

Embankment fill consists of compacted layers of clay and silt with varying amounts of sand. Fill material was compacted to an average of 100% of the maximum dry unit weight determined from the Standard Proctor Moisture-Density Test (ASTM D698). Fill placement was monitored, and moisture-density tests were obtained during construction. The upstream and downstream slopes have a steepness of 3H to 1V. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms. The crest elevation of the embankment for SCPC is approximately elevation 446 feet.

The bottom of SCPC and the upstream slopes are covered with 2 feet of compacted clay liner that has a maximum hydraulic conductivity of 1×10^{-7} cm/sec. Clay for the liner was obtained on site. The compaction criteria for the clay liner was developed using the "Daniel Method." Fill placement was monitored, and moisture-density tests were obtained during construction.

E. Surveillance, Maintenance and Repair of the CCR Units

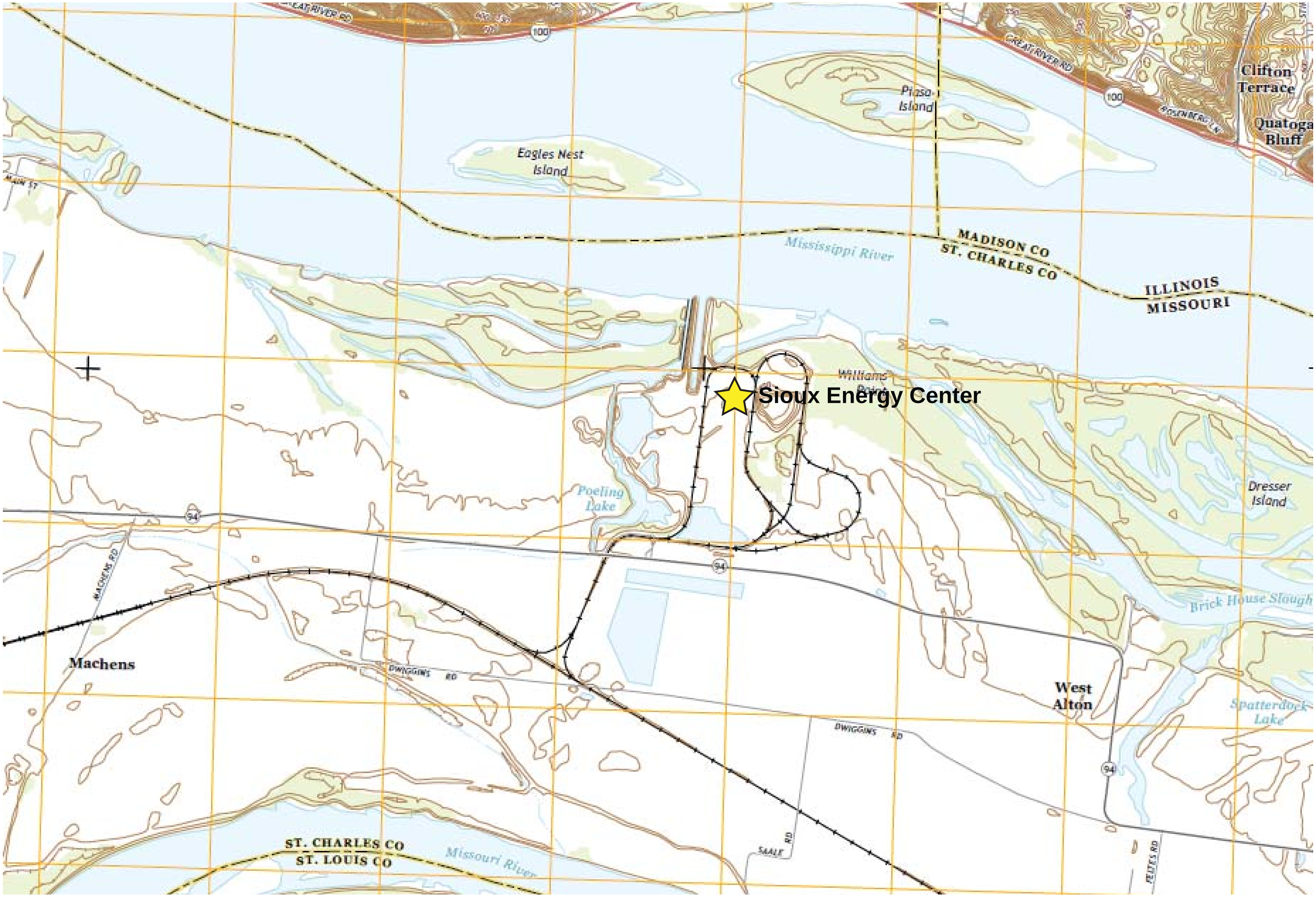
The Sioux Fly Ash and Bottom Ash Pond Embankment, and Cells 1 & 4A and Recycle Pond Operations and Maintenance Manuals outline objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Sioux CCR units. The embankments of the CCR units are visually 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 Manuals require 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 and Maintenance Manuals specify the minimum maintenance activities and require that maintenance activities be documented. The Operations and Maintenance Manuals further specify that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer.

F. Instrumentation

Pool level readings are documented in weekly inspection reports.

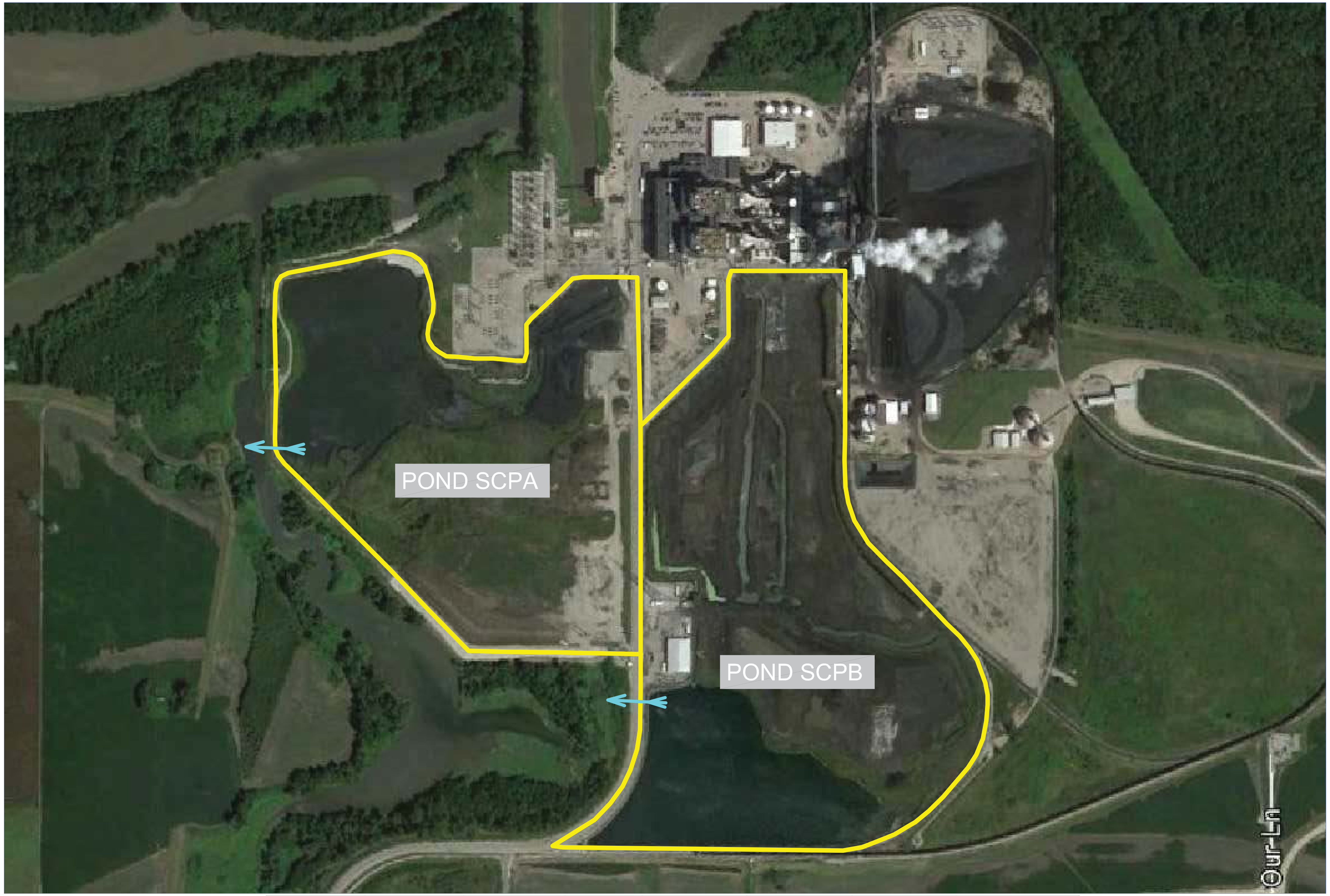
[4] The annual and periodic inspection reports contain the following information: depth of impounded water; storage capacity; modifications from last inspection, if any, CCR depth; volume of impounded water and CCR; changes to the downstream watershed, if any.



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

REITZ & JENS, INC.

Figure 1



Legend:

Pond Footprint

Primary 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)
SCPA	49.0	442.5	6700	438.0	440.3	2H:1V	2H:1V & 2.5H:1V
SCPB	62.0	441.5	7900	439.2	441.0	3H:1V	2H:1V to 3H:1V

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CCR Unit Evaluation

Figure 2 - Operational Data SCPA & SCPB

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)
SCPC	37.5	446.0	5200	441.1	441.9	3H:1V	3H:1V

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CCR Unit Evaluation

Figure 3 - Operational Data SCPC