Location Restrictions
MCPE
Meramec Energy Center

Contents

LOCATION RESTRICTIONS - MERAMEC ENERGY CENTER

I. Introduction

Ameren Missouri has evaluated the Meramec Energy Center's ("Meramec") MCPE inactive and closed surface impoundment in accordance with location restrictions set forth below:

§257.60, Placement Above the Uppermost Aquifer;
§257.61, Wetlands;
§257.62, Fault Areas;
§257.63, Seismic Impact Zones; and
§257.64, Unstable Areas.

II. Background

A. Surface Impoundments

The Meramec Energy Center (Meramec) is located at the southernmost point in St. Louis County, Missouri at the confluence of the Mississippi and Meramec Rivers, approximately 2.8 miles southeast of the City of Arnold. Meramec has four surface impoundments that were in operation to manage coal combustion residuals (CCR) produced at the facility as of October 14, 2015. The CCR surface impoundments are designated as MCPA (Bottom Ash Pond 492), MCPB (Bottom Ash Pond 493), and MCPC (Bottom Ash Pond 496), and MCPD (Fly Ash Pond 498). These CCR surface impoundments were subsequently closed. MCPE (Pond 489) was an inactive CCR surface impoundment that contained water and CCR after October 15, 2015. Closure of MCPE was completed on April 6, 2018.

Ameren Missouri redeveloped MCPE in 2000 as an above grade impoundment located within the footprint of the original 1950's vintage ash ponds which had been previously deactivated. MCPE impounds an area of approximately 25 acres and is lined with 60 MIL HDPE on the slopes and bottom.

III. Location Restrictions

A. Placement Above the Uppermost Aquifer – 40 CFR §257.60

Existing CCR surface impoundments must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate that the CCR unit meets the minimum requirements for placement above the uppermost aquifer.

Meramec is located on the northern side of the confluence of the Meramec and Mississippi rivers in an alluvial setting of water-deposited soils. The stratigraphy at the site is comprised of approximately 100 feet-thick alluvium, comprised of fine-grained soil underlain with coarse-grained soil over Mississippian-aged limestone bedrock of the Middle Warsaw formation (Shannon & Wilson, 1979). The natural alluvium consists of gray and brown, high plastic clays, silty clays and clayey silts, gray silty sands, and sands for a thickness of approximately 100 feet. The stratification of the alluvium is heterogeneous with discontinuous deposits of soft, high plastic clay in lenses. A 6- to 8-foot-thick layer of sand and gravel is intermittently encountered overlying the bedrock. During prior geotechnical investigations, the top of limestone bedrock was encountered at elevations ranging from 306 to 310 feet.

The Meramec Energy Center sits on fill placed to bring the site up to an elevation of approximately 418.5 feet. Fill depths range from about 6 to 18 feet. Fill was borrowed from the incised portion of the surface impoundments constructed in the early 1950's. In addition, fill was borrowed from incised portions of the impoundment for construction of the perimeter embankment. The fill is generally high plastic clay or silty clay. Construction activities have removed a significant portion of the uppermost fine-grained flood basin deposits at the locations of the CCR units. Given the heterogeneous nature of the alluvium at Meramec it is not likely that there is a continuous aquitard.

Groundwater levels at Meramec closely follow the stage of the adjacent Mississippi River, which controls the level of the rivers at the confluence. Historic records of the Mississippi River stages indicate that the river level varies between about el. 369 and el. 406.5, except for the high river stage of el. 416.5 during the 1993 flood.

The normal groundwater levels at Meramec can be estimated from the adjacent Mississippi River levels. Without a continuous, low permeability, fine-grained stratum above the alluvial deposits, the elevation of the uppermost aquifer is the natural ground surface prior to construction.

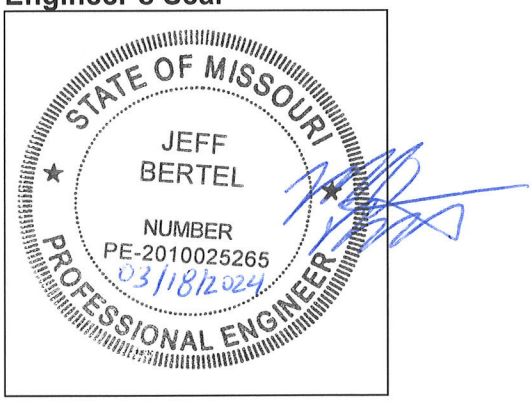
Documentation of the natural ground surface topography before construction of MCPE is unavailable. Based on historical survey data from adjacent areas the natural ground surface is estimated to be about el. 406 to 408 feet. MCPE is lined with 60 MIL HDPE on the slopes and bottom and incised to approximate elevation 400 feet. Therefore, the upper limit of the uppermost aquifer is higher than the current bottom of MCPE, which does not meet the requirements of 40 CFR §257.60.

1. Engineering Certification – Placement Above the Uppermost Aquifer

The existing CCR surface impoundment MCPE at the Meramec Energy Center was evaluated to determine if it was constructed with a base that is located no less than 5 feet above the upper limit of the uppermost aquifer, or if it can be demonstrated that there will not be intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table) to meet the requirements of §257.60, Placement Above the Uppermost Aquifer for Existing CCR Surface Impoundments. The upper limit of the uppermost aquifer is higher than the current bottom of MCPE, therefore it does not meet the requirements of §257.60.

CCR Unit	Meets requirements of 40 CFR 257.60
MCPE (489)	No

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265, MO

B. **Wetlands – 40 CFR §257.61**

Existing CCR surface impoundments must not be located in wetlands as defined in §232.2, unless the owner or operator demonstrates that the CCR unit meets the requirements of §257.61(a)(1) through (5).

The existing CCR units at Meramec were evaluated to determine whether jurisdictional wetlands were located in proximity to each CCR unit and that the operation of the CCR Unit will not cause or contribute to significant wetland degradation. Engineering and biological assessments performed in 2016 and 2018, along with weekly inspections and effluent limitations contained in the facility's water operating permit confirm that CCR Units at Meramec are not causing or contributing to significant degradation of the wetlands adjacent to the CCR units.

The proximity of wetlands to the MCPE has been identified on aerial imagery by the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory[1] (NWI) Mapper. The NWI identifies wetlands immediately to the west of MCPE. The wetlands are defined as a freshwater forested/shrub wetland.

MCPE has been closed. Surface water run-on is no longer in contact with CCRs. The potential for fugitive dusts is no longer possible due to the closure cap. Surface water within the closed surface impoundment is conveyed to the northwest corner of MCPE to the primary outfall. The outfall discharges on the west side of the CCR unit through Outfall 009 of Ameren's Missouri State Operating and NPDES permit (MO-0000361) for Meramec. The NPDES permit is administered by the MDNR. Discharges through Outfall 009 are monitored and subject to the effluent limitations stipulated in the NPDES permit.

The MCPE is incised with an earthen embankment circling the perimeter of the CCR unit. The perimeter embankment is designed and maintained to prevent catastrophic release, migration of CCR, and/or erosion of embankment material from potentially causing or contributing to significant degradation of surrounding wetlands. In the remote chance that the earthen embankment circling the perimeter of the MCPE were to fail it could impact adjacent wetlands. However, the associated environmental impacts would be minimal.

Ameren also completed a comprehensive evaluation of surface and groundwater data that demonstrates that there are no adverse impacts resulting from coal ash management practices at Meramec on human health or the environment (Haley & Aldrich, 2018).

[1] *The National Wetland Inventory is not dispositive on whether regulated wetlands exist at any particular location. According to Corps of Engineers' Guidance: "Since not all delineated areas on NWI maps are wetlands under Department of Army jurisdiction, NWI maps should not be used as the sole basis for determining whether wetland vegetation is present." 1987 Manual, at page 48. The Corps later states: "The optimum use of NWI maps is to plan field review (i.e., how wet, big, or diverse is the area?) and to assist during field review, particularly by showing the approximate areal extent of the wetland and its association with other communities." Id.*

1. Engineering Certification – Wetlands

Existing CCR surface impoundments must not be located in wetlands as defined in §232.2, unless the owner or operator demonstrates that the CCR unit meets the requirements of §257.61(a)(1) through (5). An assessment of the inactive CCR surface impoundment MCPE at the Meramec Energy Center was conducted and used to prepare a demonstration that the CCR unit meets the requirements of 40 CFR Part §257.61.

CCR Unit	Meets requirements of 40 CFR 257.61
MCPE (Fly Ash Pond 489)	Yes

Engineer's Seal

Jeff Bertel, P.E.
License: PE-2010025265, MO

C. **Fault Areas – 40 CFR §257.62**

Existing CCR surface impoundments must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit. A fault is defined in §257.53 as a fracture or zone of fractures which strata on one side have been displaced with respect to the other side.

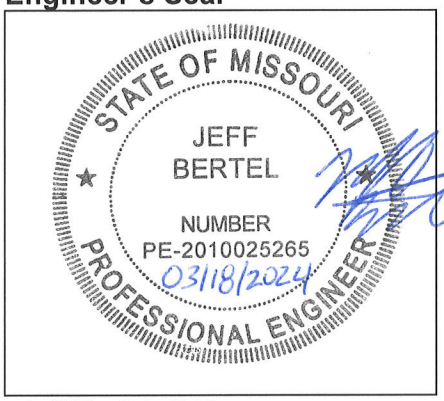
MCPE is not located within 200 feet of the outermost damage zone of a mapped fault that has had displacement in Holocene time. The closest mapped fault is the Maxville monocline and fault, which is located about 1.9 miles south of Meramec as shown in Figure 4 (MDNR, 2018). This fault is believed to be an extension of the Valmeyer anticline from Illinois. The Valmeyer Anticline is part of a large family of structure in western Illinois and Missouri that all exhibit northwest trend, strong asymmetry, and commonly faulting on the steep limb. The Valmeyer anticline predates the Mississippian age St. Louis Limestone (Denny, et. Al., 2009). Geologic structures of this family are Pennsylvanian age and are associated with the Ancestral Rocky Mountains orogeny (McBride and Nelson, 1999).

1. Engineering Certification – Fault Areas

Existing CCR surface impoundments must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit. An assessment of the inactive CCR surface impoundment MCPE at the Meramec Energy Center was conducted to prepare a demonstration that the CCR unit meets the requirements of 40 CFR Part §257.62.

CCR Unit	Meets requirements of 40 CFR 257.62
MCPE (Pond 489)	Yes

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265, MO

D. **Seismic Impact Zones – 40 CFR §257.63**

Existing CCR surface impoundments must not be located in seismic impact zones unless the owner or operator demonstrates that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

The seismic acceleration determined for MCPE was based upon the USGS 2014 seismic hazard maps for a Peak Horizontal Ground Acceleration (PHGA) for seismic loading event with a 2% probability of exceedance in 50 years. The PHGA was factored for the seismic site class in accordance with ASCE 7 Minimum Design Loads for Buildings and Other Structures, International Building Code to obtain a site specific PHGA of 0.342g. Based on this finding, Meramec is located in a seismic impact zone.

MCPE was evaluated under seismic loading to determine if the CCR unit design is adequate to prevent harmful release of CCR, leachate, and contaminants both during and after the design seismic event. In order to demonstrate the adequacy of the design, we evaluated both liquefaction potential and slope stability.

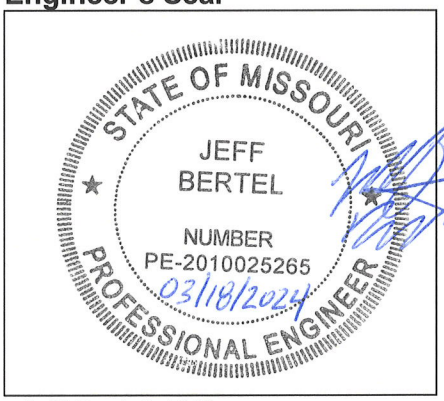
Our analyses determined that there is an acceptable factor of safety for the post-earthquake load case and estimated probable maximum deformations as the result of seismic acceleration or liquefaction induced settlement to be up to approximately 33 inches. The vertical displacement at the top of the MCPE embankment is approximately 6 inches. Given Ameren's Dam Safety Surveillance it is expected that necessary measures would be implemented in a timely fashion and prevent catastrophic release of CCR. The MCPE design is adequate to prevent harmful release of CCR, leachate, and contaminants both during and after the design seismic event.

1. Engineering Certification – Seismic Impact Zones

Existing CCR surface impoundments must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. An assessment of the inactive CCR surface impoundment MCPE at the Meramec Energy Center was conducted to prepare a demonstration that the CCR unit meets the requirements of 40 CFR §257.63.

CCR Unit	Meets requirements of 40 CFR 257.63
MCPE (Pond 489)	Yes

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265, MO

E. **Unstable Areas - 40 CFR §257.64**

Existing CCR surface impoundments must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.

Meramec is located in an alluvial plain just north of the confluence of the Mississippi and Meramec Rivers. The stratigraphy at the site is comprised of approximately 100 feet-thick alluvium, comprised of fine-grained soil underlain with coarse-grained soil over Mississippian-aged limestone bedrock of the Middle Warsaw formation (Shannon & Wilson, 1979). The natural alluvium consists of gray and brown, high plastic clays, silty clays and clayey silts, gray silty sands, and sands for a thickness of approximately 100 feet. The stratification of the alluvium is heterogeneous with discontinuous deposits of soft, high plastic clay in lenses. A 6- to 8-foot-thick layer of sand and gravel is intermittently encountered overlying the bedrock. During prior geotechnical investigations, the top of limestone bedrock was encountered at elevations ranging from 306 to 310 feet.

MCPE at Meramec was evaluated to determine if it was located in an unstable area using data from existing geotechnical investigations and relevant information including maps showing regional bedrock geology, karst features, mines and other potential unstable features. There are no known springs, caves, sinkholes, or rock outcrops within the alluvial plain. No other potentially significant geologic or geomorphic features have been identified at Meramec. No significant on-site or local human-made features or events, either surface or subsurface, are in evidence at Meramec within the footprints of the CCR units.

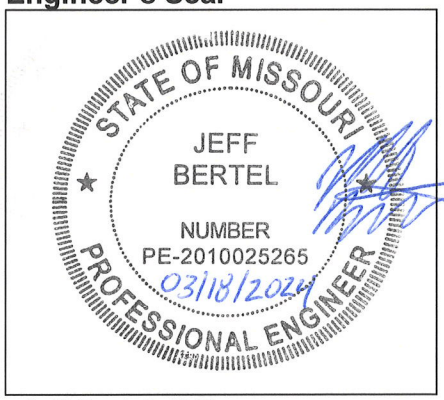
The global stability and settlement of the CCR units were evaluated during design or after construction based on the as-built conditions. These evaluations show that MCPE is not susceptible to significant differential settling or mass movement.

1. Engineer's Certification – Unstable Areas

Existing CCR surface impoundments must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. An assessment of inactive CCR surface impoundments MCPE at the Meramec Energy Center was conducted to prepare a demonstration that the CCR unit meets the requirements of 40 CFR Part 257 §257.64.

CCR Unit	Meets requirements of 40 CFR 257.64
MCPE (Pond 489)	Yes

Engineer's Seal



Jeff Bertel, P.E.
License: PE-2010025265, MO