TECHNICAL MEMORANDUM

DATE March 4, 2019

Project No. 1531406

TO Ameren Missouri

FROM Golder Associates Inc.

TESTING CONFIRMS LIMITED IMPACTS FOR ONLY THREE PARAMETERS AT AMEREN MISSOURI ENERGY CENTERS – CORRECTIVE ACTION EVALUATIONS UNDER CCR RULE TO PROCEED AT FOUR ASH BASINS

Introduction

Ameren Missouri (Ameren) owns and operates four (4) coal fired energy centers in the St. Louis, Missouri area: Labadie Energy Center (LEC), Rush Island Energy Center (RIEC), Sioux Energy Center (SEC), and Meramec Energy Center (MEC). Groundwater monitoring networks have been installed at CCR units at each location and Corrective Measures Assessments (CMA) will be performed at four of the ash basins. Recent media reports have characterized monitoring data as indicating "gross contamination" and suggest public water supplies are at risk. These claims mischaracterize the known and available record.[1] This Technical Memorandum highlights the extensive monitoring that has occurred and how, under the criteria of the CCR Rule, future investigations and evaluations are required to only focus on three parameters: molybdenum, lithium, and arsenic. Of these parameters, only one, arsenic, has a USEPA or State drinking water standard. In fact, neither Missouri nor USEPA have established drinking water standards (referred to as a Maximum Contaminant Level (MCL)) for lithium or molybdenum. This Technical Memorandum provides a summary of the results from the CCR Rule groundwater investigations and ongoing monitoring and testing to-date. CMA reports are being prepared to evaluate corrective measures at these four ash basins during the next phase of the CCR Rule compliance requirements.

Table 1: CCR Rule Parameters

Monitoring Parameters	
Appendix III	Boron
	Calcium
	Chloride
	Fluoride
	Sulfate
	pH
	Total Dissolved Solids (TDS)
Appendix IV	Antimony
	Arsenic
	Barium
	Beryllium
	Cadmium
	Chromium
	Cobalt
	Fluoride
	Lead
	Lithium
	Mercury
	Molybdenum
	Selenium
	Thallium
	Radium 226 & 228

[1] A recent report issued by the Environmental Integrity Project in discussing data from Ameren's energy centers ignores background (naturally occurring) concentrations that are used in statistical analysis required by the USEPA CCR Rule to calculate site-specific GWPS. In addition, EIP misstates the protection standard designated by USEPA for molybdenum in its most recent CCR Rule amendment.

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Review of CCR Rule Requirements

Groundwater monitoring under the CCR Rule program occurs through a phased approach to allow for a graduated response and evaluation of next steps. (See *USEPA Frequent questions about the 2015 Coal Ash Disposal Rule*).

- During the baseline phase, Ameren installed upgradient and downgradient wells at each Energy Center and collected eight (8) rounds of groundwater samples from each of the monitoring wells. The CCR Rule requires that monitoring wells be installed at locations that are as close as possible to the boundary of the ash basins intended to detect groundwater impacts near the source. ***These monitoring well locations are not intended to and do not represent public health exposure points.*** For the baseline phase, all twenty-two Appendix III and Appendix IV parameters (**Table 1**) were sampled to build the required database needed for statistical analysis for evaluating naturally occurring conditions and calculating site-specific standards.
- During the Detection Monitoring phase of the CCR Rule, Ameren collected Appendix III parameters (**Table 1**) according to the CCR Rule requirements. These sampling results were then compared to background, or natural groundwater values, in order to determine if concentrations near the base of the ash basins are present at a level above the CCR Rule levels. Values above this level are called Statistically Significant Increases (SSI) and are evaluated using statistical protocols outlined in USEPA's 2009 "*Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance*" (Unified Guidance).
- If an SSI of an Appendix III parameter exists, then the Assessment Monitoring phase occurs and triggers sampling of Appendix IV parameters (**Table 1**), which is a more expansive list of parameters associated with CCR. During this phase and using the background and baseline data, site-specific Ground Water Protection Standards (GWPS) are determined for each Appendix IV parameter. If values are found at concentrations that are statistically above the GWPS, then they are referred to as Statistically Significant Levels (SSLs). If this occurs, then the Assessment of Corrective Measures phase of the CCR Rule is triggered for such Appendix IV parameters.

To-date, in order to comply with the CCR Rule, Ameren has installed and sampled 73 monitoring wells and has performed testing on over 850 groundwater samples. In addition to the sampling requirements of the CCR Rule, Ameren has proactively and voluntarily collected over 800 additional groundwater/surface water samples to further assess possible CCR impacts to the environment and to confirm that the CCR units do not represent a risk to public health or the environment. The following sections summarize testing results at each of the four energy centers.

Table 2: Assessment Monitoring Reflects High % Compliance

Monitoring Parameters	Labadie Energy Center	Rush Island Energy Center	Sioux Energy Center	Meramec Energy Center
	LCPA	RCPA	SCPA	MEC Units
Percent of Assessment Monitoring Parameter Compliance	**96%**	**94%**	**96%**	**95%**
Percent of Assessment Monitoring Parameter Results Requiring Corrective Action	**4% Molybdenum**	**6% Molybdenum Arsenic**	**4% Molybdenum**	**5% Molybdenum Arsenic, Lithium**

Labadie Energy Center – Molybdenum is the Only Parameter of Concern

At the LEC, CCR is managed in two ash basins and a landfill. Of these three CCR units, only the bottom ash basin (LCPA) has moved into Assessment Monitoring and triggered CMA evaluations, and only due to one of the CCR Rule parameters - molybdenum. As shown on **Table 2**, the LCPA basin has entered the corrective measures phase even though 96% of the Appendix IV parameters tested are within compliance of the CCR Rule. Importantly, these results are collected from monitoring wells placed as close as practical to the basin boundary (typically within 10 to 300 feet) and provide near-source groundwater monitoring results. At short distances away from the CCR basin, concentrations decrease.

Arsenic has been shown to be naturally occurring within the alluvium and measured concentration at the ash basins are either below or similar to upgradient, off-site levels. Accordingly, since arsenic in monitoring wells is below the site-specific GWPS established for Labadie, no additional evaluations are necessary for this parameter.

> **Arsenic, Cobalt, Chromium, Lithium, Lead, Mercury, Radium and all other Appendix IV parameter concentrations are below levels established by the CCR Rule in wells around the bottom ash basin that has been in operation for 48 years.**

In addition to the requirements of the CCR Rule, Ameren has proactively and voluntarily collected additional groundwater and surface water samples to confirm that there is no risk to human health from the management of CCR at LEC. For these investigations, water samples were collected in the nearby Missouri River and Labadie Creek, as well as in the bedrock aquifer between the LEC and private drinking water wells. Results from these investigations demonstrate that rivers, streams, and bedrock groundwater used for drinking water are unimpacted by CCR at Labadie. These conclusions are discussed in depth in the 2014 "*Groundwater and Surface Water Data Demonstrate No Adverse Human Health Impact from Coal Ash Management at the Labadie Energy Center"*, the 2016 *"Ground and Surface Water Assessment*" and 2018 "*Human Health and Ecological Assessment of the Labadie Energy Center"* reports (https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/water-quality). In addition, the 2018 *Haley & Aldrich Report* demonstrates that there is a large margin of safety between the maximum groundwater concentrations in groundwater and the groundwater concentrations needed for there to be an adverse effect on the river. **For example, the maximum measured molybdenum result would need to be more than 14,000 times higher before an adverse impact to human health could occur.**

Sioux Energy Center – Molybdenum is the Only Parameter of Concern

At the SEC, CCRs are managed in two CCR ash basins, a utility waste landfill, and a lined basin to manage gypsum waste. Of these four CCR units, only the bottom ash basin (SCPA) is required to move into Assessment Monitoring and triggered CMA evaluations, and only due to one CCR Rule parameter – molybdenum. As shown on **Table 2**, the SCPA basin is entering the corrective measures phase even though 96% of Appendix IV parameters tested are in compliance with CCR Rule requirements. These results are from samples collected from monitoring wells placed as close as practical to the boundary of the CCR basin (typically within 10 to 300 feet) and provide near-source groundwater results. At short distances away from the CCR basin, concentrations of all parameters decrease.

> **Arsenic, Cobalt, Chromium, Lithium, Lead, Mercury, Radium and all other Appendix IV parameter concentrations are below levels established by the CCR Rule in wells around the bottom ash basin that has been in operation for 51 years.**

In addition to the requirements of the CCR Rule, Ameren has proactively and voluntarily collected surface water samples in the nearby Mississippi and Missouri Rivers to confirm that there are no impacts to these water bodies and no human health risks posed by CCR management at SEC. Results from these investigations demonstrate that rivers and streams are not adversely impacted by CCR at Sioux.

These conclusions are discussed in depth in the 2018 "*Human Health and Ecological Assessment of the Sioux Energy Cente*r" report (https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/water-quality). In addition, the 2018 *Haley & Aldrich Report* demonstrates that there is a large margin of safety between the maximum groundwater concentrations in groundwater and the groundwater concentrations needed for there to be an adverse effect on the Mississippi or Missouri rivers and human health. **For example, the maximum measured molybdenum concentration would need to be more than 1000 times higher before an adverse impact to surface waters could occur.**

Rush Island Energy Center - Molybdenum and Arsenic are the Only Parameters of Concern

At Rush Island, groundwater monitoring has moved into Assessment Monitoring and triggered the CMA evaluation for two parameters—molybdenum and arsenic. As shown on **Table 2,** 94% of Appendix IV parameters tested are in compliance with CCR Rule requirements. These results are from samples collected from monitoring wells placed as close as practical to the boundary of the CCR basin and provide near-source groundwater results. At short distances away from the CCR basin, concentrations decrease.

Cobalt, Chromium, Lithium, Lead, Mercury, Radium and all other Appendix IV parameter concentrations are below levels established by the CCR Rule in wells around the CCR basin that has been in operation for 40 years.

In addition to the requirements of the CCR Rule, Ameren has proactively and voluntarily collected additional groundwater and surface water samples to confirm that there is no risk to human health posed by CCR management at the RIEC. For these investigations, water samples were collected in the nearby Mississippi River and Isle de Bois Creek, as well as in the bedrock aquifer between the Rush Island Energy Center and private drinking water wells further west. Results from these investigations demonstrate that rivers, streams, and the bedrock groundwater used for drinking water do not pose a threat to human health by management of CCR at Rush Island. These conclusions are discussed in depth in the 2014 "*Groundwater and Surface Water Data Demonstrate No Off-Site Impact from Rush Island Energy Center*" and 2018 "*Human Health and Ecological Assessment of the Rush Island Energy Center"* reports (https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/water-quality). In addition, the 2018 *report* demonstrates that there is a large margin of safety between the maximum groundwater concentrations and the groundwater concentrations needed for there to be an adverse effect to the Mississippi River. **For example, the maximum measured arsenic result would need to be more than 50 times higher before an adverse impact to human health could occur.**

Meramec Energy Center – Molybdenum, Arsenic and Lithium are the Only Parameters of Concern

Groundwater monitoring around the MEC CCR basins has moved into Assessment Monitoring and triggered further CMA evaluation. As shown on **Table 2**, 95% of the Appendix IV parameters tested are in compliance with CCR Rule requirements. These results are collected from monitoring wells placed as close as practical to the waste boundary and provide near-source groundwater results. At short distances away from the CCR Units, concentrations decrease. In fact, approximately half of the monitoring wells reflect values of arsenic, molybdenum, and lithium that are below CCR Rule requirements. Only two of the eight downgradient monitoring wells have tested arsenic levels above the USEPA's Maximum Contaminant Level (MCL)).

- **All other Appendix IV parameters including Lead, Cobalt, Chromium and Mercury, Radium are within those required by the CCR Rule in wells around the Meramec CCR basins, which have been in operation for 65 years.**

In addition to the requirements of the CCR Rule, Ameren has proactively and voluntarily collected surface water samples in the nearby Mississippi and Meramec Rivers and in a small creek adjacent to the facility to confirm that there are no human health risks posed by CCR at MEC. Results from these investigations demonstrate that rivers and streams are not adversely impacted by CCR at Meramec. These conclusions are discussed in depth in the 2018 "Human Health and Ecological Assessment of the Meramec Energy Center" report (https://www.ameren.com/company/environment-and-sustainability/managing-coal-combustion/water-quality). In addition, the 2018 *report* demonstrates that there is a large margin of safety between the maximum measured groundwater concentrations and the groundwater concentrations needed for there to be an adverse effect on the river or human health. **For example, the maximum molybdenum value would need to be more than 13,000 and 90 times higher before an adverse impact to the Mississippi and Meramec Rivers could occur.**

Summary

The CCR Rule testing has demonstrated that there are only limited impacts to groundwater at the Ameren ash basins – ash basins that have been in operation for 40 to 60 years. Of the 850+ groundwater samples collected from 73 monitoring wells under the CCR Rule groundwater program, 94% or more of the results are below levels of concern. The 4-6% of the results that are above the levels defined in the CCR Rule, the impacts are limited to molybdenum at four (4) of the ash basins, arsenic at two (2) of the ash basins, and lithium at one (1) ash basin. Concentration levels decrease with distance from the ash basins.

None of the groundwater impacted by the four ash basins is used for drinking water – and additional sampling conducted by Ameren at Labadie and Rush Island demonstrate that off-site groundwater used for drinking water is not impacted by the facilities. Additional evaluation by Ameren of surface waters adjacent to these facilities – the Missouri River, the Mississippi River, the Meramec River, and small adjacent streams – demonstrate that there is no human health or ecological impact via surface water.