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May 31, 2023

**Delivered Electronically**

Mr. Brian Rockensuess, Commissioner  
Indiana Department of Environmental Management  
100 N. Senate Avenue  
Mail Code 50-01  
Indianapolis, IN 46204-2251

Dear Mr. Rockensuess:

**Re: Indiana-Kentucky Electric Corporation  
June 2023 Semi-Annual Selection of Remedy Report**

As required by 40 CFR 257.106(h)(9), the Indiana-Kentucky Electric Corporation is providing notification to the Commissioner of the Indiana Department of Environmental Management that the seventh Semi-Annual Selection of Remedy report has been completed in compliance with 40 CFR 257.97(a) for Clifty Creek Station's Landfill Runoff Collection Pond (LRCP). The intent of the report is to provide a six-month update on the progress of selecting a remedy for confirmed Appendix IV SSIs above the groundwater protection standard in the groundwater at the LRCP. The report has been placed in the facility's operating record in accordance with 40 CFR 257.105(h) (12), as well as, on the company's publicly accessible internet site in accordance with 40 CFR 257.107(h)(9), which can be viewed at <https://www.ovec.com/CCRCompliance.php>.

If you have any questions, or require any additional information, please call me at (740) 897-7768.

Sincerely,

A handwritten signature in black ink that reads "Jeremy Galloway".

Jeremy Galloway  
Environmental Specialist

JDG:tlf

# **Semi-Annual Report on the Progress of Remedy Selection**

**40 CFR 257.97(a)**

Landfill Run-off Collection Pond

Clifty Creek Station  
Madison, Indiana

June 2023

Prepared by: Indiana-Kentucky Electric Corporation  
3932 U.S. Route 23  
Piketon, OH 45661



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# 1 INTRODUCTION

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In accordance with 40 CFR § 257.97(a), the Indiana-Kentucky Electric Corporation (IKEC) has prepared this Semi-Annual report to document progress toward remedy selection, design and implementation of corrective actions associated with groundwater monitoring exceedances at the Clifty Creek Station's Landfill Runoff Collection Pond (LRCP). This report summarizes activities during the period of December 2, 2022, through June 1, 2023. Updates to the report will be published semi-annually, until such time a remedy has been selected. Upon selection, a final report will be prepared describing the selected remedy and how it meets the standards specified in the rule.

## 1.1 REGULATORY BACKGROUND

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 17, 2015) in the Federal Register, referred to as the "CCR Rule." The rule applies to new and existing landfills, and surface impoundments used to dispose of or otherwise manage CCR generated by electric utilities and independent power producers. The rule includes requirements for monitoring groundwater and assessing corrective measures if constituents listed in Appendix IV of the rule are detected in groundwater samples collected from downgradient monitoring wells at Statistically Significant Levels (SSL) greater than the established Groundwater Protection Standard (GWPS).

In May 2019, IKEC initiated an Assessment of Corrective Measures (ACM) at the Clifty Creek LRCP as a result of a confirmed SSL of Appendix IV constituent Molybdenum in monitoring well CF-15-08 during October 2018 Assessment Monitoring Activities, as required by 40 CFR § 257.97(a). In accordance with 40 CFR § 257.96(a), IKEC prepared an ACM report for the Clifty Creek LRCP. It was placed in the facility's operating record and uploaded to IKEC's CCR Rule Compliance internet site on September 19, 2019. A revised ACM report, which contains supplemental information was placed on IKEC's CCR Rule Compliance internet site, on November 30, 2020. The ACM Report provides an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c). Multiple strategies were evaluated to address groundwater exhibiting concentrations of Molybdenum above the GWPS, with two technically feasible options identified. Both options, which presently appear to be feasible require the removal of free water from the pond, followed by the execution of an engineered cap and closure of the LRCP facility, and are as follows:

- Monitored Natural Attenuation (MNA); and
- Conventional Vertical Well System (Groundwater Extraction and Treatment) (Ex-Situ).

Following the completion of the ACM Report, IKEC hosted a public meeting to present the options for remediation on November 7, 2019, in Madison, Indiana. IKEC then observed a 30-day public comment period, per 40 CFR § 257.97(a), prior to beginning the process of selecting a remedy. No comments were received during this time period.

Semi-annual reports are required pursuant to 40 CFR § 257.97(a) to document progress toward remedy selection and design. The CCR Rule provides flexibility for additional field investigation, which is still ongoing, data analysis and consideration prior to the selection of a remedy. IKEC will continue to review new data as it becomes available from active site evaluation and implement changes to the groundwater monitoring and corrective action program as necessary to maintain compliance with the rule.

## 1.2 REPORT CONTENTS

The seventh semi-annual progress report provides regulatory background, an overview of site characteristics and ACM findings, and summarizes activities supporting the selection and implementation of a remedy during the period of December 2, 2022, through June 1, 2023.

## 2 SITE BACKGROUND

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The Clifty Creek Station, located in Madison, Indiana, is a 1.3-gigawatt coal-fired generating plant operated by IKEC, a subsidiary of the Ohio Valley Electric Corporation (OVEC). The Clifty Creek Station has six (6) 217.26-MW generating units and has been in operation since 1955. Ash products were sluiced to disposal ponds located in the plant site since it began operation. During the course of plant operations, CCRs have been managed and disposed of in various units at the station. The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel. To allow for more disposal capacity, an on-site fly ash pond was developed into a Type III Landfill in 1988. All required permits for the Type III Landfill were obtained from the Indiana Department of Environmental Management (IDEM) and the Type III Landfill went operational in 1991. In March 1994, IDEM approved a pH variance for the disposal of low-sulfur coal ash in the fly ash Type III Landfill. Emplacement of low-sulfur coal ash in the Type III Landfill began in January 1995. In April 2007, IKEC submitted a permit application to IDEM to upgrade the former Type III landfill to a Type I landfill. In 2013, IDEM issued a renewed permit and approved IKEC's request to upgrade the landfill to a Type I landfill.

The Type I Landfill consists of approximately 109 acres, and has been approved by IDEM as a Type I Residual Waste Landfill. The remaining 91 acres consist of the LRCP located at the southwest end of the Type I Landfill. The Type I Landfill and the LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel.

## 2.1 UNIT SPECIFIC GEOLOGY AND HYDROGEOLOGY

Bedrock beneath the LRCP consists of impermeable limestone and shale of the Ordovician Dillsboro formation, which is overlain by approximately 20 feet of clayey gravel with sand. The clayey gravel with sand is overlain by a lean clay with sand, which is overlain by a fine to medium sand with gravel, silt and clay. The uppermost unit in the area is a surficial layer of silty clay. A limestone ridge known as the Devil's Backbone runs northeast to southwest along the length of the Type I Landfill & LRCP. The Devil's Backbone, as well as a similar steep geologic feature that runs approximately parallel to the Devil's Backbone, act as impermeable barriers that force groundwater passing beneath the Type I Landfill to flow either toward the northeast or toward the southwest. During periods when the water level in the Ohio River rises significantly and flooding occurs, groundwater flow in the uppermost aquifer will temporarily change direction of flow. The impact of this change in groundwater flow direction is still being evaluated in regard to the impact it may have on the ultimate selected remedy.

Based on historic aquifer testing conducted at the site, the upper lean clay deposits exhibit low permeability, do not yield adequate quantities of water to wells, and are considered to be an aquitard. The underlying fine-medium sand with silt is considered to be an unconfined or possibly semi-confined aquifer and is therefore designated as the uppermost aquifer at the LRCP.

## 2.2 POTENTIAL RECEPTOR REVIEW

IKEC completed an assessment of the proximity of public and private drinking water supplies to the LRCP in response to SSLs above the GWPS. It was determined that the withdrawal wells designated by the Indiana Department of Natural Resources (IDNR) as drinking water wells within a one-mile radius are not hydraulically connected to the groundwater at the LRCP facility or are located upgradient from the facility.

# 3 GROUNDWATER ASSESSMENT MONITORING PROGRAM

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Groundwater assessment monitoring for the Clifty Creek LRCP is conducted in accordance with 40 CFR § 257.95.

## 3.1 GROUNDWATER MONITORING WELL NETWORK

In compliance with 40 CFR § 257.91, the CCR groundwater monitoring network for the LRCP consists of the following eight (8) wells:

- CF-15-04 (Background);
- CF-15-05 (Background);
- CF-15-06 (Background);
- CF-15-07 (Downgradient);
- CF-15-08 (Downgradient);
- CF-15-09 (Downgradient);

- WBSP-15-01 (Background); and
- WBSP-15-02 (Background).

Additionally, four (4) monitoring wells that were installed as part of the additional assessment activities for the LRCP were added to the CCR groundwater monitoring network for the LRCP as follows:

- CF-19-14 (Downgradient); and
- CF-19-15 (Downgradient).

### 3.2 TYPE I LANDFILL ALTERNATIVE SOURCE DEMONSTRATION

The Type I Landfill and LRCP share a common monitoring network. Due to this fact, upon verification of an exceedance above the GWPS, an Alternative Source Demonstration was pursued. Based on a review of current and historic data, the Type I Landfill was not believed to be the source of Boron in groundwater in the area. An ASD was completed in general accordance with guidelines presented in the *Solid Waste Disposal Facility Criteria Technical Manual* (U.S. EPA 1993). It was concluded that the Type I Landfill was not the source of Boron detected in the area. This conclusion was supported by the following evidence:

- “Foundation soils” that extend from beneath the LRCP and the hydraulically placed fly ash southwest to the Ohio River provide a direct hydraulic connection between the historic hydraulically placed fly ash and the CCR groundwater monitoring wells CF-15-08 and CF-15-09.
- Historic data from the IDEM groundwater monitoring program indicate that Boron concentrations similar to those observed in CCR wells CF-15-08 and CF-15-09 were detected in IDEM wells CF-9406 and CF-9407 for 17 years prior to operation of the Type I Landfill, indicating that the Boron is associated with the historic hydraulically placed fly ash.
- Using the previously calculated groundwater flow velocity of 45 feet per year (ft/yr), it is estimated that it would take 120 years for groundwater flowing beneath the Type I Landfill to reach the CCR monitoring wells.

The ASD Report for the March 2018 Detection Monitoring Event was completed in June 2019, and was certified on July 3, 2019. By definition of the CCR Rule, the LRCP is unlined and the historic hydraulically placed fly ash extends beneath the LRCP to the embankment; therefore, an ACM was conducted at the LRCP.

### 3.3 GROUNDWATER CHARACTERIZATION

Groundwater assessment monitoring was first conducted at the Clifty Creek LRCP during October 2018 sampling. Molybdenum, an Appendix IV constituent, was detected

and confirmed to exceed the GWPS of 100 µg/L at well CF-15-08. In response, IKEC was required to characterize the extent of the release, pursuant to 40 CFR § 257.95(g)(1), and installed additional groundwater monitoring wells at the property boundary (wells CF-19-08D, CF-19-14, CF-19-15, and CF-19-15D). It was determined that Molybdenum was not leaving the property at levels higher than the GWPS, and therefore the potential remediation zone was confined to the LRCP complex (AGES, 2019). Semi-annual sampling at the LRCP sentinel wells has continued, and has further demonstrated the assessment that Molybdenum at levels higher than the GWPS are confined to IKEC property. Continued sampling events have verified that Molybdenum levels higher than the GWPS are not leaving IKEC property, as originally determined.

## 4 ASSESSMENT OF CORRECTIVE MEASURES

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In accordance with 40 CFR § 257.96(a), IKEC prepared an ACM report for the Clifty Creek LRCP and placed it in the facility's operating record, as well as uploaded it to IKEC's CCR Rule Compliance internet site on September 19, 2019. As noted above, a revised ACM report containing supplemental information was posted to IKEC's CCR Rule Compliance internet site on November 30, 2020. The ACM Report provided an assessment of the effectiveness of potential corrective measures in achieving the criteria provided in 40 CFR § 257.96(c).

### 4.1 PLANNED SOURCE CONTROL MEASURES

Per 40 CFR § 257.96(a), the objectives of the corrective measures evaluated in this ACM Report are "to prevent further releases, to remediate any releases, and to restore affected area to original conditions." As required in 40 CFR § 257.97(b), corrective measures, at minimum, must:

- (1) Be protective of human health and the environment;*
- (2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);*
- (2) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV to this part into the environment;*
- (5) Comply with standards for management of wastes as specified in § 257.98(d).*

During the ACM development process, several in-situ and ex-situ remedial technologies were evaluated to address Molybdenum in groundwater at the LRCP, and screened against evaluation criteria requirements in 40 CFR § 257.96(c). The two (2)



technologies that appear to be most technically feasible, and therefore most likely for selection as a remedy are:

- Monitored Natural Attenuation; and
- Conventional Vertical Well System (Groundwater Extraction) (Ex-Situ).

As previously noted, both options require removal of free water from the pond, followed by the execution of an engineered cap and closure of the LRCP facility. IKEC is committed to continued compliance with the requirements and timeframes of the CCR Rule, and will close the Clifty LRCP in accordance with 40 CFR § 257.102. IKEC is continuing to work with the site's Qualified Professional Engineer to develop the designs and implement control mechanisms necessary to prepare for the safe closure of the LRCP. IKEC has worked with IDEM to secure modification to its NPDES permit, which became effective December 1, 2022 to incorporate changes necessary to manage the changes to stormwater discharges from the LRCP facility. IKEC has continuing to work with both the Indiana Department of Natural Resources (IDNR) and the USACE to secure approval to construct the necessary stormwater controls. IKEC received the approved permit on May 19, 2023. The work is proceeding at this time.

IDEM has also requested modification to the state program groundwater monitoring system associated with the monitoring of the landfill as part of the most recent landfill permit renewal. This groundwater monitoring system is located near the CCR groundwater monitoring system, and alteration of the groundwater monitoring well system could refine or influence what IKEC has observed thus far in the monitoring program, ultimately influencing the ultimate selection of remedy. IKEC has worked with IDEM to finalize locations and installation details of the requested groundwater monitoring wells; the installation of these additional wells was completed in August 2021. Further, IDEM has expressed an interest in reviewing and approving any corrective measures prior to their implementation. Should IDEM receive authority under the Water Infrastructure Improvements for the Nation Act from U.S. EPA to implement a state level CCR Permit Program, IKEC will prepare and submit a report detailing the selected corrective measure for review and comment prior to implementing the chosen remedy. In the interim, IKEC is attempting to work cooperatively with IDEM in anticipation of their CCR permit program approval.

The initial activities described above are anticipated to assist in the reduction of the potential for releases and migration of CCR constituents. Groundwater assessment monitoring as required by 40 CFR § 257.96(b) will continue until a remedy is selected and implemented. The monitoring will be conducted to track changes in groundwater conditions as a result of these closures and operational changes. These data will also be considered in the selection and design of a remedy in accordance with 40 CFR § 257.97.

## 4.2 POTENTIAL REMEDIAL TECHNOLOGIES

As a source control measure, the Clifty Creek LRCP will be closed in accordance with CFR § 257.102 prior to implementation of further groundwater remediation efforts. In addition to source control measures, two primary strategies were identified to address groundwater exhibiting concentrations of Molybdenum above the GWPS, including:

- Monitored Natural Attenuation; and
- Conventional Vertical Well System (Groundwater Extraction) (Ex-Situ).

The ACM report titled “Clifty Creek LRCP- Assessment of Corrective Measures Report- Rev 1”, which is available on IKEC’s publicly accessible internet site, provides a more detailed description of these corrective measures. The effectiveness of each potential corrective measure was assessed in accordance with 40 CFR § 257.96 (c). Both options listed above are considered technically feasible, and appropriate for groundwater remediation efforts at the LRCP.

## 5 SELECTION OF REMEDY: CURRENT PROGRESS

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As noted in the ACM Report, IKEC determined that an effective method for source control would be to leave the CCR material in place and install a CCR compliant cap system to prevent future infiltration of stormwater.

A design to cap the LRCP in place is currently being developed by the facility’s Qualified Professional Engineer, in accordance with the Federal CCR Rule. This closure will be initiated once all non-CCR flows are diverted away from the LRCP supporting the closure.

IKEC’s hydrogeologist conducted the semi-annual groundwater sampling and testing during this report period. In addition to sampling the monitoring wells in the CCR groundwater monitoring network, the sentinel wells installed to aid in ACM activities were also sampled. A total of 10 wells (8 Network and 2 Sentinel) were sampled near the LRCP and the results are summarized in the 2022 Groundwater Monitoring and Corrective Action Report. Preliminary analyses indicate that concentrations of Molybdenum at the sentinel wells are well below the site’s GWPS. In addition to the semi-annual monitoring, IKEC’s hydrogeologist also collected monthly depth-to-groundwater readings at wells in the area of the LRCP.

A design package was developed and submitted to the Indiana Department of Natural Resources, who regulates dams and dikes in the State of Indiana, on November 8, 2021, to request permission to alter the existing LRCP dam structure to support final closure of the impoundment. Modification of the existing dam structure is necessary to

support closure activities. Impacts to groundwater caused by alterations to the LRCP dam structure are unknown at this time. No final agency action has been taken in regards to the permit application.

On July 1, 2021, IKEC submitted an application for a Minor Modification to the Clifty Creek Landfill Permit, Solid Waste ID No. 39-04, to the Indiana Department of Environmental Management to permit the installation of stormwater controls in the area of the Type I Landfill and LRCP. These controls are intended to redirect stormwater runoff from the considerable watershed the LRCP manages to support final closure of the facility. These revisions to stormwater flow in the area must be completed prior to initiating final LRCP closure activities. The final minor modification permit was received from IDEM on May 25, 2022. This work is currently underway, and not anticipated to be completed until late 2023 due to site conditions.

During the reporting period, IKEC opted to conduct a groundwater model (MODFLOW-NWT) to evaluate the installation of groundwater extraction wells to capture groundwater from areas where Molybdenum concentrations exceed the GWPS. Groundwater modeling analyses were performed by IKEC's hydrogeologist to estimate pumping rates and other design parameters for a proposed system of groundwater extraction wells to capture groundwater containing Molybdenum above the GWPS.

For the model, a grid was constructed by dividing the area around the LRCP into uniform 10-foot square finite-difference cells, with a finer grid, comprised of 5-foot square grid cells in some areas. The model was divided vertically into five layers to represent the geology of the area around the LRCP. Hydraulic conductivity, specific storage and specific yield parameter values for the permeable sand and cohesive silt and clay units were estimated using the water-level drawdowns measured during previous pumping tests at the site. Other hydraulic parameters and hydrologic model parameters were estimated using automated methods provided by the parameter-estimation computer program (PEST), which was developed by Watermark Numerical Computing of Brisbane Australia. Using PEST, model parameters were solved by repeatedly performing MODFLOW model simulations while trying to reproduce a set of target measurements. Model parameters were adjusted between successive simulations until an optimal set of parameters was derived for which the model could reasonably match measured target values.

After model calibration, a model run with particle tracking from areas where Molybdenum exceeded the GWP (without groundwater extraction) was completed. A proposed line of extraction wells (with estimated pumping rates) was then inserted into the model and particle tracking was re-run until the capture of particles from where Molybdenum exceeds the GWPS was complete. Based on successive model runs, a series of seven extraction wells with a total pumping rate of approximately of 46 gallons

per minutes (GPM) would likely be effective for capturing Molybdenum from groundwater where it exceeds the GWPS.

From December 5, 2022 to January 10, 2023, IKEC contracted a consultant (with a licensed drilling subcontractor) to install seven extraction wells at the LRCP at locations specified in the groundwater flow model. The well depths ranged from 28 to 43 feet below ground surface; the wells were constructed of 6-inch diameter, 10-foot long, 20-slot stainless-steel wire-wrapped screen with attached 6-inch diameter PVC riser. A sand pack was installed directly around the well screen as the augers were pulled back in one (1)- to two (2)-foot increments. The sand pack extended to about two (2)-feet above the top of the screen. An approximate two (2)-foot thick annular bentonite seal was then installed above the filter pack in each well.

Once in place, the bentonite seal was allowed to hydrate before the remainder of the annular space around the well was backfilled using a grout consisting of Portland cement and bentonite. The well was completed with an 8-inch diameter steel protective casing with a locking well-cap. After completion, all of the wells were developed by surging and over pumping.

In December 2022, IKEC began the process of retaining an engineering firm to prepare a design package for the groundwater extraction and treatment system that will contain and treat groundwater at the LRCP.

## 5.1 PLANNED WORK

IKEC's consultant or hydrogeologist will continue to sample and test all of the monitoring wells as part of the semi-annual requirement.

IKEC's hydrogeologist will continue to collect monthly depth-to-groundwater readings at wells in the area of the LRCP. This will help to better understand the dynamic nature of groundwater flow at the LRCP, which is a function of unique site geologic formations, and ensure the remedy selected is appropriate.

IKEC's hydrogeologist will continue to develop Time-Series evaluations to determine if the concentrations of Molybdenum are increasing, decreasing, or are asymptotic. This item is being completed to support a more robust modeling effort, and is meant to aid in the final selection of a remedy process.

IKEC's hydrogeologist will continue to evaluate the effects of flood events on the site.

IKEC and their CCR hydrogeologist will continue to evaluate the technology options identified in the ACM, and engage the site's Qualified Professional Engineer to ensure the alternatives meet the criteria set forth in 40 CFR 257.97.

IKEC will finalize the hiring of a firm to complete an engineering design package for the groundwater extraction and treatment system for groundwater at the LRCP. The design package is anticipated to be completed within the next six months.

IKEC will submit the next progress report by December 1, 2023.

A final report will be prepared after the remedy is selected. This report will describe the proposed solution and how it meets the standards specified in 40 CFR § 257.97(b) and 257.97(c). Recordkeeping requirements specified in 40 CFR § 257.105(h), notification requirements specified in 40 CFR § 257.106(h), and internet requirements specified in 40 CFR § 257.107(h) will be complied with as required by 40 CFR § 257.96(f).