U.S. EPA's Final CCR Rule
A Clean Closure Success -
Fox Lake Generating Station
Interstate Power and Light Company

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KEYWORDS: coal ash, clean closure, impoundment, CCR, USEPA, rule, compliance, hydraulic dredging, bid evaluation, certification

I. EXECUTIVE SUMMARY

The U.S. EPA's original Coal Combustion Residuals Rule (published April 17, 2015) included an exemption clause from most Rule requirements for inactive CCR surface impoundments that closed by either capping or removal before April 17, 2018. This exemption clause was the incentive for Interstate Power and Light Company to expedite clean closure of the Fox Lake Generating Station surface impoundment. The station was converted to natural gas in 1998; however, the former ash impoundment contained nominal quantities of CCR from pre-1998 operations. Although the Rule revision, published August 5, 2016 (effective date of October 4, 2016), removed the exemptions for inactive impoundments, the CCR removal activities were completed and clean closure was independently certified on August 17, 2016. Final disposal and restoration activities were completed by the end of 2016.

The scope of the overall project included:

- Preliminary studies resulting in the decision to use hydraulic dredging, geotextile dewatering tube filtration, polymer addition, and discharge water filtration as necessary to achieve compliance;
- Plans and specification preparation;
- Bid evaluation; and,
- Project execution, oversight, and certification.

Although the received bids included options of Wet Excavation, Dewatering and Excavation, and Hydraulic Dredging - options considered in the preliminary assessment - re-evaluation of these options confirmed hydraulic dredging was the best option for successful clean closure.

This paper presents the success of the CCR impoundment closure including the planning, decision-making process, construction activities, and certification of the clean closure of a CCR surface impoundment.

II. BACKGROUND

In the summer of 2015, Alliant Energy (Alliant), on behalf of its subsidiary Interstate Power and Light Company (IPL), retained Sargent & Lundy LLC (S&L) to develop a compliance strategy for Fox Lake Generating Station (Fox Lake) to meet recently-published water, wastewater discharge, and ash management regulations. One aspect of the compliance strategy pertained to the recent changes to the Resource Conservation and Recovery Act (RCRA) regarding coal combustion residuals (CCR), and how these changes would affect the former ash pond at the Station. Once the compliance strategy was selected, Alliant then decided to pursue the recommended actions and retained S&L to team with them as the Owner's Engineering, Procurement, and Construction Management contractor to see the project through to completion.

The Fox Lake Generating Station is located near Sherburn, Minnesota, along the southern edge of Fox Lake. The station has a total of four units (Units 1, 2, 3 and 4) that originally burned coal. Units 2 and 4 have been retired. Units 1 and 3 were converted to natural gas operation in 1998 and operate as peak load generators.

Figure 1: Annotated aerial photograph of the Fox Lake Generating Station prior to Clean Closure Project.

III. PROJECT DRIVER

On April 17, 2015, the U.S. EPA published 40 CFR Part 257, Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (the "CCR Rule"). CCR includes fly ash, bottom ash, boiler slag, and flue gas desulfurization (FGD) byproducts. The CCR Rule establishes minimum national criteria for CCR landfills and CCR surface

impoundments, including location restrictions, liner design criteria, structural integrity requirements, operating criteria, groundwater monitoring and corrective action requirements, closure and post-closure care requirements, and recordkeeping, notification, and internet posting requirements.

Most applicable to Fox Lake is the CCR Rule's regulations regarding closure of inactive CCR surface impoundments. The CCR Rule defines inactive CCR surface impoundments to mean CCR surface impoundments that no longer receive CCR on or after October 19, 2015, and that still contain both CCR and liquids on or after October 19, 2015.

Fox Lake has not produced CCR since converting to natural gas as its fuel source in 1998. The one surface impoundment (formally known as the ash pond) once received sluiced bottom ash from all of the units when they were coal-fired. Bottom ash was periodically dredged from the impoundment by station personnel to provide additional room for settling and storage capacity. Although the impoundment was dredged shortly after converting the Station to natural gas, the impoundment still contained some CCR materials from historic coal-fired operations. Therefore, the ash pond was classified as an inactive CCR surface impoundment per the CCR Rule definitions. The surface impoundment covers an area of approximately 1.55 acres and serves as the station's National Pollutant Discharge Elimination System (NPDES) -permitted low volume waste discharge settling basin. The Station's NPDES-permitted low volume wastes originates from demineralized wastewater, plant floor drains, equipment cooling water, and cleaning wastewater, and enters the surface impoundment as effluent from the Station's sump pump.

The original publication of CCR Rule §257.100(a) stipulated that inactive CCR surface impoundments were subject to all of the requirements applicable to existing CCR surface impoundments (e.g., location restriction assessments, structural integrity assessments, hazard potential assessments, groundwater monitoring requirements, etc.), ***unless*** the surface impoundment was closed pursuant to §257.100(b) before April 17, 2018 (emphasis added). In other words, per the initial issue of the Rule, if the inactive CCR surface impoundment was closed by April 17, 2018, then the owner or operator of the impoundment would be exempt from all other requirements of the CCR Rule.

In 2015, Alliant decided to pursue taking full advantage of the exclusion clause provided for inactive CCR surface impoundments in §257.100(b) and to work to close the inactive CCR surface impoundment at the Fox Lake Generating Station before April 17, 2018. Following the initial writing of the Rule, closure of the inactive CCR surface impoundment before April 17, 2018 would exempt Alliant from the CCR Rule requirements for 30 years of groundwater monitoring, weekly and annual inspections, receiving a hazard potential ranking, slope stability analysis, run-on/off analysis, establishing an emergency action plan, and construction documentation.

IV. CCR COMPLIANCE STRATEGY

Closure of an inactive CCR surface impoundment can be either in the form of complete removal of all CCR from the impoundment or by leaving the CCR in place and providing a final cover system that complies with several specific design requirements, which include, but are not limited to, material permeability and specified material layers and thicknesses.

In the summer of 2015, S&L conducted a detailed screening of regulations and technologies in order to identify and evaluate feasible compliance options for Fox Lake. S&L participated in plant walkdowns, collected site-specific data and drawings, and interviewed plant personnel. In the fall of 2015, based on a regulatory review and information gathered from the site visits, S&L recommended compliance options to Alliant for its overall compliance plan. This phase of the project evaluated various compliance options on the bases of costs, schedule, benefits, and risks.

The following four options were considered for the closure of the inactive CCR surface impoundment at the Fox Lake Generating Station and represent standard industry practices for effectively and efficiently closing a surface impoundment by either leaving the CCR in place or by removing the CCR.

A. CLOSURE BY CAP IN PLACE

Due to the limited volume of CCR material within the impoundment, and the station's desire to continue use of the impoundment as a settling basin for low volume waste streams, the option to close the impoundment by leaving the CCR in place and installing a compliant cover was quickly eliminated.

B. DEWATERING AND MECHANICAL EXCAVATION

One option that was considered for clean closing the inactive CCR surface impoundment involved first draining the impoundment, cutting some rim ditches, and then providing sufficient time for the material to drain and dry before removing CCR and other sediments through standard mechanical means. This method could include the use of filter bags to filter impoundment water while dewatering. The benefits of this method include the following:

- CCR would be principally contained to the impoundment area,
- CCR would be handled once,
- Very common, quick method of material removal to the offsite landfill, and
- Ease of documenting that all of the CCR has been removed from within the impoundment.

As enticing as the preceding benefits appear, further investigation of the site-specific constraints exposed several significant obstacles that prevented the selection of this method for CCR removal and clean closure.

The first major obstacle involved managing the continuous low volume waste streams from operating and non-operating units. Even when the units were not operating, the impoundment was receiving approximately 1,000 gpm of wastewater. In order to completely drain the impoundment, either this flow would need to cease, thus forcing a complete shutdown of the unit until the project was complete, the impoundment would need to be divided into multiple sections and cleaned section by section, or wastewater would need to be managed through other temporary on-site water treatment installations, which would greatly increase the cost of this closure method.

A second major obstacle pertained to the impoundment dikes separating the impoundment from Fox Lake and the adjacent cooling canal. Boring logs revealed sand and gravel seams within both dikes. The presence of these sand and gravel seams exposed the potential for hydraulic connectivity between the impoundment and the adjacent bodies of water and brought into question the validity and effectiveness of a dewatering operation. A confident quantification of the potential for infiltration from the adjacent bodies of water, and, consequently, the cost of dewatering efforts could not be performed.

As a result of these and other obstacles and risks, this option was eliminated from consideration, and other methods of removal were considered that would allow for the impoundment water to remain in place throughout the clean closure process.

C. MECHANICAL EXCAVATION IN THE WET

Another option that was considered for clean closing of the inactive CCR surface impoundment involved the use of a long stick backhoe to mechanically remove the CCR. The long stick backhoe would be located on either the perimeter dikes or on a floating barge. This method was originally employed to remove bottom ash from the impoundment prior to the Station's conversion to natural gas in 1998. This method is also very common for dredging contractors; however, several significant obstacles prevented the selection of this method for CCR removal, including:

- Likely double- or triple-handling of the CCR material (removal of CCR from pond floor to a material transfer barge, material transfer barge to a temporary on-site dewatering facility, and removal of CCR from site to landfill),
- Safety concerns with overhead electrical transmission lines, and
- Containment of CCR during handling.

Moreover, the most significant concern with this method pertained to its ability to comply with the CCR Rule requirements for a clean closure. Each pass of the dredge bucket would result in some degree of sloughing of the CCR material on the floor of the impoundment. The degree of sloughing would range greatly across the impoundment floor depending on the in-situ materials present. Additionally, the turbulence caused by the movement of the dredge bucket would cause some CCR material to be re-suspended into the water column. This method would not filter the impoundment water, and, therefore, over time, a layer of CCR would redeposit on the floor of the

impoundment, thus requiring multiple rounds of dredging, time for settlement, and re-dredging. Therefore, this method was also removed from consideration.

D. HYDRAULIC EXCAVATION COMBINED WITH GEOTEXTILE DEWATERING TUBES

A third clean closure method that was investigated combined the use of hydraulic excavation with geotextile dewatering tubes located in an on-site temporary dewatering facility. With this method, a barged-mounted hydraulic suction dredge would remove the CCR and sediments from the floor of the impoundment and transport the slurry mixture via HDPE piping to a temporary on-site dewatering facility (TDF). Within the TDF, the HDPE piping would direct the slurry into geotextile dewatering tubes where the sediment and CCR would be contained within the tubes while water filters through the permeable geotextile membranes into a collection sump. The filtrate would then be filtered one more time through temporary filter housings before being discharged into the cooling canal or returned to the impoundment as make-up water. Although this third method included the installation of a large temporary dewatering facility, this method provided the following advantages:

- 100% containment of CCR material throughout removal from pond to dewatering facility and from dewatering facility to landfill,
- Impoundment remains in operation throughout clean closure process, receiving low volume waste streams from operating and non-operating units,
- Reduced suspended particles in impoundment water column due to slowly rotating cutting head and suction method of removal,
- Hydraulic dredging process filters and recycles water to the impoundment thus reducing suspended solids within water column,
- Haul truck traffic isolated from plant operations, and
- Safety with regards to overhead electrical transmission lines.

E. SELECTED CLOSURE METHOD

The preceding four closure options were evaluated in detail during the initial development of the Fox Lake compliance strategy. Closure by removal of the CCR through the use of hydraulic excavation combined with geotextile dewatering tubes was selected for the closure method. S&L then prepared bid documents, complete with technical specifications and detailed construction drawings, and issued them to prospective bidders. Interestingly enough, some of the prospective general work contractors submitted alternate proposal schemes that included dewatering and excavation and mechanical wet excavation. Each proposal was evaluated on the basis of environmental care, completeness of bid package, contractor experience, material quality, dredging equipment, ability to achieve CCR clean-close certification, relative feasibility, and cost. Although the received bids included options of wet excavation, dewatering and excavation, and, hydraulic dredging, re-evaluation of these options confirmed hydraulic dredging was the best option for a successful clean closure of the Fox Lake Generating Facility inactive CCR surface impoundment.

V. PROJECT EXECUTION

Clean closure of the inactive CCR surface impoundment using the hydraulic excavation with geotextile dewatering tubes included, but was not limited to, the following activities:

- Installation and removal of a temporary on-site dewatering facility,
- Relocation of accumulated CCR and sediment material present within the pond to the temporary dewatering facility,
- Dewatering of the relocated CCR and sediment slurry,
- Removal of the dewatered solids to an off-site permitted landfill disposal facility, and
- Final restoration of all disturbed areas.

A. HYDRAULIC DREDGE

Based on a bathymetric pond survey, the inactive CCR surface impoundment was estimated to contain approximately 10,000 cubic yards of soft sediment, which consisted of both CCR and other soft sediments. To clean close the inactive CCR surface impoundment, the contractor was directed to remove all the CCR, soft sediments, and the upper portion of impoundment subgrade material using a barge-mounted hydraulic dredge. As previously mentioned, the dredge was used to pump a slurry mixture of sediment, CCR material, and suctioned water from the impoundment and transport the material to a temporary on-site dewatering facility. The selected dredge was equipped with a global positioning system (GPS) in order to track the progress of the dredging activity across the surface of the impoundment floor, and it had a pumping rate between approximately 1,000 to 1,800 gpm.

Figure 2: Deployment of the barge-mounted hydraulic dredge onto the impoundment.

B. DEWATERING FACILITY

Prior to commencing the dredging operation, the contractor needed to install a temporary dewatering facility to receive the pumped CCR and sediment slurry. S&L selected the former coal yard for the temporary dewatering facility to reduce the amount of grading required and utilize the existing stormwater drainage swale for collection of the filtrate from the geotextile dewatering tubes. To prepare the on-site dewatering facility, the contractor performed the following activities:

- Grade the surface of the dewatering facility to receive the geotextile dewatering tubes within manufacture recommendations,
- Install perimeter earthen berms to contain all filtrate water,
- Install a geomembrane liner on the entire surface and up all perimeter berms to prevent leakage of the filtrate water into the surrounding environment, and
- Install temporary HDPE piping, polymer injection system, and filtrate water treatment plant.

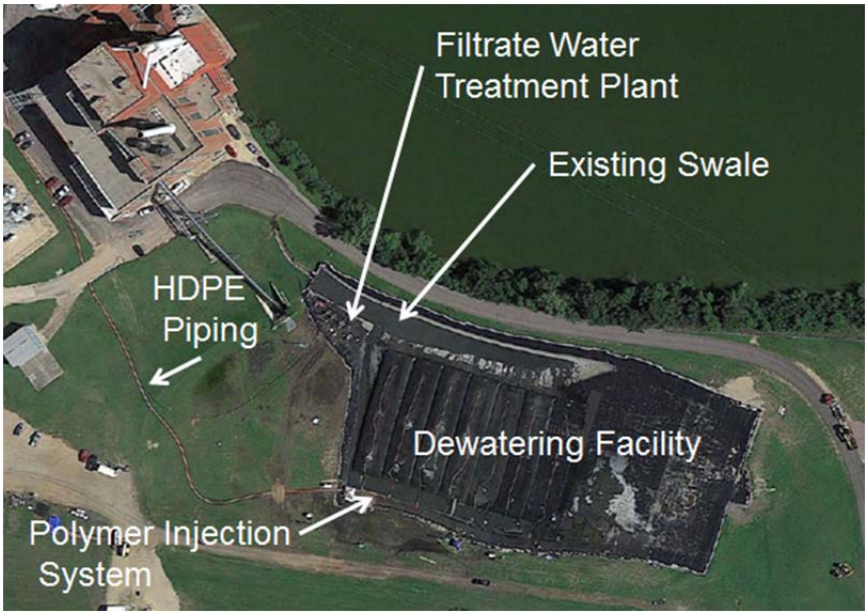

Figure 3: Annotated aerial photograph of dewatering facility halfway through dredging process.

C. NPDES COMPLIANCE STRATEGY

Effluent from the dewatering facility was directed to either return to the impoundment as make-up water for the dredging process or discharge into the cooling canal at the existing impoundment outfall location. The station was operating under an existing NPDES permit, which imposed various effluent limitations including total suspended solids (TSS). With the process flow discharging to the cooling canal, compliance with the NPDES effluent limitations became a primary objective for this project. Three means of controlling the suspended solids were employed to continuously maintain and monitor the effluent clarity: initial polymer injection system, the geotextile dewatering tubes, and a temporary water treatment plant. Figure 4 shows the water clarity at

various locations throughout the dredging and filtering process. As a result of these water clarity efforts, no NPDES effluent exceedances were reported throughout the entire duration of the pond clean-closure project.

Figure 4: Water clarity at various locations throughout the dredging and filtering process.

1. POLYMER INJECTION SYSTEM

Following S&L's recommendations, the contractor opted to install a polymer injection system upstream of the geotextile dewatering tubes. The polymers selected complied with the station's NPDES and other Minnesota Pollution Control Agency (MPCA) water quality standards in effect for Fox Lake. The addition of the polymers into the sediment slurry helped to flocculate the sediment and CCR into larger particle sizes and thus enhanced the dewatering and filtering capabilities of the geotextile dewatering tubes.

Figure 5: Polymer injection system.

2. GEOTEXTILE DEWATERING TUBES

After receiving the polymer, the CCR and sediment slurry was discharged into geotextile dewatering tubes. The geotextile dewatering tubes were fabricated by sewing permeable geotextile material into a tube shape with ports for slurry injection. The tubes enable the passage of water while simultaneously retaining the CCR and sediments. Over time, a filter-cake can build up on the inside of the geotextile material allowing for enhanced clarity of filtrate water. The tubes selected for this project were approximately 120 feet long, 30 feet wide, and 6 feet tall when full of material.

Figure 6: A geotextile dewatering tube being filled with the CCR and sediment slurry.

3. WATER TREATMENT PLANT

A temporary water treatment plant was also installed within the dewatering facility to polish the geotextile dewatering tube filtrate water before discharging to the Cooling Canal or the impoundment. The water treatment plant consisted of two 100-micron bag filter housings and an associated pump. The filtrate water coming off of the geotextile dewatering tubes contained relatively low suspended solids; however, this extra water treatment system provided an additional level of confidence in complying with the station's NPDES permit effluent limitations. Furthermore, this equipment provided an ability to control and maintain TSS levels if there was an uncontrolled release of CCR within the dewatering facility, or in the case of a rain event while removing and hauling the dewatered material offsite.

Figure 7: The two 100-micron bag filters of the temporary water treatment plant.

D. FINAL CERTIFICATION

To confirm completion of the clean closure operations, Alliant Energy retained an independent engineer to visually verify that the inactive CCR surface impoundment was free of CCR material. The independent engineer deployed the use of pre- and post-dredging sediment coring to visually examine that the CCR and soft sediment was removed from the bottom of the impoundment, or to determine whether additional dredging was needed and where. Furthermore, at the completion of the work, the independent engineer verified that all of the dredged material relocated to the dewatering facility had been completely removed from the site. Finally, the independent engineer provided Alliant with a written certification stating that the inactive CCR surface impoundment was closed in accordance with the requirements of §257.100(b)(5) of the CCR Rule on August 17, 2016.

VI. SCHEDULE CONSTRAINTS

With a specific closure date of April 17, 2018, listed explicitly in the CCR Rule, Alliant was very motivated to close the impoundment as soon as possible. Therefore, a very aggressive schedule was implemented for this project.

The CCR Rule became effective on October 19, 2015. S&L completed the compliance study phase of the project and presented recommendations to Alliant on November 4, 2015. Detailed design for the clean closure project, including detailed design of the temporary installations and writing of specifications and other technical procurement documents, began on December 1, 2015. The project went out for competitive bid on March 4, 2016, and a general work contract was signed with the successful bidder on June 1, 2016. Construction of the temporary installations began on July 5, 2016, and

dredging began on July 22, 2016. Shortly thereafter, the dredging process was complete, and on August 17, 2016, the independent engineer reviewed the pond and certified that the pond was clean in accordance with the CCR Rule. The certification came approximately two months before the effective date of the rule revision, October 4, 2016.

To summarize the speed of this project, from the effective date of the CCR Rule to clean closure certification took a total of 10 months, and from initiation of construction activities to clean closure certification was only 6 weeks.

VII. CONCLUSION

After evaluating several CCR Rule compliance strategies, the selected closure method for the impoundment was through removal of the CCR using a barge-mounted hydraulic suction dredge combined with geotextile dewatering tubes located in an on-site dewatering facility. The impoundment was successfully cleaned, closed, and certified as such by an independent engineer on August 17, 2016, ten months after the effective date of the CCR Rule. As a result of continuous monitoring of filtrate clarity and the installation of several water clarity measures, no NPDES exceedances were recorded throughout the project duration.

Even with regulatory deadline uncertainties and stringent compliance requirements of the CCR Rule, close communication and partnership between Alliant, Sargent & Lundy, and the contractors resulted in the great success of this inactive CCR surface impoundment clean closure project at the Fox Lake Generating Station.