Ash Transport Water: Interpretation of the ELG Rule

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INTRODUCTION

The definition of “transport water” is stated in the 2015 Effluent Limitations Guidelines (ELGs) Rule, Code of Federal Regulations (CFR) Title 40 § 423.11(p). The term transport water means “any wastewater that is used to convey fly ash, bottom ash, or economizer ash from the ash collection or storage equipment, or boiler, and has direct contact with the ash. Transport water does not include low volume, short duration discharges of wastewater from minor leaks (e.g., leaks from valve packing, pipe flanges, or piping) or minor maintenance events (e.g., replacement of valves or pipe sections).”¹

Upon cursory review, the definition above is clear and succinct, but only after detailed study of wet bottom boilers and their refractory cooling water, boiler seal water, and ash quench water does the definition begin to become difficult to apply to actual generating stations in need of ELG compliance.

Across the United States, coal fired generating stations are faced with budget constraints stemming from market changes, and rising environmental compliance costs of the ELG and the Coal Combustion Residual rule (CCR). It has become apparent that a delta of several hundred thousand dollars of capital project budgets can be the difference of continuing to operate for a few more decades or closing the station.

DEFINITIONS

Transport Water Definition

As stated above, the term transport water means “any wastewater that is used to convey fly ash, bottom ash, or economizer ash from the ash collection or storage equipment, or boiler, and has direct contact with the ash. Transport water does not include low volume, short duration discharges of wastewater from minor leaks (e.g., leaks from valve packing, pipe flanges, or piping) or minor maintenance events (e.g., replacement of valves or pipe sections).”¹

Before delving further into approaches for achieving ELG and CCR compliance, it is important to identify the specific types of water including ash transport water as they are defined and the compliant management methods within each of the individual ELG and
CCR rules. The 2015 ELG Rule sets limits for pollutant discharge at coal fired steam generation power facilities and in turn requires a Zero Liquid Discharge (ZLD) process for ash transport water. The rule is detailed in 40 CFR Part 423, and according to Section VI Part B.2 and B.3 of the 2015 ELG Rule, fly ash and bottom ash transport water are defined as follows:

**Fly Ash Transport Water Typical Use**

“Plants use particulate removal systems to collect fly ash and other particulates from the flue gas in hoppers located underneath the equipment. Of the coal, petroleum coke, and oil-fired steam electric power plants that generate fly ash, most of them transport fly ash pneumatically from the hoppers to temporary storage silos, thereby not generating any transport water. Some plants, however, use water to transport (sluice) the fly ash from the hoppers to a surface impoundment. The water used to transport the fly ash to the surface impoundment is usually discharged to surface water as overflow from the impoundment after the fly ash has settled to the bottom.”

**Bottom Ash Transport Water Typical Use**

“Bottom ash consists of heavier ash particles that are not entrained in the flue gas and fall to the bottom of the furnace. In most furnaces, the hot bottom ash is quenched in a water-filled hopper. For purposes of this rule, boiler slag is considered bottom ash. Boiler slag is the molten bottom ash collected at the base of the furnace that is quenched with water. Most plants use water to transport (sluice) the bottom ash from the hopper to an impoundment or dewatering bins. The ash sent to a dewatering bin is separated from the transport water and then disposed. For both of these systems, the water used to transport the bottom ash to the impoundment or dewatering bins is usually discharged to surface water as overflow from the systems, after the bottom ash has settled to the bottom. Of the coal, petroleum coke, and oil-fired steam electric power plants that generate bottom ash, most operate wet sluicing handling systems.”

According to Title 40 CFR 423 Section VIII Part B.2 and B.3, fly ash must be dry handled and bottom ash transport water must be addressed in accordance with best practices:

**Fly Ash Transport Water ELG Requirement**

The EPA requires zero discharge effluent limitations and standards for pollutants in fly ash transport water based on use of a dry handling system.

**Bottom Ash Transport ELG Requirement Water**

The EPA requires zero discharge effluent limitations and standards for pollutants in bottom ash transport water based on one of two technologies: a dry handling system or a closed-loop system.

**Low Volume Wastewater**

The term low volume waste sources means “taken collectively as if from one source, wastewater from all sources except those for which specific limitations or standards are otherwise established in this part. Low volume waste sources include, but are not limited to, the following: Wastewaters from ion exchange water treatment systems,
water treatment evaporator blowdown, laboratory and sampling streams, boiler blowdown, floor drains, cooling tower basin cleaning wastes, recirculating house service water systems, and wet scrubber air pollution control systems whose primary purpose is particulate removal. Sanitary wastes, air conditioning wastes, and wastewater from carbon capture or sequestration systems are not included in this definition.”  

Less than 50 MW Exception for Fly Ash and Bottom Ash

“For any electric generating unit with a total nameplate generating capacity of less than or equal to 50 megawatts or that is an oil-fired unit, the quantity of pollutants discharged in fly ash transport water and bottom ash transport water shall not exceed the quantity determined by multiplying the flow of fly ash transport water times the concentration listed for Oil and Grease or TSS in § 423.12(b)(4).”  

These requirements for bottom ash and fly ash transport water discharges for units under 50 MW follows below:

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>1 Day Maximum (mg/L)</th>
<th>30 Day Average (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solid (TSS)</td>
<td>100.0</td>
<td>30.0</td>
</tr>
<tr>
<td>Oil and Grease</td>
<td>20.0</td>
<td>15.0</td>
</tr>
</tbody>
</table>

Therefore, units above 50 MW will be required to recycle their ash transport water, or convert to dry ash handling systems, to comply with the ELG Rule.

Best Available Technologies for Fly Ash Transport Water Compliance

The ELG rule “identifies dry handling as the BAT technology basis for control of pollutants in fly ash transport water. Specifically, the technology basis for BAT is a dry vacuum system that employs a mechanical exhauster to pneumatically convey the fly ash (via a change in air pressure) from hoppers directly to a silo. Dry handling is clearly available to control the pollutants present in fly ash transport water.”

“Today, the vast majority of steam electric power plants use dry handling techniques to manage fly ash, and by doing so avoid generating fly ash transport water. All new generating units built since the ELGs were last revised in 1982 have been subject to a zero-discharge standard for pollutants in fly ash transport water.”

Best Available Technologies for Bottom Ash Transport Water Compliance

The 2015 ELG rule “identifies dry handling or closed-loop systems as the BAT technology basis for control of pollutants in bottom ash transport water. More specifically, the first technology basis for BAT is a system in which bottom ash is collected in a water quench bath and a drag chain conveyor (mechanical drag system) then pulls the bottom ash out of the water bath on an incline to dewater the bottom ash.

“The second technology basis for BAT is a system in which the bottom ash is transported using the same processes as a wet-sluicing system, but instead of going to an impoundment, the bottom ash is sluiced to a remote mechanical drag system. Once
there, a drag chain conveyor pulls the bottom ash out of the water on an incline to dewater the bottom ash, and the transport (sluice) water is then recycled back to the bottom ash collection system." 

LAYMAN’S DEFINITIONS IN CONTEXT OF THE 2015 ELG RULE

Ash Transport Water
Water that is used to convey or sluice (flushed or mixed with water to facilitate movement) any type of ash from coal fired power generation.

Zero Liquid Discharge
There should be no ash transport water discharged through any permitted outfalls, storm water outfalls, plant drains, ponds, impoundments, etc. Ash transport water may be recycled, evaporated, or sent to the FGD scrubber as make up water. Alternatively, a dry handling system for bottom ash and fly ash will fulfill the ZLD requirements. This applies to all transport water that is used or once used to convey ash media fly ash, bottom ash, or economizer ash from the ash collection or storage equipment, or boiler, and has direct contact with the ash.

Commingled Waters
Any water that ash transport water comes in contact with results in both waters being considered ash transport water and will be held to the ELG requirements of zero liquid discharge. For example, if 800 gallons per minute (182 cubic meters per hour) of bottom ash sluice water is routed to a storm water pond, now the entire contents of the storm water pond are considered ash transport water and are not able to be discharged.

Low Volume Wastewater
Waters around the plant that are not generated in large quantities or frequently.

Examples of low volume wastewaters include:
- wastewaters from ion exchange water treatment systems
- water treatment evaporator blowdown
- laboratory and sampling streams
- boiler blowdown
- floor drains
- cooling tower basin cleaning wastes
- recirculating house service water systems

Examples of non-low volume wastewaters:
- cooling tower blowdown
- stormwater runoff
- coal pile runoff
- metal cleaning wastes
- FGD wastewater
- bottom ash transport water
• fly ash transport water

De Minimis

Insignificant amounts, usually referring to the amount of ash in a certain tank or pond such as storm water ponds. Specifically, the de minimus definition comes from the federal Coal Combustion Residuals (CCR) Rule, and applies to impoundments and ponds where the primary purpose is not to store ash.²

VARIOUS WASTEWATERS VERSUS ASH TRANSPORT WATER

Hydrobin Overflow: Ash Transport Water

Bottom ash sluice water that overflows from the hydrobin can contain ash. Water found in the hydrobin including rain water has commingled with ash sluice water. Therefore, all water from the hydrobin is subject to zero liquid discharge requirements.

Hydrobin Decant Water: Ash Transport Water

Sluice water remaining in the hydrobin is drained through a screen after the sluicing operation is complete. The hydrobin decant water may contain low levels of ash. It is unlikely that the hydrobin screens remove all CCR material down to non-detect levels. Water found in the hydrobin including rain water has commingled with ash sluice water. Therefore, all water from the hydrobin is subject zero liquid discharge requirements.

Stormwater and Stormwater Runoff Entering Tanks, Ponds Hydrobins that Contain Ash

Transport Water:

Rain water and stormwater runoff is a challenge with the ZLD requirement of the 2015 ELG Rule. Any water (including storm water) that comes in contact with ash sluice water is characterized as ash sluice water. It may be required to cover hydrobins and tanks and to berm ponds to mitigate water infiltration, which can cause an excess of water offsetting the water balance.

Boiler Seal Water Overflow: Low Volume Wastewater

Overflow from the boiler seal or water from the “telltale” ports maintains the seal between the hopper/trough and the boiler. Water comes in contact with bottom ash but is not used to convey or sluice ash.

Refractory Cooling Water: Low Volume Wastewater

Refractory cooling water is used to prevent the refractory bricks at the bottom of the boiler from overheating. This water comes in contact with bottom ash but is not used to convey or sluice ash.

Ash Quench Water: Low Volume Wastewater

Ash quench water is the water pooled at the bottom of a wet bottom boiler in the ash hopper. This water comes in contact with bottom ash but is not used to convey or sluice ash.
Plant Floor Drains: Low Volume Wastewater

Various floor drains on the ground floor of the plant are specifically called out as low volume wastewater in the 2015 ELG Rule. Small amounts of ash may be present, but is considered de minimis under the CCR rule, and plant drains are not intended to convey or transport ash.¹ ²

Storm Drains in the Hydrobin Area: Low Volume Wastewater if bermed and isolated

Many facilities have storm drains located in the hydrobin area. Stormwater is acceptable to be routed to storm drains, however the vast majority of hydrobin gates leak significantly. This gate leakage is not considered a minor / temporary event. As described above all water in the hydrobin is characterized as ash transport water and by that reasoning, leakage is also considered ash transport water and should be routed contained within the ZLD system. It may be necessary to berm the area under the hydrobin and install a sump pump to collect the leakage and return the water to the ZLD system.³

Boiler Blowdown Tank: Low Volume Wastewater

Receives steam and condensate from various plant systems. No ash is present in this water. Boiler blowdown is specifically called out as low volume wastewater in the 2015 ELG Rule.

Leaks from Ash Sluice Pipelines: Low Volume Wastewater

Leaks in general should be attended to and fixed. Water from minor maintenance events is characterized as low volume wastewater provided that the discharge is attended to and fixed in a timely manner. Examples of minor maintenance events include, but are not limited to, the following:

- Sluice line isolation/crossover valve packing failure or other mechanical valve failure.
- Minor leaks due to corrosion/erosion in the closed-loop system pumps, piping, valves, connections, and tanks.
- Minor leaks due to packing or seal failures in pumps, ash crushers, and bottom ash hopper isolation gates.

It should be reiterated that leaks and minor maintenance events are temporary in duration and should be addressed in a timely manner.³ ⁴

Ash sluice water pipe bursts and equipment failure: Reportable NPDES Upset Condition

A major failure of pipe, valve, or equipment integral to a bottom ash sluice and transport system is considered an upset condition of a NPDES permit. Generating stations will have to refer to the specific language in their permit. The general consensus states that “Upset Condition” means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.³ ⁵
Leakage from Mechanical Seals on Ash Sluice Pumps: Low Volume Wastewater

Leaks in general should be attended to and fixed. However, mechanical seals are designed to leak. This water should be routed to a building sump or a plant drain. Leaks are specifically called out as low volume wastewater in the 2015 ELG Rule.

Submerged Flight Conveyer Water: Low Volume Wastewater

In general, this water is a closed loop system in itself. The water comes in contact with ash, but it is not used to convey ash.

HOW TO DESIGN A ZLD BOTTOM ASH SYSTEM

As stations compare different CCR compliant alternatives and approaches to their existing ash ponds, it is imperative to take a step back and fully consider the 2015 ELG Rule implications at the station as well. The 2015 ELG Rule prohibits liquid discharges from ash sluicing systems. If stations have ruled out dry handling of ash material due to cost restrictions they must convert existing ash sluicing systems into a closed loop configuration and determine whether the ash ponds are needed for an ELG-compliant, ZLD system.

Under the 2015 ELG Rule, once any non-transport water source comes into contact with ash material or ash transport water it becomes part of the bottom ash system and must be managed accordingly. Therefore, an accurate station water balance as is a critical first step when evaluating options for ELG compliance and CCR ash pond management. This water balance will be the key for the station in isolating the ash sluice system by identifying all of the influent and effluent sources of water and also guide the development of a new overarching station water management solution.

All uncontrolled influent streams into the bottom ash system will need to be either eliminated or managed effectively. This includes stormwater runoff, especially if any large existing CCR impoundments are being incorporated. Although the bottom ash system will need to periodically make-up water to the system to account for normal water losses (e.g. evaporation and moisture in dewatered ash), in developing a ZLD bottom ash system, the introduction of influent water supply needs to be engineered and controlled as to not overload the system.

If make-up water sources for the ZLD system with irregular flow patterns such as stormwater runoff are utilized, the system will need to be managed using impoundments or additional surge/equalization tank capacity to ensure that water is always available when needed while still preventing potentially uncontrolled discharges. Sizing system storage capacity is also critical since any uncontrolled discharges from bottom ash systems will need to be stopped to comply with the 2015 ELG Rule. Currently, many bottom ash system overflows are diverted to permitted outfalls or to the station’s industrial wastewater treatment system which will be in violation of the rule. With a detailed hydraulic analysis of the station’s overall water balance and specifically the bottom ash sluice system, the station will be able to determine the station’s ash sluicing needs, identify optimal make-up water sources and establish sufficient system storage requirements.
Even with regular system water make-up, the conversion of the bottom ash system to a ZLD configuration will increase the number of fines and dissolved substances that accumulate within the system. It is imperative that stations control the cycles of concentration inside the ZLD bottom ash system to prevent catastrophic failures associated with abrasion, scaling, and corrosion. The transport water chemistry can be managed through chemical addition to adjust pH or precipitate fines and / or through ELG-compliant blowdown opportunities for the bottom ash system.

Under the 2015 ELG Rule, bottom ash sluice water may be used for FGD scrubber make-up. If the station does not have a wet FGD scrubber system, it must rely on the entrained moisture in the dewatered bottom ash to serve as a primary form of blowdown. Other novel blowdown mechanisms such as using ash transport water for fly ash moisture conditioning or evaporation through station air heater outlet ducts are also options. The availability of compliant system blowdowns need to be considered when sizing closed loop ash sluicing system capacities. All of this should tie directly into the station’s decision matrix in deciding how to manage CCR compliance with ELGs and determining whether clean closure of ash ponds is the best path forward.

CONCLUSION

Complying with the 2015 ELG Rule and creating a ZLD system for ash transport water can be expensive and possibly put the fate of the generating station in jeopardy. Taking a deep dive into the definitions of low volume wastewater and ash transport water and separating streams from becoming commingled is a sound approach to cost controls for ELG compliance projects. The upcoming ELG Rule revision is anticipated to be released in late 2019. This revision may contain relaxed language for the ash transport water ZLD requirement as well as additional clarity in definitions.

REFERENCES


