REINHOLD ENVIRONMENTAL ®

2026 Reinhold/PCUG Round Table Presentation

Hosted by TVA, Southern Company and Vistra

in the Sonesta Nashville Airport Hotel, Nashville, TN

on June 22-23, 2026

UCC environmental

Sustainable Solutions for Air, Water and Solids

Lessons Learned Managing Water Chemistry in High Recycle Rate Bottom Ash Transport Systems

David Donkin, Director of Wastewater Solutions
Caleb Thornburg, Director of Sales – Material Handling and DSI

June 23, 2026

Safety Moment

Independence Day Celebrations

- Celebrate Safely
  - 14,700 reported ER visits nationally in 2025 due to fireworks mishaps
  - 11 deaths occurred in 2025
- Safe Practices include:
  - Ensure fireworks are legal in your area
  - Never allow young children to play with fireworks
  - Keep a bucket of water handy
  - Never try to re-light or pick up fireworks that have not ignited fully
  - Never use fireworks while impaired by alcohol
  - Follow manufacturers’ instructions

Agenda

- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- Experiences and Lessons Learned
- Case Studies
- Technical Review and Compliance Takeaways
- Conclusions

Agenda

- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- Experiences and Lessons Learned
- Case Studies
- Technical Review and Compliance Takeaways
- Conclusions

Regulatory Requirements Overview

Effluent Limitations Guidelines ~~2024~~ 2026 Final Rule

- Pertaining to the Treatment, Management and Discharge of Bottom Ash Transport Water
- Bottom Ash Systems Subject to the Final Rule:
  - Remote Drag Chain Systems, also known as Submerged Flight Conveyors
  - Traditional Dewatering Bins with Surge and Settling Tanks
  - Concrete Settling Basin Systems
- Bottom Ash Systems Not Subject to the Final Rule:
  - Under-boiler Drag Chains water classified as “quench water” not “transport water” so they are not regulated in the same fashion

Regulatory Requirements Overview

Effluent Limitations Guidelines ~~2024~~ 2026 Final Rule

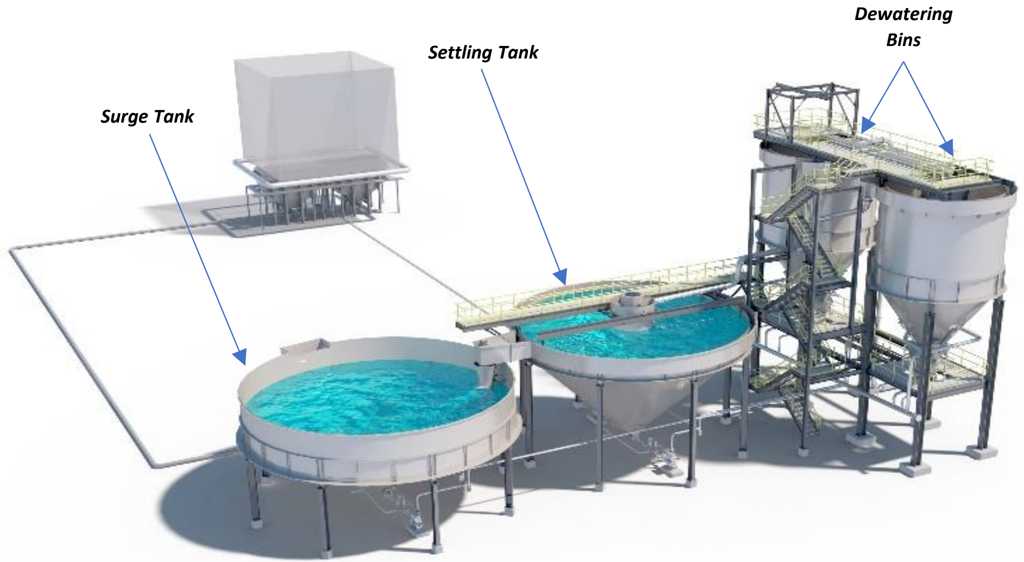
- Bottom Ash Transport Water (BATW)
  - Zero Liquid Discharge will be required for all Bottom Ash Transport Water no later than December 31st, ~~2029~~ 2034
  - "Cessation of Coal Combustion" subcategory adopters may continue to operate under the 2020 ELG requirements until December 31st, 2034
  - No regulatory relief for water balance considerations or maintenance events

Agenda

- Regulatory Requirements Overview
- **Bottom Ash Recirculation System Technologies**
- Experiences and Lessons Learned
- Case Studies
- Technical Review and Compliance Takeaways
- Conclusions

BA Recirculation System Technologies

Traditional Recirculation System



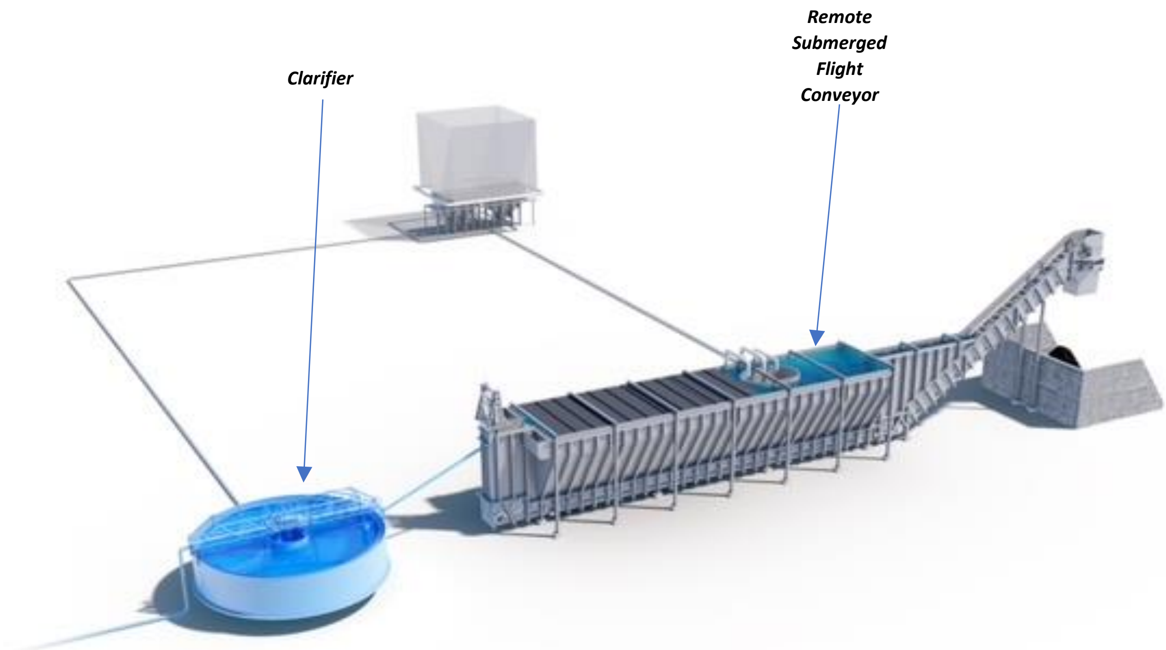
Traditional Recirculation System – Dewatering Bins with Surge/Settling Tanks

BA Recirculation System Technologies

Traditional Recirculation System

BA Recirculation System Technologies

Remove SFC with Recirculation System (CDR System)



Remote Submerged Flight Conveyor with Recirculation and Optional Clarifier

BA Recirculation System Technologies

Remove SFC with Recirculation System (CDR System)

Extensive SFC References

Closed-Loop Recirculation System

Cost Effective Solution

Eliminates Dewatering Bins

Dewaters ash to moisture levels suitable for landfill disposal or beneficial use

Sump fills over time and sluice water is pumped back to system completing the closed-loop

Combines ash dewatering, settling and surge capacity into a single unit

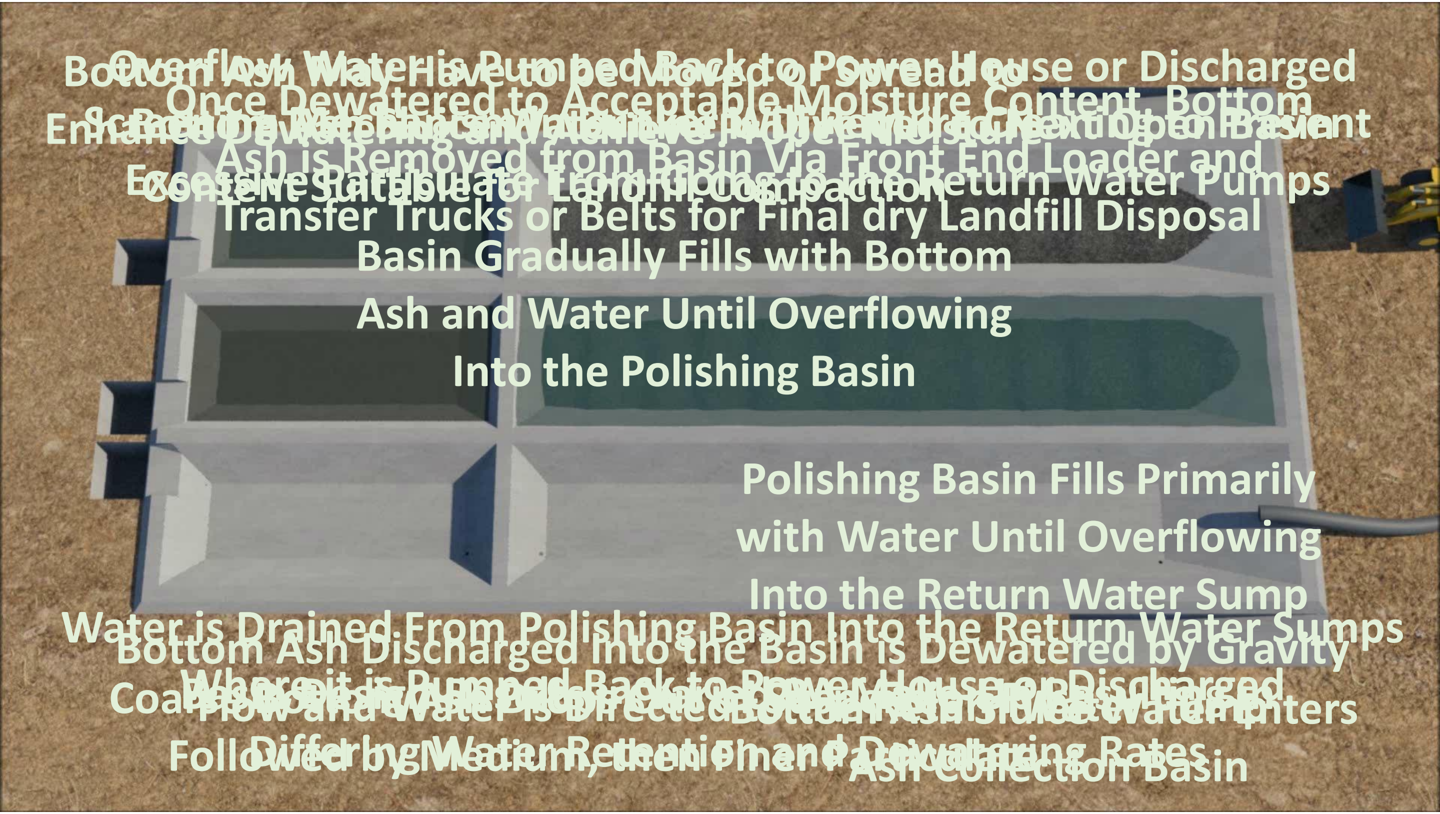
Eliminates Ash Ponds

Reduces Plant Wastewater

Runoff and Rainwater Collects in Trench

BA Recirculation System Technologies

Concrete Settling Basin with Recirculation System



Agenda

- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- **Experiences and Lessons Learned**
- Case Studies
- Technical Review and Compliance Takeaways
- Conclusions

Experiences and Lessons Learned

FAQ: UCC has designed and supplied bottom ash recirculation systems for more than 50 coal-fired plants, so what are the most common implications of closed loop recirculation / zero liquid discharge operation for these systems?

- Suspended solids
- Dissolved minerals cycling
- pH control issues
- Scaling
- Corrosion

…And an increased risk of operational problems, higher maintenance requirements, and unplanned outages.

Experiences and Lessons Learned

Pumps and Water Piping

- Bottom Ash Transport
  Water Recirculation Pumps
  - Vendor selection and materials of construction considerations
  - Mechanical seals vs. packing
- Water Piping
  - Scaling and corrosion risks
  - Erosion and possible plugging issues due to ash fines carryover

Experiences and Lessons Learned

Bottom Ash Hopper Area

- Bottom Ash Hopper Overflow
  - Overflow water typically needs to be captured in a tank or sump and pumped to the tank farm or remote SFC
  - Fines carryover from bottom ash hopper can create issues in the tank and pumps
  - pH issues with bottom ash hopper overflow can create downstream problems if not treated at the source
- Bottom Ash Hopper Nozzles
  - Scaling or suspended solids lead to plugging
  - Suspended solids causing wear

Experiences and Lessons Learned

FAQ: Why is it important to consider these lessons learned in a retrofit or new system design?

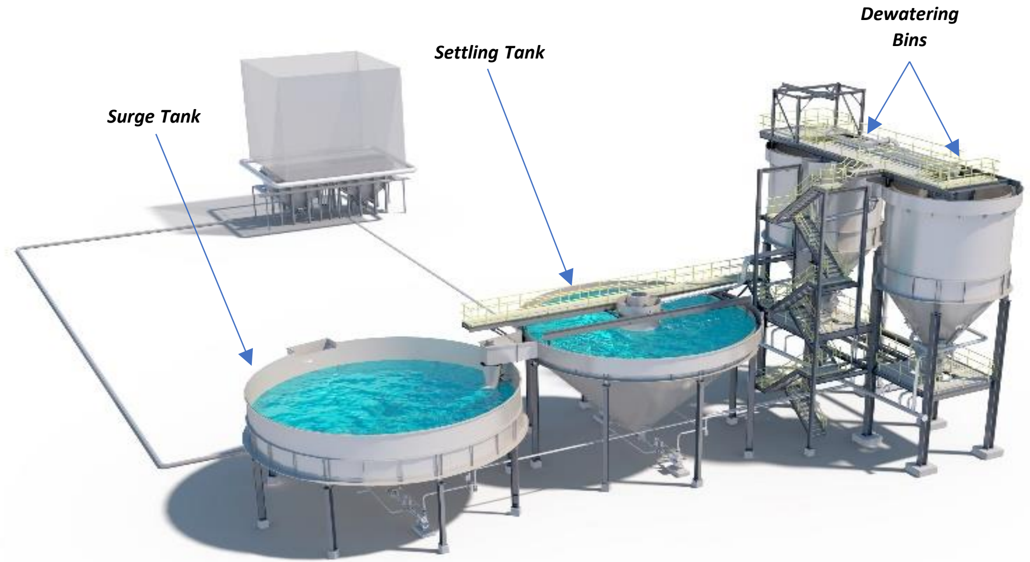
- Compliance with EPA rule requirements
- Maintain proper design parameters for existing equipment to remain in place
  - Don't wear out jet pumps, piping, valves, etc.
  - Avoid plugging of BA hopper nozzles and/or associated equipment
- Get expected wear life for new installed equipment
  - Avoid premature wear of pumps, valves, piping, etc.
  - Avoid plugging and/or buildup of material in newly installed equipment
- Provide an optimized system design with minimal operational and maintenance disruptions

Agenda

- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- Experiences and Lessons Learned
- **Case Studies**
- Technical Review and Compliance Takeaways
- Conclusions

Case Studies

Case Study #1 – Traditional Recirculation System



Traditional Recirculation System – Dewatering Bins with Surge/Settling Tanks

Case Studies

Case Study #1 – Traditional Recirculation System

- Struggled with suspended solids control
- Scale formation
- LSI ranges: 1.08 – 2.58
- pH 8.7-9.3

Case Studies

Case Study #1 – Traditional Recirculation System

- Suspended Solids Resolution
  - Jar Testing / Flocculant Selection
  - Injection Relocation / Sync Dose Rate

Case Studies

Case Study #1 – Traditional Recirculation System

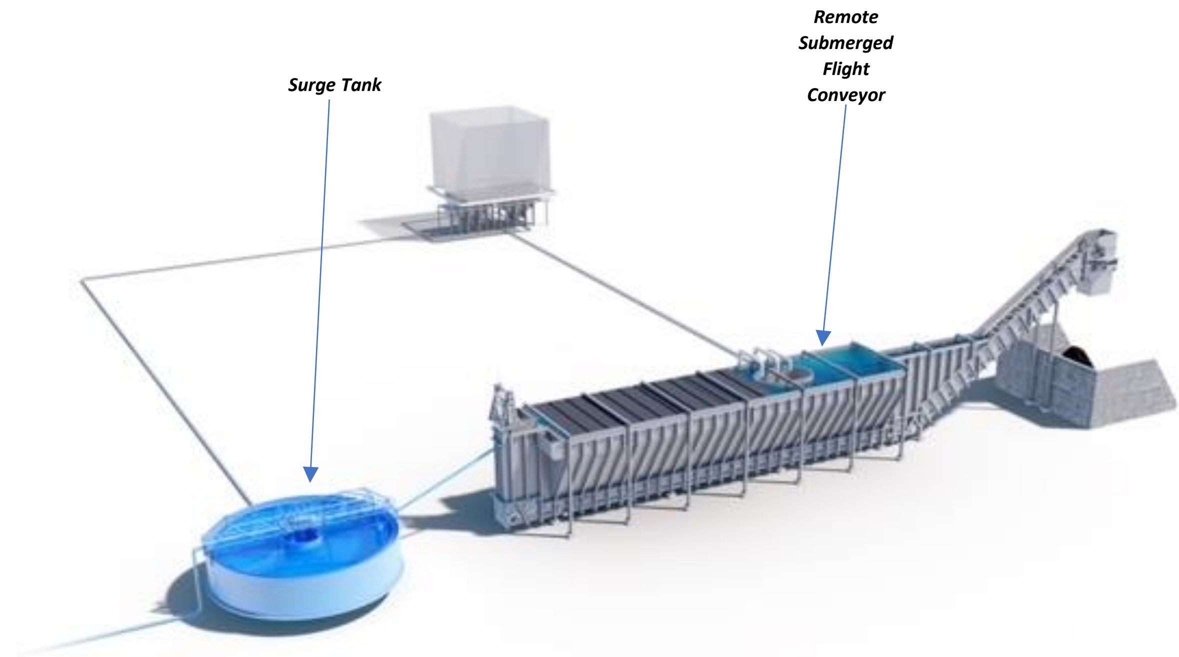
- Scaling Control
  - Sulfuric Acid addition
  - pH range: 6.55 to 7.80
  - LSI Range: -0.90 to 0.50
  - Scale Inhibitor Chemistry - 2026

So Far…

- Continued intermittent scaling is managed with targeted BATW blowdown to the FGD Scrubber System
- Chemical use meets expectations
- Continued study and data collection ongoing

Case Studies

Case Study #2 – Remote SFC with Recirculation System



Remote Submerged Flight Conveyor with Recirculation

Case Studies

Case Study #2 – Remote SFC with Recirculation System

- Initial commissioning conducted with a chemical injection program
- Injection chemistry engineered in from the start
- Initial jar testing aided final chemical selection
- Water contact time is much less
    - Days with Dewatering Bins
    - Hours with Drag Chain

Case Studies

Case Study #2 – Remote SFC with Recirculation System

- Flocculant Addition
  - Typical overflow water TSS of < 100 PPM
  - No clarifier – settling occurs in body of SFC
  - Lamella-assisted settling
  - Exit system with bottom ash

Case Studies

Case Study #2 – Remote SFC with Recirculation System

- Fines Removal
  - Reduces pump wear
  - Improves water treatability
  - Solids go where they are supposed to go

Case Studies

Case Study #2 – Remote SFC with Recirculation System

- pH Control
  - Sulfuric Acid Injection
  - pH Control Range: 6.14 to 7.84
  - LSI Range: -0.69 to 1.09

Case Studies

Case Study #2 – Remote SFC with Recirculation System

So Far…

- No issues with scaling
- No issues with solid plugging
- Chemical use meets expectations
- Baseline scale inhibitor
- Continued study and data collection recommended

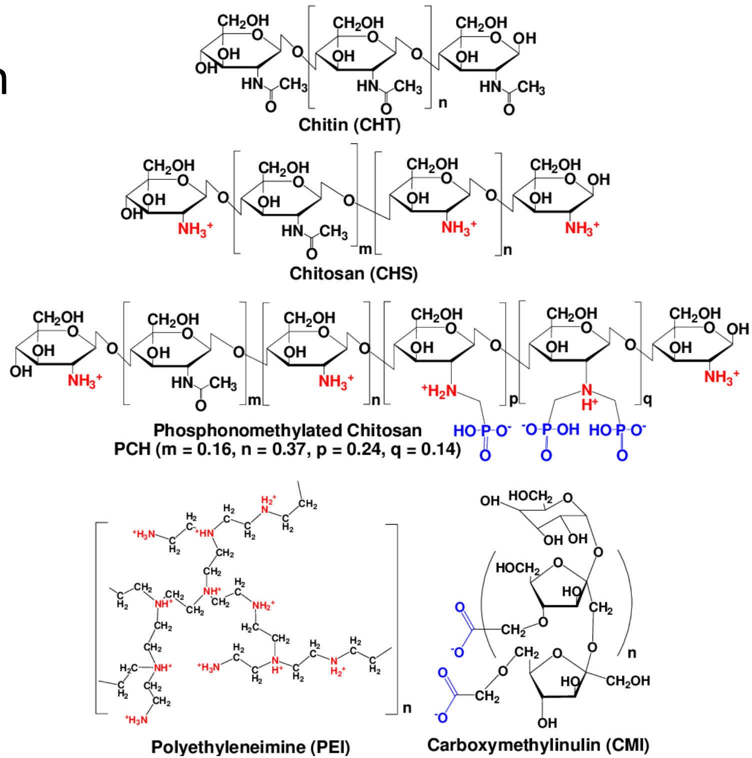
Agenda

- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- Experiences and Lessons Learned
- Case Studies
- **Technical Review and Compliance Takeaways**
- Conclusions

Scale Inhibitor Chemistry

Considerations

- Detailed Cation / Anion Analyses Required
- Temperature
- Application dose
- Application location
- Water Conditioning & Preparation
    - Suspended Solids
    - pH



Source: semanticscholar.org

Effluent Limitations Guidelines

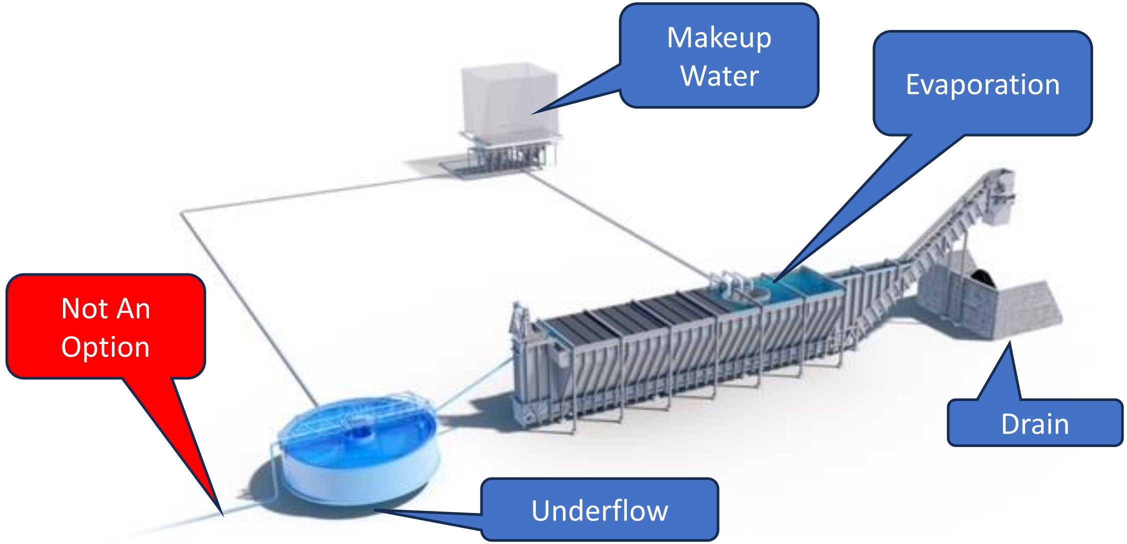
~~2024~~ 2026 Final Rule

Rule Documents have comments on slipstream treatment investments to maintain Bottom Ash Transport Water quality:

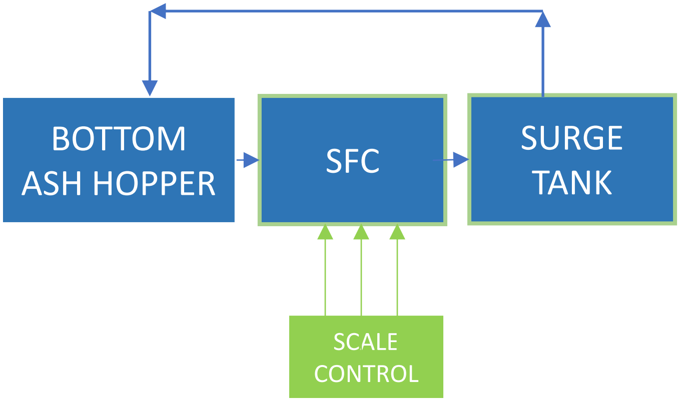
Because of the chemical properties of BA transport water, some plants may need to add flocculant or polymer to aid in the settling of fines to prevent potential plugging of the sluice pipes. Other plants may have to treat the overflow (or a slipstream of the overflow) before recycling to prevent scaling and fouling in the system. Plants that require treatment to achieve complete recycling of BA transport water could install a pH adjustment system, chemical addition, or an RO membrane (as described in the EPA's cost methodology in Section 5) depending on the BA transport water characteristics and materials of construction.

From US EPA Technical Development Document for Final Supplemental Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, April 2024

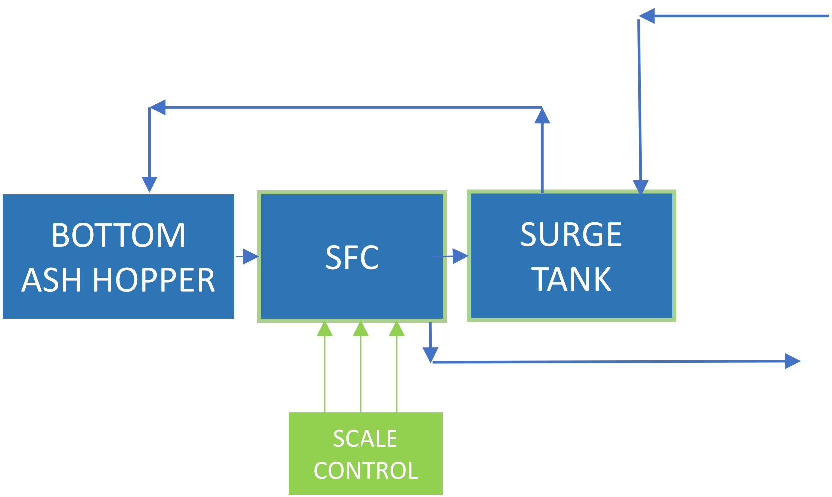
“Closed” Loop System



What the Final ELG Rule Suggests



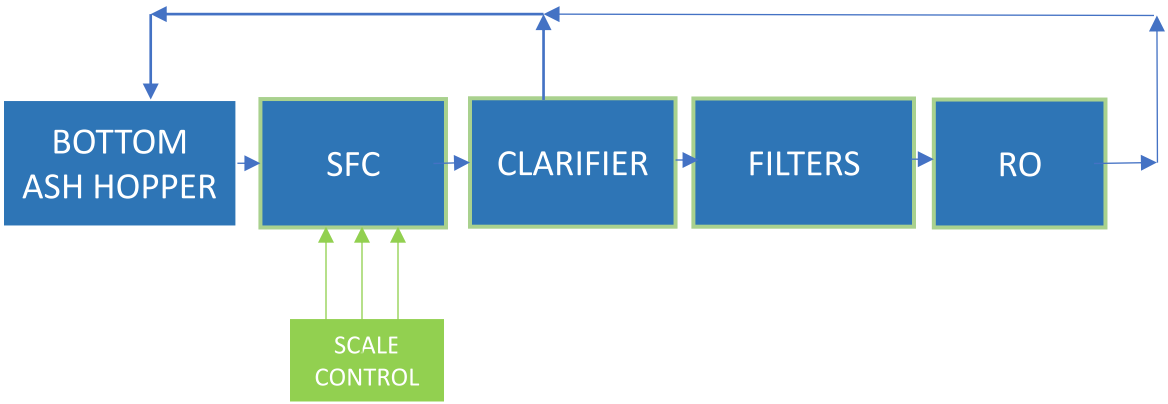
What the Final ELG Rule Suggests



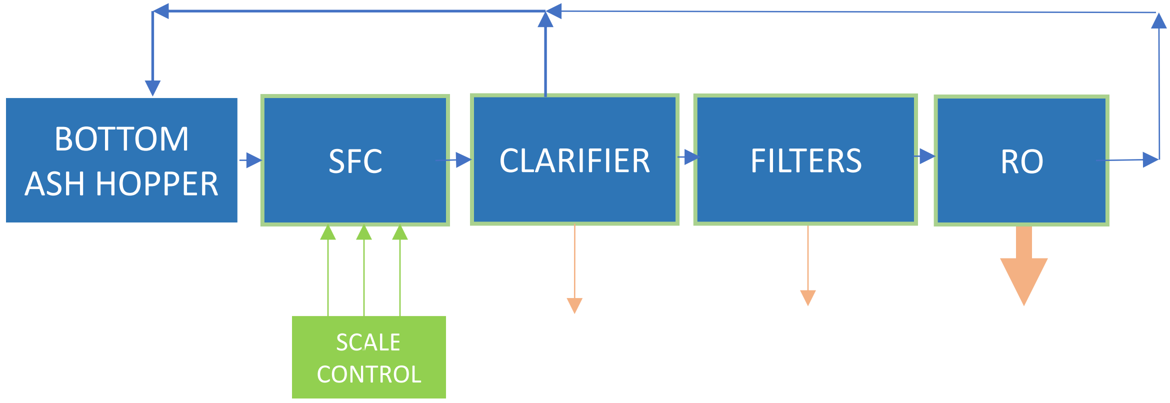
Makeup Water

Water Losses
- Evaporation
- Ash
- Purge to Reuse

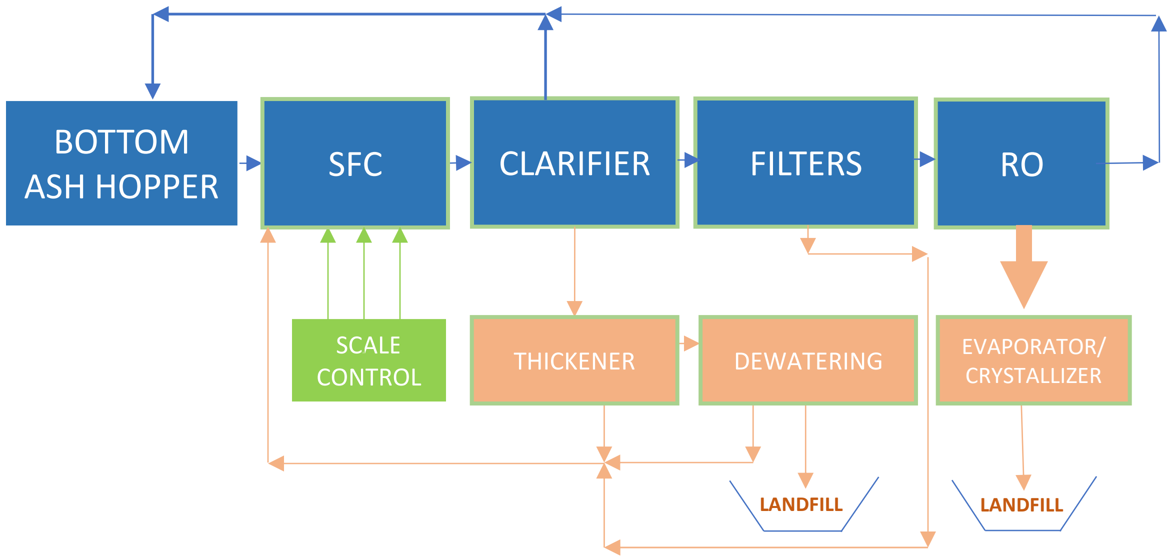
What the Final ELG Rule Suggests



Where Do The Waste Streams Go?



What Else is Needed for ZLD?

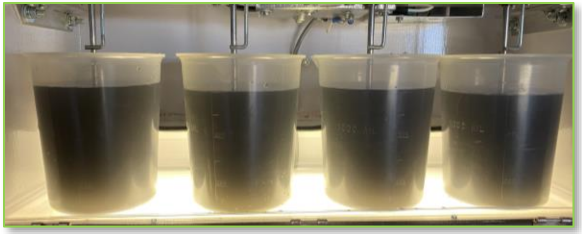


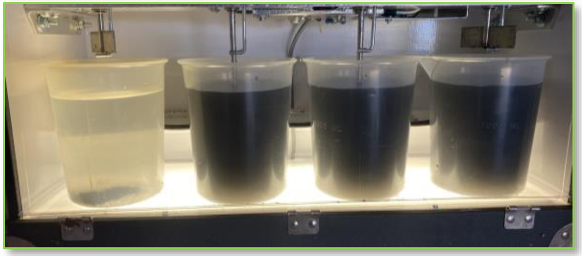
Agenda

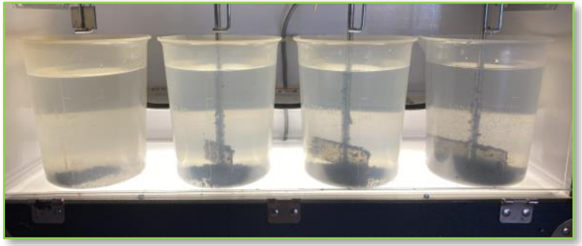
- Regulatory Requirements Overview
- Bottom Ash Recirculation System Technologies
- Experiences and Lessons Learned
- Case Studies
- Technical Review and Compliance Takeaways
- **Conclusions**

Conclusions

- Water quality increasingly getting attention to monitor and control
- Challenges are very site specific
- Era of discharge / purge is over
- Operating costs increases are the new reality
- Capital investments
  - Side stream filters
  - Membranes
  - Concentrated brines
  - Big $$$







Questions

We Value Your Feedback!

Let us know your thoughts via anonymous survey

Thank You!

David Donkin
Director, Wastewater Solutions
daviddonkin@uccenvironmental.com
330-717-1453

Caleb Thornburg
Director, Sales – Material Handling & DSI
calebthornburg@uccenvironmental.com
847-672-5220