

I PRO 302 Coal Combustion Residuals (CCR) Solutions

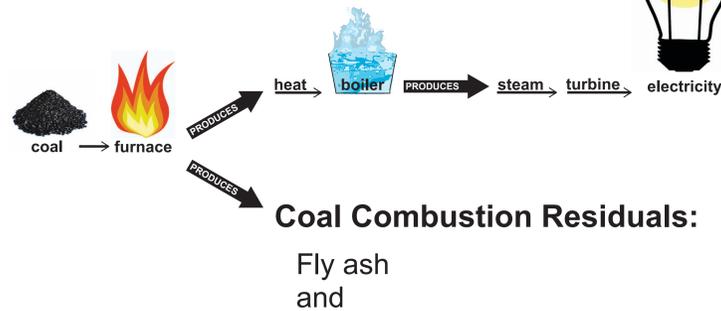
An Environmentally Sound and Cost Effective Solution to Handling Bottom Ash in Coal Power Plants

Problem Statement

Evaluate the impacts of eliminating an ash storage pond from a power plant to meet pending EPA regulations and avoid future ash pond disasters.

Background

Path From Coal to Energy



Coal Combustion Residuals:

Fly ash
and

Bottom Ash
I PRO 302's Focus

Tennessee Valley Authority (TVA) Kingston
Fossil Plant Ash Spill - Dec 22, 2008

- Dike burst at 40 acre ash pond impoundment
- Dumped one billion gallons of coal ash into 300 acres of a rural east Tennessee community
- Prompted EPA to propose changes in how coal ash is classified
- New regulations may force plants to close their existing ash ponds



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Assumptions (Provided By Sargent & Lundy)

Average coal power plant located in Illinois:

- 500 MW Power plant
- 200 tons/hr coal consumption
- 15 tons/hr bottom ash production
- 30 acre X 10' deep ash pond
- 2000 gpm ash sluice water

Objectives

To Determine:

- Current and pending coal combustion residuals (CCR) / wastewater regulations.
- CCR disposal and reuse alternatives.
- Waste water treatment and disposal alternatives.
- Pond closure and outsourcing opportunities.
- Costs and environmental implications of unlined ash pond

Team Structure

Regulations Sub-Team

Research current Environmental Protection Agency (EPA) regulations on the handling and disposal of bottom ash at coal powered power plants.

Current Bottom Ash Handling Sub-Team

Research current methods of bottom ash handling and disposal

Alternative Bottom Ash Handling Sub-Team

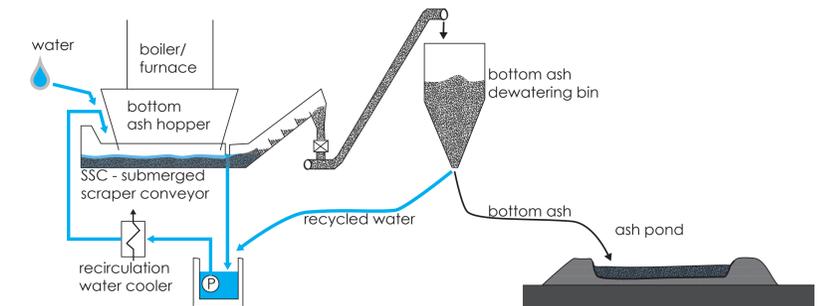
Identify alternative methods for handling bottom ash in power plant and at ash pond

Water Treatment Solutions Sub-Team

Research methods for decontamination and removal of ash-pond water.

Research Analysis

Diagram of Bottom Ash Conveyence Process



EPA's Proposed Regulations Changes

Article C:

- Ash designated "**Special Waste**".
- Ash ponds must be phased out within 7 years.
- Monitoring of all ash dumps is required.
- Ash generation, storage, transportation, and disposal of coal ash are regulated.

Article D:

- Ash designated **non-hazardous**.
- Ash ponds must be upgraded.
- Utilities not required to monitor ash dumps.
- Regulations only for disposal.

Alternatives Considered



● Chosen Method

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I PRO 302's Recommended Steps Toward Eliminating Ash Storage Pond

Conclusion

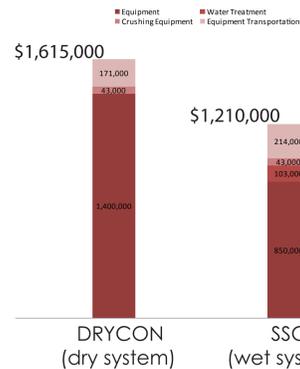
Phase 1: Convert to dry ash-handling system



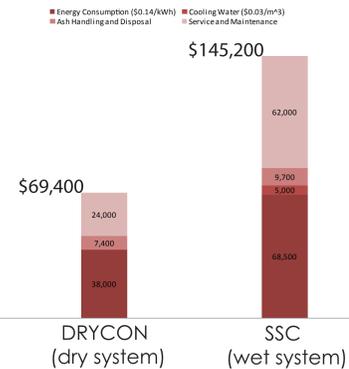
- Selected System: Drycon
- Developed by Clyde Bergman Materials Handling Ltd
 - Conveys bottom ash with using water
 - Uses negative air pressure to cool bottom ash

Image: Clyde Bergman Materials Handling Ltd

Dry System vs. Wet System INITIAL INVESTMENT COSTS (\$)



ANNUAL OPERATING COSTS (\$)



Source: Clyde Bergman Materials Handling Ltd

Phase 3: Treat and dispose of ash pond wastewater

- Best solution is to outsource task to wastewater specialists, like Charah.
- *Chemical solutions and extraction wells both considered*
- Chemical removal systems are not cost effective.
- Extraction wells pose a risk of long term seepage.



Phase 2: Establish a ground water monitoring zone (GMZ)

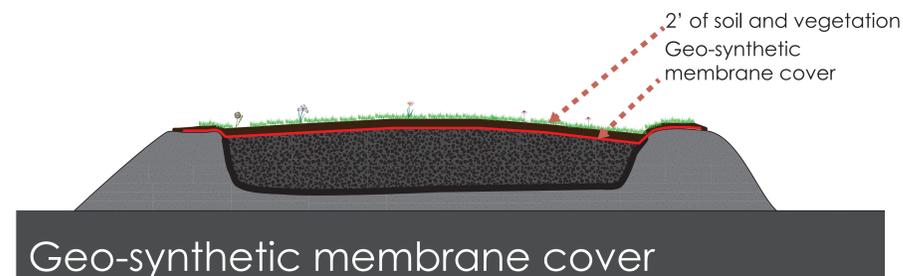
Ground Water Monitoring Zone Basics

- Monitoring wells are drilled around ash pond area.
- GMZ required to manage on-site contamination.
- System can be managed on and off-site.
- EPA must approve ground water monitoring zone before implementation.



Phase 4: Cap ash pond using a geo-synthetic membrane cover

- Porous membrane will allow for natural ground flow.
- Geo-synthetic membrane, compacted clay, and layered earth caps were all considered.



Total Cost of Ash Pond Closure

Closure Activity	Cost (\$ in millions)
Drycon Investment	1,615,000
Ground Water Monitoring Zone	151,600
Wastewater Treatment/Disposal	600,000
Geo-synthetic Membrane Cover	11,200,000
Total Capital Costs	13,566,600

Sources: Clyde Bergman Materials Handling Ltd, Ameren UE, Van Cleef Engineering Associates.

I PRO 302 Team



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