Abstract

Zero Discharge Ash Handling System Costs and Their Sensitivity to Unit Retirement and Ash Make Rate

The U.S. Environmental Protection Agency (EPA) published 40 CFR 423, Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category to the Federal Register in November 2015. The guidelines provide new discharge limitations for wastewater streams formerly categorized as low-volume wastewater. The most significant impact of the proposed changes will be to require coal-fired power plants that discharge bottom ash transportation water to eliminate the discharge. In addition, on April 17, 2015, the EPA published the Final Rule for Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule) at 40 CFR Part 257. The CCR Rule applies to owners and operators of new and existing landfills and new and existing surface impoundments (ponds). The CCR Rule requires groundwater monitoring of existing active CCR ponds. If groundwater monitoring demonstrates exceedance of a groundwater protection standard, the owner/operator must initiate corrective action. Corrective action can include closing the pond within five years of detecting groundwater impacts.

Because of the synergy between the ELG and CCR rules, the potential strategies for complying with ELG need to be evaluated in conjunction with the impacts to the existing ponds subject to CCR. Coal-fired plants that are sluicing their ash to ponds may be required to eliminate both bottom ash transport water discharge and to close the associated ponds. In these applications, a stepwise approach to compliance is required to first eliminate ash sluicing prior to closure of the ash ponds. Possible technologies to comply include mechanical drag chain systems (under-boiler and recirculating remote), recirculating through CCR-compliant ash ponds, recirculating ash settling basins, and recirculating through geotextile filter tubes. The selection of the technology to be applied must be the most economical for the plant given the challenges facing coal-fired power plants today. Using a series of power plant case studies common to each technology, this paper compares the relative sensitivity of each technology's capital and operating costs, on a present-value revenue requirement basis, to important variables, such as plant life and bottom ash make rate.

Sargent & Lundy LLC

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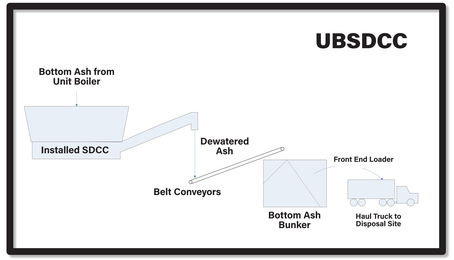
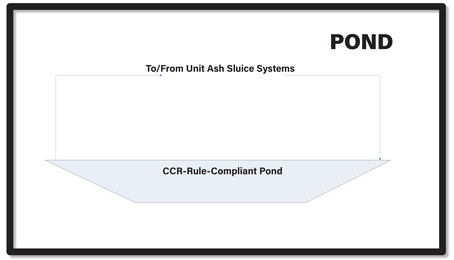
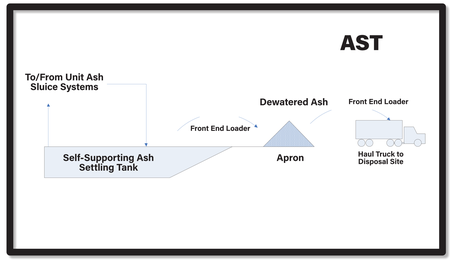
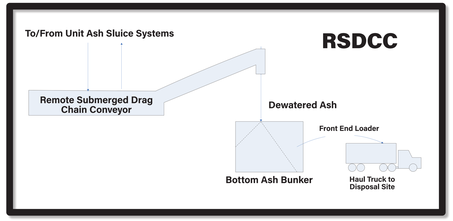
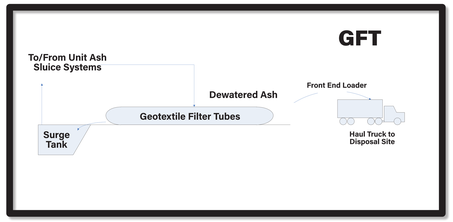










Scope of Work

Ash Settling Tank (AST)	Geotextile Filter Tube (GFT)	CCR-Compliant Pond (POND)	Under-Boiler Submerged Dragchain Conveyor (UBSDCC)	Remote Submerged Dragchain Conveyor (RSDCC)
2 x 100% ash settling tanks	N+1 100% GFT bays, one for each GFT required, with one common spare	Pond sized to contain ash for entire evaluation period without dredging (i.e. remaining life of plant)	1 x 100% UBSDC under each boiler	2 x 100% RSDCC sized to dewater entire ash make rate
Reuse existing ash sluicing pumps	Reuse existing ash sluicing pumps	Reuse existing ash sluicing pumps	Ash sluicing pumps are not required (demo)	Reuse existing ash sluicing pumps
Water recycle pumps and bays	Water recycle pumps and bays	Water recycle pumps and bays	Water recycle pumps are not bays	Water recycle pumps
Electrical building	Electrical building	Electrical building	Motor starters reuse existing MCCs	Electrical building
High TSS sump pumps	Ash distribution header			Surge tank
Decant valve	Hoses			Settling tank
Dewatering apron			Concrete ash storage bunker 72 hour capacity	

O&M Considered

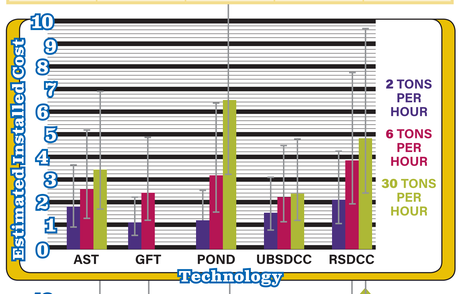
Ash Settling Tank (AST)	Geotextile Filter Tube (GFT)	CCR-Compliant Pond (POND)	Under-Boiler Submerged Dragchain Conveyor (UBSDCC)	Remote Submerged Dragchain Conveyor (RSDCC)
Ash sluice water recirculation pump operation	Ash sluice water recirculation pump operation	Ash sluice water recirculation pump operation	***Elimination*** of ash jet pump and recirculation pump operation	Ash sluice water recirculation pump operation
N/A	N/A	N/A	Drag-chain operation	Drag-chain operation
Ash removal, staging & truck loading by front-end loader	Ash truck loading by front-end loader	N/A	Ash truck loading by front-end loader	Ash truck loading by front-end loader
Polymer dosing	Polymer dosing	N/A	N/A	Polymer dosing
BOP electricity	BOP electricity	BOP electricity	BOP electricity	BOP electricity
Operations labor	Operations labor	Operations labor	Operations labor	Operations labor
Maintenance labor	Maintenance labor	Maintenance labor	Maintenance labor	Maintenance labor

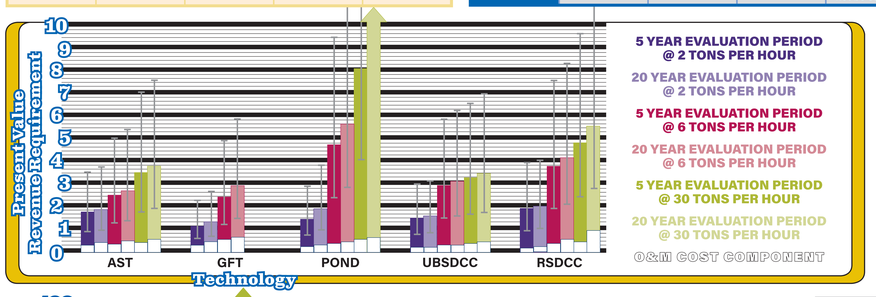
Summary

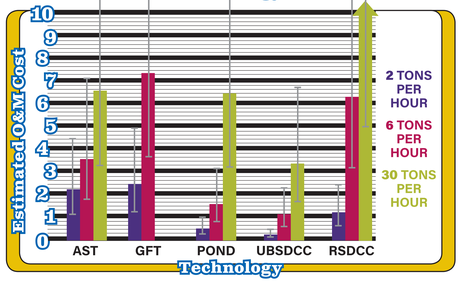
Parameter	Ash Settling Tank	Geotextile Filter Tube	CCR Compliant Pond	Under-Boiler Submerged Dragchain Conveyor	Remote Submerged Dragchain Conveyor
Evaluated PVRR	Low PVRR in all cases	Lowest PVRR at low ash make rates	Highest PVRR at high make rates	Low PVRR in all cases	Higher PVRR at higher make rates
Installed Capital Cost	Higher capital cost	Lowest capital cost at low ash make rates	High capital cost at higher make rates Highest capital cost in 20 year cases	Lowest capital cost at high ash make rates	Higher capital cost
O&M Cost	Medium O&M Cost	Highest O&M cost at make rates above 6 tons per hour	Lowest O&M cost at low and medium ash rates	Negative energy cost by not running ash sluicing jet pumps	Medium O&M cost
Footprint	Larger footprint	Larger footprint	Largest footprint by far	Smallest footprint	Smaller footprint
Ash Handling	Solids handled twice	Solids handled once	Solids not handled (pond closed in place)	Solids handled once	Solids handled once
Note 1	Recycle pump operation	Recycle pump operation	Recycle pump operation	No recycle pump required	Recycle pump operation
Note 2	Unknown recycled water quality	Proven recycled water quality	Proven recycled water quality	No recycled water	Proven recycled water quality
Note 3				Boiler configuration may not be suitable	

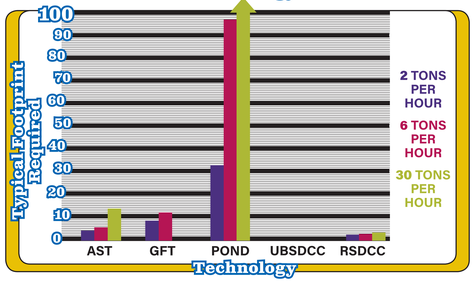
Vendors

Ash Settling Tank (AST)	Geotextile Filter Tube (GFT)	CCR-Compliant Pond (POND)	Under-Boiler Submerged Dragchain Conveyor (UBSDCC)	Remote Submerged Dragchain Conveyor (RSDCC)
Sargent & Lundy	TenCate	Sargent & Lundy	Allen-Sherman-Hoff	Allen-Sherman-Hoff
			United Conveyor Corporation	United Conveyor Corporation
			Clyde Bergmann	Clyde Bergmann
			GE-Alstom	GE-Alstom
			Howden	Howden









Present Value Revenue Requirement (PVRR)

5 Year Evaluation Period

Carrying Charge	33%
Escalation	2%
Discount Rate	9%

20 Year Evaluation Period

Carrying Charge	14%
Escalation	2%
Discount Rate	9%

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