Practical Considerations for the Management and Closure of Wet Coal Ash Pond Systems

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ABSTRACT

The continued uncertainty surrounding the US-EPA Proposed Rule for Coal Ash Residuals (CCRs) has encouraged many electric power utilities to consider an early closure of their wet coal ash pond management systems. Many coal combustion power plants that use wet ponds for processing, dewatering and storage of coal ash will be phased out in the next two to ten years. This paper reviews some of the key technical, financial and regulatory considerations that may be needed in preparation for the eventual closure of typical wet coal ash ponds. Practical methods to focus the feasibility study and design process will be explained using several project examples. This paper will identify the factors that need to be understood to facilitate the design and closure of fly ash ponds. The use of a Focused Feasibility Study (FFS) as the framework for developing this understanding will be presented.

INTRODUCTION

Through the Proposed Rule for CCRs, US-EPA introduced a significant amount of regulatory uncertainty concerning the management and operation of coal ash processing facilities, which is expected continue to remain perhaps for for several years. Meanwhile, owners and operators of coal-fired power plants and wet coal ash processing ponds are faced with questions concerning how to best prepare for future regulations in a manner that will cost-effectively serve their customers and manage business risk. While recognizing inherent uncertainties exist, this paper offers up some practical considerations for the management and potential closure of wet coal ash pond systems as utilities await the final rulemaking to become effective. The following sections provide a list of the practical steps that are typically followed when develop the plan and approach for the management and closure of a wet coal ash pond system.

FOCUSED FEASIBILITY STUDY

The purpose of the FFS is to provide information that guides the design, permitting and closure process. To develop the guidelines for the management and eventual closure of a wet coal ash pond, an FFS is can provide clarity to develop a practical and
comprehensive understanding of how the power plant interfaces with the wet coal ash processing and pond system. The FFS must include developing an understanding of the flow of plant process water; how bottom ash and fly ash is collected and pumped to the wet ash ponds; and, the operating parameters of the ash pond system. This stage of the process is analogous to preparing a flight plan that includes mapping out the destination, considering a wide variety of complex variables, checking the available finances, and choosing the most efficient way to complete the project.

Transition Plan for Wet Ash Pond Closure

These basic operation parameters and the interface between the plant electric power operation, and the wet ash processing system, should be well understood. Key questions that should be answered during the FFS include:

- How much coal ash does the plant produce at peak, average and periodic cycling electric power production?
- What are the process water solids and liquids loading volumes at the peak, average and periodic cycling electric power production?
- What are the detention times in the primary and secondary ash settling basins?
- At peak, average and periodic cycling power production how close the plant to the overall capacity of the wet ash processing system?
- What are the typical influent characteristics for the plant discharge water?
- What are the unique CCR characteristics at key locations in the processing systems?
• Do different types of coal produce different CCR characteristics and influent concentrations?

• What are the discharge regulatory requirements for coal ash processing pond/system and are there any changes expected in the future?

• Are there other plant discharges with deleterious components, cleaning solvents and/or human sewage that are routed to the wet coal ash processing system?

• Are there ways to re-route, pre-treat or eliminate this waste stream to more efficiently meet the discharge limits from the coal ash pond?

PRACTICAL CONSIDERATIONS

Effective coal ash pond management and closure typically involves a combination of stormwater management, dam safety and slope stability, materials handling and solids management and industrial wastewater design. Each of these items involves careful consideration of both the technical and financial aspects of the coal ash pond operation.

One the distinct advantages of wet coal ash pond processing systems is that most of these systems are extremely large relative to the amount of process water that is routed and treated each day. This size advantage often provides ways to increase efficiency of the coal ash processing without a lot of additional cost. The size relative to the required treatment capacity can also allow the wet coal ash pond to be downsized and/or incrementally closed without a lot of additional capital cost. The FFS can identify ways
to cost effectively process and treat the coal ash sluice water from the coal-fired power plant in a smaller and more efficient basin and system.

**Geotechnical, Materials Management and Dewatering Characteristics:** Understanding the geotechnical and dewatering characteristics of the saturated coal ash provides useful information for the operation and eventual closure of the coal ash pond system. Dewatering ash ponds involves dam safety and controlling stormwater throughout the transition and closure process. More accurate information during the pre-closure and/or transition period for the wet coal ash ponds, provides valuable insight into the time-rate of settlement of the saturated ash and provide the basis to decrease the time for dewatering and reduce double handling of coal ash after the site is closed. The following information should be obtained and evaluated during the FFS process:

- Crusted ash and fluid coal ash characteristics including thickness, volume, approximate moisture content;
- Dewatering characteristics including permeability of crusted and fluid ash and the location of drainage ditches and discharge structures;
- Anticipated final cover soil and/or geosynthetics and its location relative to the site;
- Slope and dam stability during operation, interim and post-closure conditions;
- Probable end use plan and repowering objectives;
- Job safety evaluation (JSE) of the sampling, dam safety and dewatering process;
- Develop a concept level design to set aside funding to prepare for the geotechnical and dewatering aspects of coal ash pond closure;
- Regulatory items as expressed in the geotechnical and/or dewatering requirements.

For each of the items listed above it is suggested that two or three potential options be selected so a variety of technical and financial alternatives can be considered. Many of the geotechnical and dewatering characteristics for a wet coal ash pond will also be influenced by the stormwater drainage, industrial wastewater characteristics, and regulatory requirements.

**Stormwater Management and Industrial Wastewater Characteristics:** Using information about the plant process water discharge, the next step in the FFS involves gathering information and evaluating the stormwater and industrial wastewater characteristics of the wet ash processing system. The information that needs to be obtained and evaluated includes the following:

- Develop a process flow diagram, and determine detention time and treatment parameters setup guidelines for process water quality, NPDES discharges, and settling and pre-treatment requirements where;
• Develop a simplified and phased approach to stormwater, dewatering, water quality management and discharges;
• Determine if there are ways to more efficiently manage the process water and stormwater;
• Develop a concept level design to set aside funding for the stormwater management and industrial wastewater treatment activities required during closure;
• Identify the regulatory requirements and options for addressing stormwater management and NPDES discharges.

As mentioned previously, for the completion of the stormwater management and industrial wastewater evaluation it is often best to develop a list of the two or three best options. The stormwater and industrial wastewater evaluation must be integrated with the evaluation of the geotechnical and dewatering characteristics, and regulatory requirements. The purpose of the FFS is to provide information that guides the design, permitting and closure process.

**Regulatory Considerations:** An evaluation of the Federal and State regulatory requirements (including uncertainties) must be undertaken during the FFS process. The reasons for closing or not closing a wet coal ash processing pond can be complex and vary from site to site.

In many cases, while the Federal proposed rulemaking process plays out, State regulators may be open to develop a “straw man” approach to permitting and closure of ash ponds. This can also create an opportunity to develop cost-effective solutions and should be assessed during the FFS. In other cases, State regulatory agencies may feel the pressure of pending Federal rules and be concerned about how their decisions could be second-guessed by others. The FFS process needs to consider the regulatory variables, including:

• Determine the branch or section of the State regulatory agency that is currently in charge of the coal ash pond operation and eventual closure, and how that may change pursuant to future regulations;
• Determine the stormwater, water quality, solid waste and/or dam safety permits that are required;
• Identify possible regulatory paths including a most probable regulatory “road map,” including appropriate contingency and risk reduction methods to account for the uncertainty factors;
• How and if existing and/or potential future groundwater contamination will need to be addressed and what type of final cover system will be required;
• Locking down the State coal pond closure requirements even if this area of the regulations changes at the Federal level. The requirements that typically can be considered under State regulations include:
  
  o Registration of closure plans for retired ash basins and/or soon to be closed basins under existing regulatory programs so they can be “grandfathered” in ahead of changes to the Federal program. This approach can eliminate or greatly decrease the probability of having to remove coal ash from older ash basins. It is similar to the approach used by MSW landfill owners/operators when Subtitle D landfills were being phased in.
  
  o Dam embankment classification under existing State regulatory programs.

Setting Schedule and Budget Constraints: The FFS should also evaluate the utility schedule and budget considerations for the transition and/or closure of the coal combustion power plant. The schedule and budget guidelines for ash pond closure need to be aligned with the business goals and objectives of the utility, and help to decrease the uncertainty of the closure planning process. Even if the regulations are unclear developing a most probable schedule and budget for the eventual closure of a wet coal ash pond system will reduce uncertainty and allow a reasonable and prudent method for planning by the utility.

DESIGN AND PERMITTING

The design and permitting stage of the project is the where the information from the FFS is developed into a closure design and permitting documents. It is analogous to stage right before take-off in a plane where the instruments or set and the pilot review a pre-flight checklist. The limited scope of this paper does to allow a detailed consideration of all the issues that must be address in the ash pond closure design and permitting process, a only a summary list is provided. Some of the key considerations that need to be addressed during the design and permitting of typical coal ash pond closure projects include:

- Identification of suitable borrow soils for fill material and final cover
- Sampling of crusted and wet ash areas to determine the time for settlement and stabilization
- Surveys and hydrographic surveys to determine ash pond volumes
- Dam safety and subsurface drainage design
- Phases for stormwater management, grading design and final cover
- Selection and infiltration modeling of the final cover cross section
- Dewatering and stormwater detention design
- Maintaining compliance with stormwater discharge and NPDES discharge limits
- Coordinating with other plant activities
- Conduct regular job safety evaluation (JSE) to account for changing dewatering, stormwater and slope stability conditions
- Constructability review with experienced coal ash design engineers and ash handling contractors.

IMPLEMENTATION AND CONSTRUCTION

The next step of a typical ash pond closure project involves the dewatering of the liquid ash, dismantling of discharge structures and transition of the wet ash processing pond to its original condition or the planned end use. Most of the site specific requirements and the technical and regulatory issues have already been evaluated in the design and permitting process. The project is ready to be implemented or constructed. This stage of the project is analogous to setting the instruments and flaps in a plane prior to landing, and then eventually landing the plane.

Selecting the Contractor and the Quality Assurance Team: The contractor for a wet coal ash pond closure project must have the following capabilities:

- Recent experience handling wet ash and drying large volumes of materials;
- Understanding and application of rim ditch and surcharge dewatering methods for dredged solids and/or wet industrial materials;
- Experience with installing temporary process water treatment plants and meeting discharge requirements;
- An excellent safety track record when working in the vicinity of open excavation, pipeline trench work and soft soil excavations;
- Access to construction equipment for work in soft, saturated soils and waste materials.
- Experience with landfill final cover installation and a wide variety of geosynthetic materials;
- Understanding of the applicable State and Federal regulations for stormwater management, ash basin closure, dam safety, and groundwater protection; and
- Ability to work with the owner’s plant personnel and EH&S professionals.

For these types of projects it is common for the owner to hire the design engineer to assist with interpretation of the design drawings and/or to provide construction quality assurance. There are wide variety of options for the quality assurance and final approval of the ash pond closure. These are typically developed during the design and permitting portion of the project.

Project Management Plan: An essential component of any coal ash pond closure project is the project management plan. Since the dewatering and earthwork construction portion of these projects can change regularly based on a variety of site
conditions the project management plan must be a “living” document that integrates the
PLAN, DO, CHECK, ACT model used for design projects. A project management plan
will be prepared by the project manager in conjunction with the lead team members.
This plan will typical include the following:

- Health and safety performance
- Critical success factors
- Detailed task outline
- Schedule
- Financial plan
- Team roles & responsibilities
- Quality control plan
- Communication plan
- Change management plan

FINAL STEP: PROJECT CLOSEOUT

The final stage of any successful coal ash pond closure project includes completing the
QA/QC documentation and obtaining the necessary regulatory approvals. In addition to
the completing the required QA/QC documentation there are several other project
activities that are also completed at the end of a typical ash pond closure project:

- Preparation of as-built drawings and an end of construction elevation survey. Settlement can occur after the completion of the project and the as-built elevation survey provides the information recheck the project several years after closure.
- Measurement of the baseline information for new SWM devices and detention basin discharge structures.

REFERENCES:

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http://sketchup.google.com/3dwarehouse/details?mid=5a75c1fe87a28d34be0a275b05f3f8f
OVERVIEW

• Regulatory Uncertainty
• Transition Planning
• Focused Feasibility Study
• Practical Considerations
• Design and Permitting
• Implementation and Construction
• Project Closeout
REGULATORY UNCERTAINTY

• Proposed CCR Rule - June 21, 2010
• Comment Period Ends November 19, 2010
• House Votes to Block Funding for Rulemaking - February 19, 2011
• H.R.1391 - Recycling Coal Combustion Residuals Accessibility Act of 2011 - To prohibit the Environmental Protection Agency from regulating fossil fuel combustion waste under subtitle C of the Solid Waste Disposal Act
Transition Plan for Wet Ash Pond Closure
“A Glide Path to Closure”

Year Before Transition or Closure

Relative Scale of Power Production and CCRS

Set Aside Funds for Closure

Check Pond Capacity

Develop End Use Plan

Focused Feasibility Study

Initial Schedule and Budgets for Closure

Start Design and Permitting

Start Pond Closure

Finish Pond Closure
FOCUSED FEASIBILITY STUDY

- Guides Design, Permitting, and Closure Process
- Understand Flow of Plant Process Water
- How Bottom Ash and Fly Ash is Managed
- Operating Parameters of the Ash Pond System

http://www.ukqaa.org.uk/AboutAsh3.html
FOCUSED FEASIBILITY STUDY IS THE “FLIGHT PLAN”

- Allows complex and competing variables to be considered without the risk of trial and error.
- Provides to consider the impact of the “changing weather” State and Federal regulatory constraints without being in the “storm”.
- Allows naturally conservative power utilities a way to PLAN, BUDGET and consider RISK before making a Go/No Go decision.

http://3.bp.blogspot.com/_P_uX_-a7s4I/TTMweqjCnWI/AAAAAAAAAOw/8w_uW2VX1Lg/s1600/Spotlight-Aircraft_Pilot.jpg
KEY QUESTIONS FOR THE FEASIBILITY STUDY – Ash Basin Characteristics

• What does it take to keep the plant operating, producing electricity and meeting discharge limits?
• How much coal ash does the plant produce and when?
• What are the process water solids and liquids loading volumes?
• What are the detention times in the ash settling basins – Influent and Effluent characteristics?
• What are the unique CCR characteristics at key locations in the processing systems?
• REPEAT – What does it take to keep the plant operating, producing electricity and meeting discharge limits?
MORE FS QUESTIONS – Increasing Process Water Treatment Efficiency

• What are the discharge limits of the wet ash pond/system and are they expected to change in the future?

• Are there other plant discharges with deleterious components, such as cleaning solvents or human sewage that can be routed away from the wet ash pond?

• Are there ways to re-route, pre-treat or eliminate the waste stream to meet discharge limits more efficiently?

• What is the time period to closure or transition to a dry ash system or plant repowering? Can the ash be stacked in placed and/or the ash pond be converted to a Subtitle D lined landfill?
CONSIDERATIONS FOR POND CLOSURE – Dam Safety, Drying CCRs, Wastewater and Stormwater
MORE FS QUESTIONS – Geotechnical Properties and Dewatering

• Crusted ash volume, liquid ash volume, and approximate moisture content?

• Dewatering characteristics of the ash including the location of drainage ditches and discharge. Are there other plant process wastewaters, including stormwater runoff, routed to the wet coal ash processing system?

• Are there ways to re-route, pre-treat, or eliminate these waste streams to more efficiently meet the discharge limits from the coal ash pond?
MORE FS QUESTIONS – Stormwater Management and Industrial Wastewater

• Develop a process flow diagram, and determine detention time and treatment parameters. Setup guidelines for process water quality, NPDES discharges, and settling and pre-treatment requirements.

• Develop a simplified and phased approach to stormwater, dewatering, water quality management and discharges. SIMPLER IS OFTEN BETTER of ash pond wastewater discharge.

• Can the ash ponds be downsized or put into a 100 % recirculation process and still keep the plant operating at its required capacity?

MORE FS QUESTIONS – Regulatory Considerations

• What do the State regulations require?

• Can a Brownfield agreement or similar early voluntary closure program create greater regulatory certainty and reduce the risk of wet ash pond closure?

• If closure is initiated under State regulations, what happens if the Federal regulations change?

• What is the probability of a “clean closure” if a pond has already been closed under an existing State program?

• Which State program rules for the different parts of the ash pond closure – dam safety, stormwater, pond closure, and the cover system after closure, etc.?

• Identify the regulatory requirements / options for addressing stormwater management and NPDES discharges.

• What is the RISK of doing NOTHING?

• For your State and unique situation is it better to WAIT or better to GUIDE BY QUESTIONS? The Columbo method…..
MORE FS QUESTIONS AND CONCEPT DESIGN – Linking Geotechnical, Process Water, Stormwater Management, and End Use

• What is the end use plan for the site? Probable end use plan and repowering objectives.

• Can a concept plan with “no commitments” be used to “grandfather” a site into existing programs?

• Concept Design

  ✓ Anticipated final cover cross section and the use of geosynthetics, cover soils the relative cost. What is the time rate of settlement for the CCR materials?

  ✓ Slope and dam stability during operation, interim and post-closure conditions.

  ✓ Develop estimate of preliminary quantities of ash and closure material

  ✓ Job safety evaluation (JSE) of the sampling, dam safety and dewatering process.

  ✓ Develop a concept level cost estimate

• Consider starting preparation for the geotechnical and dewatering aspects of coal ash pond closure. Note: Early dewatering and drying can reduce the ultimate cost of closure.
DECIDING WHAT TO DO – Follow the Least Cost and the “Flight Plan”

• After preparing the Feasibility Study and a Most Probable Estimate of Cost “its decision time.

• Annual Cost and Life Cycle Cost estimates are some of the best ways to make complex decisions. These are analogous to a plane’s “instruments”.

• Bad and unsafe “weather conditions” or a Regulatory No Go are also reasons to WAIT. Cloudy or uncertain “weather conditions” make it necessary to follow your “flight plan” – Feasibility Study, and your “instruments” – Annual and Life Cycle Cost estimates.

• So what is the next step?
THE FEASIBILITY AND COST STUDY SAYS: “It's time to Close”
GLIDE PATH TO CLOSURE -- Principles

• The closer a plane/pilots gets to land the more important the “instruments” and the accuracy of his/her pre-planning activities.

• Every pilot, plane and airport is different. Take nothing for granted.

• When the “weather is cloudy” then it takes more skill and instruction from other experienced pilots to be successful.

• Regular people fly and land planes everyday – even in bad weather.

• Airports have established signals that create a “glide path” so that a plane’s instruments give useful information to the pilots so they can land the plane.

A Few Absolutes:

• Don’t try to land in a snow storm, thunder storm or tornado. Analogy: Bad regulatory conditions.

• Eventually a plane has to land – even in bad weather. Analogy: Uncertain regulatory conditions.
DESIGN AND PERMITTING IS SETTING THE INSTRUMENTS AND PRE-FLIGHT CHECK
DESIGN AND PERMITTING – Starting the Closure Process

• Outline and memorialize the Objectives and Goals from the Feasibility Study and Cost Estimate (Short-term and Life Cycle).

• Educate other senior leaders and the power plant managers. Help local and corporate leadership understand what to expect and when.

• Check “the weather” – identify regulatory “No Go’s” for closure. These may differ from company to company.

• “Ground truth” your instruments
  ✓ Recent survey data
  ✓ Recent cost data
  ✓ Assurance from State regulators and in-house EH&S – In writing if possible.
DESIGN AND PERMITTING – Initial Steps

• Lock down the end use plan.
• Decide on the preferred closure cover cross section and dewatering options. Enter the closure “glide path” using the FS information.
• Get recent topog survey and ash volume information.
• Check the concept design and closure methods with the State regulators. Get assurance of remedy acceptance.
• Develop the method and sequence of construction, and get approval of plant operations personnel.
• Double check practical aspects of maintaining environmental compliance. EH&S is the “navigator” – don’t forget them if you want to avoid a wreck!
DESIGN AND PERMITTING – Practical Considerations

• Dam safety and slope stability design – get detailed information about the CCRs and develop an incremental closure plan. Soft/saturated materials can be difficult.

• Stormwater and drainage design – develop drainage maps for pre and post development and several interim closure conditions.

• Fix pre-existing problems at an ash pond, first – close-out previous problems and NOVs. If possible, start the closure with a clean slate.

• Remember a Job Safety Evaluation at each critical step in the process.
IMPLEMENTATION AND CONSTRUCTION – Selecting the Contractor and QA Team

- Recent experience in handling and drying wet ash materials.
- Specialty understanding of the rim ditch, dredge dewatering, and surcharge dewatering methods.
- Excellent safety record – especially when working in soft, saturated soils and waste materials.

**Note of Caution:** Soft soils and saturated ash can provide dangerous situations for less experienced contractors and engineers – don’t let them learn a lesson on your project.
IMPLEMENTATION AND CONSTRUCTION
– Selecting the Contractor and QA Team

• Experience with final cover installations and a wide variety of geosynthetic materials.

• Understanding of State and Federal regulations for ash pond, water quality, dam safety and groundwater.

• Ability to work with the plant personnel and EH&S.
IMPLEMENTATION AND CONSTRUCTION
– Project Management Plan

Even the most capable teams require organization, a clear “chain of command” and a way to PLAN, DO, CHECK and ACT. A good PMP for wet ash pond closure should include:

- Health & Safety requirements and guidelines – esp. wet ash handling.
- Critical success factors – regulatory compliance, cost controls, coordination with plant operations.
- Detailed task outline – who is responsible for what.
- Schedule and Financial Plan for completion.
- Team roles and responsibilities
- Communication and Change Management Plan
HANDLING REGULATORY UNCERTAINTY IN THE MIDST OF CLOSURE - Questions

What do we do if the regulations change in the middle of wet ash pond design/permitting or closure?  A few ideas.

✓ Contingencies and backup plans

✓ Plan and initiate Go/No Go minimums. Just like dealing with “cloudy weather”.  May be as simple as having a plan in place and delaying for 6 months to 1 year until the regulatory “weather clears”.

Can the pending Federal regulations force a “clean closure” if a wet ash pond is closed under existing State regulations?  A few ideas.

✓ Highly unlikely – goes against precedent for Subtitle D and RCRA.

✓ Driver is groundwater contamination – building contingency into the wet pond closure plan that allows for synthetic liner without ash removal.
FINAL CLOSEOUT

Year Before Transition or Closure

10 9 8 7 6 5 4 3 2 1 0

Relative Scale of Power Production and CCRS

Set Aside Funds for Closure

Develop End Use Plan

Focused Feasibility Study

Initial Schedule and Budgets for Closure

Start Design and Permitting

Start Pond Closure

Finish Plant Closure

Check Pond Capacity
FINAL CLOSEOUT

• Before starting closure, obtain clarity on what regulatory agency has the “final say” on ash pond closure, dam safety and the “new” ash solid waste management unit.

• Attempt to get ash pond embankment that no longer contains water to be removed from the dam safety records.

• Take thorough QA/QC documentation of the final cover soils and/or geosythetic cover system.

• If groundwater contamination is present, then develop and know the “end game” for the ash pond closure and most probable groundwater remedy.

QUESTIONS?

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http://www.hiwtc.com/photo/products/38/01/36/13674.jpg