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Disposal of Fluidized Bed Combustion Ash in an Underground Mine to Control Acid Mine Drainage and Subsidence

Quarterly Report
March 1 - May 31, 1998

Work Performed Under Contract No.: DE-FC21-94MC29244

For
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Progress Report

for the Period of

March 1, 1998 to May 31, 1998
Phase III, Quarter VI

Project - ETD05 "Disposal of Fluidized Bed Combustion Ash in an Underground Mine to Control Acid Mine Drainage and Subsidence"

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EXECUTIVE SUMMARY

This project will evaluate the technical, economic and environmental feasibility of filling abandoned underground mine voids with alkaline, advanced coal combustion wastes (Fluidized Bed Combustion -FBC ash). Success will be measured in terms of technical feasibility of the approach (i.e. % void filling), cost, environmental benefits (acid mine drainage and subsidence control) and environmental impacts (noxious ion release).

Phase I of the project was completed in September 1995 and was concerned with the development of the grout and a series of predictive models. These models were verified through the Phase II field phase and will be further verified in the large scale field demonstration of Phase III. The verification will allow the results to be packaged in such a way that the technology can be easily adapted to different site conditions. Phase II was successfully completed with 1000 cubic yards of grout being injected into Anker Energy's Fairfax mine. The grout flowed over 600 feet from a single injection borehole. The grout achieved a compressive strength of over 1000 psi (twice the level that is needed to guarantee subsidence control). Phase III is to take 26 months and will be a full scale test at Anker's eleven acre Longridge mine site.

It is expected that the FBC ash will replace what is now an acid mine pool with alkaline solid so that the groundwater will tend to flow around and through the pillars rather than through the previously mined areas. The project has demonstrated that FBC ash can be successfully disposed in underground mines. Additionally, the project is directed towards showing that such disposal can lead to reduction or elimination of environmental problems associated with underground mining such as acid mine drainage and subsidence.

During Phase III the majority of the activity involves completing two full scale demonstration projects. The eleven acre Longridge mine in Preston County will be filled with 53,000 cubic yards of grout during the spring of 1998 and monitored for following year. The second demonstration involves stowing 2000 tons of ash into an abandoned mine to demonstrate the newly redesigned Burnett Ejector. This demonstration is anticipated to take place during the winter of 1997.

This document will report on progress made during Phase III. The report will be divided into four major sections. The first will the Hydraulic Injection component. This section of the report will report on progress and milestones associated with the grouting activities of the project. The Phase III tasks of Economic Analysis and Regulatory Analysis will be covered under this section. The second component is Pneumatic Injection. This section reports on progress made towards completing the demonstration project. The Water Quality component involves background monitoring of water quality and precipitation at the Phase III (Longridge) mine site. The last component involves evaluating the migration of contaminants through the grouted mine. A computer model has been developed in earlier phases and will model the flow of water in and around the grouted Longridge mine. The Gantt Chart on the following page details progress by task.

A. Hydraulic Injection

1.0 Task Description:

Task 11 - Hydraulic Injection: The purpose of this task is to grout the eleven acre Longridge mine with a grout consisting of coal combustion byproducts.

Task 12 - Economic Analysis: Burnett Engineering, Inc. shall develop economic analyses to compare the cost associated with disposal of coal ash in landfills with disposal of coal ash in underground mines to control subsidence and acid mine drainage.

Landfill disposal of MEA AFBC Power Plant ash. Burnett Engineering, Inc. shall develop an economic analysis for disposing of MEA AFBC ash in a landfill located near the Fairfax and Longridge mines. Costs to be included in the economic analysis include, but are not limited to, loading of ash at the power plant, transportation to the disposal site, landfill construction, landfill operation, landfill maintenance, and regulatory compliance. In addition, long-term cost impact on property values shall be estimated.

Landfill disposal practices of Northeast utilities. Burnett Engineering, Inc. shall use published data from the Electric Power Research Institute, and data from Monongahela Power Company and Allegheny Power Company to generate a range of cost estimates for disposing power plant ash in landfills. Burnett Engineering, Inc. shall describe the similarities and differences in ash disposal practices and costs for three utilities. Description of the similarities and differences shall include, but is not limited to, regulatory environment, environmental protection features in landfill design (e.g., liners), monitoring requirements, transportation, and ash handling.

Underground coal mine disposal of MEA AFBC Power Plant ash. Burnett Engineering, Inc. shall develop an economic analysis for disposing of MEA AFBC ash in the Longridge coal mine. Costs to be included in the economic analysis include, but are not limited to, loading of ash at the power plant, transportation to the disposal site, production of grout, injection of grout, mine maintenance, and regulatory compliance.

Burnett Engineering, Inc. shall analyze the costs associated with the benefits of underground mine disposal of the MEA AFBC Power Plant ash. These benefits include, but are not limited to, lower quantities of waste to be placed in the landfill, reduction in land subsidence, and improvements in water quality.

Task 13 - Water Quality Model: WVU shall use existing water quality model(s) or modifications of existing water quality model(s) to estimate the impact of ash disposal in underground mines on the concentrations of contaminants in nearby surface and ground water. Data from a geographical information system (GIS) shall be coupled with the water quality model results to estimate the impact of disposal of MEA AFBC ash in the Longridge mine on concentrations of contaminants in nearby surface and ground water.

Task 14 - Regulatory Analysis: WVU shall review existing Federal, State of West Virginia, and local regulations and policies which could impact the disposal of ash from advanced coal combustion technologies in underground mines. The contractor shall identify any regulatory barriers to the widespread adoption of this disposal practice in West Virginia.

2.0 Summary of Accomplishments

2.1 The proper value for the plastic viscosity of the AFBC ash grout has been established.

2.2 Successful simulations of the partial injection of the AFBC ash grout in an underground mine with a simple layout have been performed with Groutnet.

3.0 To-Date Accomplishments

Successfully completed Phase II grout injection. Completed site preparation activities for Phase III Demonstration.

4.0 Technical Progress Report

All activities during this quarter were directed toward the set-up of the phase III demonstration site. All equipment, minus the continuous mixer, are in place and operational. The mixer should arrive by the first week in July. Grouting will commence as soon as possible and continue for approximately 13 weeks..

5.0 Plans for Next Quarter

5.1 Coordinate Phase III injection with coal company personnel.

5.2 Continue with numeric modeling of Longridge (Phase III) grouting operations.

5.3 Regulatory analysis will be updated and a draft report prepared.

5.4 Economic analysis of both technologies will commence and draft report will be prepared.

B. Pneumatic Injection

1.0 Task Description

The purpose of this task is to inject coal combustion byproducts into an underground mine via the Burnett Ejector. A complete economic analysis will be completed on the feasibility of this method of injection. Two thousand tons of ash are scheduled to be injected.

2.0 Summary of Accomplishments & Significant Events

The fabrication of the camera and lighting mounts were completed.

3.0 To Date Accomplishments

Redesigned and manufactured pneumatic ejector.

4.0 Technical Progress Report

All activities this month involved the preparation for the Phase III demonstration. Equipment and supplies are being assembled and ordered as necessary. The demonstration is scheduled for 8 June 1998 to 11 June 1998.

5.0 Plans for next Quarter

5.1 Prepare for the large scale demonstration to prove the effectiveness and economic viability of pneumatic injection.

D. Contaminant Transport

1.0 Task Description

Task 6.0 Contaminant Transport

Determine how contaminants will migrate from the grout (if any) and determine how the water that was filling the void will interact with the impermeable plug filling the void after injection.

2.0 Summary of Quarters Accomplishments and Significant Events

2.1 Modeling of Contaminant Transport at the Longridge mine was continued to study the influence of grouting.

3.0 To Date Accomplishments

3.1 Groundwater flow and contaminant transport simulations were carried out to study the impact of grouting on contaminant transport trends. This study was based on several assumptions on input data since specific data was not available.

3.2 Influence of geometric parameters of the idealized model on computed results was investigated.

3.3 Parametric studies were performed to study the influence of material and geometric parameters on the contaminant transport around a mine cavity.

3.4 Different scenarios of the area around the mine affected by cracks and fissures (i.e. fracture zones) were considered. Several groundwater flow and contaminant transport modeling cases were analyzed based on these scenarios and assumed material properties to study the impact of fracture zones on the contaminant migration trends. These computer results are being analyzed.

3.5 A draft version of some chapters for the final report were prepared.

4.0 Technical Progress Report

Influence of cracks and fissures on the contaminant transport of acid mine drainage (AMD) around a mine cavity was investigated. In this study, the computer model was based on the idealized geometric parameters at eh Longridge Mine. Based on the computer results, the extent of contaminant transport around the mine cavity at the end of 500 days was determined. A typical pattern of contaminant concentration contours in the mine layer after a period of 500 days is shown in figure 1. This figure shows the contaminant concentrations in the mine layer of a 5 layer model with a simulated fracture zone. Simliar figures ere obtained for different scenarios of assumed fracture zones around the mine cavity. The results show that the presence of a fracture zone around the mine cavity has an influence in increasing the transport of AMD. Similar figures will be generated and included int eh final report for all of the cases analyzed.

The study revealed that material and groundwater related properties have an influence on groundwater flow and contaminant transport around the mine cavity. Information on groundwater conditions, material properties, and the extent of fracture zones was not available for the Longridge Mine site. Therefore, the input parameters were assumed to study the trends. Lack of input data is a serious limitation in the site-specific modeling study.

A draft version of several chapters for the final report was prepared.

5.0 Plans for the Next Quarter

5.1 A draft of final report on this task will be prepared.

Figure [redacted]: Contaminant Concentration Contours in the Mine Layer After a Period of 500 Days for Case-5 (fr3d1)