Progress Report

for the Period of

April 1, 1999 to June 30, 1999
Phase III, Quarter X

Project - ETD05 "Disposal of Fluidized Bed Combustion Ash in an Underground Mine to Control Acid Mine Drainage and Subsidence"
DE-FC21-94MC29244

EXECUTIVE SUMMARY

This project will evaluate the technical, economic and environmental feasibility of filling abandoned underground mine voids with coal combustion byproducts. 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. The full scale demonstration began in December 1998.

It is expected that the CCB grout will replace the open mine void with a 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 CCBs 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 approximately 53,000 cubic yards of grout during the spring of 1998 and monitored for the following year. The second demonstration involves stowing 2000 tons of ash into an abandoned mine to demonstrate the newly redesigned Burnett Ejector.
This document will report on progress made during Phase III. The report will be divided into three major sections. The first will be 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 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.
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 Initiation of grouting operations at Longridge.

**3.0 To-Date Accomplishments**

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

**4.0 Technical Progress Report**

The Longridge mine in Preston County West Virginia is an 11-acre deep mine. The mine void is intercepted by an auger hole that was installed to drain a mine pool so that surface mining could proceed down dip of the Longridge mine. The auger hole allows a 11,000 cubic yard or 2.2 million gallon mine pool to remain in the Longridge Mine. The auger hole discharged about 100 gallons per minute of acid mine drainage prior to any work at the site.

The Longridge injection began in late January 1999. A total of 3000 cubic yards of grout was injected into the up dip section of the mine. After two weeks of injection, it was observed that the grout was communicating with the auger hole drainage; grout began to flow from the auger hole that is located 2000 feet from the injection hole. Grouting ceased while plans were made to stop the grout from leaving the mine. In early April, the project team decided to place a barrier 200 feet down dip from the injection borehole. The barrier was to be made by pneumatically injecting gravel into the mine void from the surface via the Burnett Ejector. A total of 300 tons of gravel was placed into two headings to create a barrier. Three thousand yards of stiff grout (2/5 cement kiln dust to 3/5 class F ash with one bucket of gravel, solids to water ratio 3:2) were placed directly up-dip from the barrier. The installation of the barrier decreased the auger hole flow by 90% (from 92 gpm to 9 gpm). Grouting with the prescribed thin grout (1/4 cement kiln dust, 3/4 class F ash, solids to water ratio 1:1) continued in holes above the barrier. A total of 12,500 yards of thin grout was placed in the upper cell after barrier construction. The auger hole continued to flow at less than 10 gpm during the Spring of 1999.

After the upper cell (Cell 1) was complete, grouting commenced just below Cell 1.
While grouting cell 1, holes were drilled across the mine void to divide it in half. The OSM camera was employed to investigate the mine void. The mine was collapsed and no void could be seen. Thin grout injected below Cell 1 did communicate with the auger hole so a thicker grout mix was employed to stop up the void space in the collapsed barrier. This has worked as 12,000 yards of grout have been placed in cell 2 with no communication with the auger hole. Table 1 shows the water quality data from the auger hole before and during grouting.

The grouting will continue during the next quarter. Water quality data will continue to be collected and analyzed.

5.0 Plans for Next Quarter

5.1 Continue Phase III injection and data collection.

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

5.3 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

As noted above.

5.0 Plans for next Quarter
C. 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

A draft version of the final report is nearing completion. The report will be delivered to U.S. Department of Energy when complete.

5.0 Plans for the Next Quarter

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