AIMM

Association for Information and Image Management

1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301-587-8202

Centimeter

Inches

MANUFACTURED TO AIMM STANDARDS
BY APPLIED IMAGE, INC.

1 of 1

Management of Dry Flue Gas Desulfurization By-Products in Underground Mines

Quarterly Report

E. M. Thomasson
Y. P. Chugh
S. Esling
R. Honaker
B. Paul
H. Sevin

January 1994

Work Performed Under Contract No.: DE-FC21-93MC30252

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
Southern Illinois University
Carbondale, Illinois

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

This report has been reproduced directly from the best available copy.

Available to DOE and DOE contractors from the Office of Scientific and Technical Information, 175 Oak Ridge Turnpike, Oak Ridge, TN 37831; prices available at (615) 576-8401.

Available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650.

**Management of Dry Flue Gas Desulfurization
By-Products in Underground Mines**

Quarterly Report

**E. M. Thomasson
Y. P. Chugh
S. Esling
R. Honaker
B. Paul
H. Sevin**

Work Performed Under Contract No.: DE-FC21-93MC30252

**For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
P.O. Box 880
Morgantown, West Virginia 26507-0880**

**By
Southern Illinois University
Carbondale, Illinois**

January 1994

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

CONTENTS

Part I	Introduction.....	1
Part II	Objectives.....	2
Part III	Management System.....	4
Part IV	Kick-Off Meeting.....	5
Part V	Residue Characterization Studies.	6
Part VI	Sample Acquisition.....	7
Part VII	Test Plan and Quality Assurance /Quality Control.....	8
Part VIII	Accounts and Sub-Contracts.....	9
Part IX	Summary	10
Part XI	Next Quarter.....	11

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART I. INTRODUCTION

The U.S. Department of Energy, Morgantown Energy Technology Center and Southern Illinois University at Carbondale entered into a cooperative agreement entitled "Management of Dry Flue Gas Desulfurization By-Products in Underground Mines" (DE-FC21-93MC30252) on September 30, 1993, in response to PRDA DE-RA21-92 MC 29244. Under the agreement, Southern Illinois University at Carbondale will develop and demonstrate several technologies for the handling and transport of dry coal combustion residues and for the underground placement in abandoned coal mines and assess associated environmental impacts.

Under the cooperative agreement, Dr. Yoginder P. Chugh, Director, Coal Combustion Residues Management Program, is named Program Director and Principal Investigator, and Mr. Edwin M. Thomasson is named Program Manager. Co-Principal Investigators are Dr. Steven Esling, Dr. Rick Honaker, Dr. Bradley Paul, Dr. Hasan Sevim, and Mr. Thomasson. For the U.S. Department of Energy, Mr. Jerry Harness is named the Contracting Officer's Representative (COR).

The overall program set forth in the cooperative agreement is for a period of four (4) years, beginning September 30, 1993. However, the program is divided into three phases, as follows:

Phase I	--	30 Months, Beginning September 30, 1993
Phase II	--	6 Months, Beginning April 1, 1996
Phase III	--	12 Months, Beginning October 1, 1996

This document sets forth the technical progress under the agreement for the initial three months (October 1 - December 31, 1994) of Phase I of the overall program.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART II. OBJECTIVES

The "Management of Dry Flue Gas Desulfurization By-Products in Underground Mines" project has the following basic objectives:

- Objective 1. Based on an assessment of current technologies - Develop and demonstrate a methodology for handling and transporting dry coal combustion residues (and mixtures of various residues) that is technically and economically feasible and that will alleviate the fugitive dust problem inherent in the handling and transportation of dry coal combustion and FGD residues.
- Objective 2. Based on an assessment of current technologies - Develop and demonstrate a methodology for disposing of coal combustion residues (and mixtures of various residues) in abandoned underground coal mine workings from the surface through a borehole utilizing dry residues and a pneumatic placement technique. The goal of the methodology to be developed is to distribute the residues over an area of at least 300 feet from the injection borehole. The methodology developed must be both economically feasible and environmentally sound.
- Objective 3. Based on an assessment of current technologies - Develop and demonstrate a methodology for coal combustion residues (and mixtures of various residues) in abandoned underground coal mine workings from the surface through a borehole utilizing a mixture of residues and water in "paste" form so that the "paste" contains approximately 80% residue solids. The goal of the methodology to be developed is to distribute the residues over an area of at least 300 feet from the injection borehole. The methodology developed must be both economically feasible and environmentally sound.
- OBJECTIVE 4. Determine whether the placement of coal combustion residues in abandoned underground coal mine workings, using either a pneumatic placement technique or a "paste" hydraulic technique will control surface subsidence over the abandoned underground workings.

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

MANAGEMENT PLAN

PART II -- OBJECTIVES (Continued)

OBJECTIVE 5. Assess environmental impacts (land, water, air) of underground management of FGD by-products.

The assessment of current technologies and development of technologies in objectives 1, 2, and 3 will be completed during Phase I. The demonstration of developed technology in objective 1 will also occur during Phase 1. Demonstration of technologies developed under objectives 2 and 3 will be done in Phase II and Phase III (April 1, 1996 - September 30, 1997). However, the foundation for the completion of Objectives 2 and 3 will be laid during Phase I. This foundation will consist of determining the physical, chemical, engineering, and leachate characteristics of various coal combustion residues and selected residue mixtures; establishing baseline data on groundwater and other environmental characteristics; and developing economic analyses and economic models of the residue placement methodologies.

Objectives 4 and 5 are dependent upon the completion of Objectives 2 and 3, and will require long-term measurements following the underground placement of coal combustion residues.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART III -- MANAGEMENT SYSTEM

During the first quarter of the program (October 1 - December 31, 1993) the major effort was directed to organizing the project and development a sound management plan in order that the program can be effectively and efficiently conducted. The management plan was completed late in the quarter, and a copy sent to the DOE Contracting Officer's Representative, Mr. Jerry Harness, early in January, 1994. Copies of the plan (absent certain budget information not pertaining to their area of work) were distributed to all Co-Principal Investigators and to the Cooperating Organizations.

In general, the management plan follows the concept of "Management by Objectives". Major objectives and sub-objectives are clearly set forth in the plan, with specific time-tables and budgets. By using a "Management by Objectives" concept, the Program Director and Program Manager have a clear picture of what is to be accomplished within certain time and budget constraints, and the Co-Principal Investigators likewise know what they are expected to accomplish, and when it is to be accomplished.

Throughout the development of the management plan the Co-Principal Investigators were consulted, and their input incorporated into the plan. The result is a management plan that has the concurrence, approval, and support of all the Co-Principal Investigators.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART IV -- KICK-OFF MEETING

During this quarter, plans were finalized for a "kick-off" meeting of the Cooperating Organizations and the Co-Principal Investigators. The meeting was held on January 5, 1994. The meeting was planned as an all-day session, and is designed to present the background of the coal combustion residue management problem, to give specific information as to the development of the DOE - SIUC cooperative agreement, to present the overall management plan for the cooperative agreement, and to seek input for the overall program and its conduct from the cooperating organizations.

The Department of Energy Contracting Officer's Representative, Mr. Jerry Harness, was invited to attend the meeting.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART V -- RESIDUE CHARACTERIZATION STUDIES

In early December, 1993, the Mining Engineering Department purchased an Inductively Coupled Plasma Atomic Emission Spectrometer (ICP Spectrometer) for use in determining the elemental composition of coal combustion residues. The instrument was purchased with SIUC funds, and was not charged to the DOE program. However, the instrument will be utilized in the residue characterization studies in this program.

A significant amount of time was spent in installing the instrument, in calibration, and in training Mining Engineering personnel in the proper operating procedures for the instrument. When fully operational the instrument will provide an accurate, fast, and efficient method of analyzing and characterizing dry flue gas desulfurization by-products. It is believed that the instrument will be of significant benefit to the overall work under this program.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART VI -- SAMPLE ACQUISITION

During this quarter, plans were made to acquire coal combustion residue samples for study and use throughout this program. Samples will be acquired from two sources: (1), the City Water, Light, and Power Company (CWLP), Springfield, Illinois Dallman power plant, and (2) the Archer Daniel Midland Company (ADM) power plant in Decatur, Illinois.

In both plants, coal quality is very stable, and thus coal quality has a negligible effect on the composition of the coal combustion residues. However, operating conditions caused by varying plant load can have an effect on the residues composition. Therefore, it was decided to sample each plant two separate times: first, during a week-day, and secondly, during a week-end (Saturday or Sunday).

Plant and Residues Material	Sample 1 ^{1/}	Sample 2 ^{2/}
CWLP Dallman Plant (Fly Ash)	3 Drums ^{2/}	3 Drums
CWLP Dallman Plant (Bottom Ash)	3 Drums	3 Drums
CWLP Dallman Plant (Scrubber Sludge)	3 Drums	3 Drums
ADM ^{3/} (FBC Fly Ash)	3 Drums	3 Drums
ADM (FBC Bottom Ash)	3 Drums	3 Drums

- ^{1/} Sample 1 to be collected on a week day; Sample 2 to be collected during a weekend.
^{2/} Drum refers to a 55 gallon steel drum or barrel.
^{3/} FBC refers to "Fluidized Bed Combustion".

TABLE 1.
COAL COMBUSTION SAMPLES TO BE OBTAINED

All coal combustion residue samples will be stored at the SIUC facility in Carterville, Illinois. In order to prevent oxidation or other chemical changes in the samples, they will be stored in a nitrogen atmosphere.

Actual sampling will begin during January, 1994.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART VII -- TEST PLAN AND QUALITY ASSURANCE/QUALITY CONTROL

As mandated under the cooperative agreement, development of a Test Plan detailing both the laboratory and field testing and experimentation to be conducted was initiated during the quarter. The complete Test Plan will be furnished to the appropriate Department of Energy officials by early February.

Included in the Test Plan are the Quality Assurance/Quality Control (QA/QC) procedures to be followed in both the laboratory and field testing. It is particularly important that a sound QA/QC plan be developed and implemented in the residue characterization and baseline environmental test phases. The QA/QC plans developed will, it is believed, meet the highest scientific standards and criteria for such studies.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART VIII -- ACCOUNTS AND SUB-CONTRACTS

The Mining Engineering Department, cooperating with the General Accounting Office of Southern Illinois University, established a main account for the program. Also, steps were taken to establish sub-accounts for the various work areas. Fiscal authority is retained by the Program Director and the Program Manager, and the sub-accounts are primarily for fiscal control purposes. Sub-accounts initially are not to exceed ten thousand dollars (\$10,000.00).

Also, for fiscal control purposes a software package (Microsoft Project) was obtained for use in the Program Manager's office. Although not designed or intended to replace or conflict with the formal fiscal accounting and control by the Southern Illinois University at Carbondale General Accounting Office, the software program will permit the Program Manager to track expenditures and budgets in a timely manner.

The SIUC Office of Research Development and Administration (ORDA) began the necessary work to prepare and execute sub-contracts where appropriate with the cooperating organizations. The first such sub-contract will be with the Illinois State Geological Survey (ISGS) for analytical work for the residues characterization studies. The analyses to be performed by ISGS involve equipment not available at SIUC. Also, as part of the Quality Control/Quality Assurance for the residues characterization studies, the ISGS will analyze some duplicate samples as a quality check on SIUC analyses.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART IX -- SUMMARY

The "Management of Dry Flue Gas Desulfurization By-Products in Underground Mines" program is one of the largest programs ever undertaken by the Mining Engineering Department of Southern Illinois University, both in terms of complexity and in terms of funding. Total funding over the expected four-year extent of the program, including both Department of Energy, matching Southern Illinois University funds, and contributed funds, this program exceeds three million dollars. The number of cooperating organizations adds to the management complexity of the program.

It was believed, therefore, that a sound management plan and management base is essential for the efficient and effective conduct of the program. This first quarter period (i.e., October 1 - December 31, 1993) was developed to establishing the management base, developing a sound management plan, developing a test plan, and developing sound fiscal management and control. Actual technical operations, such as residue sample acquisition, residue analyses, groundwater sample acquisition and analyses, and material handling studies will get underway early in the next quarter (i.e., January 1 - March 31, 1994). Some early results of residue analyses and groundwater analyses should be available by the end of the second quarter. These results will be reported in the next Technical Progress Report.

* * * * *

MANAGEMENT OF DRY FLUE GAS DESULFURIZATION
BY-PRODUCTS IN UNDERGROUND MINES

Technical Progress Report -- October 1 - December 31, 1993

PART X -- NEXT QUARTER

In the quarter beginning January 1, 1994, samples of coal combustion residues will be acquired from City Water, Light and Power Company and Archer Daniel Midland Company and laboratory analyses of these samples will begin. Also, analyses of mixtures of various residues will commence. Residue mixtures will be based on past experience, to develop mixtures with the desired flowability and other properties.

Groundwater samples from existing wells at or near the proposed underground disposal site will be obtained and analyzed to establish baseline groundwater and environmental characteristics.

Studies relating to the handling and transportation of coal combustion residues will begin. A visit to the CWLP plant is planned for very early February, to gain information on current residue handling procedures. Studies relating to underground placement techniques will also begin during the quarter, as will early studies of the economics relating to the economics relating to the management of coal combustion residues.

In summary, where the quarter ending December 31, 1993 was devoted to the planing and development of management and test plans, the quarter beginning January 1, 1994 will see actual technical and scientific work begin. This sequence is in accord with initial plans, and the overall program is on schedule and on target.

* * * * *

DATE
FILMED

7 / 8 / 94

END