931107 19 10:54

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

FINAL TECHNICAL REPORT

October 1993

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.

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

Energy and Environmental Research Corporation
Irvine, California

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

INTRODUCTION

The United States Department of Energy (DOE) established a Waste Management Program within the Office of Fossil Energy. A key goal of this program is to ensure that waste management issues do not become obstacles to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of the collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now has extended their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of five (5) of these facilities.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology (CCT) Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritized them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.
- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. A total of five sites have been sampled under these guidelines as listed below.

- An advanced slagging cyclone combustor developed by Coal Tech Corporation of Williamsport, PA.
- The Gas Reburning-Sorbent Injection (GRSI) process demonstrated by Energy and Environmental Research Corporation of Irvine, California on a wall-fired boiler.
- The Pressurized-Fluidized Bed Combustion (PFBC) process demonstrated by American Electric Power (AEP) of Canton, Ohio.
- The Babcock and Wilcox SO_x-NO_x-ROX Box Flue Gas Cleanup demonstration.
- The over-fire air (OFA) and low NO_x burner demonstration by Southern Company Services of Birmingham, Alabama.

SITE SELECTION

During the preliminary stages of the project, EERC, with the assistance of METC, established criteria for the selection of candidate sites. These criteria included:

- The demonstration had been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There was a lack of data regarding the waste products from this technology,
- Facility operators would be willing to cooperate,
- There was a possibility that the waste contained regulated compounds, and
- The demonstration was being conducted in a pilot facility or larger with the availability of 85 lbs. of waste.

Having met all of the criteria listed above, the seven previously mentioned technologies were selected for inclusion in the sampling program.

SAMPLING

This section will provide a brief discussion of each technology, sampling procedures, and general comments on any sampling activities associated with a particular site. All descriptions will be given in chronological order according to the date each site was sampled. Process diagrams, plant layouts, test day operating characteristics, and sample lists will be provided in the Appendix. Each site will be referenced by the site identification designation provided below.

- Site "A" - Coal Tech demonstration
- Site "B" - GRSI demonstration on a wall-fired boiler
- Site "C" - PFBC demonstration
- Site "D" - SNRB Flue Gas Cleanup
- Site "E" - OFA and low-NO_x burners

Site A

This project, sponsored in CCT Round I, featured the combustion of dry pulverized coal in an advanced, air-cooled, cyclone combustor retro-fitted on a 23 MMBtu/hr oil-designed package boiler. Initial objectives of this demonstration were to achieve up to a 90% reduction in SO₂, a 90-95% ash removal in the combustor, and a NO_x reduction of up to 100 ppm. Pennsylvania bituminous coals containing 1% to 4% sulfur were burned to demonstrate the combustor's emission characteristics for a wide variety of U.S. coals.

Due to a conflict of interests, Coal Tech requested that EER contract out all tasks related to sampling at the Williamsport, PA facility. Competitive bids were submitted by several outside firms of which Environmental Resources Management, Inc. (ERM) was selected. Samples were collected on February 13 and 14, 1990 to characterize both solid and liquid inlet and outlet streams.

A total of six streams were sampled: 1) unburned coal, 2) inlet water, 3) slag, 4) slag quench water, 5) scrubber solids, and 6) scrubber water. During the test run, ERM collected samples from each of these streams for later laboratory analysis. All samples were collected in 500 ml Teflon® bottles and purged with nitrogen to maintain sample integrity. Bulk samples were also taken of the slag and coal.

All samples were collected without complication or deviation from the sampling plan. Waste from the scrubber, which is typically flyash suspended in water, was separated into two sample streams. Coarse filter paper (20 μm) was used to separate this stream into both a liquid and solid sample. Refer to Appendix A for sampling locations, process diagrams, and sample lists.

Site B

As part of CCT Round I, this project was one-half of the Gas Reburning-Sorbent Injection (GRSI) demonstration sponsored by Energy and Environmental Research Corporation. As its name suggests, the technology incorporated the use of sorbent injection and supplemental firing with natural gas to achieve reductions in SO_2 and NO_x emissions, respectively. In the main combustion zone, 80% of the boiler fuel is input as coal. The remaining 20% of the fuel, natural gas, bypasses the main combustion zone and is injected above the main burners to form a reducing zone. In this reducing zone, NO_x is converted to diatomic nitrogen (N_2). Sorbent $\{\text{CaCO}_3 \text{ or } \text{Ca}(\text{OH})_2\}$ is introduced into the flue gas downstream of the combustion zone for sulfur capture.

Sampling activities were conducted by EERC on March 25, 1992. At this time, seven streams were sampled: 1) unburned coal, 2) sorbent, 3) inlet water, 4) bottom ash, 5) flyash, 6) bottom ash sluice effluent water, and 7) flyash sluice effluent water. During the sampling, EERC collected samples from each of these streams for analytical purposes with the exception of coal. All solid analytical samples were collected and packed in 500 ml Teflon® bottles while the liquid samples were placed in 1000 ml Boston Amber bottles. All bulk samples were placed in either 5-gallon buckets or 500 ml Teflon® bottles.

Dry flash was collected from three different pieces of equipment. The amounts collected from each location for the bulk flyash sample was predetermined from information available on the flyash collection rates. Samples were taken from all four (4) fields of the ESP, the economizer hopper, and the humidification duct screw conveyor. Flyash sample collection information is provided in Appendix B along with process flow and plant layout diagrams. Sluice effluent water samples were obtained by using 20 μm filter paper in a GeoTech filtration system.

Deviation from the original sampling plan did occur while sampling activities were taking place. Flyash and bottom ash were collected and placed in either 5-gallon buckets or 500 ml Teflon® containers. Triple-ply trash bags were originally designated; however, due to the high temperature of the ash samples, these bags could not be used. In addition, only a 52 lb. sample of bottom ash could be obtained due to the lack of sufficient quantities of this waste stream.

Site C

The technology demonstrated at this CCT Round I project is a pressurized-fluidized bed combustor (PFBC). In the PFBC system, coal is combusted in a high pressure environment at low temperatures (1600°F) to decrease NO_x formation. In addition, sorbent is introduced in the combustion chamber for sulfur capture. The hot combustion gases exiting the pressure vessel pass through cyclones which remove 98% of the entrained flyash. The gas is then expanded through a gas turbine. Pressurized boiler feedwater is converted to superheated steam in the tubes in the boiler zone of the combustor. The steam exits and passes through a steam turbine. A NO_x emission level of 0.2 lb/MMBtu is expected along with a SO₂ reduction of 90%.

Sampling activities were conducted by EERC on June 21, 1992. At this time, six streams were sampled: 1) unburned coal, 2) sorbent, 3) bed ash, 4) cyclone ash, 5) ESP flyash, and 6) spray curtain supply water. During the sampling, analytical samples were collected from all streams with the exception of coal. All solid analytical samples were collected in 500 ml Teflon® bottles while the spray curtain supply water sample was collected in a 1000 ml Boston Amber bottle. A 5-gallon bucket was used for the coal sample. All other bulk samples were collected in Rubbermaid® storage containers.

All samples were collected without complication or deviation from the sampling plan. All solid samples were collected from process sampling ports located through out the system. The spray curtain supply water sample was a composite consisting of three separate samples collected at various times that day. Process flow diagrams, sampling locations, and sample lists are provided in Appendix C.

Site D

Funding for this project came under Round II of the CCT Demonstration Program. This facility incorporated the use of a high temperature baghouse, sulfur injection system, and selective catalytic reduction (SCR) to reduce particulate, SO₂, and NO_x emissions. A 5 MW_e slip stream from an existing wall-fired boiler was diverted to be used in this small scale demonstration. After passing through the flue gas cleanup system, the flue gas is returned to the main flow stream.

Sampling activities took place on December 16, 1992. At this time, six streams were sampled: 1) unburned coal, 2) sorbent, 3) boiler bottom ash, 4) ESP flyash, 5) baghouse flyash, and 6) economizer/air preheater ash. During the sampling, EERC collected samples from each of these streams for analytical purposes with the exception of the sorbent and unburned coal. All analytical samples were collected in 500 ml Teflon® containers. Bulk samples were collected in Rubbermaid® containers. Refer to Appendix D for process diagrams, facility layout, and sample list.

The next few paragraphs will describe any deviations from the original sampling plan. The unburned coal bulk sample was obtained by Ohio Edison personnel employed at the R.E. Burger generating station. Approximately four (4) gallons of sample were obtained. The amount actually obtained differed from that required by the sampling plan due to the fact that the iso-kinetic sampler was unable to obtain more sample in the designated eight (8) hour sampling schedule. The EER personnel felt that the 4-gallons of sample obtained was sufficient for accurate bulk analysis since extreme care was taken to insure that the sample was representative of the process. Samples from each coal transport pipe were taken throughout the day and composited to form one bulk sample.

Approximately three (3) gallons of hydrated lime were obtained from the sorbent rotary feeder. It was extremely difficult to obtain more sample due to the time and dust problems caused by the sampling of this input stream.

Three (3) 500-ml boiler bottom ash samples were gathered from the bottom ash hopper. These samples were obtained by using a Teflon® container clamped to a metal rod as a sampling scoop. The samples were gathered approximately two (2) hours apart. The

containers were allowed to cool before the sealing the lids. All three samples were sent to the analytical lab where they were composited for analysis.

Three (3) economizer/air preheater ash samples were collected from the two (2) economizer ash hoppers. Approximately 250-ml of sample was collected from each hopper for each of the three (3) samples. The samples were obtained by scooping the ash from ash hopper sampling port using the lid of the Teflon® sampling container. All three samples were sent to the analytical lab where they were composited by being analyzed.

Three (3) 500-ml flyash samples were collected by sampling the ESP ash hoppers. The samples were obtained by using a 4" OD steel pipe to take a core sample of the hopper ash through the sampling port. The ESP consisted of four rows of four ash hoppers (4X4 arrangement). Approximately 400-ml of sample was collected from each hopper in the first collection field three separate times during the day. The same 400-ml of sample was collected from each hopper in the second field, as well. However, samples could only be obtained from all four hoppers during one of the three sampling times. For the other two sampling times, only two hoppers provided enough ash to sample. Sufficient quantities of ash could not be obtained in the third and fourth ESP fields. All samples were placed in one container and composited. Three (3) 500-ml analytical samples were then obtained from the composite and packaged for shipment to the analytical laboratory.

Ash samples collected from the SNRB baghouse proved to be extremely difficult to handle. The ash was first collected in one-hour intervals in a 5-gallon bucket. After the sample had cooled, it was placed in the bulk sample container. The first sample melted the sampling container, requiring a new container to be purchased. This replacement container was also a Rubbermaid product. The remaining samples, along with the remainder of the first sample, were then placed in the replacement container. It was felt that Rubbermaid containers were better suited for these samples than stainless steel. At the temperatures exhibited by the ash, stainless steel would react with the ash causing higher concentrations of trace metals such as nickel and chromium to be present in the samples. Even if the plastic containers were to be affected by the temperature of the ash, only polymers and rubber compounds would be introduced to the ash. It has been proven in the past that these rubber

and polymer compounds can be more easily separated from the actual ash analysis than trace metals from stainless steel sampling containers.

The original sampling container used to gather the baghouse ash could not be used to ship the ash sample. A replacement container had to be purchased at the time of the sampling event. Since all decontamination procedures were completed before arriving on site, the proper decontamination solutions were not available. The container was only rinsed with deionized water before being used.

Site E

Funding for this project came under Round II of the CCT Demonstration program. EER selected a facility with a Low-NO_x Burner Project as one of the seven sites identified for participation in the sampling program. The technology being demonstrated at the facility is being conducted on Unit Number 4.

The EER field team conducted a preliminary site visit at Site F and to familiarize themselves with operating conditions at the plant. The EER field team will conducted the sampling effort July 29, 1993. Site F was undergoing long-term testing at the plant and the operating conditions were conducive for obtaining representative waste samples. During the long-term testing period, EER took analytical samples from the bottom ash, economizer, precipitator flyash, top and bottom sluice ash, unburned coal, and influent water inlet for the sluice and sent them to Iowa State University for Analysis. EER also collected bulk samples of the unburned coal, bottom ash and fly ash for testing at the University of North Dakota Energy and Environmental Research Center (UNDERC). EER also recorded the operating conditions during the sampling event and report them to DOE. A brief final report of the field work was completed and sent to DOE. All analytical samples were collected in precleaned 1000 ml amber glass jars. Bulk samples were collected in tedlar lined 5 gallon containers. Refer to appendix F for process diagrams, facility layout and sample list.

Unburned coal was collected from sampling ports located on the six (6) coal mills. Both analytical and bulk samples were collected. Both were composite on a Teflon® sheet and "cone and quartered". There was one (1) five gallon sample in a Tedlar® lined container and three (3) 1000 ml amber sample jars. Two (2) analytical samples went to Iowa State

University and one (1) went to Southern companies. The bulk sample went to North Dakota University.

Economizer hopper ash bulk sample was collected from three (3) of the five (5) hoppers, two had no accumulated ash. The ash sample was obtained by letting the hopper empty out into a five (5) gal bucket. The sample was extremely hot. A total of one 5-gal sample was taken during the day and placed in Tedlar® lined 5 gal container. The bulk sample went to North Dakota University.

Three ESP flyash samples were collected for analytical purposes from the ESP ash hoppers. These samples were obtained by compositing flyash samples obtained during the day from each ESP hopper by collecting the sample in five (5) gallon container over an eight hour period. The container was emptied on to a Teflon® sheet and cone and quartered. These samples were placed in three 1000-ml amber glass containers, two went to Iowa State University and one went to Southern Companies. A five gallon bulk sample was placed in a Tedlar® lined container and shipped to North Dakota University

A bottom ash sample was obtained from a inspection door located at the bottom of the combustion box. These samples were extremely wet. Three (3) analytical samples and 1 bulk sample was taken. Two (2) analytical samples in 1000 ml amber glass containers went to Iowa State University, one (1) to Southern Companies and one (1) bulk sample was collected in an 5-gallon Tedlar® lined container and sent to North Dakota University.

An influent water sample was taken at the screen station, since this water was used to transport the ash to the settling pond. Two (2) samples were collected in 1000 ml amber glass containers for Iowa State University and one (1) 1000 ml amber bottle for Southern Companies.

Bottom Ash and Top Ash sluice samples were collected using six five gallon containers over an eight hour period. Each sample was from a composite sample made by combining the containers into one. Then the solids were separated from the liquid in the bottom ash sluice sample. The Top ash sluice sample was mainly fines so it was retained as one sample. Then three (3) 1000 ml amber glass containers were filled with the liquid from the bottom sluice sample and three (3) 1000 ml amber glass containers were filled with the liquid from the top sluice sample and sealed. Then three (3) 1000 ml amber glass containers

were filled with the top sluice sample and sealed. Two (2) of each sample from both locations went to Iowa State University and Southern Companies retained one of each.

Appendix A

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

SAMPLING REPORT #1

May 1990

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

Energy and Environmental Research Corporation
Irvine, California

INTRODUCTION

The United States Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. A key goal of this is to ensure that waste management issues do not become roadblocks to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now is extending their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of this project.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritize them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.
- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. One of those technologies is the advanced slagging

cyclone combustor being developed by Coal Tech Corporation of Williamsport, PA. Coal Tech agreed to inclusion of their technology in the current waste characterization project. On February 13 and 14, 1990 samples were collected to characterize both solid and liquid waste streams. This document provides background information on the site and describes sampling activities performed at this facility.

SITE SELECTION

EER established criteria for selecting the candidate sites. These included:

- The demonstration has been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There is a lack of data regarding the waste products from this technology,
- Facility operators will cooperate,
- There is a possibility that the waste contains regulated compounds,
- The demonstration is being conducted in a pilot scale facility or larger with the availability of 50 lbs of waste, and
- The demonstration will be operational before August 1990.

Coal Tech Corporation is demonstrating the operation of a pilot scale advanced cyclone slagging combustor. This is a new technology which has not been demonstrated at full scale yet and thus minimal data are available regarding the characteristics of the waste products. The demonstration has been selected as one of the projects funded in Round 1 of DOE's CCT Program, and the facility operators were willing for this sampling program to be conducted at their facility. Having met all of the criteria listed above, the slagging combustor being developed by Coal Tech in Williamsport, PA was selected for inclusion in the current sampling program.

STREAM SELECTION

A process flow diagram for Coal Tech's slagging cyclone combustor is shown in Figure 1. Both liquid and solid phase wastes are produced by this facility. The major solid waste stream consists of slag from the combustor and residue from the wet scrubber, while liquid wastes consist of scrubber water and slag quench water streams.

FIGURE 1. PROCESS FLOW DIAGRAM FOR SLAGGING CYCLONE COMBUSTOR

The slag is a glassy dark material rejected in a molten form as small nodules (approximately 1/4-inch in diameter), or as "stalagmite" formation, depending on viscosity and other operating parameters. It is collected from the bottom of the furnace and flows into a water quench where it is cooled. The slag then is transported by a submerged conveyor to drums for landfill disposal.

A venturi wet scrubber is used for particulate collection in the flue gas. The scrubber water normally consists of fly ash suspended in water. However, when limestone is injected into the combustor with coal, unreacted limestone and lime also are suspended in the scrubber water. The scrubber water and solids are directly discharged into a sanitary sewer according to a permit issued by the Williamsport Sanitary Authority.

Streams selected for sampling include the slag, the slag quench water, the scrubber water, and samples of the inlet water supply and coal supply. The slag was selected because it will be disposed in a landfill, and permitting problems may arise if the waste has not been fully characterized. The slag quench water was selected to determine the concentration of substances which may leach into the water while the slag is being cooled. There is one in-line sampling tee for extracting water samples prior to sewer disposal. This scrubber water was separated into two streams by filtering the scrubber water to obtain the scrubber solids and the filtered water. Finally, inlet water and coal samples were taken for comparison purposes. The inlet water must be characterized to determine the extent to which constituents in the slag quench water and the scrubber water can be attributed to the combustion process and which were already present in the inlet water. This same procedure was used for the solids by collecting and analyzing the coal being burned and comparing those properties to the measured characteristics of the slag and fly ash.

SAMPLING PROCEDURES

Environmental Resources Management, Inc. (ERM) of Exton, Pennsylvania was subcontracted to conduct the sampling effort. The sampling team was on-site for a two-day period during the second week in February when Coal Tech was conducting operational tests. ERM prepared a sampling plan which is provided in Appendix A. The following subsections provide a description of the sampling methods, the operational data collected and the packing and shipping procedures for delivering samples to the analytical laboratory.

Streams Sampled

As described above, there are six streams from which samples were taken: 1) unburned coal, 2) inlet water, 3) slag, 4) slag quench water, 5) scrubber solids, and 6) scrubber water. During the test run, ERM collected samples from each of these streams for later laboratory analysis. All samples were collected in 500 ml Teflon® bottles and purged with nitrogen to maintain sample integrity. Bulk samples also were taken of the slag and coal. Details of sample collection for each waste stream are provided below.

Inlet water samples were collected from a facility water supply line located upstream of the advanced coal utilization processes. Two water samples were collected each day in 500 ml Teflon® bottles. The bottles were purged with nitrogen to prepare for shipment. Each sample was collected, 100 ml at a time, in 15-minute intervals.

Solid slag samples were collected in both small analytical samples and a large bulk sample of 175 pounds (79.5 kg). For the analytical samples, approximately 3 pounds (1.4 kg) of slag was collected, thoroughly mixed, and then equally divided into two 500 ml Teflon® bottles. Two analytical samples were collected each day of the sampling effort. The bulk sample was collected over a two-day period in triple layered trash bags inside two large 80-quart (75.7 l) coolers.

Samples of the water from the slag quench tank were collected with a stainless steel ladle. Ladle samples of about 100 ml were taken at 15-minute intervals and transferred into two 500 ml bottles. Sampling continued until both bottles were filled. The bottles were then capped, purged with nitrogen, and labeled for shipping. A second set of two 500 ml bottles was collected the second day of sampling.

Waste from the scrubber, which is typically fly ash suspended in water, was separated into two sample streams. Coarse (20 mm) filter paper was used, and one 500 ml bottle of solids was collected each sampling day. Two 500 ml bottles of filtrate were collected each day. All of the jars were purged with nitrogen and labeled appropriately.

A coal sample was collected the first day of sampling. A five gallon (18.9 l) bucket was filled with coal by the coal supplier and sealed by ERM personnel. The coal is supplied to Coal Tech in a pre-pulverized form.

Operation Data

Operating data for key parameters also were collected during the test program. The parameters measured included slag flow rate, scrubber water flow rate, boiler load, boiler steam pressure, boiler steam temperature, and oxygen and carbon monoxide levels in the exhaust gas. Data were collected hourly throughout the sampling process. Appendix B provides the table of data collected during sampling. Some of the other parameters listed on the table could not be completed due to the confidential nature of the demonstration.

Sample Shipment

Samples were shipped via Federal Express to the University of North Dakota Energy Research Center for analysis. The analytical samples comprising 18 500 ml Teflon® bottles were packed into a large 80 quart (75.7 l) cooler. The samples were surrounded with ice packs and vermiculite to maintain the temperature at 4°C. Two other 80-quart (75.7 l) coolers were used to ship the slag samples which were also shipped on ice. The coal was sent in a 5-gallon (18.9 l) bucket. The chain of custody reports and shipping reports (traffic reports) are provided in Appendix C.

SAMPLE ANALYSIS

The samples obtained from the Coal Tech slagging cyclone combustor are being analyzed at University of North Dakota Energy Research Center. A comprehensive set of physical and chemical tests are being conducted on these samples. These are presented in the form of flow charts in Figures 2 and 3, respectively. Figure 4 provides more details of the ASTM Water Extraction method listed in Figure 3 as one of the chemical characterization test to be conducted. In addition, testing will include the standard RCRA hazardous classification tests and qualitative tests for organics.

Figure 2. Flow Chart for Physical Characterization

Figure 3. Flow Chart for Chemical Characterization

^aOnly the initial waste leachate will be analyzed for these parameters. Subsequent analyses will include only those parameters determined to be present in the waste.

Figure 4. Flow Chart for ASTM Water Extraction Chemical Characterization

APPENDIX A

EER - COAL TECH CORP.
COAL SLAG & WASTE WATER SAMPLING
W.O.# 972.01.00.01
FEBRUARY 1990

Background

The U.S. Department Of Energy (DOE) is conducting a survey/evaluation of alternative coal burning technologies around the country. As part of that program, the DOE contracted The Energy and Environmental Research Corporation (EER) to sample the waste products from five of the most promising alternative coal technology systems. EER has sub-contracted Environmental Resources Management, Inc. (ERM) to do this sampling at the one site in Williamsport, PA. The coal burning pilot plant is being run by Coal Tech Corp., on the plant property of the Keeler/Dorr-Oliver company. The technology being demonstrated is called a Slagging Cyclone Combustor.

Coal Tech Corp. will be conducting a test run for one week - probably the second full week in February. During this test run, ERM will take analytical samples from the coal slag, the 'raw' inlet water, the quench water, and the fly ash scrubber water, and send them to the University Of North Dakota Environmental Research Center (UNDERC) for analysis. ERM will also collect a bulk sample of the slag, and of the fly ash water for further testing at the UNDERC. ERM must also record many operating condition data during the sampling event, and report them to EER. A brief final report of the field work will also be completed and sent to EER.

APPENDIX B

OPERATING CONDITION DATA

2 | 13 | 90

2/14/90

[illegible]

APPENDIX C

[illegible]

Traffic Report

1 Project W.O. ---		2 Sample Concentration		21133	
Project Name/Location		☒ Low Concentration		3 Ship to:	
Section 10		☐ Medium Concentration			
Water sample (FA)		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: Adress: 12345678901234567890		Environmental Research	
☐ Liquid ☒ Solid		Project Manager: Frank Smith		Center	
☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Smith	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
FedEx Express		Bulk sample		1	2 gals
(Date Shipped)					
12/1/00					
(Airbill Number)					
123456789					
8 Sample Location					
Bulk sample Soil					
Date: 12/1/00					
Time: 12:00					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☐ Solid					
☐ Leachate ☒ Other: Coal		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment (Pulverized)					
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-In Person's Signature _____	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags

Traffic Report

1 Project W.O. <u> </u>		2 Sample Concentration		21134	
Project Name/Location		☒ Low Concentration		3 Ship to:	
<u>EEB / Coal / PA</u>		☐ Medium Concentration			
<u>W. Houshannon, PA</u>		5 Sampling Personnel Contact		<u>University of North Dakota</u>	
4 Sample Matrix		Sampler: <u>Robert R. Salomon</u>		<u>Environmental Research</u>	
☐ Liquid ☒ Solid		Project Manager: <u>Frank Holwer</u>		<u>Center Dr. David</u>	
☐ Other		Phone No. (215) 524-3500		Attn: <u>Frank Holwer</u>	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier) <u>Federal Express</u>		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped) <u>2/14/90</u>		<u>Bulk Sample</u>		<u>2 containers</u>	<u>~150 lbs</u>
(Airbill Number)					
8 Sample Location					
<u>Bulk Slag</u>					
Date: <u>2/14/90-2/15/90</u>					
Time: <u>1700</u>					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☐ Solid					
☐ Leachate ☒ Other: <u>Coal</u>		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment <u>slag</u>		<u>Compacted over time during</u>			
		<u>Coal / slag / slag - not dangerous</u>			
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-in Person's Signature _____	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags

Traffic Report

1 Project W.O.		2 Sample Concentration		10376	
Project Name/Location		☒ Low Concentration		3 Ship to:	
		☐ Medium Concentration			
		5 Sampling Personnel Contact			
4 Sample Matrix		Sampler:			
☒ Liquid ☐ Solid		Project Manager			
☐ Other		Phone No. (215) 524-3500		Attn:	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped)				2	1.0 L
(Airbill Number)					
8 Sample Location					
Date:					
Time:					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☐ Solid					
☐ Leachate ☐ Other: ☒ Liquid		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment					
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact				Log-In Person's Signature 	
☐ Samples at 4 degrees (C)					
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags	

Flyash Residue From Filtered Scrubber Water: Bulk Sample: Over a six hour period, we need to collect approximately 500 ml. of filtered flyash. It must be determined in the field how often, and how much of the flyash discharge water needs to be collected and filtered in order to collect the required amount. Using the coarse (20 μ m) filter paper, throughout the collection of the composite water, filter enough water through the Millipore® filtration apparatus to collect at least 500 ml. of solids, over the six hour period. Carefully remove the filtered solids from the filter paper, scraping them into one of the specially made 500 ml. sample containers, being careful not to include any of the filter paper in the sample. After filling one jar with flyash, follow the attached instructions to purge it with Nitrogen, label it and pack it for shipment to UNDERC.

Flyash Scrubber Water: Analytical Sample: For the flyash water analytical sample, split volumes between two 500 ml. Teflon® jars. Collect and filter 200 ml. of the flyash water every fifteen minutes, and split the filtered volume between the two Teflon® jars. Having filled the jars in approximately one hour, follow the attached instructions to purge the jars with Nitrogen, label them, and pack them for shipment to UNDERC. At least three hours later, under similar operating conditions as the first sample, collect a second sample in exactly the same manner as the first.

Quench Water: Analytical Sample: The quench water, through which the slag travels in order to cool, will be collected only for the analytical samples. Using a stainless steel ladle, with a five foot extension handle, carefully collect 200 milliliters of the water every fifteen minutes. Placing 100 ml. into each container will fill the two 500 ml. Teflon® jars in one hour. Having filled the jars, follow the attached instructions to purge them with Nitrogen, and then label and pack them for shipment to UNDERC. At another time, at least three hours later in the day, when the operating data are similar to those during the first sample, collect a second sample in exactly the same manner as the first. If you cannot get a direct reading of the quench water flow rate, approximate it from the discharge port, or in some other way. Record that flow rate, as well as all the other operating condition data, once an hour

Nitrogen Purging, Labelling And Packing Instructions

All samples collected into the specially made 500 ml. Teflon® jars must be purged with Nitrogen as soon after sample collection is completed as possible. This is done by attaching the hose from the Nitrogen tank to the specially fitted port on top of the sample container. With the lid loosely held on the jar, and the ball valve below the gas fill port open, start a light flow of gas into the jar, holding the lid so that the air in the jar can escape, and be replaced by the Nitrogen. After letting gas flow over the sample for several seconds, begin screwing the lid onto the jar, and simultaneously turn off the gas flow. Be very careful not to overfill or damage the jar with excessive gas pressure. Close the ball valve below the gas fill port, and then remove the Nitrogen fill line from the top of the jar.

Next, label the jar with the project name and number, the sample location, ERM Traffic Report number, date and time of sample location, initials of the samplers, and be sure to note whether it is an analytical or bulk sample.

Place the jar inside a ziplock bag, and then that inside the protective four inch PVC sleeve. Place the entire unit into the cooler, and keep it cool with ice packs until all the samples are collected, and the whole cooler is ready to be packed for shipment to UNDERC.

When packing the cooler, remove the ice packs, and place enough vermiculite around the bottles to make certain that they are unable to shift or move during transport. Pack vermiculite across the top of the containers, leaving enough room to replace one layer of ice packs. After including the ice packs, pack any remaining space with vermiculite, and make sure that nothing can shift during shipment. Seal the Traffic Report and Chain Of Custody forms inside the cooler, with the corresponding samples. Sign at least two ERM Custody Seals and use them and clear packing tape to seal the cooler. Attach the Federal Express forms and a mailing label to the top of the cooler, along with 'Fragile' and 'Handle With Care' stickers. The cooler should then be ready to be taken to the Federal Express office.

QA/QC

For each analytical sample and bulk sample, an ERM Traffic Report must be filled out, in order to help in the tracking of the samples. List the analytical samples as "Analytical Samples", and list the others as "Bulk Samples". Chain Of Custody must also be maintained and filled out for the samples. List the bulk samples on separate COC forms, but you may put all the analytical samples on the same COC form.

There are no travel blanks, nor any other QA samples to be submitted with these samples. There is also no data package to request.

Shipping

All samples will be shipped, appropriately packed (see attached instructions) in Coleman® coolers, via Federal Express to the following shipping address:

University Of North Dakota
Energy And Environmental Research Center
15 North 23rd St.

Grand Forks, ND 58201

Attn: ~~Frank~~ Beaver (701) 777-2869

The nearest Federal Express office is located at:

415 Airport Rd., Montoursville, PA

You will have to drop off the samples at that Federal Express location.
Directions:

Take I-180 South or East to the Montoursville exit. Follow the signs to Airport Rd. Fed-X is supposed to be 1/4 mile down Airport Rd.

ERM's Fed-X account #: 1288-9719-4 ERM Warehouse 208 Carter Dr., Unit 17A, West Chester, PA 19382 . (215) 430 - 0632.

Decontamination

Because most samples are being collected directly into the sample containers, there is very little equipment that needs to be deconned. In fact, the only item needing cleaned before sampling, and between the two sets of samples will be the ladle for the quench water analytical sample. Thoroughly decon the ladle with a soap scrub, tap water rinse, 10% nitric acid rinse, DI water rinse, methanol rinse, DI rinse, acetone rinse, DI rinse, and then let it air dry. Rinse it once more with DI water before beginning any sampling.

Special Considerations

Because we are sampling during a test run at a pilot plant, please try not to interfere or bother the site personnel too much. Also, since this is a test run, various hazardous situations may arise. Keep alert, and always be ready to get out of way of the site personnel, whenever necessary.

There is quite a bit of noise inside the boiler building, so it is recommended that hearing protection be worn. Be careful of hot slag and quench water as you are sampling, or working near it. Safety glasses and hard hats are required to be worn whenever you are inside the boiler building. Use clear glasses; it is fairly dark inside the building.

Contact Personnel

Frank Holmes - ERM - (215) 524 - 3523

Chris S. Goss - ERM - (215) 430 - 6219

Al Funk - ERM - (215) 524 - 3514

Dr. Zauderer - Coal Tech - (215) 667 - 0442

Williamsport Site - (717) 326 - 3361 Ext. 5156

Sue Agrawal - EER - (919) 489 - 1726

Jerry Harness - DOE - (304) 291 - 4835

Frank Beaver - Lab contact - (701) 777 - 2869

OPERATING CONDITION DATA

[illegible]

ERM TRAFFIC REPORT FORM

Traffic Report

1 Project W.O.	2 Sample Concentration	S425	
Project Name/Location	☐ Low Concentration		
	☐ Medium Concentration	3 Ship to:	
	5 Sampling Personnel Contact		
4 Sample Matrix	Sampler:		
☐ Liquid ☐ Solid	Project Manager		
☐ Other	Phone No. (215) 524-3500	Attn:	
6 Shipping Information	7 Specify Type of Analyses, Number of Containers, Approx. Volume		
(Name of Carrier)	Analyses / Method Requested	No. of Bottles	Total Volume
(Date Shipped)			
(Aerial Number)			
8 Sample Location			
Date:			
Time:			
9 Sample Description	10 Special Handling (e.g. Safety Procedures/Hazardous)		
☐ Surface Water ☐ Soil			
☐ Ground Water ☐ Solid			
☐ Leachate ☐ Other:	Additional comments: (Specify date package, rain work, special detection limits, etc.)		
☐ Sediment			
11 Condition of Samples Received (to be completed by Laboratory Log-in.)			
☐ Samples received intact			
☐ Samples at 4 degrees (C)			
☐ Samples not leaking			
☐ Container numbers match as specified in Item 7			
Log-in Person's Signature

ERM CUSTODY SEAL

<p>OFFICIAL CUSTODY SEAL</p>	<p>Name _____</p> <p>Date _____</p>
---	-------------------------------------

Appendix B

Traffic Report

1 Project W.O. —		2 Sample Concentration		21130	
Project Name/Location		☒ Low Concentration ☐ Medium Concentration			
EERL Co. - Tech				3 Ship to:	
Williamsport, PA		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: Frank Salomon		Environmental Research Center	
		Project Manager: Frank Salomon		Center	
☒ Liquid ☐ Solid ☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Cassa	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
Federal Express		Analytical sample		2	1000 ml
(Date Shipped)					
2/14/90					
(Airbill Number)					
8 Sample Location					
Row 414. #1					
Date: 2/13/90					
Time: 1710					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil ☐ Ground Water ☐ Solid ☐ Leachate ☒ Other: C-12 ☐ Sediment ☐ Water		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact ☐ Samples at 4 degrees (C) ☐ Samples not leaking ☐ Container numbers match as specified in Item 7 ☐ Container tags match Chain of Custody ☐ Cooler received with Custody Seals intact					
					Log-In Person's Signature _____
☐ Samples contained within plastic bags

Traffic Report

1 Project W.O. —		2 Sample Concentration		21131	
Project Name/Location		☒ Low Concentration		3 Ship to:	
East Coast Twp		☐ Medium Concentration			
Williamstown PA		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: C. Goss - R. Salzman		Environmental Research	
☒ Liquid ☐ Solid		Project Manager: Frank Holmes		Center	
☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Housh	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
Federal Express		Analytical Sample		2	1000 ml
(Date Shipped)					
- 11/19/90					
(Airbill Number)					
8 Sample Location					
Gus. J. Vialer #1					
Date: 2/10/90					
Time: 1300					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water	☐ Soil				
☐ Ground Water	☐ Solid				
☐ Leachate	☒ Other:	Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment	Process Water				
11 Condition of Samples Received (to be completed by Laboratory Log-In.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-In Person's Signature _____	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags

Traffic Report

1 Project W.O. —		2 Sample Concentration		21132	
Project Name/Location		☒ Low Concentration		3 Ship to:	
EER/Coal Tech		☐ Medium Concentration			
Williamsport, PA		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: C. Goss C. B. Solomon		Environmental Research Center	
☐ Liquid		☒ Solid		Project Manager	
☐ Other		Project Manager: Frank Holmes		Phone No. (215) 524-3500	
				Attn: Dr. David Lassett	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier)		Analyses / Method Requested		No. of Bottles	Total Volume
Federal Express		Analytical Sample		2	1000 ml
(Date Shipped)					
2/11/90					
(Airbill Number)					
8 Sample Location					
Coal Slag #1					
Date: 2/13/90					
Time: 1330					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water		☐ Soil			
☐ Ground Water		☐ Solid			
☐ Leachate		☒ Other: Slag		Additional comments: (Specify data package, rush work, special detection limits, etc.)	
☐ Sediment					
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-In Person's Signature	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags	

Traffic Report

Project W.O.		2 Sample Concentration		13645	
Project Name/Location		☒ Low Concentration		3 Ship to:	
EER Co. - h		☐ Medium Concentration			
Williamsport, PA		5 Sampling Personnel Contact		University of North Carolina	
4 Sample Matrix		Sampler: C. Goss - CRILumen		Environmental Research	
☐ Liquid ☒ Solid		Project Manager: Frank Holm		Center	
☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Nassif	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier) FedEx Express		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped) 2-15-90		Analytical Sample		1	500mls
(Airbill Number)					
8 Sample Location					
EER Co. #1					
Date: 2/15/90					
Time: 4:00					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☐ Solid					
☐ Leachate ☒ Other: Filtered		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment ☐ Fluvial		Field filtered w/ 20mm filter.			
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-In Person's Signature	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags

Traffic Report

1 Project W.O.		2 Sample Concentration		24858	
Project Name/Location		☒ Low Concentration		3 Ship to:	
EER / Coal Tech		☐ Medium Concentration			
Williamsport, PA		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: C B Salomon, C & Goss		Environmental Research	
☒ Liquid ☐ Solid		Project Manager: Frank Holmes		Center	
☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Hasset	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier) Federal Express		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped) 2/14/90		Analytical Sample		2	1000 ml
(Airbill Number)					
8 Sample Location					
Filtered ^{C&G} Flush Water #2					
Scrubber					
Date: 2/14/90					
Time: 1310					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☐ Solid					
☐ Leachate ☒ Other: Filtered		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment Process Water		Field filtered w/ 20µ filter			
11 Condition of Samples Received (to be completed by Laboratory Log-In.)					
☐ Samples received intact		Log-In Person's Signature _____			
☐ Samples at 4 degrees (C)					
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact		☐ Samples contained within plastic bags

Traffic Report

1 Project W.O. Project Name/Location EER Coal Tech Williamsport, PA	2 Sample Concentration ☒ Low Concentration ☐ Medium Concentration	24850 3 Ship to: University of North Dakota Environmental Research Center Attn: Dr. David Hassett																											
4 Sample Matrix ☒ Liquid ☐ Solid ☐ Other	5 Sampling Personnel Contact Sampler: C & Goss, C B Salomon Project Manager: Frank Holmes Phone No. (215) 524-3500																												
6 Shipping Information (Name of Carrier) Federal Express (Date Shipped) 2/14/90 (Airbill Number)	7 Specify Type of Analyses, Number of Containers, Approx. Volume <table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:40%;">Analyses / Method Requested</th> <th style="width:15%;">No. of Bottles</th> <th style="width:45%;">Total Volume</th> </tr> </thead> <tbody> <tr> <td>Analytical Sample</td> <td>2</td> <td>1000 ml</td> </tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>		Analyses / Method Requested	No. of Bottles	Total Volume	Analytical Sample	2	1000 ml																					
Analyses / Method Requested	No. of Bottles	Total Volume																											
Analytical Sample	2	1000 ml																											
8 Sample Location Quench Water #2 Date: 2/14/90 Time: 1320																													
9 Sample Description ☐ Surface Water ☐ Soil ☐ Ground Water ☐ Solid ☐ Leachate ☒ Other: Process ☐ Sediment Water	10 Special Handling (e.g. Safety Procedures/Hazardous) Additional comments: (Specify data package, rush work, special detection limits, etc.)																												
11 Condition of Samples Received (to be completed by Laboratory Log-in.) <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%; vertical-align: top;"> ☐ Samples received intact ☐ Samples at 4 degrees (C) ☐ Samples not leaking ☐ Container numbers match as specified in Item 7 ☐ Container tags match Chain of Custody ☐ Cooler received with Custody Seals intact </td> <td style="width:50%; vertical-align: top;"> Log-In Person's Signature <div style="border-top: 1px solid black; height: 40px;"></div> </td> </tr> <tr> <td colspan="2"> ☐ Samples contained within plastic bags </td> </tr> </table>			☐ Samples received intact ☐ Samples at 4 degrees (C) ☐ Samples not leaking ☐ Container numbers match as specified in Item 7 ☐ Container tags match Chain of Custody ☐ Cooler received with Custody Seals intact	Log-In Person's Signature <div style="border-top: 1px solid black; height: 40px;"></div>	☐ Samples contained within plastic bags																								
☐ Samples received intact ☐ Samples at 4 degrees (C) ☐ Samples not leaking ☐ Container numbers match as specified in Item 7 ☐ Container tags match Chain of Custody ☐ Cooler received with Custody Seals intact	Log-In Person's Signature <div style="border-top: 1px solid black; height: 40px;"></div>																												
☐ Samples contained within plastic bags

Traffic Report

1 Project W.O.		2 Sample Concentration		24361
Project Name/Location		☒ Low Concentration		
EER / Coal Term		☐ Medium Concentration		3 Ship to:
		5 Sampling Personnel Contact		University of North Dakota
4 Sample Matrix		Sampler: C. Goss, C. B. Solomon		Environmental Research
☐ Liquid		Project Manager: Frank Holmes		Center
☐ Solid		Phone No. (215) 524-3500		Attn: Dr. David Hosselt
☐ Other				
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume		
(Name of Carrier)		Analyses / Method Requested		No. of Bottles
Federal Express		Analytical Sample		2
(Date Shipped)				Total Volume
2/14/90				1000 ml
(Airbill Number)				
8 Sample Location				
Coal Slag #2				
Date: 2/14/90				
Time: 1330				
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)		
☐ Surface Water				
☐ Soil				
☐ Ground Water				
☒ Solid				
☐ Leachate		Additional comments: (Specify data package, rush work, special detection limits, etc.)		
☒ Other: Coal				
☐ Sediment				
slag				
11 Condition of Samples Received (to be completed by Laboratory Log-in.)				
☐ Samples received intact				
☐ Samples at 4 degrees (C)				
☐ Samples not leaking				
☐ Container numbers match as specified in Item 7				
☐ Container tags match Chain of Custody				
☐ Cooler received with Custody Seals intact				
☐ Samples contained within plastic bags				

Log-In Person's Signature

Traffic Report

1 Project W.O.		2 Sample Concentration		24862	
Project Name/Location		☒ Low Concentration		3 Ship to:	
EER/Coal Tox		☐ Medium Concentration			
Williamsport PA		5 Sampling Personnel Contact		University of North Dakota	
4 Sample Matrix		Sampler: C & Goss C B Salomon		Environmental Research	
☐ Liquid ☒ Solid		Project Manager Frank Holmes		Center	
☐ Other		Phone No. (215) 524-3500		Attn: Dr. David Hassett	
6 Shipping Information		7 Specify Type of Analyses, Number of Containers, Approx. Volume			
(Name of Carrier) Federal Express		Analyses / Method Requested		No. of Bottles	Total Volume
(Date Shipped) 2/14/90		Analytical Sample		1	500 ml
(Airbill Number)					
8 Sample Location					
Fly ash #2					
Date: 2/14/90					
Time: 1315					
9 Sample Description		10 Special Handling (e.g. Safety Procedures/Hazardous)			
☐ Surface Water ☐ Soil					
☐ Ground Water ☒ Solid					
☐ Leachate ☒ Other:		Additional comments: (Specify data package, rush work, special detection limits, etc.)			
☐ Sediment Fly ash		Filtered w/ 20µm filter			
11 Condition of Samples Received (to be completed by Laboratory Log-in.)					
☐ Samples received intact					
☐ Samples at 4 degrees (C)				Log-In Person's Signature _____	
☐ Samples not leaking					
☐ Container numbers match as specified in Item 7					
☐ Container tags match Chain of Custody					
☐ Cooler received with Custody Seals intact				☐ Samples contained within plastic bags	

Directions

It takes approximately three hours to get to the Coal Tech site from the ERM warehouse. From the warehouse, take Rt. 202 N. to Rt. 100 N. to the PA Turnpike, heading West. Get off the Turnpike at Exit 19 - "Harrisburg East". Follow the signs for Rts. 322 & 22 West - toward "State College". Follow 22 & 322 across the Susquehanna River. Within a mile after crossing the river, get onto Rts. 11 & 15, headed North - toward Sellinsgrove. A few miles North of Sellinsgrove, Rts. 11 & 15 split. Continue following Rt. 15 North, all the way into Williamsport. ****Note: Do not take the "Downtown Williamsport" exit off of Rt. 15. - Stay on Rt. 15.** As you cross the river into Williamsport, you will see the Keeler/Dorr-Oliver plant from the bridge on the left. Follow Rt. 15 to Hepburn Street - now the plant will be on the right. Go to the left side of the front of the plant, that is where the pilot plant is located. Look for a smallish building with three small stacks on top of it.

Pre-Sampling

Call Dr. Bert Zauderer at (717) 326 - 3361 ext. 5156 at the Williamstown site the day before the sampling is scheduled to begin. Make certain that the process is up and running, and that Dr. Zauderer is aware that we will be there to sample. You must have a signed copy of the Nondisclosure Agreement before Dr. Zauderer will answer any questions, or give you any help.

Call Frank Beaver at (701) 777 - 2869 at the Univ. Of North Dakota. He is our lab contact, and needs to be notified when the sampling is taking place, so that he can be prepared to receive the samples.

Sampling

There are four locations at the plant, from which samples will be taken. The 'solid' slag sample will be taken off the conveyor belt that brings it out from under the coal furnace, through the quench water. The quench water will be sampled directly from the pool into which the hot slag falls, under the coal furnace. The fly ash scrubber sample will be taken from a tap located outside the furnace building, next to the main plant building right next door. A 'solid' flyash sample will also be collected from that sampling location. The last sample will be a raw water sample taken from somewhere in the plant, before the water enters any of the coal processes.

Each of the four locations will be sampled for the analytical parameters at two different times during the day, when the operating data are all about the same. Each sample will be collected in duplicate 500 ml. volumes. One bulk slag sample will be composited over a six hour period, for a total of 100 pounds. A bulk sample of the fly ash will be collected by periodically be taking and filtering the fly ash water over a six hour period, and the resulting flyash filtered out of the water will be composited, for a total of 500 ml. of solid sample.

Equipment

Reserve the necessary equipment, listed below, with Dieter at the warehouse as early before the sampling event as possible.

Coolers/ Ice packs	Special sample jars (Teflon®)
S/S ladle w/ extension handle & spoons	Plastic sheeting
Paper towels	Trash bags
Bottle labels & pens	Surgical gloves
Nitrile gloves	Cloth gloves
Hardhats	Safety glasses
Ear plugs	Scrub bucket & brush
Liquid soap & other decon solutions	Distilled water
First Aid kit	Fire extinguisher
Scale - to weigh samples	Nitrogen tank - for samples
Tools - Knife	Field book
Traffic Reports & COC's	Sampling and H&S Plans
Flash light	Bottle overpacks
Vermiculite & other packing supplies	Fed-X forms
Cooler custody seals	Zip-lock bags
Stainless steel spatulas	Millipore® filter unit & filters

Bottle List

18 - 500 ml. Teflon® bottles have been specially prepared by Dieter for this project

1 - Large Coleman® cooler will be needed for the bulk sample of the slag, as well as three large trash bags

500 ml Teflon® Sample Container

Sampling Instructions

Operating Condition Data: The information in Table One must be completed each hour during which samples are collected. Ask Dr. Zauderer for help in where to obtain all the necessary information.

Solid Slag: Analytical Sample: Grab four or five ounces every five minutes from the slag conveyor with a stainless steel spoon or scoop. Thereby, approximately three pounds should be collected in about fifty minutes. Place the three pounds of slag onto a new, clean plastic sheet. Fold over the corners of the sheet, and roll the slag back and forth until it is thoroughly mixed. Next, equally divide the slag sample into two 500 ml. Teflon® jars. Follow the attached instructions to purge the jars with Nitrogen, label them, and pack them for shipment to UNDERC. At another time, at least three hours later in the day, when the operating data are similar to those during the first sample, collect a second sample in exactly the same manner as the first.

Solid Slag: Bulk Sample: The rate at which the furnace generates slag will directly determine the rate at which it will be collected for the bulk sample. It may take six, or more, hours to get 100 pounds, even if all of it is collected for the sample. Collect the sample directly off the conveyor belt, into triple layered trash bags inside a large Coleman® cooler. If the flow of slag is higher than anticipated, simply divert the slag into another collection basin, so that you collect between fifteen and twenty pounds of slag per hour. Make certain that the rate at which you collect the sample, and the way you collect it, remain fairly constant throughout the six hour period. Therefore the slag flow rate should be checked and recorded hourly, as should all the other operating condition data.

Having collected the 100 pounds of slag, securely close the plastic bags, use vermiculite, if necessary, seal the cooler with appropriate Chain Of Custody and Traffic Report forms included, and label the cooler for shipment to UNDERC.

Raw Water: Analytical Sample: The raw water will be collected for the analytical samples only. The general protocol for this sample will apply to all the water samples. Wearing surgical gloves, collect 100 milliliters of the water in each 500 ml. bottle from the raw water tap. Do this every fifteen minutes, until the bottles are filled, which will take one hour. Having filled the two 500 ml. Teflon® jars, Follow the attached instructions to purge them with Nitrogen, label them, and pack them for shipment to UNDERC. At another time, at least three hours later in the day, when the operating data are similar to those during the first sample, collect a second sample in exactly the same manner as the first.

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

SAMPLING REPORT #2

May 1992

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

**Energy and Environmental Research Corporation
Irvine, California**

INTRODUCTION

The United States Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. A key goal of this program is to ensure that waste management issues do not become obstacles to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of the collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now is extending their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of five (5) of these facilities.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology (CCT) Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritize them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.

- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. One of those technologies is the Gas Reburning-Sorbent Injection (GRSI) process being developed by Energy and Environmental Research Corporation of Irvine, CA. On March 25, 1992 samples were collected to characterize both solid and liquid waste streams. This document provides background information on the site and describes sampling activities performed at this facility.

SITE SELECTION

EER established criteria for selecting candidate sites. These include:

- The demonstration has been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There is a lack of data regarding the waste products from this technology,
- Facility operators will cooperate,
- There is a possibility that the waste contains regulated compounds, and
- The demonstration is being conducted in a pilot scale facility or larger with the availability of 85 lbs of waste.

EER is demonstrating the operation of a full-scale GRSI process. This is a new technology which has not been demonstrated commercially and thus limited data is available regarding the characteristics of the waste products. The demonstration was selected as one of the projects funded in Round 1 of DOE's CCT Program, and the facility operators were willing to have this sampling program conducted at their facility. Having met all of the criteria listed above, the GRSI technology being developed by EER in Irvine, CA was selected for inclusion in the current sampling program.

STREAM SELECTION

A schematic of the GRSI demonstration unit that was sampled is shown in Figure 1. This figure indicates the air, fuel, sorbent, flue gas, and waste stream flow paths through the unit as well as the locations for waste streams sampling. Both liquid and solid phase wastes were produced by this facility. The major solid waste stream consists of bottom ash and flyash, while liquid wastes consist of sluice water used for transport of the solid wastes streams.

The bottom ash consists of molten metals, rocks, and large particles of ash, sorbent and unburned coal. This ash is collected in the bottom of the furnace where water is present to quench these larger particles. The quenched bottom ash is then passed through a crusher and to a collection tank where it is transported by sluice lines to the ash pond. Ash from the economizer section of the boiler is also collected and transported with the bottom ash to the ash pond.

Flyash is collected in each of the following places: (1) the electrostatic precipitator, (2) the humidification duct, (3) the air preheater, and (4) the economizer ash hopper. The electrostatic precipitators (ESP's) are the primary collectors of flyash. The direct current electricity present in each of the fields of the ESP's charge the ash particles causing them to be attracted by the neutral plates. Ash is removed from the neutral plates by mechanically striking the support structures for the plates. The ash falls into ash hoppers where it is collected and transported by sluice lines to the ash pond. Ash that is collected in either the humidification duct or the air preheater is a result of fallout. The ash particles are too dense to stay suspended in the air flow; therefore, they collect in one of the two places. Ash that is deposited in these areas is collected in ash hoppers and sluiced out to the ash pond along with the flyash collected in the ESP. All discharges from the ash pond are regulated by a National Pollutant Discharge Elimination System (NPDES) permit issued by the Illinois Environmental Protection Agency.

Figure 1. Waste stream sampling locations (sample form and type).

Streams identified for sampling include the bottom ash, flyash, flyash sluice water, bottom ash sluice water, and samples of the inlet water supply, coal supply, and sorbent. The bottom ash and flyash were sampled to characterize the sluice water entering the ash pond which has a discharge to the Illinois River. The sluice water was sampled to determine the concentration of substances that may leach into the water while the ash is being transported and to determine the pH of the water. The presence of the sorbent in the waste stream necessitates regulation of the sluice water pH. This sluice water discharge stream needs to be fully characterized to ensure compliance with the appropriate permit. The bottom ash was collected in semi-dry form from the bottom ash holding tank for a bulk sample. In addition, samples of the bottom ash sluice line effluent were collected by filtering the bottom ash sluice line discharge to separate the bottom ash solids from the sluice effluent. Dry flyash was collected from each of the four hoppers on the ESP, the air preheater hopper, and the humidification screw conveyor for a bulk sample. Flyash sluice water was collected by filtering the flyash solids from the discharge of the flyash sluice line and collecting the filtered water. Finally, inlet water, unburned coal, and sorbent samples were taken for comparison purposes. The inlet water must be characterized to determine the extent to which substances in the bottom and flyash can be attributed to the combustion process and which were already present in the inlet water. The solids were characterized by collecting and analyzing the coal and sorbent and comparing their properties to the measured characteristics of the bottom ash and flyash.

SAMPLING PROCEDURES

The sampling team was on-site for the entire day of March 25, 1992 when EER was conducting operational tests. A copy of the sampling plan is provided in Appendix A. The following subsections provide a description of the sampling methods, the operational data collected and the packing and shipping procedures for delivering samples to the laboratories.

Streams Sampled

As described above, there are seven streams from which samples were taken:

1) unburned coal, 2) sorbent, 3) inlet water, 4) bottom ash, 5) flyash, 6) bottom ash sluice effluent water, and 7) flyash sluice effluent water. During the sampling, EER collected samples from each of these streams for analytical purposes with the exception of coal. Ash and sorbent analytical samples were placed in 500 ml Teflon® bottles and sealed. The bottles were then placed in coolers, packed with ice and sent to Iowa State University for analysis. Effluent analytical samples were put in 1-liter Boston Amber bottles and sealed. These samples were also placed in a cooler, packed with ice and sent to Iowa State University. Bulk samples were taken of the bottom ash, flyash, coal, and sorbent. Some bulk samples were collected in 500-ml Teflon® bottles while others were collected in 5-gallon buckets. In the sampling report, bulk samples were to be collected in three-ply trash bags. Due to the high temperature of the samples, 5-gallon buckets and 500-ml Teflon® bottles were used so that the samples would not be contaminated by the melted plastic and to ensure that the sample would remain intact. All bulk samples collected in 500-ml bottles were sealed and packed in the same manner as the 500-ml analytical samples. All bulk samples were sealed and shipped to the University of North Dakota Energy and Environmental Research Center. Figure 1, on page 5, represents the location and type (ie. bulk or analytical) of samples taken at various points for the Hennepin sampling visit.

Inlet water samples were collected from a water supply line located upstream of the ash sluice lines. One sample was collected in a 500-ml Teflon® bottle. The sample was collected 100 ml at a time in 15-minute intervals.

Unburned coal was collected from each of the three pulverizer mills supplying coal to the boiler. Approximately 1.6 gallons of coal was obtained from each mill and combined in one 5-gallon bucket.

A single 500-ml Teflon® bottle of sorbent was collected for bulk sample analysis. This sample was obtained from an inspection port in the sorbent silo hopper.

A bulk bottom ash sample was collected with a stainless steel scoop from the bottom ash hopper. Approximately 52 lbs. of bottom ash was collected in a 5-gallon bucket for bulk analysis. EER intended to obtain an 85 lb. sample but a lack of sufficient quantities of ash prevented this from being accomplished.

An analytical sample of bottom ash was also obtained from the bottom ash hopper. A stainless steel scoop was used to collect two 5-ml samples of bottom ash. These samples were placed in 500-ml Teflon® bottles and sealed for shipment to the analytical laboratory.

Flyash bulk samples were collected with a stainless steel scoop. Approximately 62 lbs. of flyash were collected from the various sampling location. Two 28 lb. samples were collected from ESP Hoppers 1 & 2 and packed in 5-gallon buckets. Two one pound samples were collected in 500-ml Teflon® bottles and sealed from the ESP 3 & 4 hoppers, the humidification duct screw conveyor, and the economizer ash hopper. The quantities of bulk samples taken at each location were determined through assessing the quantities of ash collected in each location. A break-down of the calculated splits for each location is provided in Table 1.

**Table 1. System Mass Flow Inputs, Outputs
and Waste Collection**

Inputs		Outputs (All parameters in lb/s)		Percentages	Total of 85 lbs.
Dry Coal Flow (lb/s)	16.27	Total Ash and Sorbent	3.559		
% Ash in Coal	9.56	Bottom Ash	0.3889		
% S in Coal	2.82	Economizer Ash	0.0347	1.1	0.93
Sorbent Flow Ca(OH)2 (lb/s)	1.81	Humidification Duct Ash	0.0809	2.56	2.18
% SO2 Removal	55.00	ESP Inlet Ash	3.0514		
% Bottom Ash	25.00	1 & 2 ESP Field Ash	2.9221	92.43	78.56
% Economizer Ash	30.00	3 & 4 ESP Field Ash	0.1238	3.92	3.33
Inlet ESP Loading (gr/scfm)	8.9	Flyash Emissions	0.0055		
Flow at ESP Inlet (dscfm)	144000	ESP Efficiency	99.82%		
Outlet ESP Loading (gr/scfm)	0.013	ESP Efficiency	99.82%		
Flow at ESP Outlet (dscfm)	177000	ESP Efficiency	99.82%		

Intermediate Parameters

Bottom ash and flyash	1.5554
Sorbent	2.0005
Single Field Efficiency	79.42%
Field 1 Collection	79.42%
Field 2 Collection	16.35%
Field 3 Collection	3.37%
Field 4 Collection	0.69%
Ash and Sorbent Collected	3.1616
Ash Emissions	0.3943
Ca/S Ratio	1.71

Analytical samples of flyash were also collected from ESP Hoppers 1 & 2, ESP Hoppers 3 & 4, the humidification duct, and economizer ash hopper. Two 500-ml samples were collected from both the ESP 1 & 2 hoppers and the ESP 3 & 4 hoppers. One 500-ml sample was collected from both the economizer ash hopper and the humidification duct screw conveyor. All samples were collected with a stainless steel scoop and sealed in 500-ml Teflon® bottles.

Bottom ash sluice line effluent samples were collected at the discharge of the ash sluice lines to the ash pond. Water was separated from the bottom ash by filtering the sluice discharge through a GeoTech filtration system using 20 um filter paper. Four 1-liter Boston Amber bottles of filtered sluice effluent were gathered for the bottom ash discharge line.

Flyash sluice line effluent samples were collected in the same manner as the bottom ash sluice line samples. The GeoTech filtration system using 20 um filter paper was used to separate 4 liters of flyash sluice effluent from the flyash. The effluent samples were collected in four 1-liter Boston Amber bottles and sealed for shipment to the Iowa State analytical laboratory.

Operation Data

Operating data for key parameters were also collected during the test program. The parameters measured included coal flow rate, sorbent flow rate, steam temperature, steam pressure, percent excess air in boiler exhaust, and ESP inlet and outlet temperatures. Data was collected approximately every 45 minutes throughout the sampling. Table 2 outlines the operating parameters measured. Appendix B provides the original data table. The ESP is operated to achieve an optimal outlet temperature of 275°F. Since the outlet temperature is the only one of importance, the accuracy of the inlet temperature is not of concern.

Table 2. Operating Condition Data
(this table must be completed hourly during sample collection)

Parameter		Time				
		13:37	14:30	15:15	15:58	16:17
Coal Flow Rate (lb/min)		945	962	960	959	952
Sorbent Flow Rate (lb/hr)		6555	6836	6893	6776	6595
Sluicing Period (min)						
Boiler Load (MW)		70	70	70	70	70
Steam Temperature (F)		986	997	992	987	988
Steam Pressure (psig)		1394	1393	1393	1392	1393
Excess Air (%) in Boiler Exit Gas		16.8	19.2	18	19.3	20
Inlet Temperature of ESP (F)	EAST	230	233	223	226	228
	WEST	246	245	248	249	247
Outlet Temperature of ESP (F)	EAST	277	276	278	278	279
	WEST	279	272	271	274	273
Bottom Ash Description		wet				
Fly Ash Description		dry				

Sample Shipment

Analytical samples were shipped via Federal Express to Iowa State's Spangler Laboratory for analysis. The analytical samples comprising 10 500-ml Teflon® bottles and 8 1-liter Boston Amber bottles were packed in coolers. The samples were surrounded with vermiculite and covered with ice packs. All bulk samples were shipped to the University of North Dakota Energy and Environmental Research Center for analysis. The bulk samples consisted of 4 5-gallon buckets and 6 500-ml Teflon® bottles. The bottles were packed in coolers, surrounded with vermiculite. The chain of custody forms and shipping reports are provided in Appendix C.

Appendix A

**EER-Sampling Plan
Solid Waste Sampling Project
Hennepin, Illinois**

January 10, 1992

Background

The U.S. Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. One of the projects in this program is to characterize the solid waste from advanced coal combustion or conversion technologies. In order to implement the characterization process, it is necessary to identify the potential units with waste streams of interest, obtain samples of the waste, and perform a complete analysis of the samples. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of this project. EER selected Illinois Power's (IP's) Hennepin Plant as one of five sites identified for participation in the sampling program. The technology being demonstrated at the Hennepin Plant is called Gas Reburning-Sorbent Injection.

This Clean Coal Technology is being demonstrated by EER at the Hennepin Plant. Therefore, the EER field team is very familiar with the operating conditions at the plant. The EER field team will conduct the sampling effort in the middle of January. At this time, EER will be conducting longterm testing at the plant and the operating conditions will be conducive for obtaining representative waste samples. During the long-term testing period, EER will take analytical samples from the 'raw' water inlet, the bottom ash hopper, the fly ash hoppers, the sluice water effluent line, and the sorbent (i.e. hydrated lime), and send them to Iowa State University for analysis. EER will also collect bulk samples of the bottom ash, fly ash, and raw coal for testing at the University of North Dakota Environmental Research Center (UNDERC). EER must also record any operating condition data during the sampling event, and report them to DOE. A brief final report of the field work will also be completed and sent to DOE.

Pre-Sampling

Call Sam Kruger at (815) 339-2241 ext. 266 at the Hennepin site the day before the sampling is scheduled to begin. Make certain that the process is up and running, and that Sam Kruger is aware that we will be there to sample.

Call Ed Olson at (701)777-5155 at the University of North Dakota, Environmental Research Center (UNDERC). He is our lab contact for the bulk samples and needs to be notified when the sampling is taking place, so that he can be prepared to receive the samples.

Call Dr. Carol Kilgour at (515)294-8203 at the Iowa State University. She is our lab contact for analytical samples and needs to be notified when the sampling is taking place, so that she can be prepared to receive the samples.

Sampling

There are six locations at the plant, from which samples will be taken. The coal sample will be taken from each of the three mills which supply coal to the boiler. The sorbent sample will be taken from an unloading sorbent truck or from the sorbent silo located on-site. The inlet water sample will be taken from the facility water supply line located upstream of the advanced coal utilization processes. A dry bottom ash sample will be taken from the bottom ash hopper before the ash is sluiced. Dry fly ash samples will be taken from the economizer clean-out ports, the humidification duct screw conveyors, and the cover plates on each of the hoppers before the fly ash is sluiced. A bottom ash effluent sample and a fly ash effluent sample will be taken from the inline sluice sampler before the sluice water empties into the ash pond.

Each of the six locations will be sampled during the normal 8-hour operating period for both analytical and/or bulk samples. The bottom and fly ash at the facility are sluiced sequentially during a 3-hour sluice cycle each day. During the bottom ash sluicing period, four 1-liter composite samples will be taken of the bottom ash sluice water effluent by compositing samples at intervals within the sluicing cycle. These samples will be filtered as to obtain only the liquid portion of the sluice sample for analytical purposes. During the fly ash sluicing period, four 1-liter composite samples will be taken of the fly ash sluice water effluent by compositing samples at intervals within the sluicing cycle. These samples will also be filtered as to obtain only the liquid portion of the sluice sample for analytical purposes. Two 500 ml containers of the fly ash and bottom ash will be collected from the hoppers in a dry form for analytical purposes. One 500 ml container of the sorbent will also be collected in dry form for analytical purposes. Bulk bottom and fly ash samples of approximately 85 lb. each will also be obtained. The bulk fly ash samples will be taken from each of the following sources in a dry form: economizer, humidification duct, ESP Hopper (Fields #1, #2), ESP Hopper

(Fields #3,#4). The bulk bottom ash sample will be obtained from the bottom ash hopper. Bulk samples from each location will be taken to enable the lab to composite the ash. A bulk coal sample obtained from each of the three mills will be collected in a 5-gallon bucket in dry form.

A detailed description of the specific sampling procedures for each sample location is listed in the "Sampling Instructions" section of this report.

Equipment

The following equipment will be used for the sampling program.

- 1- (5)Coolers/Ice Packs
- 2- Stainless steal ladle
- 3- Paper Towels
- 4- Bottle labels and pens
- 5- Nitrile gloves
- 6- Hardhats
- 7- Ear plugs
- 8- Liquid soap and other decon solutions
- 9- First Aid Kit
- 10- Scale-to weigh samples
- 11- Tools-Knife
- 12- Traffic Reports and Chain of Custodies
- 13- Flash Light
- 14- Vermiculite and other packing supplies
- 15- Cooler custody seals
- 16- Stainless Steal Spatulas
- 17- 500 ml Teflon Sample Jars
- 18- Plastic Sheeting
- 19- Trash Bags
- 20- Cloth Gloves
- 21- Safety Glasses
- 22- Scrub Bucket and Brush
- 23- Distilled water
- 24- Fire Extinguisher
- 25- Field Book
- 26- Sampling and Health and Safety Plans
- 27- Bottle Overpacks
- 28- Fed Ex Forms
- 29- Zip-lock bags
- 30- barrel filter unit & 20 um filter paper
- 31- Flex Hose with an 8" diameter
- 32- Approx. five 5-gallon buckets with lids

Bottle List

- 11- 500 ml Teflon bottles will be used for the dry analytical samples.
- 2- 500 ml Teflon bottles will be used for the raw water inlet analytical sample.
- 8- 1-liter Boston Round Amber bottles with Teflon caps will be used for the liquid samples.
- 1- Large Coleman cooler will be used for the bulk samples of the fly ash, as well as three large trash bags.
- 1- Large Coleman cooler will be used for the bulk samples of the bottom ash, as well as three large trash bags.
- 2- Large Coleman coolers will be used for the analytical samples.

Pre-Sampling Decontamination Procedures

The following procedures should be followed before the sampling event takes place, ideally the afternoon before initiation of the sampling event. In addition, these procedures for decontamination should be followed in between any sets of samples in which the same sampling equipment may be utilized more than once.

- 1- Identify the sampling items to be decontaminated. These items consist of the following:
 - All Teflon sampling containers necessary for the sampling event.
 - All buckets to be used for collecting the sluice or dry samples.
 - All spatulas or stainless steel scoops to be used for the sampling event.

*The Boston Round amber bottles with Teflon caps are pre-cleaned to EPA specifications and do not need to be decontaminated prior to sampling.
- 2- Obtain all necessary decontamination solutions and equipment:
 - Plastic sheeting
 - 1-five gallon bucket
 - 1-scrub brush
 - 1-concentrated liquid soap
 - Tap water
 - Deionized water
 - 10% Nitric Acid
 - Methanol
 - Acetone
 - Polyethylene squirt bottles
- 3- Establish an area where the decontamination procedure can take place. Make the following preparations for the area:
 - Lay clear plastic sheeting over a specific area for drying the cleaned items;
 - Have all cleaning solutions and equipment set up near plastic sheeting so that a wash and dry area is established.
- 4- The decontamination procedure for each piece of equipment should be as follows:
 - Wash the piece of equipment with the concentrated liquid soap
 - Rinse with tap water
 - Rinse with 10% nitric acid
 - Rinse with deionized water
 - Rinse with methanol

- Rinse with deionized water
- Rinse with acetone
- Rinse with deionized water
- Let air dry on plastic sheeting
- Rinse once more with deionized water before beginning sampling

Sampling Instructions

All samples will be obtained during a normal 8-hour operating period in which the Gas Reburning/Sorbent Injection Technology is being demonstrated at full load. The standard sluicing period for bottom ash and fly ash during a normal day of operation is approximately 3 hours. During this sluicing period the bottom ash and fly ash are sluiced sequentially. The operating condition data must be completed each hour during which samples are collected. This information should be documented in Table 1. Sam Kruger will aid in obtaining this information. The sampling parameters, locations, and sampling approach are described below:

Unburned Coal-A coal sample will be collected during the first day of sampling. A five-gallon bucket will be filled with coal from each of the three mills and sealed for an analytical sample. Approximately 1.6 gallons of coal will be collected from each mill. Label the bucket for shipment to the UNDERC.

Designated sampler: John Barker-before daily operation begins.

Sorbent-A sorbent sample will be collected from an unloading sorbent truck or from the sorbent silo in one 500 ml sampling jar for an analytical sample. This sorbent should be representative of the sorbent used for that day. Label the bottle and pack them for shipment to Iowa State University.

Designated sampler: John Barker-before daily operation begins.

Inlet Water-The inlet water will be collected for analytical samples. Wearing surgical gloves, collect 100 milliliters of water in each of two 500 ml. bottles from the raw water tap. Do this every fifteen minutes, until the bottles are filled, which will take one hour. Fill the bottles to the rim with the water. Label the bottles and pack them for shipment to Iowa State University.

Designated sampler: Robert Cook-before daily operation begins.

Bottom Ash Samples-Two 500 ml containers of dry bottom ash will be obtained from the bottom ash hopper for analytical purposes. This sample will be obtained prior to the bottom ash sluice cycle using a long-handled stainless steel scoop. These analytical samples will be labeled and packed for shipment to Iowa State University.

Designated sampler: Robert Cook-with operator, before bottom ash sluice cycle begins.

Bulk Bottom Ash Sample-A dry bulk sample of approximately 85 lb. will be obtained from the bottom ash hopper prior to the bottom ash sluice cycle using a long-handled stainless steel scoop. This bulk sample will be labeled and packed for shipment to the UNDERC.

Designated sampler: Robert Cook-with operator, before bottom ash sluice cycle begins.

Fly Ash Samples-Two 500 ml containers of dry fly ash will be obtained from each of the following locations for analytical purposes: Economizer, Humidification Duct, ESP Hopper (Fields #1, #2), and ESP Hopper (Fields #3, #4). The ash samples will be obtained prior to the fly ash sluice cycle using a long-handled stainless steel scoop. These analytical samples will be labeled and packed for shipment to Iowa State University.

Designated sampler: Jerry Lewis-before the fly ash sluice cycle begins.

Bulk Fly Ash Samples-The bulk fly ash samples will be collected from the following locations: Economizer, Humidification Duct, ESP Hopper (Fields #1, #2), and ESP Hopper (Fields #3, #4). Each of these locations will be sampled for the bulk quantities noted below.

The bulk samples will be labeled and packed for shipment to the UNDERC. These samples will be taken prior to the fly ash sluicing cycle.

- Economizer- A bulk sample of approximately 1 lb. will be obtained from the clean out ports of the economizer.
- Humidification Duct-A bulk sample of approximately 2 lbs. will be obtained from the screw conveyors in the humidification duct.
- ESP Hoppers (Fields #1, #2)- A bulk sample of approximately 79 lbs. will be obtained by removing the cover plate to the hopper.
- ESP Hoppers (Fields #3, #4)- A bulk sample of approximately 3 lbs. will be obtained by removing the cover plate to the hopper.

Designated sampler: Jerry Lewis-before the fly ash sluice cycle begins.

Bottom Ash Effluent Water Sample-The bottom ash effluent samples will be taken in composite form from the end of the effluent pipe which releases into the ash pond. Four filtered 1-liter effluent water samples will be taken. As stated previously the ash is sluiced sequentially at the site. Therefore, a sampler will be located at the end of the effluent pipe to take samples at specific intervals during the sluicing cycle when only the bottom ash is being sluiced. These samples will then be composited and filtered using the (20 um) filter paper. It must be determined in the field how much of the bottom ash effluent water needs to be collected and filtered in order to collect the required amount. Note that only the liquid portion of the sample will be collected, after the filtration, for analysis. After filling each jar with fly ash effluent water, label and pack them for shipment to Iowa State University.

Designated sampler: Charlie Drager-set-up before sluicing cycle

Jerry Lewis-After bottom ash sluice cycle has been completed. Note that the sluice line sampler container

will have to be emptied and reset before the fly ash sluice cycle begins.

Fly Ash Effluent Water Sample-The fly ash effluent samples will be taken from the in-line sluice water sampler during the fly ash sluice cycle. Four filtered 1-liter effluent water samples will be taken. As stated previously the ash is sluiced sequentially at the site. Therefore, the in-line sampler will be programmed to take samples at specific intervals during the sluicing cycle when only the fly ash is being sluiced. These samples will then be composited and filtered using the (20 um) filter paper. It must be determined in the field how much of the fly ash effluent water needs to be collected and filtered in order to collect the required amount. Note that only the liquid portion of the sample will be collected, after the filtration, for analysis. After filling each jar with fly ash effluent water, label and pack them for shipment to Iowa State University.

Designated sampler: Charlie Drager-set-up before sluicing cycle

Jerry Lewis-After fly ash sluice cycle has been completed.

Labeling and Packing Instructions

- 1- All dry analytical samples will be collected into 500 ml Teflon jars with the exception of the bulk samples. All wet analytical samples will be collected into 1-liter Boston Round amber bottles with Teflon caps, with the exception of the raw water inlet sample which will be collected in 500 ml Teflon containers.
- 2- Each jar should be labeled with the project name and number, the sample location, the date and time of the sample, initials of the samplers, and be sure to note whether the sample is analytical or bulk. The analytical sample jars will also be marked to indicate the liquid levels before shipping. The only bulk samples will be the fly ash bulk samples and the bulk sample of raw coal.
- 3- Chain of Custody forms and EER Field Sample Tracking Reports should be completed to document the type, quantity, location, and sampler involved with collecting each sample. A copy of these forms and an EER sampling label are attached in Appendix A.
- 4- Place each analytical sample inside a ziplock bag, and then place the bagged jar inside the protective four inch PVC sleeve. Place the entire unit into the cooler, and keep it cool with ice packs until all the samples are collected, and the whole cooler is ready to be packed for shipment to Iowa State University. The bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept on ice.

- 5- When packing the cooler with the analytical samples, remove the ice packs, and place enough vermiculite around the bottles to make certain that they are unable to shift or move during transport. Pack vermiculite across the top of the containers, leaving enough room to replace one layer of ice packs. After including the ice packs, pack any remaining space with vermiculite, and make sure that nothing can shift during shipment. As stated previously, the bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept or mailed on ice.
- 6- All bulk samples will be sent in one cooler to the University of North Dakota, UNDERC, laboratory. All analytical samples will be sent in two coolers to the Iowa State University laboratory. Make sure that each of the mailing addresses is written correctly on each of the appropriate coolers.
- 7- Seal the appropriate Chain of Custody forms inside the cooler, with the corresponding samples. Sign at least two EER Custody Seals. These seals along with clear packing tape will be used to seal the cooler.
- 8- Attach the Federal Express forms and a mailing label to the top of the cooler, along with 'Fragile', 'Handle With Care', and 'Caustic' stickers. The cooler should then be ready to take to the Federal Express office.

QA/OC

Chain of Custody forms and Field Sample Tracking Reports must be maintained and filled out for the samples. List the bulk samples on separate Chain of Custody forms, but you may put all the analytical samples on the same Chain Custody form.

There are no travel blanks, nor any other QA samples to be submitted with these samples. There is also no data package to request.

Shipping

•All bulk samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

University of North Dakota
Energy and Environmental Research Center
15 North 23rd St.
Grand Forks, ND 58201
Attn: Ed Olson (701) 777-5155

•All analytical samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

Iowa State University
Spangler Laboratory
Ames, Iowa, 50011
Attn: Dr. Carol Kilgour

The nearest Federal Express office is located at: Peru, Illinois
The Federal Express will pick up the samples at Hennepin on-site when notified.

Special Considerations

There is quite a bit of noise inside the boiler building, so it is recommended that hearing protection be worn. Safety glasses and hard hats are required to be worn whenever you are inside the boiler building. Use clear glasses; it is fairly dark inside the building.

Contact Personnel

Jerry Lewis-	EER-	(919)-489-1726
Sam Kruger-	Illinois Power	
	Hennepin Site-	(815)-339-2241 Ext. 266
Heather Rooney-	EER-	(919)-489-1726
Jerry Harness-	DOE-	(304)-291-4835
Ed Olson-	Lab contact-Bulk	(701)-777-5155
Carol Kilgour-	Lab contact-Analytical	(515)-294-8203

Appendix B

Switching ~~valve~~ Period (min)

Darryl: I discussed this table with Heather
 (this table must be completed hourly during sample collection)

→ this is the revised table 1/11/1558

Parameter	Time 1337	1435	1515	1558	1617
Coal Flow Rate (lb/s) lb/m ³	945	962	910	959	952
Sorbent Flow Rate (lb/s) lb/hr	6555	6836	6893	6776	6591
Sludge Water Flow Rate (gpm)	2				
Flue Gas Flow Rate (scfm)	70 gross	70	70	71	70
Boiler Load (MW)	986	997	996	987	988
Steam Boiler Temperature (F)	1394	1393	1393	1392	1393
Boiler Pressure (psia)	16.88	19.2	18.0	193	20.0
Excess Air (%) in exit ^{exit}	2.30/water	2.33/1095	2.25/1218	2.26/1249	2.28/1277
Inlet Temperature of ESP (F)	279/water	276/1095	278/1218	278/1249	279/1277
Outlet Temperature of ESP (F)					
Bottom Ash Production Rate (lb/hr)					
Fly Ash Production Rate (lb/hr)					
Bottom Ash Description	W8				
Fly Ash Description	OK				

Ash Slake Ring no. 1248-1345 (b. for no. 1352-1410) and no. 1411

Appendix C

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 3/25/92

Sample No.	Test No.	Description
<u>143796</u>	<u>NA</u>	<u>Bottom Ash Bulk Sample (~52 lb)</u>

Sampling System Prepared By _____

Test Operator NA

Others Involved in Test NA

Sample Recovery By D. Rasnake, B. Fullerton

Relinquished by	Received by	Time	Date	Reason
<u>Daryl R. (EER)</u>	<u>UNDEERC</u>	<u>1730</u>	<u>3/25/92</u>	<u>Analysis</u>

Laboratory Analysis By _____ Date _____

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 3/25/92

Sample No.	Test No.	Description
<u>143797</u>	<u>NA</u>	<u>ESP Hoppers 1 & 2 Bulk Sample (~28 lb)</u>
<u>143798</u>	<u>NA</u>	<u>ESP Hoppers 1 & 2 Bulk Sample (~26 lb)</u>

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By D. Rasnake and B. Fullerton

Relinquished by	Received by	Time	Date	Reason
<u>Daryl K. (EER)</u>	<u>UNDEERC</u>	<u>1730</u>	<u>3/25/92</u>	<u>Analysis</u>

Laboratory Analysis By _____ Date _____

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 2/25/92

Sample No.	Test No.	Description
<u>143800</u>	<u>NA</u>	<u>ESP Hoppers 3 & 4 Ash Bulk Sample (~1 lb)</u>
<u>143801</u>	<u>NA</u>	<u>ESP Hoppers 3 & 4 Ash Bulk Sample (~1 lb)</u>
<u>143806</u>	<u>NA</u>	<u>E Humidification Duct Ash Bulk Sample (~1 lb)</u>
<u>143807</u>	<u>NA</u>	<u>Humidification Duct Ash Bulk Sample (~1 lb)</u>
<u>143802</u>	<u>NA</u>	<u>Economizer Ash Bulk Sample (~1 lb)</u>
<u>143804</u>	<u>NA</u>	<u>Economizer Ash Bulk Sample (~1 lb)</u>
<u>143783</u>	<u>NA</u>	<u>Coal (5 gal)</u>

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By D. Rasnake and B. Fullerton

Relinquished by	Received by	Time	Date	Reason
<u>Daryl K</u>	<u>UNDEERC</u>	<u>1730</u>	<u>2/25/92</u>	<u>Analysis</u>

Laboratory Analysis By _____ Date _____

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 3/25/92

Sample No.	Test No.	Description
143780	NA	Sorbent (500ml)
143781	NA	Raw Water (500ml)
143786	NA	ESP ash Hoppers 1 & 2 (500ml)
143788	NA	ESP ash Hoppers 1 & 2 (500ml)
143794	NA	Bottom Ash (500ml)
143795	NA	Bottom Ash (500ml)
143787	NA	ESP ash Hoppers 3 & 4 (500ml)
143789	NA	ESP ash Hoppers 3 & 4 (500ml)

Sampling System Prepared By NA
 Test Operator NA
 Others Involved in Test NA

Sample Recovery By D. Rasmak, B. Fullerton, B. Boullianne, B. Koontz

Relinquished by [Signature]

Received by Carol Kilgore, Town St.

Time 1730

Date 3/25/92

Reason Analysis

Laboratory Analysis By _____

Date _____

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 3/25/92

Sample No.	Test No.	Description
<u>143792</u>	<u>NA</u>	<u>Economizer Ash (500ml)</u>
<u>143824</u>	<u>NA</u>	<u>Humidification Duct Ash (500ml)</u>

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By D. Rasnke, B. Fullerton, B. Boulianne, B. Koontz

Relinquished by	Received by	Time	Date	Reason
<u>D. Rasnke</u>	<u>Carol Kilgore, Towh St.</u>	<u>1730</u>	<u>3/25/92</u>	<u>Analysis</u>

Laboratory Analysis By _____ Date _____

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant Site B Project No. 8638.30 Date 3/25/92

Sample No.	Test No.	Description
143825	NA	Sluice line effluent bottom ash (1 liter)
143826	NA	Sluice line effluent bottom ash (1 liter)
143827	NA	Sluice line effluent bottom ash (1 liter)
143828	NA	Sluice line effluent bottom ash (1 liter)
143829	NA	Sluice line effluent flyash (1 liter)
143830	NA	Sluice line effluent flyash (1 liter)
143831	NA	Sluice line effluent flyash (1 liter)
143832	NA	Sluice line effluent flyash (1 liter)

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By D. Rasnake, B. Fullerton, & B. Boulianne

Relinquished by	Received by	Time	Date	Reason
<u>Nayll Kle (DER)</u>	<u>Iowa State Carol Kilgore</u>	<u>1730</u>	<u>3/25/92</u>	<u>Analysis</u>

Laboratory Analysis By _____ Date _____

E
E
R

FIELD SAMPLE TRACKING REPORT

Project No. 863P.30 Page 1 of 2
Plant Site B

SAMPLE NO.	PROCESS STREAM /LOCATION	DESCRIPTION	DATE	TIME	SAMPLER	LAB SENT TO	DATE
143783	Coal mills	Coal	3/25/92	1055A	D. Rasnake	UNDEERC	3/25/92
13797	ESP Hoppers 1 & 2	ESP Ash	3/25/92	1445	D. Rasnake	UNDEERC	3/25/92
43798	ESP Hoppers 1 & 2	ESP Ash	3/25/92	1445	D. Rasnake	UNDEERC	3/25/92
43800	ESP Hoppers 3 & 4	ESP Ash	3/25/92	1445	D. Rasnake	UNDEERC	3/25/92
13801	ESP Hoppers 3 & 4	ESP Ash	3/25/92	1445	D. Rasnake	UNDEERC	3/25/92
13806	Humidification duct	Humidification duct ash	3/25/92	1545	D. Rasnake	UNDEERC	3/25/92
13807	Humidification duct	Humidification duct ash	3/25/92	1545	D. Rasnake	UNDEERC	3/25/92
13802	Economizer Hoppers	Economizer Ash	3/25/92	1530	D. Rasnake	UNDEERC	3/25/92
43804	Economizer Hoppers	Economizer Ash	3/25/92	1530	D. Rasnake	UNDEERC	3/25/92
143796	Bottom Ash Hopper	Bottom Ash	3/25/92	1310	D. Rasnake	UNDEERC	3/25/92
143825	Sluice line	Bottom Ash Effluent	3/25/92	1400	D. Rasnake	Iowa State	3/25/92
43826	Sluice line	Bottom Ash Effluent	3/25/92	1400	D. Rasnake	Iowa State	3/25/92
43827	Sluice line	Bottom Ash Effluent	3/25/92	1400	D. Rasnake	Iowa State	3/25/92
43828	Sluice line	Bottom Ash Effluent	3/25/92	1400	D. Rasnake	Iowa State	3/25/92
143829	Sluice line	Flyash effluent	3/25/92	1620	D. Rasnake	Iowa State	3/25/92

E
E
R

FIELD SAMPLE TRACKING REPORT

Project No. 8638.30
Plant Site B

Page 2 of 2

SAMPLE NO.	PROCESS STREAM / LOCATION	DESCRIPTION	DATE	TIME	SAMPLER	LAB SENT TO	DATE
143830	Sluice line	Flyash effluent	3/25/92	1620	D. Resnick	Iowa State	3/25/92
143831	Sluice line	Flyash effluent	"	1620	"	"	"
143832	Sluice line	Flyash effluent	"	1620	"	"	"
143780	Sorbent Silo	Sorbent analytical	"	945	"	"	"
143781	Raw water inlet	Raw water analytical	"	1010	"	"	"
143786	ESP Hoppers 1 & 2	ESP ASH analytical	"	1445	"	"	"
143788	ESP Hoppers 1 & 2	ESP ASH analytical	"	1445	"	"	"
143794 143789	Bottom Ash Hopper	Bottom ASH analytical	"	1310 1400	"	"	"
143795	Bottom Ash Hopper	Bottom ASH analytical	"	1310 1400	"	"	"
143787	ESP ASH HOPPER ^{3 & 4}	ESP ASH analytical	"	1445	"	"	"
143789	ESP Hoppers 3 & 4	ESP ASH analytical	"	1445	"	"	"
143792	Economizer ASH HOPPER	Economizer ash anal.	"	1530	"	"	"
143824	Humidification duct	Humidification duct ash anal.	"	1545	"	"	"

E
E
R

FIELD SAMPLE TRACKING REPORT

Project No. 8638.30 Page 2 of 2
Plant Site B

SAMPLE NO.	PROCESS STREAM /LOCATION	DESCRIPTION	DATE	TIME	SAMPLER	LAB SENT TO	DATE
143830	Sluice line	Flyash effluent	3/25/92	1620	D. Resnick	Iowa State	3/25/92
143831	Sluice line	Flyash effluent	"	1620	"	"	"
143832	Sluice line	Flyash effluent	"	1620	"	"	"
143780	Sorbent Silo	Sorbent analytical	"	945	"	"	"
143781	Raw water inlet	Raw water analytical	"	1010	"	"	"
143786	ESP Hoppers 1 & 2	ESP ASH analytical	"	1445	"	"	"
143788	ESP Hoppers 1 & 2	ESP ASH analytical	"	1445	"	"	"
143794 143782	Bottom Ash Hopper	Bottom ASH analytical	"	1310 1400	"	"	"
143795	Bottom Ash Hopper	Bottom ASH analytical	"	1310 1400	"	"	"
143787	ESP ASH HOPPER 3 & 4	ESP ASH analytical	"	1445	"	"	"
143789	ESP Hoppers 3 & 4	ESP ASH analytical	"	1445	"	"	"
143792	Economizer ASH HOPPER	Economizer ash anal.	"	1530	"	"	"
143824	Humidification duct	Humidification duct ash anal.	"	1545	"	"	"

Appendix C

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

SAMPLING REPORT #3

July 1992

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

**Energy and Environmental Research Corporation
Irvine, California**

INTRODUCTION

The United States Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. A key goal of this program is to ensure that waste management issues do not become obstacles to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of the collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now is extending their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of five (5) of these facilities.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology (CCT) Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritize them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.

- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. One of those technologies is the Pressurized Fluidized-Bed Combustion (PFBC) process being developed by American Electric Power (AEP) of Canton, OH. On June 21, 1992 samples were collected to characterize both solid and liquid waste streams. This document provides background information on the site and describes sampling activities performed at this facility.

SITE SELECTION

EER established criteria for selecting candidate sites. These include:

- The demonstration has been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There is a lack of data regarding the waste products from this technology,
- Facility operators will cooperate,
- There is a possibility that the waste contains regulated compounds, and
- The demonstration is being conducted in a pilot scale facility or larger with the availability of 85 lbs of waste.

American Electric Power is demonstrating the operation of a full-scale PFBC process. This is a new technology which has not been demonstrated commercially and thus limited data is available regarding the characteristics of the waste products. The demonstration was selected as one of the projects funded in Round 1 of DOE's CCT Program, and the facility operators were willing to have this sampling program conducted at their facility. Having met all of the criteria listed above, the PFBC technology being developed by AEP in Canton, OH was selected for inclusion in the current sampling program.

STREAM SELECTION

A schematic of the PFBC demonstration unit that was sampled is shown in Figure 1. This figure indicates the air, fuel, sorbent, flue gas, and waste stream flow paths through the unit as well as the locations for stream sampling. Only solid phase wastes were produced by this facility. The major solid waste streams consists of bottom ash and flyash. Additional solids samples were taken of the dolomite sorbent and coal. A liquid sample was taken of the inlet water used to spray the flyash before it is transported by truck to the ash landfill.

The bottom ash consists of coal ash, unburned coal, small rocks, and captured sulfur. This ash is collected in the bottom of the bed and passed to one of the two bed ash lockhoppers. When full, the lockhoppers are depressurized and emptied by gravity into a common atmospheric pressure hopper. The ash is then fed by screw conveyor to a bed ash conveyor which transports the ash to the bed ash silo. Once in the silo, the ash collects until it is transported by truck to be disposed of in the ash landfill.

Flyash is collected in one of two places: (1) the cyclone dust collectors and (2) the electrostatic precipitator (ESP). The cyclone dust collectors are the primary collectors of flyash. There are seven parallel sets of cyclones, with each set consisting of both a primary and secondary cyclone. The circulating flow of combustion gases in the cyclones cause the flyash particles to separate from the combustion gases and collect in the cyclone ash hoppers. This cyclone ash is continuously removed via a pneumatic transport system in which a small portion of the high pressure combustion gas conveys the ash to an atmospheric pressure silo. The gas stream that leaves the cyclone dust collectors is passed through a gas turbine. The shaft output of the turbine is used to drive a compressor to deliver pressurized air to the combustion chamber and provide additional electric power generation. Secondary ash collection takes place in the ESP. The direct current electricity present in each of the fields of the ESP's charge the ash particles causing them to be attracted by the neutral plates. Ash is removed from the neutral plates by mechanically striking the support structures for the

TIDD Pressurized Fluidized Bed Combustion System

Figure 1. Stream Sampling Locations (Sample Form and Type)

plates. The ash falls into hoppers where it is collected and transported pneumatically to the cyclone ash silo.

Streams identified for sampling include the bottom ash, cyclone dust collector ash, ESP flyash, coal, dolomite sorbent, and spray curtain supply water. Bottom ash was collected in dry form from the bed ash conveyor previous to being collected in the bed ash silo. Dry cyclone ash was collected from a sampling port at the entrance to the cyclone ash silo. Flyash from the ESP was collected in dry form from a sampling port located in the ESP hopper that serves the #1 field. A coal sample was taken from the coal sampler located between the roll crushers and the coal feed hopper. Sorbent was collected upstream of the cyclone separators just prior to being sent to the sorbent storage silo. Finally, spray curtain inlet water was sampled from the high pressure service line that supplies water to the ash silo spray curtains. This water is sampled to insure that no potential exists for the impurities in the water to react with the flyash or bottom ash to produce any unwanted by-products. All of the ash is hauled by truck to a landfill that is also used ash disposal from the neighboring Cardinal Plant. The landfill site has been designated as an Ohio Environmental Protection Agency permitted area.

SAMPLING PROCEDURES

The sampling team was on-site for the entire day of June 21, 1992 when EER was conducting operational tests. A copy of the sampling plan is provided in Appendix A. The following subsections provide a description of the sampling methods, the operational data collected and the packing and shipping procedures for delivering samples to the laboratories.

Streams Sampled

As described above, there are six streams from which samples were taken:

1) unburned coal, 2) sorbent, 3) bed ash, 4) cyclone ash, 5) ESP flyash, and 6) spray curtain supply water. During the sampling, EER collected samples from each of these streams for analytical purposes with the except of coal. Ash and sorbent analytical samples were placed in 500 ml Teflon® bottles and sealed. The bottles were then placed in coolers, packed with ice and sent to Iowa State University for analysis. The spray curtain supply water analytical sample was put in 1-liter Boston Amber bottles and sealed. This sample was also placed in a cooler, packed with ice and sent to Iowa State University. Bulk samples were taken of the combustor bed bottom ash, cyclone ash, ESP flyash, and coal. The bulk coal sample was taken in one 5-gallon bucket. The bottom ash and cyclone ash bulk samples were each collected in individual 18-gallon Rubbermaid® containers. The bulk ESP flyash sample was collected in a 28-quart cooler. All bulk samples were sealed and shipped to the University of North Dakota Energy and Environmental Research Center. Figure 1, on page 5, represents the location and type (ie. bulk or analytical) of samples taken at various points for the Site "C" sampling visit.

Unburned coal was collected from the automatic sampler located between the roller crusher and the coal feed hopper. A 5-gallon bucket of coal was collected for bulk analysis over a one hour period by allowing the sampler to take continuous measurements.

An analytical sample of sorbent was taken from a point located just after the cyclone separator. Four small samples were taken over a 20-minute period through the use of a pneumatic sampler. This composite sample was then riffled down to a single analytical sample. The sorbent sample was collected in a 500-ml Teflon® container.

Combustor bed bottom ash was collected from the bed ash conveyor. Approximately 102 lbs. of bottom ash was collected over a two hour period. The sample was collected by allowing a small amount of the ash on the conveyor to continuously empty into the sample container. This bulk sample was collected in an 18-gallon Rubbermaid® container and sealed.

Two analytical samples of bottom ash were taken from the bed ash conveyor in the same manner as was the bulk sample. Two 500-ml Teflon® containers of bottom ash were collected and prepared for shipment to the analytical laboratory.

A bulk sample of cyclone ash was collected from a port located just prior to the cyclone ash silo. Approximately 92 lbs. of ash was collected in 18-gallon Rubbermaid® container. The sample was collected by opening a valve at the sampling port which allowed ash to flow into the sampling container.

Two analytical samples of cyclone ash were collected in 500-ml Teflon® containers and prepared for shipment to the analytical laboratory. These samples were gathered in the same manner and in the same location as the bulk cyclone ash sample.

A bulk ESP flyash sample was taken from a sampling port located at the #1 ESP field ash hopper. This sample was obtained by opening the sampling valve and allowing the ash to flow into the sample container. Approximately 12 lbs. of ESP flyash was collected in a 28-quart cooler and prepared for shipment to the bulk laboratory.

Analytical samples were taken of the ESP flyash from the #1 ESP field ash hopper as well. Two 500-ml Teflon® containers of flyash were obtained in the same way as the bulk sample. These samples were sealed and prepared for shipment to the analytical lab.

One 1-liter Boston Amber bottle of spray curtain supply water was taken from the high pressure service water line that supplies the spray curtain. The sample was collected from spray curtain supply line connected to the service water. Water was allowed to flow through the line for 20 minutes prior to taking the sample.

Operation Data

Operating data for key parameters were also collected during the test program. The parameters measured included coal flow rate, sorbent flow rate, PFBC vessel pressure, boiler load, steam temperature, steam pressure, combustion gas temperatures before and after the gas turbine, percent excess air in boiler exhaust, ESP inlet and outlet temperatures, and the average bed temperature. Data was collected approximately every hour throughout the time in which samples were being taken. Table 1 outlines the operating parameters measured. Appendix B provides the original data tables.

Sample Shipment

Analytical samples were shipped via Federal Express to Iowa State's Spangler Laboratory for analysis. The analytical samples comprising 7 500-ml Teflon® bottles and 1 1-liter Boston Amber bottle were packed in a single cooler. The samples each wrapped in two clear plastic bags, surrounded with vermiculite and covered with ice packs. All bulk samples were shipped to the University of North Dakota Energy and Environmental Research Center for analysis. The bulk samples consisted of one 5-gallon bucket, two 180-gallon Rubbermaid® containers and one 28-quart cooler. The chain of custody forms and shipping reports are provided in Appendix C.

Table 1. Operating Condition Data
(this table must be completed hourly during sample collection)

Parameter		Time			
		8:30	9:02	10:03	11:00
Coal Flow Rate (kpph)		49.12	51.34	50.37	48.15
Sorbent Flow Rate (kpph)		17.24	18.27	18.10	8.25
Vessel Pressure (psig)		137.78	137.82	137.25	137.48
Boiler Load (MW)		50.56	49.64	49.79	51.34
Steam Temperature (F)		818.85	804.59	911.48	814.14
Steam Pressure (psig)		1276.28	1294.44	1267.19	1231.00
Temperature of Boiler Exit Gas (F)	Before Gas Turbine	1393.20	1385.30	1390.75	1394.00
	After Gas Turbine	649.40	643.50	651.31	650.90
Excess Air (%) in Boiler Exit Gas		4.40	4.55	4.28	4.30
Inlet Temperature of ESP (F)		401.40	409.70	402.41	406.80
		410.84	408.13	411.21	405.10
Stack Gas Temperature (F)		391.80	392.30	393.10	390.60
Average Bed Temperature (F)		1560.00	1545.00	1558.20	1563.90

Appendix A

**EER-Sampling Plan
Solid Waste Sampling Project
Tidd Site
Brilliant, OH**

February 25, 1992

Background

The U.S. Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. One of the projects in this program is to characterize the solid waste from advanced coal combustion or conversion technologies. In order to implement the characterization process, it is necessary to identify the potential units with waste streams of interest, obtain samples of the waste, and perform a complete analysis of the samples. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of this project. EER selected American Electric Power's (AEP's) Tidd Plant as one of five sites identified for participation in the sampling program. The technology being demonstrated at the Tidd Plant is called Pressurized Fluidized Bed Combustion (PFBC).

This Clean Coal Technology is being demonstrated by AEP at the Tidd Plant. The EER field team has already conducted a preliminary site visit at the Tidd site and is familiar with operating conditions at the plant. The EER field team will conduct the sampling effort at the end of February. At this time, Tidd will be undergoing long-term testing at the plant and the operating conditions will be conducive for obtaining representative waste samples. During the long-term testing period, EER will take analytical samples from the ash silo spray curtain supply line, discharge boiler bed ash hoppers, cyclone dust collectors, dolomite sorbent, and fly ash hoppers and send them to Iowa State University for analysis. EER will also collect bulk samples of the raw coal, dolomite sorbent, sand, bottom ash, and fly ash for testing at the University of North Dakota Energy and Environmental Research Center (UNDERC). EER must also record any operating condition data during the sampling event, and report them to DOE. A brief final report of the field work will also be completed and sent to DOE.

Pre-Sampling

Call Dennis Rathburn at (614) 598-4155 at the Tidd site the day before the sampling is scheduled to begin. Make certain that the process is up and running, and that Dennis Rathburn is aware that we will be there to sample.

Call Ed Olson at (701)777-5155 at the University of North Dakota, Environmental Research Center (UNDERC). He is our lab contact for the bulk samples and needs to be notified when the sampling will take place, so that he can be prepared to receive the samples.

Call Dr. Carol Kilgour at (515)294-8203 at the Iowa State University. She is our lab contact for analytical samples and needs to be notified when the sampling is taking place, so that she can be prepared to receive the samples.

Sampling

There are six locations at the plant, from which samples will be taken. The coal sample will be taken from the coal sampler prior to being fed into the boiler. Sorbent (dolomite) samples will be taken from the crusher unit. A dry boiler bed ash sample will be taken while the ash is being loaded onto trucks for transportation to the disposal site. Ash collected by the cyclone dust collectors will be sampled automatically from their ash hoppers. Fly ash samples will be collected automatically from the electrostatic precipitator (ESP) before being combined with the cyclone ash and transported to the landfill for disposal. Water samples will be taken from the ash silo spray curtain supply lines.

Each of the six locations will be sampled during the normal 8-hour operating period for both analytical and/or bulk samples. One 1-liter Boston Amber bottle of ash silo spray curtain water will be collected from its water supply line. Two 500 ml containers of the fly ash, boiler bottom ash, and cyclone dust collector ash will be collected from the hoppers in a dry form for analytical purposes. One 500 ml containers of the sorbent from the crusher unit will be collected in dry form for analytical purposes. Bulk bottom and fly ash samples of approximately 88 lb. each will also be obtained. The bulk fly ash samples will be taken in a dry form from both the ESP Hopper and the cyclone dust collector by way of automatic samplers (83 lb. and 5 lb. respectively). The bulk bottom ash sample will be obtained from the bed ash silo while loading onto disposal trucks. Bulk samples from each location will be taken to enable the lab to composite the ash. All bulk ash samples will be taken in 5-gallon buckets. A bulk coal sample obtained from the coal samplers will be collected in a 5-gallon bucket in dry form.

A detailed description of the specific sampling procedures for each sample location is listed in the "Sampling Instructions" section of this report.

Equipment

The following equipment will be used for the sampling program.

- 1- (5)Coolers/Ice Packs
- 2- Stainless steal ladle
- 3- Paper Towels
- 4- Bottle labels and pens
- 5- Nitrile gloves
- 6- Hardhats
- 7- Ear plugs
- 8- Liquid soap and other decon solutions
- 9- First Aid Kit
- 10- Scale-to weigh samples
- 11- Tools-Knife
- 12- Traffic Reports and Chain of Custodies
- 13- Flash Light
- 14- Vermiculite and other packing supplies
- 15- Cooler custody seals
- 16- Stainless Steal Spatulas
- 17- 10 - 500 ml Teflon Sample Jars
- 18- Plastic Sheeting
- 19- Trash Bags
- 20- Cloth Gloves
- 21- Safety Glasses
- 22- Scrub Bucket and Brush
- 23- Distilled water
- 24- Fire Extinguisher
- 25- Field Book
- 26- Sampling and Health and Safety Plans
- 27- Bottle Overpacks
- 28- Fed Ex Forms
- 29- Zip-lock bags
- 30- barrel filter unit & 20 um filter paper
- 31- Flex Hose with an 8" diameter
- 32- Approx. ten 5-gallon buckets with lids

Bottle List

- 7- 500 ml Teflon bottles will be used for the dry analytical samples.
- 1- 1-liter Boston Round Amber bottle with Teflon cap will be used for the liquid samples.
- 10- 5-gallon buckets with lids for the bulk bottom ash and flyash samples.
- 2- Large Coleman coolers will be used for the analytical samples.

Pre-Sampling Decontamination Procedures

The following procedures should be followed before the sampling event takes place, ideally the afternoon before initiation of the sampling event. In addition, these procedures for decontamination should be followed in between any sets of samples in which the same sampling equipment may be utilized more than once.

- 1- Identify the sampling items to be decontaminated. These items consist of the following:
 - All Teflon sampling containers necessary for the sampling event.
 - All buckets to be used for collecting the sluice or dry samples.
 - All spatulas or stainless steel scoops to be used for the sampling event.

*The Boston Round Amber bottles with Teflon caps are pre-cleaned to EPA specifications and do not need to be decontaminated prior to sampling.
- 2- Obtain all necessary decontamination solutions and equipment:
 - Plastic sheeting
 - 1-five gallon bucket
 - 1-scrub brush
 - 1-concentrated liquid soap
 - Tap water
 - Deionized water
 - 10% Nitric Acid
 - Methanol
 - Acetone
 - Polyethylene squirt bottles
- 3- Establish an area where the decontamination procedure can take place. Make the following preparations for the area:
 - Lay clear plastic sheeting over a specific area for drying the cleaned items;
 - Have all cleaning solutions and equipment set up near plastic sheeting so that a wash and dry area is established.

4- The decontamination procedure for each piece of equipment should be as follows:

- Wash the piece of equipment with the concentrated liquid soap
- Rinse with tap water
- Rinse with 10% nitric acid
- Rinse with deionized water
- Rinse with methanol
- Rinse with deionized water
- Rinse with acetone
- Rinse with deionized water
- Let air dry on plastic sheeting
- Rinse once more with deionized water before beginning sampling

Sampling Instructions

All samples will be obtained during a normal 8-hour operating period in which the Pressurized Fluidized Bed Combustor is being demonstrated at full load. The operating condition data must be completed each hour during which samples are collected. This information should be documented in Table 1. Dennis Rathburn will aid in obtaining this information. The sampling parameters, locations, and sampling approach are described below:

Unburned Coal-A coal sample will be collected during the first day of sampling. A five-gallon bucket will be filled with coal from the coal sampler and sealed for a bulk sample. Label the bucket for shipment to the UNDERC.
Designated sampler:

Dolomite Samples-One 500 ml containers of dolomite will be obtained from the Dolomite Crusher automatic sampler for analytical purposes. This sample should be taken prior to being transported to the conveyor system which supplies the sorbent storage silos. Label the containers and pack them for shipment to Iowa State University.
Designated sampler:

Bottom Ash Samples-Two 500 ml containers of dry bottom ash will be obtained from the Bed Ash Silo for analytical purposes. This sample will be obtained prior to or during loading onto an ash disposal truck using a long-handled stainless steel scoop. These analytical samples will be labeled and packed for shipment to Iowa State University.
Designated sampler:

Bulk Bottom Ash Sample-A dry bulk sample of approximately 88 lbs. consisting of bed ash will be obtained from the Bed Ash Silo prior to or during loading into an ash disposal truck using a long-handled stainless steel scoop. This bulk sample will be labeled and packed for shipment to the UNDERC.

Designated sampler:

Spray Curtain Water Sample-One 1-liter Boston Amber bottle of ash silo spray curtain supply water will be taken for analytical purposes. The water sample will be obtained from the supply line that feeds the curtains. Samples of 200 ml will be taken at 5 minute intervals until the bottle is completely full (this should take 20 minutes). Each of these 200 ml samples will be collected in the same 1-liter Boston Amber bottle. This analytical sample will be labeled and packed for shipment to Iowa State University.

Designated sampler:

Fly Ash Samples-Two 500 ml containers of dry fly ash will be obtained from the Cyclone Dust Collector Hopper and two 500 ml containers of fly ash will be obtained from the ESP Hopper for analytical purposes. The ash samples will be obtained prior to mixing of the two streams for disposal using automatic samplers. These analytical samples will be labeled and packed for shipment to Iowa State University.

Designated sampler:

Bulk Fly Ash Samples-The bulk fly ash samples will be collected from the same locations mentioned previously. Each of these locations will be sampled for the bulk quantities noted below.

- Cyclone Dust Collector-A bulk sample of approximately 83 lbs will be obtained from the automatic samplers.
- ESP Hopper- A bulk sample of approximately 5 lbs. will be obtained by removing the cover plate to the hopper.

The bulk samples will be labeled and packed for shipment to the UNDERC. These samples will be taken prior to fly ash stream mixing.

Designated sampler:

Labeling and Packing Instructions

- 1- All dry analytical samples will be collected into 500 ml Teflon jars with the exception of the bulk samples. All wet analytical samples will be collected into 1-liter Boston Round Amber bottles with Teflon caps.
- 2- Each jar should be labeled with "Site C" and a designated sample number, the sample location, the date and time of the sample, initials of the samplers, and be sure to note whether the sample is analytical or bulk. The analytical sample jars will also be marked to indicate the liquid levels before shipping. The only bulk samples will be the fly ash bulk samples and the bulk sample of raw coal.
- 3- Chain of Custody forms and EER Field Sample Tracking Reports should be completed to document the type, quantity, location, and sampler involved with collecting each sample. A copy of these forms and an EER sampling label are attached in App. A.
- 4- Place each analytical sample inside a ziplock bag, and then place the bagged jar inside the protective four inch PVC sleeve. Place the entire unit into the cooler, and keep it cool with ice packs until all the samples are collected, and the whole cooler is ready to be packed for shipment to Iowa State University. The bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept on ice.
- 5- When packing the cooler with the analytical samples, remove the ice packs, and place enough vermiculite around the bottles to make certain that they are unable to shift or move during transport. Pack vermiculite across the top of the containers, leaving enough room to replace one layer of ice packs. After including the ice packs, pack any remaining space with vermiculite, and make sure that nothing can shift during shipment. As stated previously, the bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept or mailed on ice.
- 6- All bulk samples will be sent in one cooler to the University of North Dakota, UNDERC, laboratory. All analytical samples will be sent in two coolers to the Iowa State University laboratory. Make sure that each of the mailing addresses is written correctly on each of the appropriate coolers.
- 7- Seal the appropriate Chain of Custody forms inside the cooler, with the corresponding samples. Sign at least two EER Custody Seals. These seals along with clear packing tape will be used to seal the cooler.
- 8- Attach the Federal Express forms and a mailing label to the top of the cooler, along with 'Fragile', 'Handle With Care', and 'Caustic' stickers. The cooler should then be ready to take to the Federal Express office.

QA/QC

Chain of Custody forms and Field Sample Tracking Reports must be maintained and filled out for the samples. List the bulk samples on separate Chain of Custody forms, but you may put all the analytical samples on the same Chain Custody form.

There are no travel blanks, nor any other QA samples to be submitted with these samples. There is also no data package to request.

Shipping

•All bulk samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

University of North Dakota
Energy and Environmental Research Center
15 North 23rd St.
Grand Forks, ND 58201
Attn: Ed Olson (701) 777-5155

•All analytical samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

Iowa State University
Spangler Laboratory
Ames, Iowa, 50011
Attn: Dr. Carol Kilgour (515) 294-8203

The nearest Federal Express office is located at: Wheeling, WV
The Federal Express will pick up the samples at Tidd on-site when notified.

Special Considerations

There is quite a bit of noise inside the boiler building, so it is recommended that hearing protection be worn. Safety glasses and hard hats are required to be worn whenever you are inside the boiler building. Use clear glasses; it is fairly dark inside the building.

Contact Personnel

Jerry Lewis-	EER-	(919)-489-1726
Tom Whitmer-	AEP-	(614)-223-1381
Dennis Rathburn-	Tidd Site-	(614)-598-4155
Jim Holland-	Tidd Site-	(614)-598-4155
Heather Rooney-	EER-	(919)-489-1726
Jerry Harness-	DOE-	(304)-291-4835
Ed Olson-	Lab contact-Bulk	(701)-777-5155
Carol Kilgour-	Lab contact-Analytical	(515)-294-8203

Appendix B

261-1-11
7-1-11

Table 2. Operating Condition Data
(this table must be completed hourly during sample collection)

Parameter		Time								
		11:00	8:30 9:02	9:02	10:02					
42	Coal Flow Rate (lb/min) (Kgph)	48.15		49.12	51.34	50.37				
415	Sorbent Flow Rate (lb/hr) (Kgph)	8.25		17.24	18.27	18.10				
	Sliding Bed Temp (F)									
1	PFBC Pressure (psig)	137.48		137.78	137.82	137.25				
357	Boiler Load (MW)	51.34		50.56	49.64	49.79				
323	Steam Temperature (F)	814.14		818.85	804.59	911.48				
317	Steam Pressure (psig)	1231.0		1276.28	1294.44	1267.19				
91	Temperature of Boiler Exit Gas (F)	Before GT 1394.0		1393.2	1383.3	1390.75				
124		After GT 650.9		649.4	643.5	651.31				
191	Excess Air (%) in (%O2)									
	Boiler Exit Gas	4.30		4.40	4.55	4.28				
705	Inlet Temperature of ESP (F)	406.8		401.4	409.70	402.41				
706		405.1		410.84	408.13	411.21				
79	Outlet Temperature of ESP (F)									
78		stack 390.6		391.8	392.3	393.1				
	Boiler Exit Gas									
	Boiler Exit Gas									
17	AVERAGE BED TEMPERATURE (°F)	1563.9		1560.0	1545.0	1558.2				

Appendix C

E
E
R

FIELD SAMPLE TRACKING REPORT

Project No. 7638.30 Page 1 of 1
Plant Site C

SAMPLE NO.	PROCESS STREAM /LOCATION	DESCRIPTION	DATE	TIME	SAMPLER	LAB SENT TO	DATE
143849	Dolomite Sampler	Dolomite Sorbent	6/22/92	1200	T. Beaver	Iowa State	6/22/92
143853	Cyclone Ash Sampler	Cyclone Ash	6/22/92	1022	T. Beaver	Iowa State	6/22/92
143854	Cyclone Ash Sampler	Cyclone Ash	6/22/92	1025	T. Beaver	Iowa State	6/22/92
143858	Bed Ash Sampler	Bottom Ash	6/22/92	1100	T. Beaver	Iowa State	6/22/92
143859	Bed Ash Sampler	Bottom Ash	6/22/92	1050	T. Beaver	Iowa State	6/22/92
143850	ESP Ash Hopper	ESP Ash	6/22/92	0957	T. Beaver	Iowa State	6/22/92
143851	ESP Ash Hopper	ESP Ash	6/22/92	0955	T. Beaver	Iowa State	6/22/92
143855	HP Service Water (Ash Silo)	Spray Curtain Water	6/22/92	1040	T. Beaver	Iowa State	6/22/92
143857	ESP Flyash Sampler	ESP Ash	6/22/92	1115	T. Beaver	UNDERC	6/22/92
143852	Cyclone Ash Sampler	Cyclone Ash	6/22/92	1020	T. Beaver	UNDERC	6/22/92
143856	Coal Sampler	Bulk Coal	6/22/92	1045	T. Beaver	UNDERC	6/22/92
143860	Bed Ash Sampler	Bottom Ash	6/22/92	1335	T. Beaver	UNDERC	6/22/92

CHAIN OF CUSTODY

Plant Site C

Project No. 8638.30

Date 6/22/1992

Sample No.	Test No.	Description
<u>143857</u>	<u>NA</u>	<u>Exp Flyash Bulk (~10 lbs)</u>
<u>143852</u>	<u>NA</u>	<u>Cyclone Flyash Bulk (~90 lbs)</u>
<u>143856</u>	<u>NA</u>	<u>Bulk Coal (1-5 gallon Bucket)</u>
<u>143860</u>	<u>NA</u>	<u>Bottom Ash (~70 lbs)</u>
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By T. Beaver, B. Porter

Relinquished by	Received by	Time	Date	Reason
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Laboratory Analysis By _____ Date _____

CHAIN OF CUSTODY

Plant Site C Project No. 8638.30 Date 6/22/1992

Sample No.	Test No.	Description
143849	NA	Dormant Ash Analytical (1-500ml)
143853	NA	Cyclone Ash Analytical (1-500ml)
143854	NA	Cyclone Ash Analytical (1-500ml)
143858	NA	Bottom Ash Analytical (1-500ml)
143859	NA	Bottom Ash Analytical (1-500ml)
143860	NA	Dry ESP Flyash Analytical (1-500ml)
143851	NA	Dry ESP Flyash Analytical (1-500ml)
143855	NA	Spray Curtain Supply Under Analytical (1-500ml)

Sampling System Prepared By NA

Test Operator NA

Others Involved in Test NA

Sample Recovery By T. Beaver, B. Rafter

Relinquished by R. And Beaver (ESP) Received by T. Beaver, B. Rafter Time 1230 Date 6/22/92 Reason Analysis

Laboratory Analysis By

Date

Appendix D

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

SAMPLING REPORT #4

January 1993

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

**Energy and Environmental Research Corporation
Irvine, California**

INTRODUCTION

The United States Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. A key goal of this program is to ensure that waste management issues do not become obstacles to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of the collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now is extending their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of five (5) of these facilities.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology (CCT) Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritize them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.

- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. One of those technologies is the SO_x-NO_x-RO_x Box (SNRB) Flue Gas Cleanup process being demonstrated by Babcock & Wilcox (B&W) at Site E. On December 16, 1992 samples were collected to characterize solid waste streams. This document provides background information on the site and describes sampling activities performed at this facility.

SITE SELECTION

EER established criteria for selecting candidate sites. These include:

- The demonstration has been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There is a lack of data regarding the waste products from this technology,
- Facility operators will cooperate,
- There is a possibility that the waste contains regulated compounds, and
- The demonstration is being conducted in a pilot scale facility or larger with the availability of 85 lbs of waste.

Babcock & Wilcox is demonstrating a 5 MWe pilot scale usage of the SNRB process. This is a new technology which has not been demonstrated commercially and thus limited data is available regarding the characteristics of the waste products. The demonstration was selected as one of the projects funded in Round II of DOE's CCT Program, and the facility operators were willing to have this sampling program conducted at their facility. Having met all of the criteria listed above, the SNRB technology being developed by B&W and Ohio Edison of Akron, OH was selected for inclusion in the current sampling program.

STREAM SELECTION

A schematic of the SNRB demonstration unit and accompanying boiler is shown in Figure 1. This figure indicates the air, fuel, sorbent, flue gas, ammonia and waste stream flow paths through the unit as well as the locations for stream sampling. Figure 2 provides an equipment layout for the SNRB process. Only solid phase by-products were generated by this facility. The major solid by-product stream sampled was the baghouse flyash. Additional solids samples were taken of the hydrated lime sorbent, coal, boiler bottom ash, economizer ash, and electrostatic precipitator (ESP) flyash. A process flow diagram of the SNRB demonstration is provided in Figure 3.

The bottom ash consists of coal ash, unburned coal, small rocks, and metal. This ash is collected in the bottom of the boiler and passed to sluice lines on either side of the boiler. The bottom ash drops into a water channel which transports the ash to the ash pond.

Some ash particles that remain present in the boiler exit gases are collected in the economizer/air preheater hopper. This ash is collected in one of two hoppers located just below the air preheater for the unit. The ash collected in these two hoppers is sluiced along with the boiler bottom ash to the bottom ash disposal pond.

Flyash from the SNRB process is collected in the high temperature baghouse. A 5 MW_e slipstream of flue gas is sent through the SNRB process. Sorbent and ammonia are injected into the flue gas for SO_x and NO_x reduction, respectively. Next, the mixture of ammonia, sorbent, and flue gas passes through a high temperature baghouse. The flue gas passes through the bag filters which collect the flyash. The ammonia in the flue gas reacts in the catalyst bed located in the bag filters to reduce the NO_x emissions of the boiler. Sulfur compounds are captured in the flyash which consists of coal ash and reacted sorbent. The flyash is collected in hoppers located at the bottom of the baghouse. The hoppers are emptied one at a time. A valve at the bottom of the hopper is opened and the ash falls into a lock hopper. Once full, the valve at the top of the hopper is closed and the lock hopper is

C112 025

SCR Demonstration Equipment Layout

Figure 3. SNRB Process Flow Diagram

emptied pneumatically. The ash is transported to a storage silo then emptied by gravity into a trailer for disposal. The cleaned flue gas stream is returned to the main boiler flue gas stream prior to the ESP inlet.

Flyash present in the flue gas stream which does not travel through the SNRB process is removed in the ESP. The direct current electricity present in each of the fields of the ESP charge the ash particles causing them to be attracted to the neutral plates. Ash is removed from the neutral plates by mechanically striking the support structure for the plates. The ash falls into ash hoppers where it is collected and pneumatically transported to flyash storage silos. The flyash remains in these silos until it is loaded onto trucks for disposal.

Streams identified for sampling include boiler bottom ash, economizer/air preheater ash, ESP flyash, baghouse flyash, sorbent, and unburned coal. The boiler bottom ash was collected from an inspection door at the end of the bottom ash hopper. Economizer ash was collected from a sampling port located at the bottom of the ash hopper. Samples of the ESP ash were obtained by collecting samples throughout the day from each of the ESP hoppers. Baghouse ash samples were obtained from a sampling port on one of the baghouse ash hoppers. A sampling port on the sorbent rotary feeder was used to gather the bulk sorbent sample. Finally, a bulk sample of unburned pulverized coal was obtained from the boiler coal transport piping.

SAMPLING PROCEDURES

The sampling team was on-site for the entire day of December 16, 1992, when B&W was conducting operational tests. A copy of the sampling plan is provided in Appendix A. Addendum 1 of this report outlines any actions or procedures taken during the sampling visit that deviated from the original sampling plan. The following subsections provide a description of the sampling methods, the operational data collected and the packing and shipping procedures for delivering samples to the laboratories.

Streams Sampled

As described above, there are six streams from which samples were taken: 1) unburned coal, 2) sorbent, 3) boiler bottom ash, 4) ESP flyash, 5) baghouse flyash, and 6) economizer/air preheater ash. During the sampling, EER collected samples from each of these streams for analytical purposes with the exception of sorbent and unburned coal. Ash analytical samples were placed in 500 ml Teflon® bottles and sealed. The bottles were then placed in coolers, packed with ice and sent to Iowa State University for analysis. This sample was also placed in a cooler, packed with ice and sent to Iowa State University. Bulk samples were taken of the baghouse flyash, sorbent, and coal. The bulk coal sample was taken in one 8-gallon Rubbermaid® containers. The sorbent sample was collected in one 5-gallon container. Baghouse flyash was collected in one 18-gallon Rubbermaid® container. All bulk samples were sealed and shipped to the University of North Dakota Energy and Environmental Research Center. Figure 1, on page 5, represents the location and type (ie. bulk or analytical) of samples taken at various points for the Site "E" sampling visit.

Unburned coal was collected from sampling ports located on the coal transport piping. A roto-probe isokinetic sampler was used to collect the samples. Each transport pipe was sampled with each sample being placed in the same bulk container. Only 4-gallons of coal could be collected during the eight hour sampling period due to restrictions on the capacity of the sampler.

A bulk sample of sorbent was taken from a sampling port located at the bottom of the sorbent silo rotary feeder. Due to the consistency of the sorbent analysis, one bulk sample was collected near the end of the sampling period. This sample was placed in a 5-gallon Rubbermaid® container.

Boiler bottom ash analytical samples were collected using a Teflon® container clamped at the end of an extension arm. The ash sample was obtained by filling the container with ash accessible through the bottom ash hopper inspection door. A total of three 500-ml samples were taken during the day and placed in Teflon® containers. These samples were composited at the lab to form two separate samples.

Three ESP flyash samples were collected for analytical purposes from the ESP ash hoppers. These samples were obtained by compositing flyash samples obtained at three separate times from each ESP hopper. These samples were placed in 500-ml Teflon® containers and prepared for shipment to the analytical laboratory.

A bulk baghouse flyash sample was obtained from a sampling port located at the bottom of the baghouse ash hopper. Samples were obtained each hour and combined to form the composite bulk sample. The bulk sample was collected in an 18-gallon Rubbermaid® container.

Two analytical samples of baghouse ash were obtained by filling two 500-ml Teflon® jars with the composited bulk baghouse ash sample. These samples were collected and packed for shipment to the analytical laboratory.

Operation Data

Operating data for key parameters were also collected during the test program. Data was collected for both the boiler operation as well as the SNRB process operation. Data was collected approximately every hour throughout the time in which samples were being taken. Table 1 outlines the operating parameters measured for the boiler. Table 2 identifies the parameters measured for the SNRB process. Appendix B provides the original data tables.

Sample Shipment

Analytical samples were shipped via Federal Express to Iowa State's Spangler Laboratory for analysis. The analytical samples comprising 11 500-ml Teflon® bottles and were packed in a single cooler. Each sampling container was placed in a plastic zip-lock bag, surrounded with vermiculite and covered with ice packs. All bulk samples were shipped to the University of North Dakota Energy and Environmental Research Center for analysis. The bulk samples consisted of one 5-gallon, one 8-gallon and one 18-gallon Rubbermaid® containers. The chain of custody forms and shipping reports are provided in Appendix C.

**Table 1. Operating Condition Data
R.E. Burger Boiler #8**

(this table must be completed hourly during sample collection)

Parameter		Time								
		0800	0900	1000	1100	1200	1300	1400	1500	1600
Coal Flow Rate (lb/min)										
Sluicing Period (min)										
Boiler Load (MW)		159	159	159	158	159	157	157		156
Steam Temperature (F)		1029	1040	1039	1036	1053	1054	1053		1050
Steam Pressure (psig)		2010	2011	2020	2020	2011	2009	2009		2011
Temperature of Boiler Exit Gas (F)		645	650	650	648	650	650	650		650
Excess Air (%) in Boiler Exit Gas		3.1	3.5	3.0	2.8	3.1	3.1	3.2		3.6
Inlet Temperature of ESP (F)		305	305	305	305	310	310	312		315
Outlet Temperature of ESP (F)		302	302	302	302	310	310	310		310

Table 2. Operating Condition Data
SNRB Demonstration Project

(this table must be completed hourly during sample collection)

		TIME								
		0800	0900	1000	1100	1200	1300	1400	1500	1600
Parameter										
System Inlet Flow Rate	(lb/hr)		33,000	33,000	32,000	32,000	31,900	32,300	32,100	
Baghouse Inlet Flow	(lb/hr)		39,000	39,200	38,000	38,000	38,400	38,600	38,700	
Sorbent/SO ₂ Ratio	(mol/mol)		2.00	2.00	2.00	2.00	2.00	2.00	2.00	
Ammonia/NO _x Ratio	(mol/mol)		0.80	0.79	0.79	0.79	0.79	0.79	0.77	
System Inlet Temperature	(deg. F)		632	634	630	629	631	632	630	
Burner Temperature	(deg. F)		1115	1114	1116	1122	1116	1113	1107	
Injection Temperature	(deg. F)		841	841	843	840	839	840	840	
Inlet Cooler Flue Gas Temp.	(deg. F)		902	901	902	900	899	899	901	
Baghouse Inlet Temp	(deg. F)		841	841	843	840	839	840	840	
Baghouse Outlet Temp	(deg. F)		781	781	782	783	779	780	780	
Outlet Cooler Flue Gas Temp.	(deg. F)		301	300	298	300	299	300	300	
Outlet Cooler Air Temp	(deg. F)		100	100	100	100	100	100	100	
Sorbent Type			SHL	SHL	SHL	SHL	SHL	SHL	SHL	
Sorbent Injection Flow	(lb/hr)		490	520	495	500	490	480	480	
Injection Location (1,2,3,4,5)			1	1	1	1	1	1	1	
Total Sorbent Res. Time	(sec)		0.68	0.67	0.69	0.69	0.69	0.68	0.69	
Sorbent Injection Temperature	(deg. F)		841	841	843	840	839	840	840	

ADDENDUM

The following describes any procedures or actions taken during the sampling visit on December 16, 1992 that deviated from the original sampling plan submitted for sampling activities at Site E.

All decontamination of sampling containers was performed before shipment of equipment to the sampling location. All analytical sampling containers were cleaned and inclosed in plastic bags. All bulk sampling containers were sealed by placing packing tape around the lid of the container.

The unburned coal bulk sample was obtained by Ohio Edison personnel employed at the R.E. Burger generating station. Approximately four (4) gallons of sample was obtained. The amount actually obtained differed from that required by the sampling plan due to the fact that the iso-kinetic sampler was unable to obtain more sample in the designated eight (8) hour sampling schedule. The EER personnel felt that the 4-gallons of sample obtained was sufficient for accurate bulk analysis since extreme care was taken to insure that the sample was representative of the process. Samples from each coal transport pipe were taken throughout the day and composited to form one bulk sample.

Approximately three (3) gallons of hydrated lime were obtained from the sorbent rotary feeder. It was extremely difficult to obtain more sample due to the time and dust problems caused by the sampling of this input stream.

Three (3) 500-ml boiler bottom ash samples were gathered from the bottom ash hopper. These samples were obtained by using a Teflon container clamped to a metal rod as a sampling scoop. The samples were gathered approximately two (2) hours apart. The containers were allowed to cool before sealing the lids. All three samples were sent to the analytical lab where they were composited for analysis.

Three (3) economizer/air preheater ash samples were collected from the two (2) economizer ash hoppers. Approximately 250-ml of sample was collected from each hopper to

form each of the three (3) samples. The samples were obtained by scooping the ash from ash hopper sampling port using the lid of the Teflon sampling container. All three samples were sent to the analytical lab where they were composited by being analyzed.

Three (3) 500-ml flyash samples were collected by sampling the ESP ash hoppers. The samples were obtained by using a 4" OD steel pipe to take a core sample of the hopper ash through the sampling port. The ESP consisted of four rows of four ash hoppers (4X4 arrangement). Approximately 400-ml of sample was collected from each hopper in the first collection field three separate times during the day. The same 400-ml of sample was collected from each hopper in the second field, as well. However, samples could only be obtained from all four hoppers during one of the three sampling times. For the other two sampling times, only two hoppers provided enough ash to sample. Sufficient quantities of ash could not be obtained in the third and fourth ESP fields. All samples were placed in one container and composited. Three (3) 500-ml analytical samples were then obtained from the composite and packaged for shipment to the analytical laboratory.

Ash samples collected from the SNRB baghouse proved to be extremely difficult to handle. The ash was first collected in one-hour intervals in a 5-gallon bucket. After the sample had cooled, it was placed in the bulk sample container. The first sample melted the sampling container, requiring a new container to be purchased. This replacement container was also a Rubbermaid product. The remaining samples, along with the remainder of the first sample, were then placed in the replacement container. It was felt that Rubbermaid containers were better suited for these samples than stainless steel. At the temperatures exhibited by the ash, stainless steel would react with the ash causing higher concentrations of trace metals such as nickel and chromium to be present in the samples. Even if the plastic containers were to be affected by the temperature of the ash, only polymers and rubber compounds would be introduced to the ash. It has been proven in the past that these rubber and polymer compounds can be more easily separated from the actual ash analysis than trace metals from stainless steel sampling containers.

The original sampling container used to gather the baghouse ash could not be used to ship the ash sample. A replacement container had to be purchased at the time of the sampling event. Since all decontamination procedures were completed before arriving on site, the proper decontamination solutions were not available. The container was only rinsed with deionized water before being used.

Appendix A

**EER-Sampling Plan
Solid Waste Sampling Project
Site E
SNRB Project**

November 30, 1992

Background

The U.S. Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. One of the projects in this program is to characterize the solid waste from advanced coal combustion or conversion technologies. In order to implement the characterization process, it is necessary to identify the potential units with waste streams of interest, obtain samples of the waste, and perform a complete analysis of the samples.

Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of this project. EER selected Babcock & Wilcox's (B&W) SO_x-NO_x-RO_x Box (SNRB) Flue Gas Cleanup demonstration as one of five sites identified for participation in the sampling program. The technologies being demonstrated at Site E are sorbent injection, selective catalytic reduction (SCR), and high efficiency particulate collection.

This Clean Coal Technology is being demonstrated by B&W at Site E. The EER field team has already conducted a preliminary site visit at Site E and is familiar with operating conditions at the plant. The EER field team will conduct the sampling effort in December. At this time, Site E will be undergoing continuous operation. These operating conditions will be conducive for obtaining representative waste samples. During the long-term testing period, EER will take analytical samples from the bottom ash hopper, economizer, precipitator, sorbent storage silo, and baghouse ash silo and send them to Iowa State University for analysis. EER will also collect bulk samples of the pulverized coal, sorbent, baghouse ash for testing at the University of North Dakota Energy and Environmental Research Center (UNDERC). EER must also record any necessary operating condition data during the sampling event, and report them to DOE. A brief final report of the field work will also be completed and sent to DOE.

Pre-Sampling

Call Rita Bolli with Ohio Edison at (216) 384-4901 and Kevin Redinger with B&W at (216) 829-7719 several days before the sampling is scheduled to begin. Make certain that the process is up and running, and that Rita Bolli and Kevin Redinger are aware that we will be there to sample.

Call Ed Olson at (701) 777-5155 at the University of North Dakota Environmental Research Center (UNDERC). He is our lab contact for the bulk samples and needs to be notified when the sampling will take place, so that he can be prepared to receive the samples.

Call Dr. Carol Kilgore at (515) 294-8203 or Dr. Colin Criswell at (515) 294-6776 at Iowa State University. Dr. Kilgore is our lab contact for analytical samples and needs to be notified when the sampling is taking place, so that she can be prepared to receive the samples. In the event that Dr. Kilgore is unable to be reached, contact Dr. Criswell and notify him of the impending sample shipment.

Sampling

There are seven locations at the plant, from which samples will be taken. The coal sample will be taken from the transport piping leading from the pulverizers to the burner panels. Sorbent samples will be taken from the sorbent storage silo. A dry boiler bottom ash sample will be taken from the bottom ash hopper prior to being sluiced. Dry flyash samples will be taken from the economizer, precipitator, and baghouse hoppers.

Each of the seven locations will be sampled during the normal 8-hour operating period for analytical samples. Bulk samples will only be taken of the pulverized coal, baghouse ash and sorbent. One 5-gallon sample of unburned coal will be collected for the coal transport piping using an isokinetic sampler. One 5-gallon bulk sample of sorbent will be collected from a rotary feeder located at the bottom of the sorbent storage silo. Two 500-ml analytical samples of boiler bottom ash will be obtained from the bottom ash hopper by restricting the flow of sluice water while sampling. Two 500-ml analytical samples of economizer ash and precipitator flyash will be collected from sampling points located at the bottom of the respective ash hoppers (total of 4 samples). An 85 lb. bulk sample of baghouse ash will be collected while the ash is being loaded into trucks for disposal. Two 500-ml analytical samples will also be taken from this location.

A detailed description of the specific sampling procedures for each sample location is listed in the "Sampling Instructions" section of this report.

Equipment

The following equipment will be used for the sampling program.

- 1- (1) Coolers/Ice Packs
- 2- 10 - 500 ml Teflon Sample Jars
- 3- (2) 8-gallon Rubbermaid trash cans with lids
- 4- Stainless steel ladle
- 5- Paper Towels
- 6- Bottle labels and pens
- 7- Hardhats
- 8- Ear plugs
- 9- First Aid Kit
- 10- Tools-Knife
- 11- Traffic Reports and Chain of Custodies
- 12- Flash Light
- 13- Vermiculite and other packing supplies
- 14- Cooler custody seals
- 15- Cloth Gloves
- 16- Safety Glasses
- 17- Field Book
- 18- Sampling and Health and Safety Plans
- 19- Bottle Overpacks
- 20- Fed Ex Forms
- 21- Zip-lock bags

Bottle List

- 10- 500 ml Teflon jars will be used for the dry analytical samples.
- 2- 8-gallon Rubbermaid containers with lids for the bulk bottom ash and flyash samples.
- 1- Large Coleman coolers will be used for the analytical samples.

Pre-Sampling Decontamination Procedures

The following procedures should be followed before the sampling event takes place, ideally the afternoon before initiation of the sampling event. In addition, these procedures for decontamination should be followed in between any sets of samples in which the same sampling equipment may be utilized more than once. However, these procedures will take place before arrival at Site E due to the lack of adequate space.

- 1- Identify the sampling items to be decontaminated.
 - All Teflon sampling containers necessary for the sampling event.
 - All buckets to be used for collecting the sluice or dry samples.
 - All spatulas or stainless steel scoops to be used for the sampling event.

*The Boston Round Amber bottles with Teflon caps are pre-cleaned to EPA specifications and do not need to be decontaminated prior to sampling.
- 2- Obtain all necessary decontamination solutions and equipment:
 - Plastic sheeting
 - 1-five gallon bucket
 - 1-scrub brush
 - 1-concentrated liquid soap
 - Tap water
 - Deionized water
 - 10% Nitric Acid
 - Methanol
 - Acetone
 - Polyethylene squirt bottles
- 3- Establish an area where the decontamination procedure can take place. Make the following preparations for the area:
 - Lay clear plastic sheeting over a specific area for drying the cleaned items;
 - Have all cleaning solutions and equipment set up near plastic sheeting so that a wash and dry area is established.
- 4- The decontamination procedure for each piece of equipment should be as follows:
 - Wash the piece of equipment with the concentrated liquid soap
 - Rinse with tap water
 - Rinse with 10% nitric acid
 - Rinse with deionized water
 - Rinse with methanol
 - Rinse with deionized water
 - Rinse with acetone
 - Rinse with deionized water
 - Let air dry on plastic sheeting
 - Rinse once more with deionized water before beginning sampling

Sampling Instructions

All samples will be obtained during a normal 8-hour operating period in which the SNRB Project is being demonstrated at full load. The operating condition data must be completed each hour during which samples are collected. This information should be documented in Table 1. Rita Bolli and Kevin Redinger will aid in obtaining this information. The sampling parameters, locations, and sampling approach are described below:

Bulk Unburned Coal-A five-gallon Rubbermaid® container will be filled with coal obtained from the coal transport piping using an isokinetic sampler coal sampler and sealed for a bulk sample. Label the bucket for shipment to the UNDERC.
Designated sampler:

Bulk Sorbent Samples-A 5-gallon Rubbermaid® container sorbent will be obtained from a rotary feeder located at the bottom of the Sorbent Storage Silo for bulk purposes. The sample will be sealed, labeled and packed for shipment to UNDERC.
Designated sampler:

Bottom Ash Samples-Two 500 ml Teflon® containers of dry bottom ash will be obtained from the Bottom Ash Hopper for analytical purposes. These samples will be obtained in dry form using a long-handled stainless steel scoop prior to being sluiced to the ash pond. These analytical samples will be labeled and packed for shipment to Iowa State University.
Designated sampler:

Fly Ash Samples-Two 500 ml Teflon® containers of dry fly ash will be obtained from each of the following locations: economizer ash hopper and precipitator ash hopper. The ash samples will be collected from sampling locations located at the bottom of the respective ash hoppers. Three (3) samples will be taken from each hopper at approximately one hour intervals. These three samples will be combined to produce two (2) analytical samples from each location. These analytical samples will be labeled and packed for shipment to Iowa State University.
Designated sampler:

Bulk Baghouse Ash Samples-An 85 lb. bulk sample of baghouse ash will be collected for bulk analysis. This sample will be collected while loading the baghouse ash into the storage trailer using a stainless steel scoop. The bulk sample will be labeled and packed for shipment to the UNDERC.
Designated sampler:

Baghouse Ash Samples-Two 500-ml analytical samples of baghouse ash will be collected from the baghouse storage trailer. These samples will be collected after loading the baghouse ash into the storage trailer using a stainless steel scoop. A core sample of the ash in the storage trailer will be taken and mixed to form these two analytical samples. The analytical samples will be labeled and packed for shipment to the Iowa State University.

Designated sampler:

Labeling and Packing Instructions

- 1- All dry analytical samples will be collected into 500 ml Teflon® jars with the exception of the bulk samples.
- 2- Each jar should be labeled with "Site E" and a designated sample number, the sample location, the date and time of the sample, initials of the samplers, and be sure to note whether the sample is analytical or bulk. The analytical sample jars will also be marked to indicate the liquid levels before shipping. The only bulk samples will be the fly ash bulk samples and the bulk sample of raw coal.
- 3- Chain of Custody forms and EER Field Sample Tracking Reports should be completed to document the type, quantity, location, and sampler involved with collecting each sample. A copy of these forms and an EER sampling label are attached in App. A.
- 4- Place each analytical sample inside a ziplock bag, and then place the bagged jar inside the protective four inch PVC sleeve. Place the entire unit into the cooler, and keep it cool with ice packs until all the samples are collected, and the whole cooler is ready to be packed for shipment to Iowa State University. The bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept on ice.
- 5- When packing the cooler with the analytical samples, remove the ice packs, and place enough vermiculite around the bottles to make certain that they are unable to shift or move during transport. Pack vermiculite across the top of the containers, leaving enough room to replace one layer of ice packs. After including the ice packs, pack any remaining space with vermiculite, and make sure that nothing can shift during shipment. As stated previously, the bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept or mailed on ice.
- 6- All bulk samples will be sent in one cooler to the University of North Dakota, UNDERC, laboratory. All analytical samples will be sent in one cooler to the Iowa State University laboratory. Make sure that each of the mailing addresses is written correctly on each of the appropriate coolers.
- 7- Seal the appropriate Chain of Custody forms inside the cooler, with the corresponding samples. Sign at least two EER Custody Seals. These seals along with clear packing tape will be used to seal the cooler.
- 8- Attach the Federal Express forms and a mailing label to the top of the cooler, along with 'Fragile', 'Handle With Care', and 'Caustic' stickers. The cooler should then be ready to take to the Federal Express office.

QA/QC

Chain of Custody forms and Field Sample Tracking Reports must be maintained and filled out for the samples. List the bulk samples on separate Chain of Custody forms, but you may put all the analytical samples on the same Chain Custody form.

There are no travel blanks, nor any other QA samples to be submitted with these samples. There is also no data package to request.

Shipping

•All bulk samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

University of North Dakota
Energy and Environmental Research Center
15 North 23rd St.
Grand Forks, ND 58201
Attn: Ed Olson (701) 777-5155

•All analytical samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

Iowa State University
Spangler Laboratory
Ames, Iowa, 50011
Attn: Dr. Carol Kilgour (515) 294-8203

The nearest Federal Express office is located at: Wheeling, WV
The Federal Express will pick up the samples at Site E when notified as long as the samples are ready by 4:00 pm. If the samples are not ready at this time, they can be taken to the Federal Express cargo office at Pittsburgh International Airport.

Special Considerations

There is quite a bit of noise inside the boiler building, so it is recommended that hearing protection be worn. Safety glasses and hard hats are required to be worn whenever you are inside the boiler building. Use clear glasses; it is fairly dark inside the building.

Contact Personnel

Todd Beaver-	EER	(919)-489-1726
Jerry Harness-	METC/DOE	(304)-291-4835
Rita Bolli-	Ohio Edison	(216)-384-4901
Kevin Redinger-	Babcock & Wilcox	(216)-829-7719 or (614)-676-8112
Jerry Amritein/-	Babcock & Wilcox	(614)-676-8112
John McCoury		
Ed Olson-	Lab contact-Bulk	(701)-777-5155
Carol Kilgour-	Lab contact-Analytical	(515)-294-8203
Colin Criswell-	Lab contact-Analytical	(515)-294-6776

Table 2. Operating Condition Data
SNRB Demonstration Project

(this table must be completed hourly during sample collection)

Parameter		TIME							
System Inlet Flow Rate	(lb/hr)								
Baghouse Inlet Flow	(lb/hr)								
Sorbent/SO ₂ Ratio	(mol/mol)								
Ammonia/NO _x Ratio	(mol/mol)								
System Inlet Temperature	(deg. F)								
Burner Temperature	(deg. F)								
Injection Temperature	(deg. F)								
Inlet Cooler Flue Gas Temp.	(deg. F)								
Baghouse Inlet Temp	(deg. F)								
Baghouse Outlet Temp	(deg. F)								
Outlet Cooler Flue Gas Temp.	(deg. F)								
Outlet Cooler Air Temp	(deg. F)								
Sorbent Type									
Sorbent Injection Flow	(lb/hr)								
Injection Location (1,2,3,4,5)									
Total Sorbent Res. Time	(sec)								
Sorbent Injection Temperature	(deg. F)								

(this table must be completed hourly during sample collection)

		Time							
Parameter									
Coal Flow Rate (lb/min)									
Sluicing Period (min)									
Boiler Load (MW)									
Steam Temperature (F)									
Steam Pressure (psig)									
Temperature of Boiler Exit Gas (F)									
Excess Air (%) in Boiler Exit Gas									
Inlet Temperature of ESP (F)									
Outlet Temperature of ESP (F)									

Appendix B

(this table must be completed hourly during sample collection)

		Time								
Parameter		0800	0900	1000	1100	1200	1300	1400	1500	1600
Coal Flow Rate (lb/min) —										
Sluicing Period (min)										
Boiler Load (MW) gross		159	159	159	158	159	157	157		154
Steam Temperature (F)		1029	1040	1039	1036	1053	1054	1053		1050
Steam Pressure (psig)		2010	2011	2020	2020	2011	2009	2009		2011
Temperature of Boiler Exit Gas (F)		645°	650°	650°	648°	650	650	650		650
Excess Air (%) in GAZ Log Econ. Boiler Exit Gas		3.1%	3.5%	3.0%	2.8%	3.1%	3.1%	3.2%		3.6%
Inlet Temperature of ESP (F)		305°	305°	305°	305°	310	310°	312°		315°
Outlet Temperature of ESP (F)		302°	302°	302°	302°	310	310°	310°		310°

TABLE 2. Operating Condition Data
(this table must be completed hourly during sample collection)

12/16/92

PARAMETER	UNITS	TIME							
		0900	1000	1100	1200	1300	1400	1500	
System Inlet Flow Rate	(lb/hr)	33,000	33,000	32,000	32,000	31,900	32,300	32,100	
Baghouse Inlet Flow Rate	(lb/hr)	39,000	39,200	38,000	38,000	38,400	38,600	38,700	
Sorbent/SO ₂ Ratio	(mol/mol)	2.00	2.00	2.00	2.00	2.00	2.00	2.00	
Ammonia/NO _x Ratio	(mol/mol)	0.80	0.79	0.79	0.79	0.79	0.79	0.77	
System Inlet Temperature	(°F)	632	634	630	629	631	632	630	
Burner Temperature	(°F)	1115	1114	1116	1122	1116	1113	1107	
Injection Temperature	(°F)	841	841	843	840	839	840	840	
Inlet Cooler Flue Gas Temp	(°F)	902	901	902	900	899	899	901	
Baghouse Inlet Temp	(°F)	841	841	843	840	839	840	840	
Baghouse Outlet Temp	(°F)	781	781	782	783	779	780	780	
Outlet Cooler Flue Gas Temp	(°F)	301	300	298	300	299	300	300	
Outlet Cooler Air Temp	(°F)	100	100	100	100	100	100	100	
Sorbent Type *		SHL	SHL	SHL	SHL	SHL	SHL	SHL	
Sorbent Injection Flow	(lb/hr)	490	520	495	500	490	480	480	
Injection Location (1,2,3,4,5)		1	1	1	1	1	1	1	
Total Sorbent Res. Time	(sec)	0.68	0.67	0.69	0.69	0.69	0.68	0.69	
Sorbent Injection Temperature	(°F)	841	841	843	840	839	840	840	

* SHL - SUGAR HYDRATED LIME

Appendix C

FIELD SAMPLE TRACKING REPORT

Analytical

Plant SITE E

Page 1 of 1

[illegible]

RE

SAMPLE NO.	PROCESS STREAM	LOCATION	DESCRIPTION	DATE	TIME	SAMPLER	LAB SENT TO	DATE
142734	Corbent Rotary Loader		Bulk Corbent Sample	12/6/92	2:00 PM	Feld House	UNDEC	12/6/92
142737	Baghouse Air Hopper		Bulk Baghouse Ash Sample	12/6/92	3:00 PM	Serry Round Hair	UNDEC	12/6/92
142738	Coal Transport Ripping		Bulk Unburned Coal Sample	12/6/92	4:30 PM	Mt. Micks	UNDEC	12/6/92

Analysis

Name: SITE E

Project No. 8638

Date 12/16/92

<u>Sample No.</u>	<u>Test No.</u>	<u>Description</u>
142724		Economizer Hopper Ash (500-ml analytical)
142725		Boiler Bottom Ash (500-ml analytical)
142726		Boiler Bottom Ash (500-ml analytical)
142727		Economizer Hopper Ash (500-ml analytical)
142730		ESP Hopper Ash (500-ml analytical)
142731		ESP Hopper Ash (500-ml analytical)
142736		Boiler Hopper Ash (500-ml analytical)
142732		ESP Hopper Ash (500-ml analytical)

Sampling System Prepared By Todd Beaver / EEZ-NC

Test Operator Todd Beaver / EEP-NC

Others Involved in Test Rita Balli / OHIO Edison

Gary Sansone / Ohio Edison

Sample Recovery By Gary Sansone and Todd Beaver

[illegible]

_____ Analysis by _____

Date _____

Analytical

Plant SITE E

Project No. 8638

Date 12/16/92

Test No.

Description

142728

Boiler Bottom Ash (500-ml analytical)

142733

VOID

142729

Emulsifier - Alder Ash LSCC - ml analytical

142735

Barhouse Hopper Ash (500-ml analytical)

Test Operator Todd Benner / EEP-NC

Others Involved in Test Rita Belli / Ohio Edison

Gary Samsone/Ohio Edison

Sample Recovery By Gary Sansone and Todd Bower

Reinquished by

Received by

Time

Date _____

Reason

SECRET - 100-363331

Date:

Bulk

Plant SITE E Project No. 8638 Date 12/16/97

Plant SITE E

Project No. 8638

Date 12/16/92

[illegible]

Test Operator MR. MEELS AND TODD BEYER

Others Involved in Test JERRY ARMENTHEIM / B & W

Sample Recovery By TODD BEAVER / MR. MEERS / MR. ARMENTHEIM

[illegible]

Signature: James E. Smith Date:

EXPRESS

AIRBILL
PACKAGE
TRACKING NUMBER

SEE THIS AIRBILL FOR IMPORTANT SHIPPING INFORMATION. IF YOU ARE SHIPING TO A U.S. ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A FOREIGN ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, COUNTRY, AND PHONE NUMBER. IF YOU ARE SHIPING TO A PO BOX, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A BUSINESS ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A RESIDENTIAL ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A SCHOOL ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A GOVERNMENT ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A MILITARY ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A FOREIGN ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, COUNTRY, AND PHONE NUMBER. IF YOU ARE SHIPING TO A PO BOX, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A BUSINESS ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A RESIDENTIAL ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A SCHOOL ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A GOVERNMENT ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER. IF YOU ARE SHIPING TO A MILITARY ADDRESS, PLEASE PRINT THE FOLLOWING INFORMATION: NAME, ADDRESS, CITY, STATE, ZIP CODE, AND PHONE NUMBER.

EXPRESS

EXPRESS

9050700201

Sender's Federal Express Account Number

Date

12/16/92

SENDER'S COPY

From (Your Name) Please Print
R. Todd Beaver

Your Phone Number (Very Important)
1919 1489-1726

To (Recipient's Name) Please Print
DR. COLIN C. REISER

Recipient's Phone Number (Very Important)
1513 294-6776

Company
EER Corp.

Street Address
370 University Dr., Suite 160

City
Durham

State
NC

ZIP Required
277071

Company
Ames Lab. Warehouse / Iowa State University

Exact Street Address (No Street Address in P.O. Boxes or P.O. Codes)
Ames Lab. Warehouse / Iowa State University

City
Ames

State
IA

ZIP Required
50011

Department/Floor No.
1

Job No. 8638

YOUR INTERNAL BILLING REFERENCE INFORMATION (Print in brackets will appear on invoice)

DELIVERY AND SPECIAL HANDLING
(Check services required)

1 ☐ **HOLD FOR PICK-UP** (9 a.m. to 4 p.m.)

2 ☒ **DELIVER NEXT DAY**

3 ☐ **DELIVER SAME DAY** (charge extra)

4 ☐ **DANGEROUS GOODS** (charge extra)

5 ☐ **OVERSIZE** (charge extra)

6 ☐ **OTHER SPECIAL SERVICE**

7 ☐ **OVERSIGHT SERVICE**

8 ☐ **SAVEDAY PICK UP** (charge extra)

9 ☐ **SAVEDAY DELIVERY** (charge extra)

10 ☐ **SAVEDAY DELIVERY** (charge extra)

11 ☐ **SAVEDAY DELIVERY** (charge extra)

12 ☐ **SAVEDAY DELIVERY** (charge extra)

SERVICES
(Check only one box)

Priority Overnight Service
(Delivery by next business day)

11 ☐ **OVERNIGHT**

12 ☐ **OVERNIGHT**

13 ☐ **OVERNIGHT**

14 ☐ **OVERNIGHT**

15 ☐ **OVERNIGHT**

16 ☐ **OVERNIGHT**

17 ☐ **OVERNIGHT**

18 ☐ **OVERNIGHT**

19 ☐ **OVERNIGHT**

20 ☐ **OVERNIGHT**

21 ☐ **OVERNIGHT**

22 ☐ **OVERNIGHT**

23 ☐ **OVERNIGHT**

24 ☐ **OVERNIGHT**

25 ☐ **OVERNIGHT**

26 ☐ **OVERNIGHT**

27 ☐ **OVERNIGHT**

28 ☐ **OVERNIGHT**

29 ☐ **OVERNIGHT**

30 ☐ **OVERNIGHT**

31 ☐ **OVERNIGHT**

32 ☐ **OVERNIGHT**

33 ☐ **OVERNIGHT**

34 ☐ **OVERNIGHT**

35 ☐ **OVERNIGHT**

36 ☐ **OVERNIGHT**

37 ☐ **OVERNIGHT**

38 ☐ **OVERNIGHT**

39 ☐ **OVERNIGHT**

40 ☐ **OVERNIGHT**

41 ☐ **OVERNIGHT**

42 ☐ **OVERNIGHT**

43 ☐ **OVERNIGHT**

44 ☐ **OVERNIGHT**

45 ☐ **OVERNIGHT**

46 ☐ **OVERNIGHT**

47 ☐ **OVERNIGHT**

48 ☐ **OVERNIGHT**

49 ☐ **OVERNIGHT**

50 ☐ **OVERNIGHT**

51 ☐ **OVERNIGHT**

52 ☐ **OVERNIGHT**

53 ☐ **OVERNIGHT**

54 ☐ **OVERNIGHT**

55 ☐ **OVERNIGHT**

56 ☐ **OVERNIGHT**

57 ☐ **OVERNIGHT**

58 ☐ **OVERNIGHT**

59 ☐ **OVERNIGHT**

60 ☐ **OVERNIGHT**

61 ☐ **OVERNIGHT**

62 ☐ **OVERNIGHT**

63 ☐ **OVERNIGHT**

64 ☐ **OVERNIGHT**

65 ☐ **OVERNIGHT**

66 ☐ **OVERNIGHT**

67 ☐ **OVERNIGHT**

68 ☐ **OVERNIGHT**

69 ☐ **OVERNIGHT**

70 ☐ **OVERNIGHT**

71 ☐ **OVERNIGHT**

72 ☐ **OVERNIGHT**

73 ☐ **OVERNIGHT**

74 ☐ **OVERNIGHT**

75 ☐ **OVERNIGHT**

76 ☐ **OVERNIGHT**

77 ☐ **OVERNIGHT**

78 ☐ **OVERNIGHT**

79 ☐ **OVERNIGHT**

80 ☐ **OVERNIGHT**

81 ☐ **OVERNIGHT**

82 ☐ **OVERNIGHT**

83 ☐ **OVERNIGHT**

84 ☐ **OVERNIGHT**

85 ☐ **OVERNIGHT**

86 ☐ **OVERNIGHT**

87 ☐ **OVERNIGHT**

88 ☐ **OVERNIGHT**

89 ☐ **OVERNIGHT**

90 ☐ **OVERNIGHT**

91 ☐ **OVERNIGHT**

92 ☐ **OVERNIGHT**

93 ☐ **OVERNIGHT**

94 ☐ **OVERNIGHT**

95 ☐ **OVERNIGHT**

96 ☐ **OVERNIGHT**

97 ☐ **OVERNIGHT**

98 ☐ **OVERNIGHT**

99 ☐ **OVERNIGHT**

100 ☐ **OVERNIGHT**

DECLARED VALUE
(Check one box)

1 ☐ **NO DECLARED VALUE**

2 ☐ **DECLARED VALUE** (up to \$100)

3 ☐ **DECLARED VALUE** (over \$100 to \$500)

4 ☐ **DECLARED VALUE** (over \$500 to \$1,000)

5 ☐ **DECLARED VALUE** (over \$1,000 to \$5,000)

6 ☐ **DECLARED VALUE** (over \$5,000 to \$10,000)

7 ☐ **DECLARED VALUE** (over \$10,000 to \$25,000)

8 ☐ **DECLARED VALUE** (over \$25,000 to \$50,000)

9 ☐ **DECLARED VALUE** (over \$50,000 to \$100,000)

10 ☐ **DECLARED VALUE** (over \$100,000 to \$250,000)

11 ☐ **DECLARED VALUE** (over \$250,000 to \$500,000)

12 ☐ **DECLARED VALUE** (over \$500,000 to \$1,000,000)

13 ☐ **DECLARED VALUE** (over \$1,000,000 to \$2,500,000)

14 ☐ **DECLARED VALUE** (over \$2,500,000 to \$5,000,000)

15 ☐ **DECLARED VALUE** (over \$5,000,000 to \$10,000,000)

16 ☐ **DECLARED VALUE** (over \$10,000,000 to \$25,000,000)

17 ☐ **DECLARED VALUE** (over \$25,000,000 to \$50,000,000)

18 ☐ **DECLARED VALUE** (over \$50,000,000 to \$100,000,000)

19 ☐ **DECLARED VALUE** (over \$100,000,000 to \$250,000,000)

20 ☐ **DECLARED VALUE** (over \$250,000,000 to \$500,000,000)

21 ☐ **DECLARED VALUE** (over \$500,000,000 to \$1,000,000,000)

22 ☐ **DECLARED VALUE** (over \$1,000,000,000 to \$2,500,000,000)

23 ☐ **DECLARED VALUE** (over \$2,500,000,000 to \$5,000,000,000)

24 ☐ **DECLARED VALUE** (over \$5,000,000,000 to \$10,000,000,000)

25 ☐ **DECLARED VALUE** (over \$10,000,000,000 to \$25,000,000,000)

26 ☐ **DECLARED VALUE** (over \$25,000,000,000 to \$50,000,000,000)

27 ☐ **DECLARED VALUE** (over \$50,000,000,000 to \$100,000,000,000)

28 ☐ **DECLARED VALUE** (over \$100,000,000,000 to \$250,000,000,000)

29 ☐ **DECLARED VALUE** (over \$250,000,000,000 to \$500,000,000,000)

30 ☐ **DECLARED VALUE** (over \$500,000,000,000 to \$1,000,000,000,000)

31 ☐ **DECLARED VALUE** (over \$1,000,000,000,000 to \$2,500,000,000,000)

32 ☐ **DECLARED VALUE** (over \$2,500,000,000,000 to \$5,000,000,000,000)

33 ☐ **DECLARED VALUE** (over \$5,000,000,000,000 to \$10,000,000,000,000)

34 ☐ **DECLARED VALUE** (over \$10,000,000,000,000 to \$25,000,000,000,000)

35 ☐ **DECLARED VALUE** (over \$25,000,000,000,000 to \$50,000,000,000,000)

36 ☐ **DECLARED VALUE** (over \$50,000,000,000,000 to \$100,000,000,000,000)

37 ☐ **DECLARED VALUE** (over \$100,000,000,000,000 to \$250,000,000,000,000)

38 ☐ **DECLARED VALUE** (over \$250,000,000,000,000 to \$500,000,000,000,000)

39 ☐ **DECLARED VALUE** (over \$500,000,000,000,000 to \$1,000,000,000,000,000)

40 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000 to \$2,500,000,000,000,000)

41 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000 to \$5,000,000,000,000,000)

42 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000 to \$10,000,000,000,000,000)

43 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000 to \$25,000,000,000,000,000)

44 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000 to \$50,000,000,000,000,000)

45 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000 to \$100,000,000,000,000,000)

46 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000 to \$250,000,000,000,000,000)

47 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000 to \$500,000,000,000,000,000)

48 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000 to \$1,000,000,000,000,000,000)

49 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000 to \$2,500,000,000,000,000,000)

50 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000 to \$5,000,000,000,000,000,000)

51 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000 to \$10,000,000,000,000,000,000)

52 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000 to \$25,000,000,000,000,000,000)

53 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000 to \$50,000,000,000,000,000,000)

54 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000 to \$100,000,000,000,000,000,000)

55 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000 to \$250,000,000,000,000,000,000)

56 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000,000 to \$500,000,000,000,000,000,000)

57 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000,000 to \$1,000,000,000,000,000,000,000)

58 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000,000 to \$2,500,000,000,000,000,000,000)

59 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000,000 to \$5,000,000,000,000,000,000,000)

60 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000,000 to \$10,000,000,000,000,000,000,000)

61 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000,000 to \$25,000,000,000,000,000,000,000)

62 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000,000 to \$50,000,000,000,000,000,000,000)

63 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000,000 to \$100,000,000,000,000,000,000,000)

64 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000,000 to \$250,000,000,000,000,000,000,000)

65 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000,000,000 to \$500,000,000,000,000,000,000,000)

66 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000,000,000 to \$1,000,000,000,000,000,000,000,000)

67 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000,000,000 to \$2,500,000,000,000,000,000,000,000)

68 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000,000,000 to \$5,000,000,000,000,000,000,000,000)

69 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000,000,000 to \$10,000,000,000,000,000,000,000,000)

70 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000,000,000 to \$25,000,000,000,000,000,000,000,000)

71 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000,000,000 to \$50,000,000,000,000,000,000,000,000)

72 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000,000,000 to \$100,000,000,000,000,000,000,000,000)

73 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000,000,000 to \$250,000,000,000,000,000,000,000,000)

74 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000,000,000,000 to \$500,000,000,000,000,000,000,000,000)

75 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000,000,000,000 to \$1,000,000,000,000,000,000,000,000,000)

76 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000,000,000,000 to \$2,500,000,000,000,000,000,000,000,000)

77 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000,000,000,000 to \$5,000,000,000,000,000,000,000,000,000)

78 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000,000,000,000 to \$10,000,000,000,000,000,000,000,000,000)

79 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000,000,000,000 to \$25,000,000,000,000,000,000,000,000,000)

80 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000,000,000,000 to \$50,000,000,000,000,000,000,000,000,000)

81 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000,000,000,000 to \$100,000,000,000,000,000,000,000,000,000)

82 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000,000,000,000 to \$250,000,000,000,000,000,000,000,000,000)

83 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000,000,000,000,000 to \$500,000,000,000,000,000,000,000,000,000)

84 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000,000,000,000,000 to \$1,000,000,000,000,000,000,000,000,000,000)

85 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000,000,000,000,000 to \$2,500,000,000,000,000,000,000,000,000,000)

86 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000,000,000,000,000 to \$5,000,000,000,000,000,000,000,000,000,000)

87 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000,000,000,000,000 to \$10,000,000,000,000,000,000,000,000,000,000)

88 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000,000,000,000,000 to \$25,000,000,000,000,000,000,000,000,000,000)

89 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000,000,000,000,000 to \$50,000,000,000,000,000,000,000,000,000,000)

90 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000,000,000,000,000 to \$100,000,000,000,000,000,000,000,000,000,000)

91 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000,000,000,000,000 to \$250,000,000,000,000,000,000,000,000,000,000)

92 ☐ **DECLARED VALUE** (over \$250,000,000,000,000,000,000,000,000,000,000 to \$500,000,000,000,000,000,000,000,000,000,000)

93 ☐ **DECLARED VALUE** (over \$500,000,000,000,000,000,000,000,000,000,000 to \$1,000,000,000,000,000,000,000,000,000,000,000)

94 ☐ **DECLARED VALUE** (over \$1,000,000,000,000,000,000,000,000,000,000,000 to \$2,500,000,000,000,000,000,000,000,000,000,000)

95 ☐ **DECLARED VALUE** (over \$2,500,000,000,000,000,000,000,000,000,000,000 to \$5,000,000,000,000,000,000,000,000,000,000,000)

96 ☐ **DECLARED VALUE** (over \$5,000,000,000,000,000,000,000,000,000,000,000 to \$10,000,000,000,000,000,000,000,000,000,000,000)

97 ☐ **DECLARED VALUE** (over \$10,000,000,000,000,000,000,000,000,000,000,000 to \$25,000,000,000,000,000,000,000,000,000,000,000)

98 ☐ **DECLARED VALUE** (over \$25,000,000,000,000,000,000,000,000,000,000,000 to \$50,000,000,000,000,000,000,000,000,000,000,000)

99 ☐ **DECLARED VALUE** (over \$50,000,000,000,000,000,000,000,000,000,000,000 to \$100,000,000,000,000,000,000,000,000,000,000,000)

100 ☐ **DECLARED VALUE** (over \$100,000,000,000,000,000,000,000,000,000,000,000 to \$250,000,000,000,000,000,000,000,000,000,000,000)

DECLARED VALUE
(Check one box)

1 ☐ **NO DECLARED VALUE**

2 ☐ **DECLARED VALUE** (up to \$100)

3 ☐ **DECLARED VALUE** (over \$100 to \$500)

4 ☐ **DECLARED VALUE** (over \$500 to \$1,000)

5 ☐ **DECLARED VALUE** (over \$1,000 to \$5,000)

6 ☐ **DECLARED VALUE** (over \$5,000 to \$10,000)

7 ☐ **DECLARED VALUE** (over \$10,000 to \$25,000)

8 ☐ **DECLARED VALUE** (over \$25,000 to \$50,000)

9 ☐ **DECLARED VALUE** (over \$50,000 to \$100,000)

10 ☐ **DECLARED VALUE** (over \$100,000 to \$250,000)

11 ☐ **DECLARED VALUE** (over \$250,000 to \$500,000)

12 ☐ **DECLARED VALUE** (over \$500,000 to \$1,000,000)

13 ☐ **DECLARED VALUE** (over \$1,000,000 to \$2,500,000)

14 ☐ **DECLARED VALUE** (over \$2,500,000 to \$5,000,000)

15 ☐ **DECLARED VALUE** (over \$5,000,000 to \$10,000,000)

16 ☐ **DECLARED VALUE** (over \$10,000,000 to \$25,000,000)

17 ☐ **DECLARED VALUE** (over \$25,000,000 to \$50,000,000)

18 ☐ **DECLARED VALUE** (over \$50,000,000 to \$100,000,000)

19 ☐ **DECLARED VALUE** (over \$100,000,

Appendix E

SOLID WASTE SAMPLING AND DISTRIBUTION PROJECT

SAMPLING REPORT # 5

October 1993

Work Performed Under Contract No. DE-AC21-88MC25185

for

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

by

**Energy and Environmental Research Corporation
Irvine, California**

INTRODUCTION

The United States Department of Energy (DOE) has established a Waste Management Program within the Office of Fossil Energy. A key goal of this program is to ensure that waste management issues do not become obstacles to the commercialization of advanced coal utilization technologies. In achieving this goal, the Waste Management Program identifies various emerging coal utilization technologies and performs comprehensive characterizations of the waste streams and products. The characterizations include engineering assessments to define waste streams of interest/potential concern, field studies to collect samples of the waste, and complete chemical analysis of the collected samples.

In a previous effort under the above mentioned program, DOE obtained waste stream samples from approximately 20 different facilities utilizing advanced coal technologies. These facilities were mainly small pilot scale facilities. DOE now is extending their characterization program to include a number of new facilities, particularly larger pilot- and commercial-scale units. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of five (5) of these facilities.

The current EER contract consists of two interrelated efforts: site selection and waste sampling. Detailed sample analysis is being conducted under another DOE contract. The primary objectives of the site selection and sampling effort are listed below.

- Survey sites at which advanced fossil energy combustion technologies are being operated, and identify five sites for sampling. Priority should be given to DOE Clean Coal Technology (CCT) Program Sites.
- Identify candidate solid waste streams in advanced coal utilization processes likely to present disposal problems and prioritized them for sampling at selected sites.
- Contact site personnel for site access, sample the streams representatively and document them according to established methodology and known process conditions.

- Distribute the samples to DOE's Morgantown Energy Technology Center or their representatives for analysis and report on the site visit.

Several advanced coal utilization technologies have been tentatively selected for comprehensive waste characterization. One of those technologies is the Low NO_x process being demonstrated by Southern Company Services, Inc. at Site F. On July 29, 1993 samples were collected to characterize solid waste streams. This document provides background information on the site and describes sampling activities performed at this facility.

SITE SELECTION

EER established criteria for selecting candidate sites. These include:

- The demonstration has been selected as part of DOE's Clean Coal Technology (CCT) Program,
- There is a lack of data regarding the waste products from this technology,
- Facility operators will cooperate,
- There is a possibility that the waste contains regulated compounds, and
- The demonstration is being conducted in a pilot scale facility or larger with the availability of 85 lbs of waste.

This is a Low NO_x Burner technology which has been demonstrated commercially however there is limited data available regarding the characteristics of the waste products. The demonstration was selected as one of the projects funded in Round II of DOE's CCT Program, and the facility operators were willing to have this sampling program conducted at their facility. Having met all of the criteria listed above, the Low NO_x Burner technology being developed by Southern Company Services, Inc. and Georgia Power was selected for inclusion in the current sampling program.

STREAM SELECTION

A schematic of the Low NO_x Burner demonstration unit and accompanying boiler is shown in Figure 1. This figure indicates the air, fuel, flue gas, and waste stream flow paths through the unit as well as the locations for stream sampling. Solids samples were taken of the unburned coal, boiler bottom ash, economizer ash, sluice ash, influent water and electrostatic precipitator (ESP) flyash.

The bottom ash consists of coal ash, unburned coal, small rocks, and metal. This ash is collected in the bottom of the boiler and passed to sluice lines on either side of the boiler. The bottom ash drops into a water channel (sluice lines) which transports the ash to the ash settling pond. The sluice water is pulled directly from the river and passed through a screening station to remove particulates and debris prior to entering the bottom of the boiler

Some ash particles that remain present in the boiler exit gases are collected in the economizer/air preheater hopper. This ash is collected in one of five hoppers located just below the air preheater for the unit. The ash collected in these five hoppers is sluiced along with the boiler bottom ash to the bottom ash disposal pond.

Figure 1 - Schematic Low NO_x Burner Demonstration Unit

The direct current electricity present in each of the fields of the ESP, charge the ash particles remaining in the gas stream causing them to be attracted to the neutral plates. Ash is removed from the neutral plates by mechanically striking the support structure for the plates. The ash falls into ash hoppers where it is collected and pneumatically transported to flyash storage silos. The flyash remains in these silos until it is loaded onto trucks for disposal.

Streams identified for sampling include unburned coal, economizer hopper, bottom ash, ESP flyash, Influent water, Sluice Bottom Ash and Sluice Top Ash. The boiler bottom ash was collected from an inspection door at the end of the bottom ash hopper. Economizer ash was collected from a sampling ports located at the bottom of the ash hoppers. Samples of the ESP ash were obtained by collecting samples throughout the day from each of the ESP ash hopper banks. A bulk sample of unburned pulverized coal was obtained from the boiler coal mills. The sluice top and bottom ash was collected at the end of each pipe at the entrance of the settling pond. The influent water was collected at the screening station prior to the bottom of the boiler.

SAMPLING PROCEDURES

The sampling team was on-site for the entire day of July 29, 1993, when Southern Company Services, Inc. was conducting operational tests. A copy of the sampling plan is provided in Appendix A.

The attached addendum on page 14 outlines any actions or procedures taken during the sampling visit that deviated from the original sampling plan. The following subsections provide a description of the sampling methods, the operational data collected and the packing and shipping procedures for delivering samples to the laboratories.

Streams Sampled

As described above, there are six streams from which samples were taken:

1) unburned coal, 2) economizer hopper, 3) bottom ash, 4) ESP ash, 5) bottom Ash Sluice, 6) top ash sluice, and 7) influent water. During the sampling, EER collected samples from each of these streams for analytical purposes. Ash analytical samples were placed in 1000 ml amber glass bottles and sealed except. The bottles were then placed in coolers, packed with ice and sent to Iowa State University for analysis. Bulk samples were taken of the unburned coal, economizer hopper, bottom ash and ESP flyash. The bulk coal sample was taken in one 5-gallon Tedlar® lined containers. All bulk samples were sealed and shipped to the University of North Dakota Energy and Environmental Research Center. Table 1 represents the location and type (ie. bulk or analytical) of samples taken at various points for the Site "E" sampling visit.

Unburned coal was collected from sampling ports located on the six (6) coal mills. Both analytical and bulk samples were collected. Both were composite on a Teflon® sheet and "cone and quartered". There was one (1) five gallon sample in a Tedlar® lined container and three (3) 1000 ml amber sample jars. Two (2) analytical samples went to Iowa State University and one (1) went to Southern companies. The bulk sample went to North Dakota University.

Table 1
Sampling List Summary
Georgia Power, Low-NO_x Burner

Sample Type	Wet/Dry	Location	Quantity
Unburned Coal	Dry	Coal Mills	5-gal container
Bottom Ash	Wet	inspection door	3-1000 ml containers
	Wet	inspection door	60 lb bulk sample
Economizer Fly Ash	Dry	Hoppers	5 gal. bulk sample
ESP Flyash	Dry	Hoppers	3-1000 ml containers
	Dry	Hoppers	60 lb bulk sample
Influent Water	Wet	Screen Station	3-1000 ml containers
Bottom Ash Sluice	Wet-liquid	End of Pipe	3-1000 ml containers
	Wet-solids	End of Pipe	3-1000 ml containers
Top Ash Sluice	Wet	End of Pipe	3-1000 ml containers

Economizer hopper ash bulk sample was collected from three (3) of the five (5) hoppers, two had no accumulated ash. The ash sample was obtained by letting the hopper empty out into a five (5) gal bucket. The sample was extremely hot. A total of one 5-gal sample was taken during the day and placed in Tedlar® lined 5 gal container. The bulk sample went to North Dakota University.

Three (3) ESP flyash samples were collected for analytical purposes from the ESP ash hoppers. These samples were obtained by compositing flyash samples obtained during the day from each ESP hopper by collecting the sample in five (5) gallon container over an eight hour period. The container was emptied on to a Teflon® sheet and cone and quartered. These samples were placed in three 1000-ml amber glass containers, two went to Iowa State University and one went to Southern Companies. A five gallon bulk sample was placed in a Tedlar® lined container and shipped to North Dakota University

A bottom ash sample was obtained from a inspection door located at the bottom of the combustion box. These samples were extremely wet. Three (3) analytical samples and 1 bulk sample was taken. Two (2) analytical samples in 1000 ml amber glass containers went to Iowa State University, one (1) to Southern Companies and one (1) bulk sample was collected in an 5-gallon Tedlar® lined container and sent to North Dakota University.

An influent water sample was taken at the screen station, since this water was used to transport the ash to the settling pond. Two (2) samples were collected in 1000 ml amber glass containers for Iowa State University and one (1) 1000 ml amber bottle for Southern Companies.

Bottom Ash and Top Ash sluice samples were collected using six five gallon containers over an eight hour period. Each sample was from a composite sample made by combining the containers into one. Then the solids were separated from the liquid in the bottom ash sluice sample. The Top ash sluice sample was mainly fines so it was retained as one sample. Then three (3) 1000 ml amber glass containers were filled with the liquid from

the bottom sluice sample and three (3) 1000 ml amber glass containers were filled with the liquid from the top sluice sample and sealed. Then three (3) 1000 ml amber glass containers were filled with the top sluice sample and sealed. Two (2) of each sample from both locations went to Iowa State University and Southern Companies retained one of each.

Operation Data

Operating data for key parameters were also collected during the test program. Data was collected for the boiler operation. Data was collected approximately every hour throughout the time in which samples were being taken. Table 2 outlines the operating parameters measured for the boiler.

Sample Shipment

Analytical samples were shipped via Federal Express to Iowa State's Spangler Laboratory for analysis. The analytical samples comprising 16 - 1000-ml amber glass bottles and were packed in a single cooler. Each sampling container was placed in a plastic zip-lock bag, surrounded with vermiculite and covered with ice packs. All bulk samples were shipped to the University of North Dakota Energy and Environmental Research Center for analysis. The bulk samples consisted of three 5-gallon Tedlar® lined containers. The chain of custody forms and shipping reports are provided in Appendix C.

Table 2 - Boiler Operating Parameters

TABLE 2
DOE/SOUTHERN COMPANY SERVICES, INC.

GEORGIA POWER COMPANY-PLANT HAMMOND-UNIT FOUR
INNOVATIVE CLEAN COAL TECHNOLOGY PROJECT
RE: DAS DATA DURING DOE/METC TESTING ON JULY 29, 1993

Historical Data File =93072900.H24
Start Time on Average =09:00:00
Stop Time on Average =10:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load-MWe	438.3	9.6	449	417.2	13
Steam Flow-KPPH	3229.1	81.5	3314.4	3083.4	13
Total Fuel-KPPH	323	5.6	329.4	310.8	13

Historical Data File =93072900.H24
Start Time on Average =10:00:00
Stop Time on Average =11:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load-MWe	442.2	3.6	447	432.8	13
Steam Flow-KPPH	3275.6	25.5	3309.4	3205.4	13
Total Fuel-KPPH	324.2	5.8	334.2	315.6	13

Historical Data File =03072900.H24
Start Time on Average =11:00:00
Stop Time on Average =12:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load-MWe	441.9	3.9	445.3	432.8	13
Steam Flow-KPPH	3270.9	34.6	3316.4	3205.4	13
Total Fuel-KPPH	325.8	3.8	331.1	318.1	13

Historical Data File =93072900.H24
Start Time on Average =12:00:00
Stop Time on Average =13:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load MWe	435.1	1.8	439.5	432.5	13
Steam Flow-KPPH	3222.4	20.2	3259.4	3199.4	13
Total Fuel-KPPH	319.8	2	323.8	316.2	13

Historical Data File =93072900.H24
Start Time on Average =13:00:00
Stop Time on Average =14:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load-MWe	435.4	2.1	437.8	429.2	13
Steam Flow-KPPH	3220.7	11.9	3227.4	3184.4	13
Total Fuel-KPPH	320.1	4	327.4	310.4	13

Historical Data File =93072900.H24
Start Time on Average =14:00:00
Stop Time on Average =15:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load MWe	433.8	7	447.1	427.3	13
Steam Flow	3198.8	57.8	3310.4	3134.4	13
Total Fuel-l	320.7	7.2	332	311	13

Historical Data File =93072900.H24
Start Time on Average =15:00:00
Stop Time on Average =16:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load-MWe	445	3.4	451	438.6	13
Steam Flow	3307.3	17.5	3337.4	3271.4	13
Total Fuel-l	328.4	4.1	335.2	322.3	13

Historical Data File 93072900.H24
Start Time on Average =16:00:00
Stop Time on Average =17:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load MWe	446.6	1.9	449.5	443.2	13
Steam Flow	331.1	16.5	3371.4	3299.4	13
Total Fuel-l	328.8	4.1	335.8	321.6	13

Historical Data File =93072900.H24
Start Time on Average =17:00:00
Stop Time on Average =18:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load MWe	442.2	2.3	444.4	436.4	13
Steam flow-	3297.8	19.1	3339.4	3262.4	13
Total Fuel-l	326.6	3.3	332.6	321.4	13

Historical Data File =93072900.H24
Start Time on Average =18:00:00
Stop Time on Average =19:00:00

TAG	AVG	STD	MAX	MIN	CNT
Load MWe	445.8	9.2	475.2	436.4	13
Steam Flow	3322.8	87.4	3579.4	3259.4	13
Total Fuel-l	331.6	9.9	351.8	311.8	13

ADDENDUM

The following describes any procedures or actions taken during the sampling visit on July 29, 1993 that deviated from the original sampling plan submitted for sampling activities at Site E.

All decontamination of sampling containers was performed before shipment of equipment to the sampling location. All analytical sampling containers were cleaned and inclosed in plastic bags. All bulk sampling containers were sealed by placing packing tape around the lid of the container. Three samples were collected at each location at Southern Company's request, instead of the two specified in the sampling plan, with the third sample being retained by them for reference. The volume of sample was increased from 500 ml to 1000 ml after discussions with the laboratory indicated they would be more comfortable with the larger samples.

Approximately one (1) 5 gallon Tedlar® lined container of sample was obtained of the unburned coal from the coal mills. The amount actually obtained differed from that required by the sampling plan due to the fact that the sampling team could only collect sixty (60) pounds over the required sampling period, instead of the required eighty five (85) pounds from the sampling plan. The EER personnel felt that the 5-gallons of sample obtained was sufficient for accurate bulk analysis since extreme care was taken to insure that the sample was representative of the process. Samples from each coal transport mill were taken throughout the day and composite to form one bulk sample.

Three (3) 1000-ml boiler bottom ash samples were gathered from the bottom ash hopper. These samples were obtained by using an 1000 ml amber glass container as a sampling scoop. The samples were gathered approximately two (2) hours apart. Two (2) samples were sent to the analytical lab and one (1) went to Southern Companies.

Three (3) 1000-ml samples from the economizer/air preheater were collected from three (3) of five economizer ash hoppers. The two additional hoppers had no accumulated ash. A sample was collected in a 5 gallon container and cone and quartered on a Teflon®

sheet. Three (3) 1000 ml amber glass containers were used for the analytical samples (two (2) for the lab and one (1) for Southern Companies) and a 5 gallon Tedlar® lined container was used for the bulk sample.

Three (3) 1000-ml flyash samples were collected by sampling the ESP ash hoppers. The samples were obtained by using a sample tapes on the hoppers instead of using the 4" stainless steel pipe since there was no other access to the hoppers during operation. The ESP consisted of four rows of five ash hoppers (4X5 arrangement). Approximately two thirds of the sample (three and a half (3.5) gallons) was collected from the first two rows of hoppers and one third of sample was collected from each of the additional hoppers. The hoppers had to be tethered with a 5 pound hammer to get this much sample. They were extracted from the sample port with an iron thief since there was no other type sampling apparatus available that could reach the ports. All samples were placed in one container and composite. Two (2) analytical samples were then obtained from the composite and packaged for shipment to the analytical laboratory, one was given to Southern companies. One (1) 5 gallon Tedlar® lined container was shipped to North dakota University.

The Tedlar® lined containers were used since they were thought to be more inert than the Rubbermaid products originally specified by the plan.

Appendix A

**EER Sampling Plan
Solid Waste Sampling Project
Site E
Low-NO_x Burner Project**

July 26, 1993

Background

The U.S. Department of Energy (DOE) has established a Waste Management Program within the office of Fossil Energy. One of the projects in this program is to characterize the solid waste from advanced coal combustion or conversion technologies. In order to implement the characterization process, it is necessary to identify the potential units with waste streams of interest, obtain samples of the waste, and perform a complete analysis of the samples. Energy and Environmental Research Corporation (EER) was selected to perform the site selection and the sampling aspects of this project. EER selected Georgia Power's Low-NO_x Burner Project as one of the seven sites identified for participation in the sampling program. The technology being demonstrated at the Coosa, Georgia, facility is being conducted on Unit Number 4.

This Clean Coal Technology is being demonstrated by Georgia Power at Site E. The EER field team has already conducted a preliminary site visit at Site E and is familiar with operating conditions at the plant. The EER field team will conduct the sampling effort July 29, 1993. At this time, Site E will be undergoing long-term testing at the plant and the operating conditions will be conducive for obtaining representative waste samples. During the long-term testing period, EER will take analytical samples from the bottom ash hopper, economizer, precipitator, coal, and water inlets and send them to Iowa State University for Analysis. EER will also collect bulk samples of the raw coal, bottom ash and fly ash for testing at the University of North Dakota Energy and Environmental Research Center (UNDERC). EER must also record any operating condition data during the sampling event and report them to DOE. A brief final report of the field work will also be completed and sent to DOE.

Pre-Sampling

Call Danny Morton with the Georgia Power Company at (706) 290-6238 and Lamar Larimore with Southern Companies at (205) 870-6920 the day before sampling is scheduled to begin. Make certain that the process is up and running, and that Mr. Morton and Mr. Larimore are aware that EER will be there to sample.

Call Ed Olson at (701) 777-5155 at the University of North Dakota Environmental Research Center (UNDERC). He is our lab contact for the bulk samples and needs to be notified when the sampling will take place, so that he can be prepared to receive the samples.

Call Dr. Carol Kilgroe at (515) 294-8203 or Dr. Colin Criswell at (515) 294-6776 at Iowa State University. Dr. Kilgroe is our lab contact for analytical samples and needs to be notified when sampling is taking place, so that she can be prepared to receive the samples. In the event that Dr. Kilgroe cannot be reached, contact Dr. Criswell and notify him of the impending sample shipment.

Sampling

There are six locations at the plant from which samples will be taken. The coal sample will be taken from the transport piping leading from the pulverizers to the burner panels. A dry boiler bottom ash sample will be taken from the bottom ash hopper prior to being sluiced. Dry fly samples will be taken from the economizer if possible, the precipitator, and the sluice lines.

Each of the six locations will be sampled during the normal 8-hour operating period for both analytical and/or bulk samples. One 5-gallon composite sample of unburned coal will be collected from the coal transport piping using a grab sampling thief. An 85 lb. dry bulk sample of boiler bottom ash will be obtained from the bottom ash transport lines, just prior to the clinker grinders. An 85 lb. fly ash sample will be taken by timing each hopper as it empties so that a composite sample can be conducted with accuracy. Two 500 ml. analytical samples will also be collected from these locations.

A detailed description of the specific sampling procedures for each sample location is listed in the "Sampling Instructions" section of this report.

Equipment

The following equipment will be used for the sampling program.

- 1) (5) Coolers/Ice Packs
- 2) Stainless steel ladle
- 3) Paper Towels
- 4) Bottle labels and pens
- 5) Nitrile gloves
- 6) Hardhats
- 7) Ear plugs
- 8) Liquid soap and other decon solutions
- 9) First Aid Kit
- 10) Scale-to weigh samples
- 11) Tools-Knife
- 12) Lab Tracking Sheets and Chain of Custodies
- 13) Flash Light
- 14) Vermiculite and other packing supplies

- 15) Cooler custody seals
- 16) Stainless Steel Spatulas
- 17) 36- 500 ml amber glass sample jars, fitted with Teflon caps
- 18) Plastic Sheeting
- 19) Cloth Gloves
- 20) Safety Glasses
- 21) Scrub Bucket and Brush
- 22) Distilled water
- 23) Fire Extinguisher
- 24) Field Book
- 25) Sampling and Health and Safety Plans
- 26) Bottle Overpacks
- 27) Fed Ex Forms
- 28) Zip-lock bags
- 29) barrel filter unit & 20 um filter paper
- 30) Flex Hose with an 8" diameter
- 31) Approx. ten 5-gallon buckets with lids, Tedlar coated

Bottle List

- 7- 500 ml Teflon bottles will be used for the dry analytical samples.
- 1- 1-liter Boston Round amber bottle with Teflon cap will be used for liquid samples.
- 10- 5-gallon buckets with lids for the bulk bottom ash and fly ash samples. These buckets are to be Teflon coated to reduce the potential of trace metal contaminants.
- 2- Small Coleman coolers will be used for the analytical samples, so as not to cross contaminate samples of interest

Pre-Sampling Decontamination Procedures

The following procedures should be followed before the sampling event takes place (ideally the afternoon before initiation of the sampling event). In addition, these procedures for decontamination should be followed in between any sets of samples in which the same sampling equipment may be utilized more than once.

- 1) Identify the sampling items to be contaminated. These items are:
 - All Teflon sampling containers necessary for the sampling event.
 - All buckets to be used for collecting the sluice or dry samples.
 - All spatulas or stainless steel scoops to be used for the sampling event.
 - Note: The Boston Round amber bottles with Teflon caps are pre-cleaned to EPA specifications and do not need to be decontaminated prior to sampling.

- 2) Obtain all necessary decontamination solutions and equipment:
 - Teflon sheeting
 - 1-five gallon bucket
 - 1-scrub brush
 - 1-concentrated liquid soap
 - Tap water
 - Deionized water
 - 10% Nitric Acid
 - Methanol
 - Acetone
 - Polyethylene squirt bottles
- 3) Establish an area where the decontamination procedure can take place. Make the following preparations for the area:
 - Lay clear Teflon sheeting over a specific area for drying cleaned items.
 - Have all cleaning solutions and equipment set up near plastic sheeting so that a wash and dry area is established.
- 4) The decontamination procedure for each piece of equipment should be as follows:
 - Wash the piece of equipment with the concentrated liquid soap
 - Rinse with tap water
 - Rinse with 10% nitric acid
 - Rinse with deionized water
 - Rinse with methanol
 - Rinse with deionized water
 - Rinse with acetone
 - Rinse with deionized water
 - Let air dry on Teflon sheeting
 - Rinse once more with deionized water before beginning sampling

Sampling Instruction

All samples will be obtained during a normal 8-hour operating period which the Low NOx burner on Unit Number 4 is being demonstrated at full load. The operating condition data must be completed each hour during which samples are collected. This information should be documented in a table in the sampling report. An operator will need to be identified to aid in obtaining this information. The sampling parameters, locations, and sampling approach are described below:

Unburned Coal --

A Coal sample will be collected during the first day of sampling. A five-gallon bucket will be filled with coal sampler and sealed for a bulk sample. Label the bucket for shipment to the UNDERC designated sampler: Jerry Lewis

Bottom Ash Sample--

Two 500 ml containers and a 5-gal Tedlar-lined bucket of dry bottom ash will be obtained from transition lines prior to the clinker grinder. These analytical samples will be labeled and packed for shipment to Iowa State University. Designated sampler: Jerry Lewis

Bulk Bottom Ash Sample--

A dry bulk sample of approximately 88 lbs consisting of ash will be obtain from the transition lines prior to the clinker grinder. This bulk sample will be labeled and packed for shipment to the UNDERC. Designated sampler: Jerry lewis

Fly Ash Samples --

Two 500 ml containers of fly ash will be obtained from the ESP hoppers for analytical purposes. These analytical samples will be labeled and packed for shipment to Iowa State University. Designated sampler: Jerry Lewis

Bulk Fly Ash--

The bulk fly ash samples will be collected from the same locations mentioned previously. At each of these locations, a bulk sample of approximately 5 lbs. will be obtained from the ESP hoppers by removing the cover plate to the hoppers. The bulk samples will be labeled and packed for shipment to the UNDERC. These samples will be taken prior to fly ash stream mixing.

Labeling and Packing Instructions

- 1) All dry analytical samples will be collected into 500 ml amber glass jars fitted with Teflon caps, with the exception of the bulk samples. All wet analytical samples will be collected into 1-liter Boston Round amber bottles with Teflon Caps.
- 2) Each jar should be labeled with "Site E" and a designated sample number, the sample location, the date and time of the sample, initials of the samplers, and be sure to note whether the sample is analytical or bulk. The analytical sample jars will be also be marked to indicate the liquid levels before shipping. The only bulk samples will be the fly ash bulk samples and the bulk sample of raw coal.
- 3) Chain-of-Custody forms and EER field Sample Tracking Reports should be completed to document the type, quantity, location, and sampler involved with collecting each sample. A copy of the forms and an EER sampling label are attached in Appendix A.

- 4) Place each analytical sample inside a ziplock bag, and then place the bagged jar inside the protective four inch PVC sleeve. Place the entire unit into the cooler and keep it cool with ice packs until all the samples are collected, and the whole cooler is ready to be packed for shipment to Iowa State University. The bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do need to be kept on ice.
- 5) When packing the cooler with the analytical samples, remove the ice packs and place enough vermiculite around the bottles to make certain that they cannot shift or move during transport. Pack vermiculite across the top of the containers, leaving enough room to replace one layer of ice packs. After including the ice packs, pack any remaining space with vermiculite and make sure that nothing can shift during shipment. As stated previously, the bulk samples should be packed in triple-layer trash bags inside one of the coolers. The bulk samples do not need to be kept or mailed on ice.
- 6) All bulk samples will be sent in one cooler to the University of North Dakota, UNDERC, laboratory. All analytical samples will be sent in two coolers to the Iowa State University laboratory. Make sure that each of the mailing addressees is written correctly on each of the appropriate coolers.
- 7) Seal the appropriate Chain-of Custody forms inside the cooler, with the corresponding samples. Sign at least two EER Custody Seals. These seals, along with clear packing tape, will be used to seal the cooler.
- 8) Attached the Federal Express forms and a mailing label to the top of the cooler, along with "Fragile," "Handle With Care" and "Caustic" stickers. The cooler should then be ready to take to the Federal Express office.

QA/QC

Chain-of-Custody forms and field Sample Tracking Reports must be maintained and filled out for the samples. List the bulk samples on separate Chain-of Custody forms, but you may put all the analytical samples on the same Chain Custody form.

There are no travel blanks or any other QA samples to be submitted with these samples. There is also no data package to request.

Shipping

All bulk samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

University of North Dakota
Energy and Environmental Research Center
15 North 23rd St.
Grand Forks, ND 58201
Attn: Ed Olson (701) 777-5155

All analytical samples will be shipped, appropriately packed (see packing instructions) in Coleman coolers, via Federal Express to the following shipping address:

Iowa State University
Spangler Laboratory
Ames, Iowa, 50011
Attn: Dr. Carol Kilgroe (515) 294-8203

The nearest Federal Express office is located in Rome, Georgia. Federal Express will pick up the samples at Site F on-site when notified several hours ahead of time.

Special Considerations

There is concern about obtaining sluice lines samples and safety issues relating to point sample. Also, there is some question about what is to be considered a representative sample.

Contact Personnel

Jerry Lewis	EER	(919)-489-1726
Jerry Harness	DOE	(304)-291-4835
Ed Olson	Lab contact-Bulk	(701)-777-5155
Carol Kilgroe	Lab contact-Analytical	(515)-294-8203
Danny Morton	Georgia Power	(706)-290-6238
Lamar Larimore	Southern Companies	(205)-870-6920

**Sampling List Summary
Georgia Power, Low-NO_x Burner**

Sample Type	Wet/Dry	Location	Quantity
Unburned Coal	Dry	Coal Mills	5-gal container
Bottom Ash	Wet	inspection door	2-500 ml containers
	Wet	inspection door	88 lb bulk sample
Economizer Fly Ash	Dry	Hoppers	5 gal. bulk sample
ESP Flyash	Dry	Hoppers	2-500 ml containers
	Dry	Hoppers	80 lb bulk sample
Influent Water	Wet	Screen Station	2-500 ml containers
Bottom Ash Sluice	Wet-liquid	End of Pipe	2-500 ml containers
	Wet-solids	End of Pipe	2-500 ml containers
Top Ash Sluice	Wet	End of Pipe	2-500 ml containers

All analytical dry samples will be collected in 5-gal buckets and transferred to the sampling containers with a Teflon coated lid, long-handled stainless steel scoop and contained in 500 ml amber glass containers.

The bulk bottom and fly ash samples will be collected in Tedlar-lined 5-gal buckets, contained in and packed with blue ice for shipping.

The coal sample will be collected in a 5-gal coated bucket and sealed for shipping.

The analytical wet sample will be collected in a 1-liter Boston amber bottle using the method noted in the sampling plan.

APPENDIX A

No. 142723
 FERR
 Date _____
 Time _____
 Test No. _____
 Site _____
 Location _____
 Sample Description _____

18 Mason Irvine, CA 92714 (714) 859-3851

Energy and
 Environmental
 Research Corporation

Official Custody Seal
 Name _____
 Date _____

FIELD SAMPLE TRACKING REPORT

[illegible]

Energy and
Environmental
Research Corporation

CHAIN OF CUSTODY

Plant _____ Project No. _____ Date _____

<u>Sample No.</u>	<u>Test No.</u>	<u>Description</u>
-------------------	-----------------	--------------------

_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Sampling System Prepared By _____

Test Operator _____

Others Involved in Test _____

Sample Recovery By _____

<u>Relinquished by</u>	<u>Received by</u>	<u>Time</u>	<u>Date</u>	<u>Reason</u>
------------------------	--------------------	-------------	-------------	---------------

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Laboratory Analysis By _____

Date _____

Appendix B

DOE/SOUTHERN COMPANY SERVICES, INC.
 INNOVATIVE CLEAN COAL TECHNOLOGY PROJECT
 GEORGIA POWER COMPANY - PLANT HAMMOND - UNIT FOUR

RE: DAS DATA DURING DOE/METC TESTING ON JULY 29, 1993

Historical Data File = 93072900.H24
 Start Time on Average = 09:00:00
 Stop Time on Average = 10:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	438.3	9.8	449.0	417.2	13.0
STEAM FLOW - KPPH	3229.1	81.5	3314.4	3083.4	13.0
TOTAL FUEL - KPPH	323.0	5.8	329.4	310.8	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 10:00:00
 Stop Time on Average = 11:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	442.2	3.8	447.0	432.8	13.0
STEAM FLOW - KPPH	3275.6	25.5	3308.4	3205.4	13.0
TOTAL FUEL - KPPH	324.2	5.8	334.2	315.6	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 11:00:00
 Stop Time on Average = 12:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	441.9	3.9	445.3	432.8	13.0
STEAM FLOW - KPPH	3270.9	34.6	3316.4	3205.4	13.0
TOTAL FUEL - KPPH	325.8	3.8	331.1	318.1	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 12:00:00
 Stop Time on Average = 13:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	435.1	1.8	439.5	432.5	13.0
STEAM FLOW - KPPH	3222.4	20.2	3259.4	3199.4	13.0
TOTAL FUEL - KPPH	319.8	2.0	323.8	316.2	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 13:00:00
 Stop Time on Average = 14:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	435.4	2.1	437.8	429.2	13.0
STEAM FLOW - KPPH	3220.7	11.9	3227.4	3184.4	13.0
TOTAL FUEL - KPPH	320.1	4.0	327.4	310.4	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 14:00:00
 Stop Time on Average = 15:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	433.8	7.0	447.1	427.3	13.0
STEAM FLOW - KPPH	3198.8	57.8	3310.4	3134.4	13.0
TOTAL FUEL - KPPH	320.7	7.2	332.0	311.0	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 15:00:00
 Stop Time on Average = 16:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	445.0	3.4	451.0	438.6	13.0
STEAM FLOW - KPPH	3307.3	17.5	3337.4	3271.4	13.0
TOTAL FUEL - KPPH	328.4	4.1	335.2	322.3	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 16:00:00
 Stop Time on Average = 17:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	446.6	1.9	449.5	443.2	13.0
STEAM FLOW - KPPH	3331.1	16.5	3371.4	3299.4	13.0
TOTAL FUEL - KPPH	328.8	4.1	335.8	321.6	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 17:00:00
 Stop Time on Average = 18:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	442.2	2.3	444.4	436.4	13.0
STEAM FLOW - KPPH	3297.8	19.1	3339.4	3262.4	13.0
TOTAL FUEL - KPPH	326.6	3.3	332.6	321.4	13.0

Historical Data File = 93072900.H24
 Start Time on Average = 18:00:00
 Stop Time on Average = 19:00:00

TAG	AVG	STD	MAX	MIN	CNT
LOAD - MWe	445.8	9.2	475.2	436.4	13.0
STEAM FLOW - KPPH	3322.8	87.4	3579.4	3259.4	13.0
TOTAL FUEL - KPPH	331.6	9.9	351.8	311.8	13.0

UNIT 4 ELECTROSTATIC PRECIPITATOR DAILY REPORT

DATE: 7-29-93

NO.	PRI. VOLTAGE			PRI. CURRENT			SEC. CURRENT			SEC. VOLTAGE			AUTOMATIC			MANUAL (%)		
	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E
4A1	310	441	313	31	42	23	.22	.34	.18	0	-	-	A	✓		✓		
4A2	426	520	405	83	112	62	.62	1.18	.36	0	-	-	A	✓		✓		
4A3	446	442	443	125	125	123	1.25	1.27	.81	0	-	-	A	✓		✓		
4A4	412	423	408	104	103	104	.94	.93	.94	0	-	-	A	✓		✓		
4A5	360	345	337	90	90	90	.70	.67	.69	0	-	-	A	✓		✓		

NO.	PRI. VOLTAGE			PRI. CURRENT			SEC. CURRENT			SEC. VOLTAGE			AUTOMATIC			MANUAL (%)		
	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E
4B1	428	480	422	92	76	51	.83	.71	.64	0	-	-	A	✓		✓		
4B2	396	364	387	44	38	46	.49	.36	.44	0	-	-	A	✓		✓		
4B3	406	444	441	120	118	119	1.14	1.19	1.19	0	-	-	A	✓		✓		
4B4	428	459	437	115	122	119	1.24	1.25	1.23	0	-	-	A	✓		✓		
4B5	400	425	400	95	95	94	.78	.77	.77	22	23	21	A	✓		✓		

Appendix C

FIELD SAMPLE
TRACKING REPORT

PROJECT NO. 9638.030 PAGE 1 of 2
 PLANT PROJECT Georgia Power, Hammond Plant

UNIT # 4

SAMPLE NO.	RUN NO.	PROCESS STREAM LOCATION	DESCRIPTION	SAMPLE DATA			SENT TO:	
				DATE	TIME	SAVFLER	LABORATORY	DATE
155432	Coal Sample	Coal Mills	Brow Coal Comp. 7/25/83	" " "	" " "	J Lewis	Town State	9/2/83
155435	" "	" "	" " "	" " "	" " "	" "	" "	" " "
152064	Exhausting ^{Sub} hopper ^{hopper}	hoppers	Ash Comp. 10/10-1020	" " "	" " "	" "	U of N Oak Ridge	" " "
155430	Bottom Ash	After Clinker Cooler	Comp. 10/10-1020	" " "	" " "	" "	Town State	" " "
155432	" "	" "	" "	" " "	0928-940	" "	Town State	" " "
155465	" "	" "	" "	" " "	" " "	" "	U of N Oak Ridge	" " "
155458	Bottom Ash Sluice	Settling Pond	Liquid	" " "	1550	" "	Town State	" " "
155459	" "	" "	Solid	" " "	" "	" "	Town State	" " "
152068	Top Ash Sluice	" "	Liquid	" " "	1900	" "	" "	" " "
155457	" "	" "	Solid	" " "	1701	" "	" "	" " "
152067	Precip Ash	Precip hopper	Ash	" " "	1400-1430	" "	" "	" " "
152066	" "	" "	Ash	" " "	" "	" "	" "	" " "
155460	" "	" "	" "	" " "	" "	" "	U of N Oak Ridge	" " "

TRACKING REPORT

PLANT PROJECT Georgia, Brunswick County

UNIT # _____

[illegible]

CHAIN OF CUSTODY

Plant _____ Page 1 of 1
 Unit #4
 Location Coosa, Ga Project No. 8638.030 P.O No. _____

Sample No.	Test No.	Test Date	Description
<u>155460</u>	<u>Coal Mills</u>	<u>7/29/93</u>	<u>Raw Coal Bulk Sgal Bucket</u>
<u>152064</u>	<u>Examination</u>	<u>7/29/93</u>	<u>Ash - Sgal " " Tredline (And</u>
<u>155465</u>	<u>Bottom Ash</u>	<u>" " "</u>	<u>Wet Ash - Sgal, Tredline (And</u>
	<u>Bottom Slat Ash (JWD)</u>		<u>Bottom Ash</u>
<u>155468</u>	<u>Precipitor Ash</u>	<u>" " "</u>	<u>Ash composite 10, 11, 12, 13</u>

Sampling system prepared by _____
 Test operator _____
 Sample recovery by _____

Relinquished By	Received By	Time	Date	Reason
<u>Jerry Lewis</u>	<u>Ed Olson</u>	<u>11:00</u>	<u>8/2/93</u>	<u>Analysis</u>

Laboratory analysis by _____ Date _____

CHAIN OF CUSTODY

Plant _____ Page 1 of 1
 Unit #4
 Location Coosa, Ga Project No. 8638.030 P.O. No. _____

Sample No.	Test No.	Test Date	Description
<u>155433</u>	<u>Coal Sample</u>	<u>7/25/93</u>	<u>Raw coal Composite</u>
<u>155435</u>	<u>" "</u>	<u>" " "</u>	<u>" " " 1000ml</u>
<u>155430</u>	<u>Bottom Ash</u>	<u>" " "</u>	<u>" " " 1000ml</u>
<u>155432</u>	<u>" "</u>	<u>" " "</u>	<u>Bottom Ash 1000ml</u>
<u>155458</u>	<u>Bottom Ash Slurries</u>	<u>" " "</u>	<u>Bottom Ash Slurries (liquid) 1000ml</u>
<u>155459</u>	<u>" "</u>	<u>" " "</u>	<u>" " " Solid 1000ml</u>
<u>152068</u>	<u>Top Ash Slurries</u>	<u>" " "</u>	<u>Top Ash Slurries 1000ml</u>
<u>155457</u>	<u>" "</u>	<u>" " "</u>	<u>" " " "</u>
<u>152067</u>	<u>Precipitated Ash</u>	<u>" " "</u>	<u>Precipitated Ash - (Composite) 1000ml</u>
<u>152066</u>	<u>" "</u>	<u>" " "</u>	<u>" " " " "</u>
<u>155437</u>	<u>Inlet H₂O</u>	<u>" " "</u>	<u>Inlet H₂O 1000ml</u>
<u>155436</u>	<u>" "</u>	<u>" " "</u>	<u>" " " " "</u>

Sampling system prepared by Jerry Lewis
 Test operator Jerry Lewis
 Sample recovery by Jerry Lewis

Relinquished By	Received By	Time	Date	Reason
<u>Jerry Lewis</u>	<u>Joseph Tang</u>	<u>A.M.</u>	<u>Aug 2, 1993</u>	<u>Analysis</u>
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Laboratory analysis by Town State University Date _____

DATE

FILMED

5/5/94

END